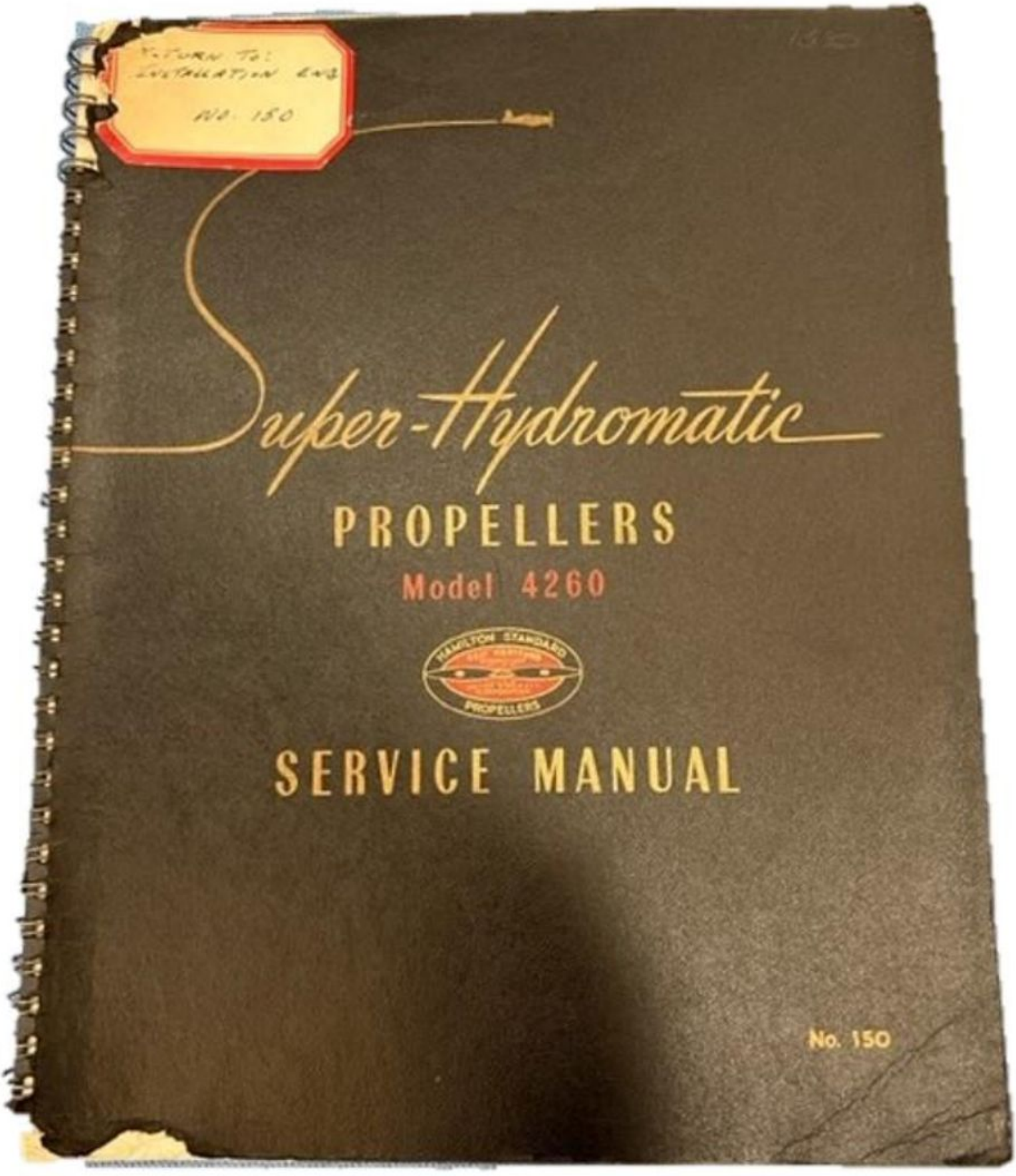

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HAMILTON STANDARD PROPELLERS

Division of United Aircraft Corporation

EAST HARTFORD, CONNECTICUT

June 11, 1945

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UNITED STATES OF AMERICA

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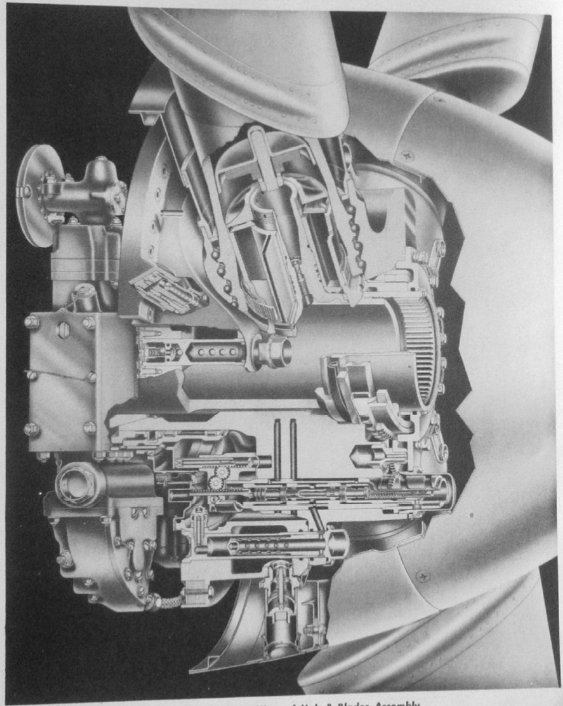


Figure 1—Cutaway View of Hub & Blades Assembly

SECTION I
INTRODUCTION

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

2. It includes a detailed description of the parts, installation procedure, a description of operation, service instructions, and overhaul instructions for the Hamilton Standard *Super*-Hydromatic Model 4260 propeller. Throughout this handbook the term "propeller" includes two assemblies: the hub & blades assembly and the control assembly.

3. The propeller is manufactured by Hamilton Standard Propellers, Division of United Aircraft Corporation, East Hartford, Connecticut.

SECTION II
DESCRIPTION

1. GENERAL DESCRIPTION.

a. GENERAL.

(1) The *Super*-Hydromatic propeller is designed to meet the constantly increasing demands for superior propeller performance and versatility. In this respect, it surpasses previous propeller types in operational possibilities in that it includes, besides constant speed operation and feathering, the additional features of reversing, lock pitch, and extremely fast rate of pitch change. The increased rate of pitch change minimizes overspeeding of the engine, permits feathering to be accomplished very rapidly, and makes practical the reverse pitch feature. Feathering, as applied to a propeller, means the blades are set to an angle such that their average chord lies in the direction of aircraft flight. In this position, they act as brakes to stop rotation of the propeller and engine, and at the same time are in the position to offer the least possible drag on the aircraft. The reverse pitch feature allows the propeller to develop negative thrust and, therefore, to exert a considerable braking effect on the aircraft.

(2) The principal characteristics of the *Super*-Hydromatic design are:

(a) The propeller is capable of changing pitch at a rate of approximately 35 degrees per second. This high rate of pitch change permits the following performance:

1. The blades can attain the feathered position from a normal take-off blade angle in approximately two seconds.

2. Blades can reverse from a normal blade angle at take-off power and rpm to an equivalent negative blade angle in approximately one second.

(b) The propeller is completely independent of the engine for its control and oil supply, and no modification of the standard engine nose and shaft is necessary.

(c) The propeller is capable of reversing to a negative blade angle, thereby providing negative thrust for the maneuvering of flying boats on the water, the deceleration of aircraft in landing, and tactical maneuvers of military aircraft such as dive bombing.

(d) The control system permits the optional use of all or any appropriate combination of the following functions:

1. Constant speed.
2. Feathering.
3. Reversing
4. Fixed pitch.
5. Manual pitch changing.
6. Pitch indication.

(e) The use of low viscosity oil for pitch control and lubrication insures satisfactory performance under low temperature conditions.

(f) The propeller shaft bore is unrestricted and makes possible the use of a propeller shaft cannon.

(g) The propeller has provisions for the correction of aerodynamic unbalance.

(3) The Hamilton Standard *Super*-Hydromatic propeller consists of two major assemblies: the hub & blades assembly and the control assembly. The hub & blades assembly has the following major subassemblies: the barrel; the pump assembly which includes eight radially mounted two-stage piston pump units; the eccentric assembly which actuates the pump pistons; the vane motors which, with the blade connecting gear and stops assembly, make up the pitch changing mechanism; the distributor valve; and the hollow steel blade assemblies. All the major subassemblies are readily interchangeable and can be removed and replaced as units with little adjustment necessary, as are the units making up these parts.

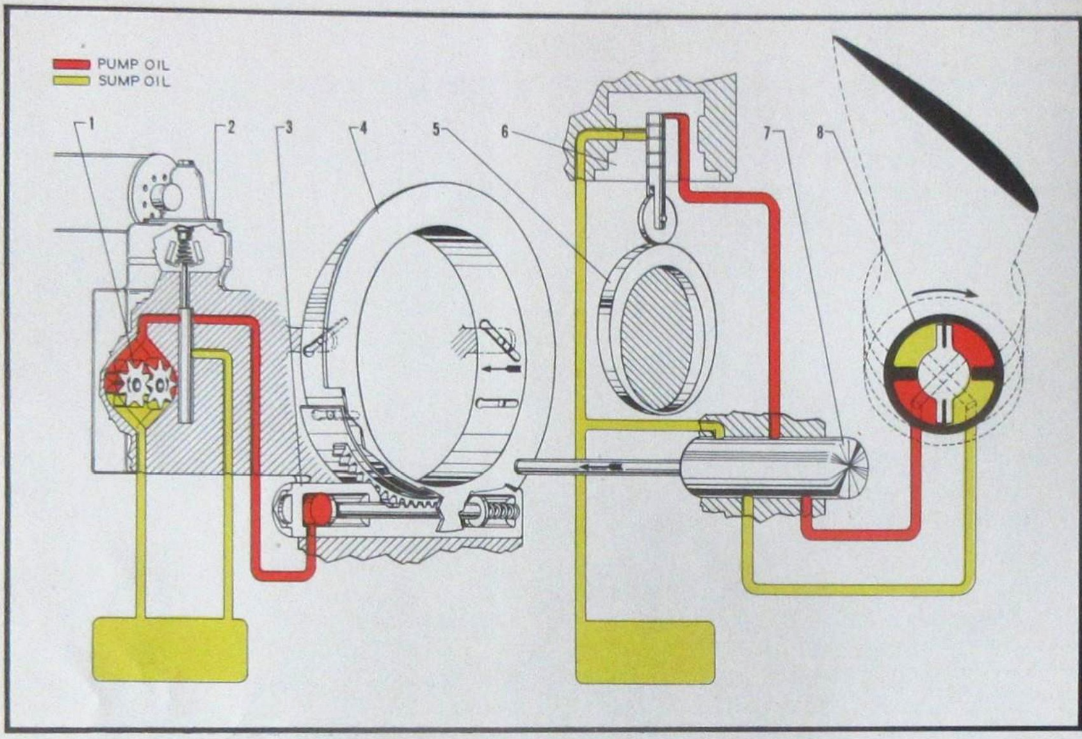


Figure 2—Basic Operating Diagram

1 GOVERNOR PUMP
2 GOVERNOR
3 SERVO MOTOR
4 TRANSLATING CONTROL
5 ECCENTRIC
6 PISTON TYPE PUMP
7 DISTRIBUTOR VALVE
8 VANE MOTOR

(4) The control system includes nine subassemblies mounted upon the control support which, in turn, is fastened to the engine nose about the propeller shaft. These subassemblies are: governor head, governor, servo motor, solenoid pack, pitch transmitter, pitch limit solenoid, wiring harness, auxiliary motor, and translating control & rotating seal. Each of these subassemblies is a unit in itself and can be replaced separately. On certain aircraft where limited propeller operation does not require certain subassemblies, those subassemblies are replaced with cover plates.

b. BASIC OPERATING PRINCIPLES.

(1) PROPELLER OIL FORCE.—Pitch change of the blades toward either a lower or a higher angle (as shown in figure 2) is accomplished by means of oil pressure which is developed by the piston pump (6) running on an eccentric cam (5). This pressure is converted into pitch changing torque in the vane motors (8) which are secured in the propeller blades. Control of propeller blade angle during constant speed, fixed pitch, feathering or reversing operation is determined by the position of the distributor valve assembly (7) in the hub. The distributor valve assembly meters the flow of oil between the pump and the vane motors and is so designed that each axial position of the distributor valve determines a definite blade angle. For fixed pitch operation, therefore, it is only necessary to maintain a fixed position of the distributor valve. For constant speed operation, the valve position is determined by a centrifugal type compensating governor (2), acting through a mechanical relay (4).

(2) GOVERNOR OIL FORCE.—During constant speed operation, the centrifugal type compensating governor (2) controls a hydraulic servo mechanism (3) which regulates the position of a mechanical translating control (4). The position of this translating control, as determined by the balance of forces on the servo rack, in turn determines the position of the distributor valve in the hub. Governor oil pressure acting against the servo piston on one end of the rack and the servo spring acting against the rack in the opposite direction provide these rack control forces. The oil pressure is developed by a gear type pump (1) driven by the rotating hub. Oil is metered to or from the servo chamber either by the action of the governor pilot valve sleeve which is controlled by the flyweights and speeder spring, or by the manual operation of individual solenoid valves.

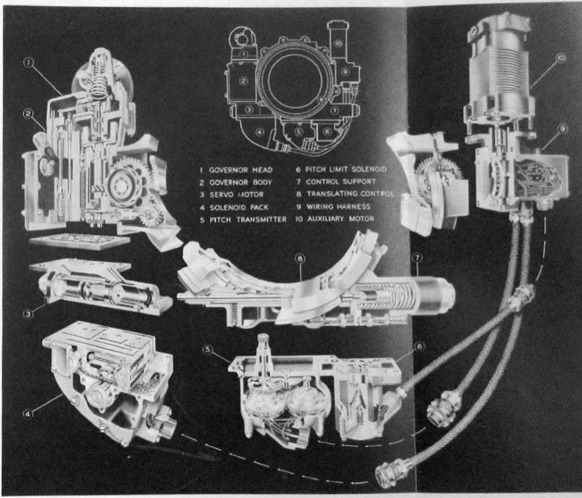


Figure 3—Cutaway View of Control Assembly

c. MODEL DESIGNATION.

(1) HUB AND CONTROL.

(a) The model designation system for *Super-Hydromatic* propellers explains in part the type and use of the propeller. The group of numbers preceding the dash describes the basic propeller model, and the number following the dash (the dash number) indicates the minor modifications incorporated in that basic model. As an example, on a propeller designated as model 4260-3, the number group preceding the dash indicates the following:

1. The first number, "4", indicates the number of blades in the propeller.

2. The second number, "2", identifies the blade shank size and is approximately equivalent to the Hamilton Standard Hydromatic "E" size.

3. The last two numbers preceding the dash, in this example, "60", indicate the SAE propeller shaft size.

(b) The number following the dash indicates the minor modifications incorporated in the propeller. It also denotes the combination of control subassemblies and, therefore, the operational possibilities. Right-hand propellers are indicated by an odd dash number, and left-hand propellers by an even number. In each case an even dash number indicates that the propeller is the left-hand version of the propeller bearing the next lower (odd) dash number.

(c) The hub & blades assembly and the control assembly are not identified as separate units except within the parts list for the complete propeller. In common usage, a "60" control assembly is one which fits an engine having an SAE No. 60 shaft. The control subassemblies, except the support, are interchangeable among all propeller models.

(2) BLADE.—Each steel blade is identified by a group of numbers and letters which describe its type and use. This identification is stamped on the camber side of each blade between the 18- and 24-inch stations. A blade designated as a 2C15B1-6-D indicates the following:

(a) The number "2" indicates the Hamilton Standard Propellers blade shank size, and the blade will, therefore, fit a hub having a similar shank size.

(b) The first letter, "C", in this case, specifies the activity factor. The letters A, B, C, etc. designate activity factors of 55 to 65, 65 to 75, 75 to 85, etc. respectively for blades of the same diameter. The higher the activity factor, the greater the power which can be absorbed.

(c) The next group of numbers, "15", is the basic diameter (to the nearest foot) of the propeller incorporating these blades.

(d) The next letter, "B", indicates the major blade design type, and in this case denotes a blade made of a thin steel shell formed to the proper aerodynamic section and brazed to a steel core. The inner end of this core has integral hardened races to accommodate the balls used in the retention of the blade in the hub.

(e) Direction of rotation is indicated by the last number of the first group. In this example, "1", an odd number, signifies a blade for right-hand rotation, and a number "2" would designate a left-hand blade of the same design.

(f) The dash number indicates the number of inches the propeller diameter has been reduced from the basic diameter. The "-6" in the example shows that the propeller diameter has been reduced six inches by a straight cut-off, which means that only the cut-off station is modified by blending the edges into the blade profile.

(g) The letter "D" denotes the type of blade shell cut-off used to adapt the blades for a particular spinner installation.

2. DETAILED DESCRIPTION.

a. HUB ASSEMBLY.

(1) BARREL ASSEMBLY.—The barrel with its hydraulic passages is made from a forging of chrome-molybdenum steel with a high carbon content which permits proper hardening of the integral bearing races and the rear hub boss. During the early stages of manufacture, an insert which provides certain oil passages is shrunk and brazed into the outboard end of the barrel bore, thus becoming an integral part. The central bore of the hub is splined to fit the engine-propeller shaft, with one spline segment, at the number one arm bore, omitted to match the wide spline on the propeller shaft. There are cone seats at each end of the central bore of the spline, the rear cone seat being at 15 degrees and the front cone seat at 30 degrees with respect to the propeller axis. By means of the splines and the cones, engine torque is transmitted to the propeller. The pump is attached to the rear of the

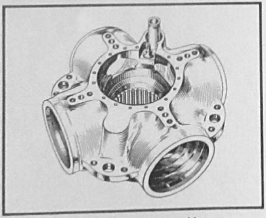


Figure 4—Barrel Assembly

1 DRAIN BUSHING
2 DE-ICER BUSHING
3 BUSHING GASKET
4 PUMP HOUSING
5 STRAINER BUSHING
6 BUSHING RETAINER SCREW
7 RELIEF VALVE BUSHING
8 TOROID SEAL

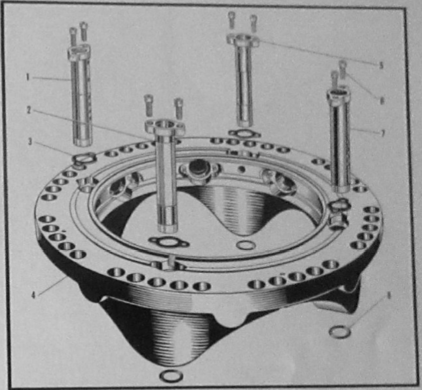


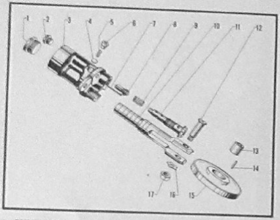
Figure 5—Extended View of Pump Housing

propeller barrel by means of the pump attaching bolts which fasten to webs located between the blade arms. The webs also reinforce the hub at these points of relatively high stress. The boss on the inboard side of the barrel supports and acts as a race for the eccentric assembly. A steel distributor valve bushing is shrunk into the hub to become an integral part of the assembly, and is carefully honed to minimize leakage between the distributor valve sleeve and the bushing. The pin on which the cam drive idler gear is mounted is shrunk into the barrel adjacent to the distributor valve bushing, and is never removed except for replacement. All exposed surfaces of the barrel are shot-blasted to produce a desired residual stress pattern and are then plated as a protection against corrosion. Currently, the barrel and some other parts are protected by zinc plating covered with Iridite, a special process which produces an olive drab finish. Each blade is supported in the barrel arm by four rows of balls, the races for which are ground directly into the barrel arm bore and on the outer surface of the blade shank. The races in both the barrel and blades are hardened by induction heating methods. The balls are inserted into the races through loading holes in the barrel adjacent to each of the ball races.

(2) PUMP ASSEMBLY.

(*a*) HOUSING ASSEMBLY.— The housing assembly contains four steel bolt bushings shrunk into the aluminum alloy pump housing and secured with attaching cap screws and 16 studs to which are fastened the eight cylinder assemblies. These bushings and studs need never be removed except for replacement. A gasket is placed under the flanged head of each bushing, and between the outboard end of each bushing and the housing a synthetic toroid seal is placed to prevent external oil leakage past the bushing. The housing is shaped to conform to the barrel, making a compact assembly. Circular recesses in the housing outer flange are used to receive the lead discs that may be necessary for final balancing of the hub & blades assembly. On the flange at each arm well there is a location number to facilitate proper alignment of the pump assembly relative to the hub at assembly. The bolt bushings into which the barrel-pump attaching bolts are screwed contain ports to allow oil flow between the hub hydraulic passages and the hollow pump housing which acts as a sump.

1. The drain bolt bushing is threaded at both ends to receive the sump relief valve assembly in the inboard end and the hollow drain bolt in the outboard end.



1 PISTON PLUG
2 CHECK VALVE PLUG
3 PUMP CYLINDER
4 L.P. CHECK VALVE DISC
5 L.P. CHECK VALVE SPRING
6 L.P. CHECK VALVE BUSHING
7 L.P. CHECK VALVE PIN
8 H.P. CHECK VALVE PLUNGER
9 H.P. CHECK VALVE SPRING
10 PUMP PISTON
11 MANIFOLD BOLT
12 PUMP ROLLER SHAFT
13 PUMP ROLLER INNER RACE
14 BEARING NEEDLE
15 PUMP ROLLER
16 SHAFT LOCK WASHER
17 ROLLER SHAFT NUT

Figure 6—Extended View of Pump Cylinder Assembly

Four holes in the body of the bushing act as connecting ports between the drain bolt and pump sump. The port immediately beneath the flange is the dump passage for the sump relief valve, and the port at the bottom of the inboard hole is the valve intake.

2. The de-icing bushing has a through passage with no connection to the sump. The outboard end is threaded to receive a hollow dummy bolt. On non-de-icing installations, a bolt similar to the drain bolt is used.

3. The high pressure relief valve bushing contains ports through which the valve relieves into the sump. The intake port inboard of the bushing flange is threaded for the manifold bolt connecting with the high pressure system. The outboard end is internally threaded to hold the high pressure relief valve bolt.

4. The strainer bolt bushing contains no side connecting ports between the bolt and the sump. A threaded port leading to the high pressure manifold is located beneath the flange. The strainer bolt screws into the open end of the bushing.

(*b*) CYLINDER, PUMP ROLLER, RETURN RING, AND MANIFOLD.

1. Each cylinder assembly is a complete two-stage reciprocating piston pump containing a cylinder, a two-stage nitrided piston closely fitted to the cylinder

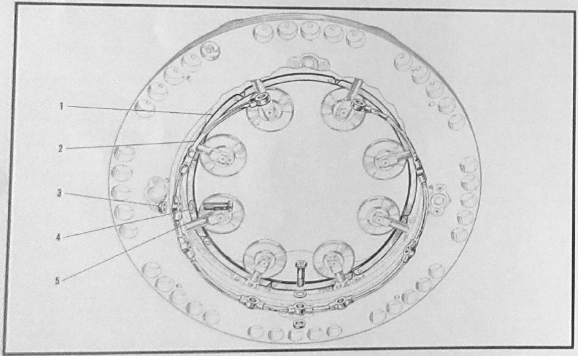


Figure 7—Rear View of Pump With Manifold Extended

1 PISTON RETURN RING
2 HIGH PRESSURE MANIFOLD
3 HIGH PRESSURE MANIFOLD SPACER
4 HIGH PRESSURE MANIFOLD GASKET
5 MANIFOLD BOLT

and forked at the lower end, a low pressure (first-stage) check valve and a high pressure (second-stage) check valve. The low pressure check valve consists of a phenolic disc, a soft spring, and a plug which is held in the cylinder by a brass pin. The high pressure check valve incorporates a fluted plunger, a spring, and a hollow bolt which retains the spring and plunger and also connects the valve to the high pressure manifold. The eight cylinder assemblies are mounted radially in the housing and are secured to the studs by self-locking nuts.

2. The pump roller assembly, which rolls between the eccentric cam surface and the return ring, includes a roller and an inner race with bearing needles between the two. Each roller assembly is held in the piston fork by means of a roller shaft secured in place by a star-type lock washer and a hex nut.

3. The steel return ring assembly is composed of eight segments riveted together into a jointed ring. This flexibility is necessary for assembly and disassembly of the pump. The return ring runs through the piston forks and presses the rollers into contact with the eccentric surface at all times.

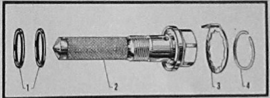
4. The high pressure manifold is a collector ring for the oil discharge of all the individual pump assemblies, and is made of high tensile steel sections brazed together into a ring. Discharge into the manifold from the cylinders flows through hollow bolts attaching it to the cylinders at the high pressure check valves. Discharge from the manifold flows through an additional hollow bolt to the strainer bolt bushing, and also through a similar bolt to the high pressure relief valve.

(*c*) PUMP STRAINER BOLT ASSEMBLY.—The pump strainer bolt strains the oil from the high pressure system in the pump, and directs it through two cross ports beneath the bolt head into the barrel web passage to the distributor valve. It is a soldered assembly, made up of a housing containing ports which open into the bushing, a steel tip, and a fine mesh screen which strains incoming oil. A synthetic toroid seal is used between the bolt and the barrel.

(*d*) HIGH PRESSURE RELIEF VALVE ASSEMBLY.—The high pressure relief valve assembly is composed of a housing, a long stemmed conical plunger, a spring, a shim, a valve plug, and several toroid seals. This valve plug fitting into the head of the housing and over the valve plunger stem, acts as a dash pot for the valve and a retainer for the spring. The housing has a series of cross holes which open into the bushing. Relief pressure (approximately 3000 p.s.i.) is adjusted by shims between the valve plug and the spring. The seals are used between the housing and the bushing, and between the housing and the barrel.

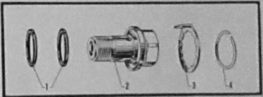
(*e*) DRAIN BOLT AND DUMMY BOLT.—The pump drain bolt is a short hollow bolt with a cross passage beneath the bolt head to connect the barrel drain passages to the pump sump. A similar bolt without the cross passage is used in the de-icer bushing on non-de-icing installations. A toroid seal fits between the bolt and the barrel.

(*f*) SUMP RELIEF VALVE.—Installed in the inboard end of the drain bushing, the sump relief valve assembly consists of a retainer, a check ball, a spring, a valve screw, a lock pin, and two seals. This valve relieves



1 TOROID SEAL
2 PUMP STRAINER BOLT
3 PUMP BOLT LOCK
4 PUMP BOLT SNAP RING

Figure 8—Strainer Bolt



1 TOROID SEAL
2 DRAIN BOLT
3 PUMP BOLT LOCK
4 PUMP BOLT SNAP RING

Figure 10—Drain Bolt

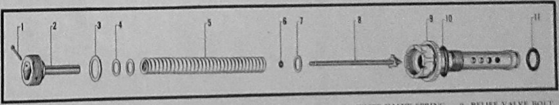
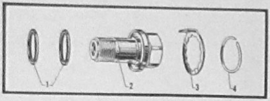


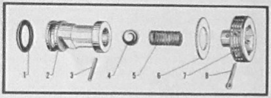
Figure 9—Extended View of High Pressure Relief Valve Assembly

1 COTTER PIN
2 RELIEF VALVE PLUG
3 VALVE PLUG GASKET
4 ADJUSTMENT SHIM
5 RELIEF VALVE SPRING
6 RELIEF VALVE SEAL
7 RELIEF VALVE SPACER
8 RELIEF VALVE
9 RELIEF VALVE BOLT
10 BOLT-PUMP SEAL
11 TOROID SEAL



1 TOROID SEAL
2 DRAIN BOLT
3 PUMP BOLT LOCK
4 PUMP BOLT SNAP RING

Figure 11—Dummy Bolt



1 TOROID SEAL
2 SUMP RELIEF VALVE RETAINER
3 LOCK PIN
4 BALL
5 SPRING
6 GASKET
7 SCREW
8 COTTER PIN

Figure 12—Extended View of Sump Relief Valve

oil from the sump at a pressure of approximately 30 p.s.i., thus keeping the pump sump at a pressure which facilitates delivery of oil to the high pressure stage of the pump. Discharge through this valve aids in the lubrication of the pump rollers and the eccentric bearings.

(3) ECCENTRIC ASSEMBLY.—The eccentric assembly, mounted on the inboard boss of the barrel, is retained by a light drive fit of the governor drive gear and by a lock pin inserted through mating holes in the barrel and the governor drive gear. The assembly consists of two major parts: the eccentric which is held stationary in respect to the engine during normal propeller operation to impart reciprocating motion to the pistons, and the governor drive gear which transmits power from the propeller shaft to the governor. The assembly rotates on rollers which fit into races in the inner surface of the eccentric and are held in position by brass cages. The barrel boss serves as the inner races of these roller bearings. The parts are positioned axially by three thrust segments which fit through slots in the governor drive gear into a race in the eccentric. Pressure for operation of both the hub & blades assembly and the control assembly when the propeller is not rotating is obtained by rotating the eccentric. This actuates the pistons of the pump and also operates an auxiliary piston pump in the control. The eccentric is driven by an electric motor mounted on the control support assembly.

(4) VANE MOTOR ASSEMBLY.

(*a*) VANE MOTOR.—The vane motor is the mechanism by means of which oil pressure from the pump is converted into pitch changing torque on the blades. The vane motor is an assembly of two principal components; namely, an internal stationary portion consisting of a center post with a barrel vane which is fixed with respect to the barrel, and an external (or blade) vane component which is fixed with respect to the blade. The blade vane is free to turn about the barrel vane through an angular range of approximately 120 degrees.

1. The hollow center post is integral with a flat disc having two projections which fit into mating holes at the inner end of the barrel blade bore. Two dowel bush-

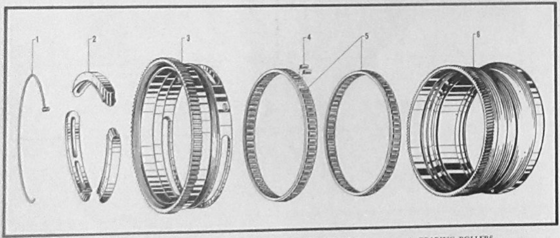


Figure 13—Extended View of Eccentric Assembly

1 LOCK PIN ASSEMBLY
2 THRUST SEGMENTS
3 GOVERNOR DRIVE GEAR
4 BEARING ROLLERS
5 BEARING RETAINER ASSEMBLY
6 ECCENTRIC

ings are shrunk into the disc to provide oil passages between the barrel and the vane motor chambers. Synthetic toroid seals are used between the dowel bushings and the barrel. Internal passages connect the dowel bushings to the four chambers. Four ports on the inner end of the center post are labelled in pairs "L-L" and "R-R". Pipe plugs and oil control pins are used to plug the passages under one pair of ports according to the direction of rotation as shown in figure 34. Similar pipe plugs seal the other pair of ports against leakage. A bronze ring shrunk onto the OD of the disc acts as a bearing surface. There are grooves for oil seals and splines to match the barrel vane splines on the inner portion of the center post, while the outer end is threaded to accommodate the cover nut. The central hole is threaded to hold the jack-screw. The barrel vane which fits tightly over the center post has grooves for the strip seals and ports for oil to enter the chambers.

2. The blade vane is a hollow cylinder having the two fins on its ID and an integral induction hardened bevel gear segment on its inboard end. The micro-adjustment ring is splined to the OD of the vane and secured by a snap ring. Since this ring also is splined to fit the blade splines, it permits blade pitch adjustment relative to the barrel vane in increments of .05 degree. Such adjustment can be made on any blade independently.

3. Bronze plates and triangular-section gaskets with springs are incorporated to seal each end of the vane motor chambers. The cover nut with its seal holds the assembly together. It is locked by a clevis and a cotter pin.

(*b*) VANE MOTOR JACK-SCREW ASSEMBLY.—One end of the jack-screw bears against the bottom of the barrel arm bore, and as the jack-screw is turned, the center post is forced outward. This, in turn, forces the blade outward against the retaining balls in the arm bore and blade races. The jack-screw contains a spring loaded latch mechanism to hold the screw in the set position.

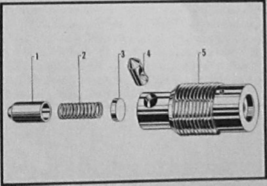
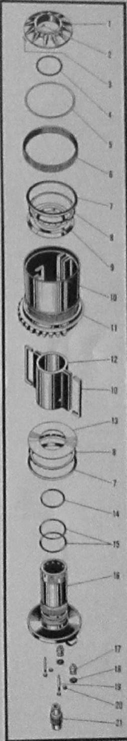


Figure 14—Extended View of Jack-Screw Assembly

1 PLUNGER
2 SPRING
3 PLUG
4 LATCH
5 HOUSING



1 VANE MOTOR COVER NUT
2 CLEVIS PIN
3 COTTER PIN
4 COVER NUT—CENTER POST SEAL
5 MICRO-ADJUSTMENT RING SNAP RING
6 MICRO-ADJUSTMENT RING
7 END PLATE GASKET
8 END PLATE GASKET SPRING
9 COVER END PLATE
10 VANE MOTOR STRIP SEAL
11 BLADE VANE
12 BARREL VANE
13 BOTTOM END PLATE
14 CENTER POST UPPER SEAL
15 CENTER POST LOWER SEAL
16 VANE MOTOR CENTER POST
17 OIL TRANSFER DOWEL
18 OIL TRANSFER DOWEL SEAL
19 OIL CONTROL PIN
20 PIPE PLUG
21 JACK-SCREW ASSEMBLY

Figure 15—Extended View of Vane Motor Assembly

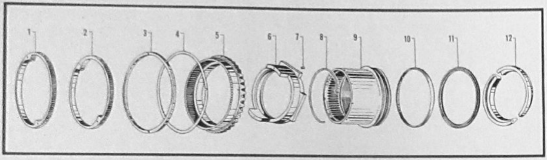


Figure 16—Extended View of Retaining Nut, Connecting Gear, and Stops Group

1 HIGH PITCH STOP RING
2 LOW PITCH STOP RING
3 CAM DRIVE GEAR
4 PRELOAD SHIM
5 BLADE CONNECTING GEAR
6 STOP SLEEVE
7 STOP SLEEVE DOWEL
8 RETAINING NUT LOCK WIRE
9 RETAINING NUT
10 RETAINING NUT PACKING RETAINER
11 RETAINING NUT PACKING
12 FRONT CONE

(5) RETAINING NUT GROUP.—The front cone is the standard SAE No. 60 two-piece type fitting around the inboard flange of the bronze propeller retaining nut. To prevent oil leakage from the hub through the shaft splines, a chevron type seal with retainer is placed between the upper flange of the retaining nut and the front cone. The stop sleeve of the connecting gear assembly, fitting over the retaining nut, holds the cone, seal, and nut in place in the barrel. The cover plate, when bolted in position, bears down on the cam drive gear of the connecting gear assembly and holds the parts in position. The retaining nut, therefore, is not removed from the assembly during installation and removal of the propeller. It is locked to the cover plate with a lock wire. A toroid seal on the inside diameter of the cover plate prevents external leakage from the hub by fitting closely around the retaining nut.

(6) BLADE CONNECTING GEAR & STOPS ASSEMBLY.—This assembly contains a stop sleeve fixed to the barrel, a blade connecting gear assembly fitting over the stop sleeve and meshing with gear segments on the vane motors, the high and low pitch mechanical stop rings splined on the outside diameter to mate with the connecting gear assembly, and a bronze cam drive gear through which the distributor valve cam can be indexed in either direction to obtain proper angular relationship with the blades. The stop sleeve fits over the retaining nut and into barrel recesses. The blade connecting gear synchronizes the blades which are actuated by individual vane motors. The proper amount of preloading on the vane motor gear segments by the cover plate is obtained by means of shims placed between the cam drive gear and the connecting gear. During actual propeller operation, the mechanical stops do not come in contact with the stop sleeve since the blades are hydraulically held and limited in their range by the hydraulic stops in the control assembly. To keep the mechanical stops from contacting the sleeve, they are set one degree above and below the settings of the hydraulic stops in the control assembly, and become effective only in the case of interruption of the hydraulic control. If possible, the high pitch mechanical stop should be set five degrees above the hydraulic feather stop. A maximum total included pitch range of 120 degrees can be obtained. This range is normally −25 to +95 degrees. Other ranges are achieved by different graduations on the same parts.

(7) DISTRIBUTOR VALVE ASSEMBLY.—The distributor valve assembly performs three functions: (1) it meters the flow of oil between the pump and the vane motors to increase or decrease the blade pitch; (2) it holds the blades at a constant pitch when the distributor valve is held in a fixed position; (3) it acts as an unloading valve to limit the pump pressure to the required minimum when no pitch change is required by bypassing the oil to the

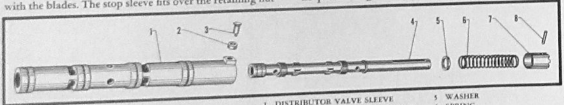


Figure 17—Extended View of Distributor Valve Assembly

1 DISTRIBUTOR VALVE SLEEVE
2 DISTRIBUTOR VALVE CAM ROLLER
3 CAM ROLLER PIN
4 DISTRIBUTOR VALVE
5 WASHER
6 SPRING
7 DISTRIBUTOR VALVE LOCK
8 LOCK PIN

sump. It consists of two major parts: the distributor valve sleeve and the distributor valve itself. A spring, placed over the outboard end of the valve and held in position with a lock and pin through the valve, furnishes part of the force necessary to keep the control rack assembly bearing against the translating control thrust plate. The valve assembly is retained in the sleeve by means of a cam roller pin inserted through a lug on the outboard end of the sleeve and seating in a slot in the top of the valve lock. The distributor valve is very closely fitted to the sleeve, and the two parts are then hydraulically balanced. This makes the parts non-interchangeable with other assemblies. The same serial number is electrically etched on both parts as a means of identification. The distributor valve cam meshes with the cam drive gear of the connecting gear assembly through an idler gear. The cam is held onto the barrel post by a snap ring. The cam roller on the valve sleeve engages the slot of the cam and imparts an axial movement to the sleeve as the cam rotates. The cam track is divided into three ranges: reversing, constant speed, and feathering. The corresponding blade angle limits between the "knees" of the constant speed range are approximately 10 and 60 degrees. The distributor valve assembly is covered by the valve cap screwed through the cover plate into the barrel. The cap is safetied to the cover plate by a cotter pin inserted through a hole in the valve cap base aligned with a slot on the edge of the cover plate.

(8) LUBRICATING VALVE & OFFSET CONTROL ASSEMBLY.—The lubricating valve is built into the distributor valve offset control which is fastened to a flat on the barrel behind the distributor valve. It furnishes lubrication to the eccentric bearings and the pump rollers. A ball type check valve opened by barrel pressure and centrifugal force controls oil flow into a spout directed at the bearings. The valve is fully opened at approximately 15 p.s.i. and fully closed at approximately 5 p.s.i. The same oil is centrifugally thrown out from the bearings and onto the pump rollers, furnishing them with splash lubrication. The offset control provides a direct mechanical linkage between the translating control thrust plate and the inboard end of the distributor valve to which it is attached. Positive movement in both directions is obtained through the use of a pair of idler gears running between the control rack assembly which bears against the thrust plate and the extension rack which is attached to the distributor valve.

(9) ROTATING SEAL THRUST RING ASSEMBLY.—A nitrided steel ring is soldered permanently to the retainer to act as a bearing surface for the carbon ring seal on the control assembly. The small cup projecting from the rear surface covers the extension rack of the offset control. This assembly is attached to the pump with shoulder screws. A toroid seal is used between the retainer and the pump.

1 EXTENSION RACK
2 EXTENSION RACK GEAR
3 CONTROL RACK GEAR
4 WASHER
5 LOCATING WASHER
6 COTTER PIN
7 GEAR RETAINING SPRING
8 RETAINING PLUG
9 COTTER PIN
10 LUBRICATING VALVE SPRING
11 LUBRICATING VALVE BALL
12 GEAR SHAFT
13 EXTENSION RACK ROLLER
14 EXTENSION RACK ROLLER SHAFT
15 OFFSET CONTROL HOUSING
16 CONTROL RACK

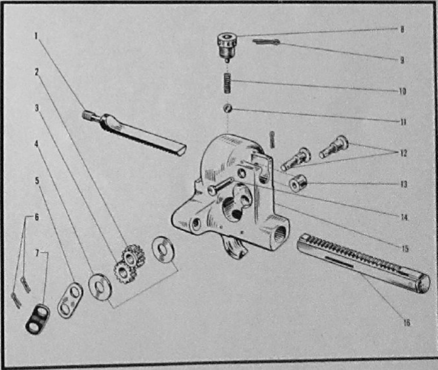
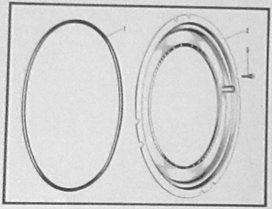


Figure 18—Extended View of Lubricating Valve & Offset Control Assembly



1 THRUST RING-PUMP HOUSING SEAL
2 ROTATING SEAL THRUST RING
3 RETAINING SCREW

Figure 19—Rotating Seal Thrust Ring

(10) MISCELLANEOUS PARTS.

(*a*) BLADE RETENTION SYSTEM.—Four induction hardened races, as previously mentioned, are incorporated in each barrel arm. These races match corresponding races in the blade. Each is actually a combination of races: a bearing race and a loading race. Forty-six steel balls are placed into each loading race through the loading holes in the barrel. If the blades are then pulled out, the balls become seated in the bearing races. A gasket and a cover plate attached by two screws cover the three exposed loading holes.

(*b*) BLADE ARM PACKING.—Present propeller models are using two types of blade packing seals. The chevron type, which consists of three chevron seals and a header ring all retained by a washer and a two-piece retainer ring fitting into an annular recess in the end of each arm bore, is used in the earlier propellers. The single toroid seal type, in which the seal is retained by a split blade packing ring and locked by a blade packing nut screwed into the outer end of the barrel arm bore, is found on all later models. The packing nut is safetied by a tab type ring placed between the nut and the end of the barrel arm with a tab bent to fit in the barrel arm slot and into one of the serrations on the nut.

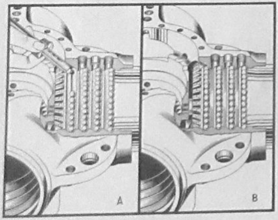


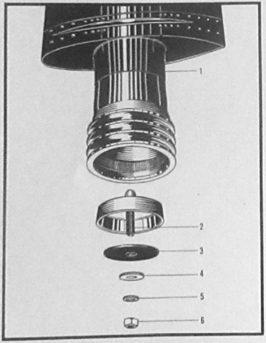
Figure 20—Blade Retention System
A. Blade in Loading Position
B. Blade in Running Position

(*c*) DE-ICING DEVICE ASSEMBLY.—The first model 4260 propellers do not include a de-icing device assembly, although provision is made for it. The slinger ring attached to the rear of the pump receives the de-icing fluid from its source. The nozzle assembly, which fits into a hole in the pump, directs the fluid from the slinger ring to the blades.

(*d*) BALANCING WASHER GROUP.—Lead balancing washers to the number required are held in recesses on the pump OD by bolts and self-locking nuts.

b. BLADE ASSEMBLY.

(1) BLADE.—In order to develop larger diameter propellers and to obtain the desired weight saving, the



1 STEEL BLADE
2 BALANCING PLUG
3 BALANCING WASHER
4 PLAIN WASHER
5 LOCK WASHER
6 NUT

Figure 21—Extended View of Blade Assembly

2C15B1 (section II, paragraph 1.c.(2)) type hollow steel blade was developed. The main structural member is a tubular steel core having supporting surfaces for the vane motor on the inside bore of the shank end and incorporating blade retention races in the outer surface of the shank. This tubular member carrying the main stress loading is brazed into a steel shell of uniform wall thickness which provides the proper blade airfoil sections. The shell is made from a high tensile steel sheet formed to incorporate the blade pitch and the double curvatures of the face and camber side. The space between the core and the shell is filled with sponged synthetic rubber for improved vibration characteristics.

(2) BLADE BALANCING PLUG.—The blade balancing plug is a steel cup vulcanized into the hollow steel shank with a synthetic rubber compound. An attaching bolt in this plug holds the lead washers used in balancing. These washers are held in position by a washer, lock washer, and hex nut.

c. SPINNER ASSEMBLY.

(1) GENERAL.—*Super*-Hydromatic spinners are of reinforced aluminum alloy construction with the proper contour which permits a streamline air flow past the hub, and in certain installations blends the propeller hub into the nacelle of the airplane. For ease in installation, spinners are constructed in three parts: the shell, the bulkhead, and the nose section.

(2) INSTALLATION.—On propeller models having threaded barrel arms, the aluminum alloy spinner is attached to tubes threaded into the arms. The rear bulkhead and the shell section are held together and onto these tubes by clamps built into the spinner at the blade opening. The nose section attaches to the shell after the propeller has been installed. An oil filler tube assembly is used to connect to the sump.

d. CONTROL ASSEMBLY.—The *Super*-Hydromatic control system consists of ten unit assemblies: the governor head, the governor, the servo motor, the solenoid pack, the pitch indication system, the pitch limit solenoid, the wiring harness, the auxiliary motor, the translating control & rotating seal, and the control support. The units of the control assembly fit together as shown in figure 3. The governor head, governor, servo motor, and solenoid pack are assembled together as the hydraulic unit, and the auxiliary motor and the wiring harness are also assembled as a unit. The wiring harness assembly, pitch limit solenoid, pitch transmitter, and hydraulic assembly (or appropriate cover plates in place of assemblies not included in the installation) are assembled to the control support assembly, which in turn mounts onto the engine nose. The proper connection of the wiring harness connectors completes the control assembly.

(1) GOVERNOR HEAD ASSEMBLY.

(a) HEAD AND SUBHEAD.—The aluminum head and subhead form a housing for the speeder spring adjusting rack, balancing spring, and control shaft. The control shaft bore is perpendicular to the speeder rack bore. A soft steel bushing is pressed into the rack bore. Two tapped bosses for high and low rpm adjustment screws are integral parts of the head. These screws are locked by self-locking nuts when they have been properly adjusted. A hole in the upper end of the speeder rack bore is sealed by a screw secured by a tab lock washer. A circular flange on the lower end of the head fits a recess in the upper surface of the subhead, and the two parts are secured by segmental washers and self-locking nuts. This arrangement makes it possible to locate the head in small angular increments with respect to the subhead. A scribed line on the head and a dial on the subhead indicate the position. The mounting studs are screwed permanently into the subhead.

(b) CONTROL SHAFT AND PULLEY GROUP.—The steel control shaft with its integral pinion gear is held in the control shaft bore by a self-lubricating bushing and a cover plate which is secured by three screws. Two washers, one on each side of the pinion gear, maintain control shaft alignment (with respect to the speeder rack). The control shaft seal is in a recess at the end of the shaft bore. The pulley assembly has a steel toothed insert with a hexagonal hole to fit the end of the control shaft. This permits adjustment of the pulley relative to the insert and of the insert relative to the control shaft. (See figure 48.) Washers on both sides of the pulley hold the pulley and serrated insert together. The pulley stop pin which projects from the inside of the pulley to contact the high and low rpm adjustment screws can be positioned in any one of 12 holes. The cable clamp assembly fits a recess in the outer diameter of the pulley.

(c) SPEEDER RACK AND BALANCE SPRING GROUP.—The speeder spring adjusting rack meshes with the control shaft pinion gear, and by this means pulley rotation is transformed into longitudinal motion of the rack which varies the compression on the governor speeder spring. This, in turn, determines the governor rpm setting. The balancing spring, whose function is to return the rack to an intermediate position in case of control system failure, is held between the upper end of the speeder rack and the balancing spring lock nut by the adjusting screw. The lock spring at the lower end of the lock nut clamps around the square shank of the balancing spring adjusting screw. This allows adjustment of the screw while still being sufficiently strong to lock once an adjustment has been made. Since the adjusting screw has a screw driver slot at each end, the compression of the balancing spring can be changed externally after the screw at the upper end of the speeder rack bore is removed.

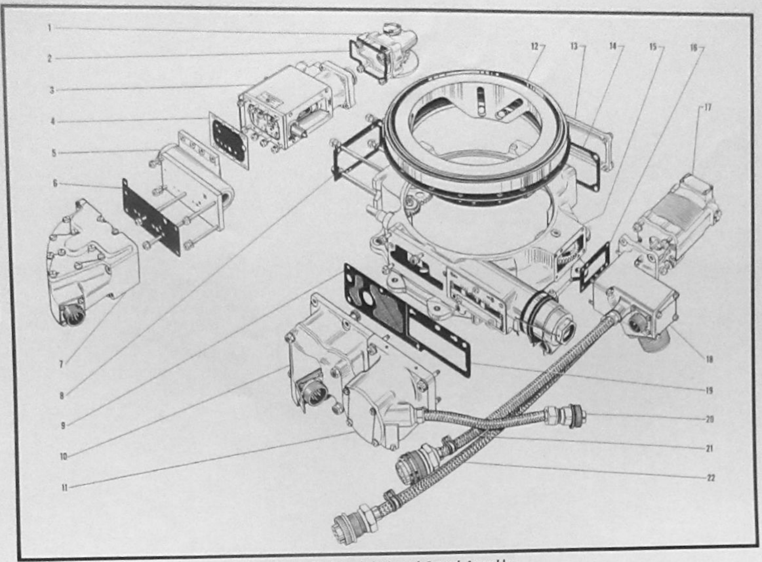
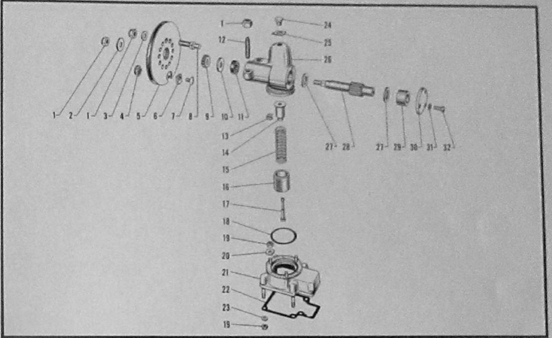


Figure 22—Extended View of Control Assembly



1 SELF-LOCKING NUT
2 PULLEY (OUTER) WASHER
3 WASHER
4 CABLE CLAMP & NUT
5 PULLEY
6 CABLE CLAMP
7 CABLE CLAMP SCREW
8 PULLEY STOP PIN
9 PULLEY INSERT
10 PULLEY (INNER) WASHER
11 CONTROL SHAFT SEAL
12 RPM ADJUSTMENT SCREW
13 LOCK NUT LOCK SPRING
14 LOCK NUT
15 BALANCING SPRING
16 SPEEDER RACK
17 ADJUSTING SCREW
18 HEAD-SUBHEAD GASKET
19 SELF-LOCKING NUT
20 HEAD-SUBHEAD CLAMP
21 SUBHEAD
22 HEAD-GOVERNOR GASKET
23 WASHER
24 HEAD PLUG
25 HEAD PLUG LOCK WASHER
26 HEAD
27 THRUST WASHER
28 CONTROL SHAFT
29 END COVER BUSHING
30 CONTROL SHAFT END COVER
31 LOCK WASHER
32 END COVER SCREW

Figure 23—Extended View of Governor Head Assembly

Nomenclature for Figure 22

1 GOVERNOR HEAD ASSEMBLY
2 GOVERNOR HEAD-GOVERNOR GASKET
3 GOVERNOR ASSEMBLY
4 GOVERNOR-SERVO MOTOR GASKET
5 SERVO MOTOR ASSEMBLY
6 SERVO MOTOR-SOLENOID PACK GASKET
7 SOLENOID PACK ASSEMBLY
8 GOVERNOR-CONTROL SUPPORT GASKET
9 PITCH TRANSMITTER-CONTROL SUPPORT GASKET
10 PITCH TRANSMITTER ASSEMBLY
11 PITCH LIMIT SOLENOID ASSEMBLY
12 TRANSLATING CONTROL & ROTATING SEAL ASSEMBLY
13 AUXILIARY PAD COVER
14 AUXILIARY PAD GASKET
15 CONTROL SUPPORT ASSEMBLY
16 WIRING HARNESS & CONTROL SUPPORT GASKET
17 AUXILIARY MOTOR ASSEMBLY
18 WIRING HARNESS ASSEMBLY
19 PITCH LIMIT SOLENOID-CONTROL SUPPORT GASKET
20 PITCH LIMIT SOLENOID CABLE
21 PITCH TRANSMITTER CABLE
22 SOLENOID PACK CABLE

(2) GOVERNOR ASSEMBLY.—The governor includes the following components: body, fly-weight head assembly, controlet, speeder spring, compensating piston, accumulator relief valve, gear pump with bottom plate, compensating needle valve, and auxiliary pump.

(*a*) BODY.—The aluminum alloy body contains the upper sump and oil passages and provides support for the various other components. A sight glass built into the side cover of the body enables a visual check on the amount of oil in the sump. An oil filler hole with an included strainer is incorporated into the top of the body. The governor sump check valve consists of a ball in a sleeve located below the fly-weight cup. During normal flight, the ball is down and the valve is open, allowing a small amount of oil to flow from the governor sump into the fly-weight head chamber and thence to the drive shaft bearings. During inverted flight, the force of gravity causes the ball to shift position, preventing an excessive amount of governor sump oil from draining into the governor head. Liners are press fitted in the compensating piston and needle valve bores, and are never removed

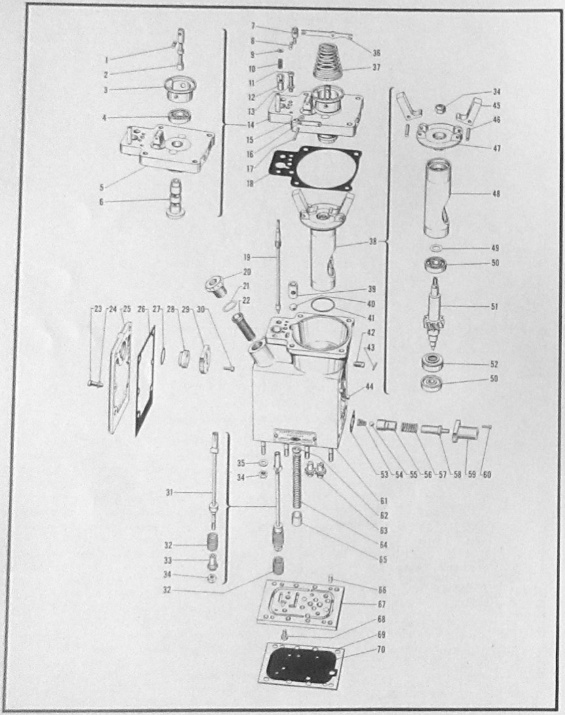


Figure 24—Extended View of Governor Assembly

Nomenclature for Figure 24

1 PILOT VALVE PIN
2 PILOT VALVE
3 SPRING SEAT
4 BALL BEARING
5 CONTROLET
6 PILOT VALVE SLEEVE
7 COMPENSATING PISTON FORK
8 COMPENSATING PISTON FORK PIN
9 NEEDLE VALVE SPRING WASHER
10 NEEDLE VALVE SPRING
11 ATTACHING SCREW
12 NEEDLE VALVE LOCK
13 WASHER
14 CONTROLET ASSEMBLY
15 LINK PIN WASHER
16 SPRING SEAT LINK
17 CENTER PIN
18 CONTROLET GASKET
19 NEEDLE VALVE
20 SUMP FILLER PLUG
21 FILLER PLUG GASKET
22 OIL FILTER
23 COVER PLATE SCREW
24 WASHER
25 SUMP COVER PLATE
26 COVER PLATE GASKET
27 SIGHT GLASS GASKET
28 SIGHT GLASS
29 SIGHT GLASS RETAINER
30 SCREW
31 COMPENSATING PISTON
32 COMPENSATING PISTON SPRING
33 SPRING SEAT
34 SELF-LOCKING NUT
35 WASHER
36 COMPENSATION LINK
37 SPEEDER SPRING
38 FLY-WEIGHT HEAD ASSEMBLY
39 SUMP CHECK VALVE RETAINER
40 SUMP CHECK VALVE BALL
41 TOROID SEAL
42 BUSHING LOCK SCREW
43 BUSHING LOCK SCREW KEY
44 LOCATING DOWEL
45 FLY-WEIGHT
46 FLY-WEIGHT HINGE PIN
47 FLY-WEIGHT HEAD
48 DRIVE SHAFT BUSHING
49 SHIM
50 BALL BEARING
51 DRIVE GEAR SHAFT
52 BELLOWS OIL SEAL
53 AUXILIARY PUMP GASKET
54 CHECK VALVE SPRING
55 CHECK VALVE BALL
56 AUXILIARY PUMP BUSHING
57 AUXILIARY PUMP SPRING
58 AUXILIARY PUMP PLUNGER
59 AUXILIARY PUMP HOUSING
60 SCREW
61 GOVERNOR BODY
62 RELIEF VALVE SEAT
63 PUMP GEAR
64 RELIEF VALVE SPRING
65 RELIEF VALVE PISTON
66 LOCATING DOWEL
67 GOVERNOR BOTTOM PLATE
68 SCREW
69 BASE GASKET SHIM
70 GOVERNOR BASE GASKET

except for replacement. Studs to which the servo motor assembly is attached are screwed into the lower surface.

(*b*) FLY-WEIGHT HEAD ASSEMBLY.—The governor drive gear shaft, incorporating a spiral gear, is mounted vertically on ball bearings in the fly-weight head bushing. A bellows type seal immediately above the lower ball bearing prevents leakage of oil from the gear pump coupled directly to the lower end of the shaft. The fly-weight head assembly is attached to the upper end of the shaft. The shaft is driven through an idler gear mounted in the control support which in turn is driven by the governor drive gear on the hub eccentric assembly. The fly-weights, which are mounted on the head, control movement of the pilot valve sleeve. They are so mounted that when they are moved outward by centrifugal force, they raise the pilot valve sleeve against speeder spring force. The entire fly-weight head assembly is secured in the governor body by a set-screw.

(*c*) CONTROLET ASSEMBLY.—The controlet plate fits between the governor head and the body. It contains oil transfer passages which connect to passages in the body. The bronze bushing and the integral projection on the bottom of the controlet plate have ports connecting to passages which lead from the gear pump and to the solenoid pack. The lower end of the pilot valve sleeve has a flange with a shallow slot into which the fly-weights seat. The speeder spring seat assembly fits onto a ball bearing on the upper end of the sleeve. The pilot valve which is very accurately fitted to the sleeve is held in position by a mechanical linkage to the compensating piston. The pivot pin for the link arm projects through a raised boss on the controlet plate. Since the link from the compensating piston to the pilot valve passes through an opening in the speeder spring seat, another link to this boss is used to prevent the spring seat from rotating. A permanent plug seals an opening needed during manufacture of the internal passages. A vent dowel opens the upper sump to the head chamber.

(*d*) COMPENSATING PISTON GROUP.—Due to the rapid blade angle change, governor action must be stabilized by a compensation system. The compensating piston acts against a dual spring force which tends to keep the piston (and the pilot valve) in a centered position. Motion of the servo piston causes an increase or decrease of oil pressure which moves the compensating piston against spring force. A link arm which is connected to the pilot valve is attached to an extension of the compensating piston. Movement of the pilot valve sleeve and consequent movement of the servo piston results in a compensating movement of the pilot valve to follow sleeve motion.

(*e*) COMPENSATING NEEDLE VALVE.—The compensating needle valve relieves oil to the sump from the line connecting the servo piston compensation chamber with the compensating piston. This valve can be

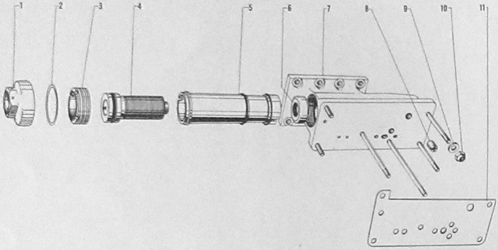


Figure 25—Extended View of Servo Motor Assembly

1 PISTON LINER OUTER LOCK NUT
2 LOCK NUT GASKET
3 PISTON LINER INNER LOCK NUT
4 SERVO PISTON
5 PISTON LINER
6 SERVO OIL SEAL
7 SERVO MOTOR HOUSING
8 CHECK VALVE ASSEMBLY
9 WASHER
10 SELF-LOCKING NUT
11 SOLENOID PACK-SERVO MOTOR GASKET

adjusted and locked at 30-degree intervals by means of the locating bushing and locking spring. By slowly relieving oil to the sump, the needle valve controls the rate at which the compensating piston returns to its centered position after having been displaced by servo piston motion. It also regulates slightly the rate at which the compensating piston moves in response to pressure variations caused by servo piston motion, i.e., the larger the opening, the slower the response.

(f) GEAR PUMP AND BOTTOM PLATE.—The pump gears, which are identical, fit into recesses in the bottom of the governor body, and are supported on one side by the governor body and on the other side by the governor bottom plate. One of the gears is driven by the governor drive gear shaft, and the other is an idler. Sump oil is admitted to one side of the gears, and its pressure is boosted to that required for operation of the servo piston. Oil delivered out the other side is used as directed by the governor or the solenoid valves. The governor bottom plate contains the feed and distribution passages for the pump. It also serves to retain the pump gears and accumulator relief valve in the body. For clockwise rotation of the engine, the two holes marked C-C in the bottom plate are plugged. For anticlockwise rotation, the holes marked A-A are plugged.

(g) ACCUMULATOR RELIEF VALVE.—This consists of a piston, a spring, and a spacer in a governor body recess. The primary function of the accumulator relief valve is to relieve, at about 150 p.s.i., the pressure built up by the governor gear pump. Its secondary function is to store a small supply of oil under pressure.

(h) AUXILIARY PUMP.—Since the gear pump does not operate when the propeller is not rotating, an auxiliary source of oil is needed to operate the servo piston. This oil is provided by the auxiliary piston type pump mounted on the governor body which is driven by the auxiliary pump drive gear cam on the control support. After the ball type check valve is inserted into the recess under the auxiliary pump mounting pad, the pump is installed. This pump is composed of a housing, a plunger, a spring, and a bushing.

(i) MISCELLANEOUS PARTS.—Composition gaskets are provided between the body and the controlet, and between the body and the servo motor assembly. The locating shim holds the latter gasket in position. Washers and nuts retain the servo motor assembly to the governor.

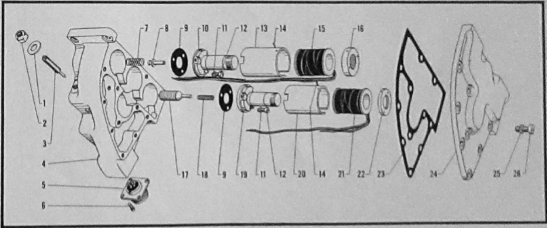
(3) SERVO MOTOR ASSEMBLY.—The servo motor is mounted between the governor and the solenoid pack, and contains the connecting oil passages between these two assemblies. The main units, shown in figure 25, are the housing, the piston liner, the piston, and the lock nut. The aluminum alloy housing includes oil passages and a chamber to receive the piston liner. Six studs in the lower face of the housing accommodate the solenoid pack. The top of the housing is a finished surface and incorporates eight holes for the governor studs. A small check valve on the bottom of the housing transmits the scavenged oil pumped by the servo rack from the pitch transmitter recess to the upper sump. The piston liner fits inside the housing and provides a cylinder within which the servo piston operates. An annulus around the liner connects the governor sump with the solenoid sump. Synthetic toroid seals around the outside of the liner separate the various oil chambers along its length. The servo piston has two diameters and incorporates a seal around the larger diameter to eliminate leakage between the piston and the liner. A spiral groove around the smaller diameter permits oil to enter and lubricate the piston. The lock nut seals the outer end of the piston chamber. The servo rack is pressed by the servo springs against the small end of the servo piston. Servo oil pressure acting against the face of the large diameter of the piston actuates the rack against spring force. The position of the piston in the liner, therefore, is determined by the balance of these two opposing forces.

(4) SOLENOID PACK ASSEMBLY.—The solenoid pack consists of the housing and the solenoid valves. The aluminum alloy housing has an oil reservoir (lower sump) for the governor, and has passages for oil flow as directed by the solenoid valves. Four chambers in the housing accommodate the solenoid valves. Each valve has a plunger with a spring inside a core, a coil assembly which actuates the plunger, and a retaining shell with a lock pin. A needle valve arrangement is included in the lower, or bypass solenoid, chamber. An AN connector at the lower end of the pack provides the electrical connection for the cable from the wiring harness to the solenoid pack. The solenoid valves, as controlled by the cockpit control switches, open and close oil passages in the pack and regulate the direction of oil flow.

(*a*) LOCK PITCH SOLENOID.—The lock pitch solenoid controls oil flow between the governor and the servo chamber, removing the governor from the control system when the valve is closed.

(*b*) DECREASE PITCH SOLENOID.—The decrease pitch solenoid controls oil flow in the line between the governor gear pump and the servo chamber, allowing oil from the pump to flow into the servo chamber when the valve is opened. On installations not incorporating the manual control and reversing features, this solenoid valve is omitted from the pack.

(*c*) INCREASE PITCH SOLENOID.—The increase pitch solenoid controls oil flow in the line between the servo chamber and the sump, allowing oil from the



1 WASHER
2 SELF-LOCKING NUT
3 NEEDLE VALVE
4 SOLENOID PACK HOUSING
5 ELECTRICAL PLUG
6 PLUG ATTACHING SCREW
7 SOLENOID SPRING
8 SOLENOID VALVE
9 SOLENOID GASKET
10 CORE ASSEMBLY
11 LOCK WASHER
12 CORE ATTACHING SCREW
13 SOLENOID SHELL
14 LOCK PIN
15 COIL ASSEMBLY
16 END BELL
17 SOLENOID PLUNGER
18 SOLENOID SPRING
19 SOLENOID CORE
20 SOLENOID SHELL
21 COIL ASSEMBLY
22 END BELL
23 COVER GASKET
24 SOLENOID PACK COVER
25 WASHER
26 COVER ATTACHING SCREW

Figure 26—Extended View of Solenoid Pack Assembly

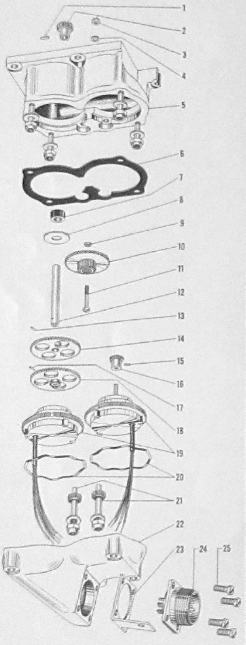


Figure 27—Extended View of Pitch Transmitter

servo chamber to drain into the sump when the valve is opened. In installations not requiring manual or feathering control, the solenoid is omitted.

(*d*) BYPASS SOLENOID.—The bypass solenoid, when energized, allows oil flowing through either the decrease pitch or increase pitch solenoid valve to bypass the needle valve restriction in the line to the servo chamber to provide rapid control action as desired in feathering and reversing operations. On installations not incorporating manual control, this solenoid valve is omitted.

(5) PITCH INDICATION SYSTEM.—Three separate units comprise the pitch indication system; namely, the pitch transmitter, the pitch indicator, and the inverter. The pitch transmitter contains two permanent magnets geared together with a 10 to 1 ratio, each of which is mounted in a field of three resistance coils, arranged in bridge circuits around the magnets, which are connected to similar circuits in the pitch indicator. The circuits are energized by the inverter in such a way that the position of the magnets determines the balance of voltage across each coil. Attached to one of the magnet drive shafts is a pinion gear which fits through the control support and meshes with the gear teeth on the inboard side of the rack. Thus, reciprocating motion of the servo rack is translated into rotational motion of the magnets. The pitch indicator, mounted in the cockpit, has a wiring arrangement similar to the pitch transmitter. However, the magnets are not geared together and are attached directly to needles which swing across dials calibrated to read in degrees of propeller pitch. A change in position of the transmitter magnets unbalances the voltage of the bridge circuits and provides the magnetic force necessary to swing the

Nomenclature for Figure 27

1 LOCKING PIN
2 PINION GEAR
3 SELF-LOCKING NUT
4 WASHER
5 PITCH TRANSMITTER HOUSING
6 HOUSING & COVER GASKET
7 DRIVE SHAFT BUSHING
8 DRIVE SHAFT WASHER
9 IDLER GEAR
10 IDLER GEAR ASSEMBLY
11 IDLER GEAR SHAFT
12 DRIVE SHAFT
13 LOCKING PIN
14 DRIVE GEAR
15 LOCKING PIN
16 HIGH SPEED TRANSMITTER GEAR
17 LOCKING PIN
18 LOW SPEED TRANSMITTER GEAR
19 MAGNETIC UNITS
20 MAGNETIC UNIT SPRINGS
21 ADJUSTING PINIONS
22 PITCH TRANSMITTER COVER
23 CABLE BRACKET
24 CABLE CONNECTOR
25 SCREWS

indicator magnets to a corresponding balance position. Coarse and fine external adjustments on the transmitter provide for correct setting of the indicator. The function of the inverter is to convert 24-volt D.C. current to 26-volt 400 cycle A.C. current which is supplied to the bridge circuits of the above units.

(6) PITCH LIMIT SOLENOID ASSEMBLY.—The aluminum alloy housing which contains the pitch limit solenoid mounts on the control support. The plunger connects to the stop links, and the solenoid spring maintains the stop links in a position which limits travel of the rack within the constant speed range when the solenoid is not energized. When the solenoid is energized, the links are pulled down and the servo rack can then move to either the feathered or reverse position as determined by the limit stops in the control support. A shielded cable equipped with an AN plug and carrying the two solenoid leads is connected to the bottom of the housing.

(7) WIRING HARNESS ASSEMBLY.—The wiring harness housing mounts on the control support adjacent to the auxiliary motor idler gear. Four cap screw holes and two dowels are used to locate and maintain the worm drive shaft in alignment with the auxiliary motor idler gear. The worm gear drive shaft with its two ball bearings fits into a sleeve which is pressed into the housing. One side of the sleeve is cut away to permit the worm gear to mesh with the idler gear in the control support. A coupling joins the worm gear to the electric auxiliary motor. On the inboard side, mounted at an angle, is a large male AN connector to which all wiring connections for the control system are attached. Wires from this connector are distributed from the housing to various parts of the control. Two wires are connected directly to the auxiliary motor. Through two shielded cables, equipped with AN connectors, six wires are distributed to the solenoid pack and five to the pitch transmitter. Two wires for the pitch limit solenoid leave the housing through an AN connector mounted on the lower side of the box. Inside the wiring harness cover plate is a stud for the attachment of ground wires.

Nomenclature for Figure 28

1 SCREW
2 PLUNGER
3 STOP LINK
4 WASHER
5 STOP LINK
6 LINK PIN
7 ELECTRICAL CONNECTOR
8 SHIELDED CABLE
9 PITCH LIMIT SOLENOID HOUSING
10 SOLENOID BUSHING
11 COIL ASSEMBLY
12 SOLENOID CORE
13 STOP PIN
14 SPRING
15 CORE PLUG
16 COVER GASKET
17 PITCH LIMIT SOLENOID COVER
18 WASHER
19 ATTACHING SCREW

(8) AUXILIARY MOTOR ASSEMBLY.—The auxiliary motor is a 24-volt, series wound, D.C. motor designed for intermittent operation only. It is mounted on the wiring harness housing with four mounting studs. There are two leads from the motor to the wiring harness. During feathering and unfeathering operation, the motor drives the worm shaft, which drives the eccentric assembly through an idler gear.

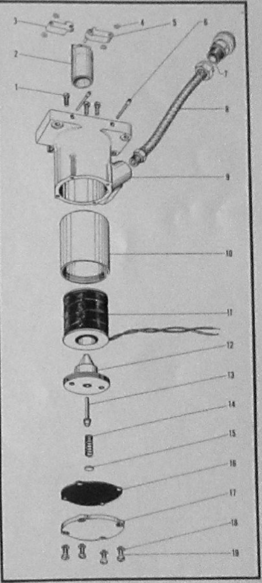


Figure 28—Extended View of Pitch Limit Solenoid

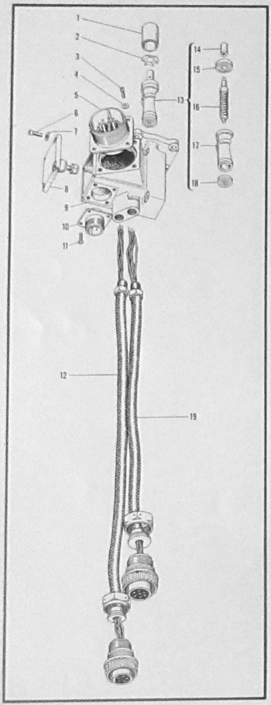


Figure 29—Extended View of Wiring Harness Assembly

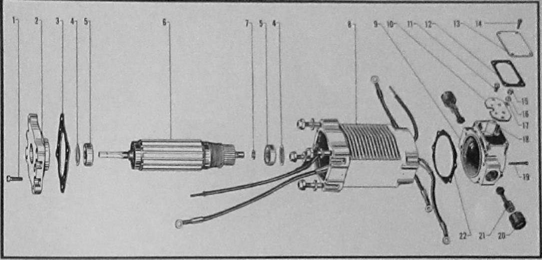
(9) TRANSLATING CONTROL & ROTATING SEAL ASSEMBLY.

(a) TRANSLATING CONTROL.—The translating control is the mechanical means of converting motion of the servo rack at right angles to the engine shaft to fore-and-aft motion of the distributor valve thrust plate. This in turn actuates the distributor valve. The inner ball race ring incorporates gear teeth which mesh with the rack to drive the ring. Two rollers are assembled onto this inner ring for driving the distributor valve thrust plate rotationally. The outer race, which is fastened to the control support by cap screws, secures the translating control in position on the support. Three holes are included for supporting rollers which ride in the angular slots of the thrust plate. Angular cam slots in the distributor valve thrust plate, in conjunction with the rollers assembled with the outer race, convert rotational motion of the inner race to fore-and-aft motion of the thrust plate. Enlargements at the ends of the slots permit assembly of the five flanged rollers. A stop in the outer race restricts the rotational travel of the inner race and thereby the axial travel of the thrust plate. This prevents the rollers from falling out of the loading enlargements in the ends of the slots. The thrust plate incorporates a flange against which the distributor valve rides. The axial position of the thrust plate in the translating control, therefore, determines the axial position of the distributor valve in the hub.

(b) ROTATING SEAL.—Small spring cups in the flange of the outer race contain springs to load the carbon seal against the surface of the thrust ring on the hub. A steel band containing two lugs to fit into two corresponding slots of the outer race flange is shrunk around the carbon ring. A cotter pin in each lug retains the carbon ring against the springs. To prevent oil leakage between the outer race and the rotating seal, a toroid seal is placed between the surfaces. The carbon surface contacting the thrust ring in the hub forms an effective seal.

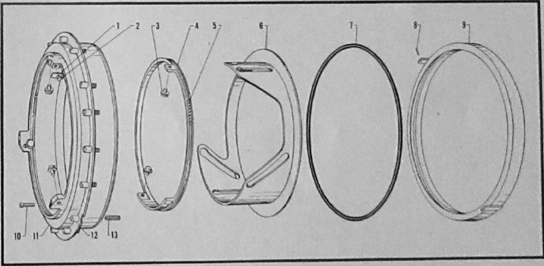
Nomenclature for Figure 29

1 SPACER
2 LOADING SPRING
3 ELECTRICAL PLUG SCREW
4 WASHER
5 LARGE ELECTRICAL PLUG
6 TERMINAL COVER SCREW
7 WASHER
8 TERMINAL COVER
9 WIRING HARNESS HOUSING
10 SMALL ELECTRICAL PLUG
11 ELECTRICAL PLUG SCREW
12 SOLENOID PACK CABLE
13 WORM GEAR ASSEMBLY
14 AUXILIARY MOTOR COUPLING
15 WORM GEAR UPPER BEARING
16 WORM GEAR
17 WORM GEAR HOUSING
18 WORM GEAR LOWER BEARING
19 PITCH TRANSMITTER CABLE



1 SCREW
2 BASE PLATE
3 BASE PLATE GASKET
4 WASHER
5 BALL BEARING
6 ARMATURE
7 SPACER
8 HOUSING ASSEMBLY
9 BRUSH HOUSING ASSEMBLY
10 TERMINAL PLATE
11 ATTACHING SCREW
12 COVER PLATE GASKET
13 COVER PLATE
14 COVER PLATE SCREW
15 TERMINAL NUT
16 NUT
17 LOCK WASHER
18 TERMINAL SCREW
19 BRUSH HOUSING SCREW
20 BRUSH COVER
21 BRUSH ASSEMBLY
22 BRUSH HOUSING GASKET

Figure 30—Extended View of Auxiliary Motor Assembly



1 THRUST PLATE STOP WASHER
2 THRUST PLATE STOP
3 THRUST PLATE ROLLER
4 INNER BALL RACE
5 BALL
6 DISTRIBUTOR VALVE THRUST PLATE
7 ROTATING SEAL TOROID SEAL
8 COTTER PIN
9 ROTATING SEAL
10 CONTROL SUPPORT SCREW
11 SUPPORT RACE ASSEMBLY
12 SPRING SEAT
13 ROTATING SEAL SPRING

Figure 31—Extended View of Translating Control Assembly

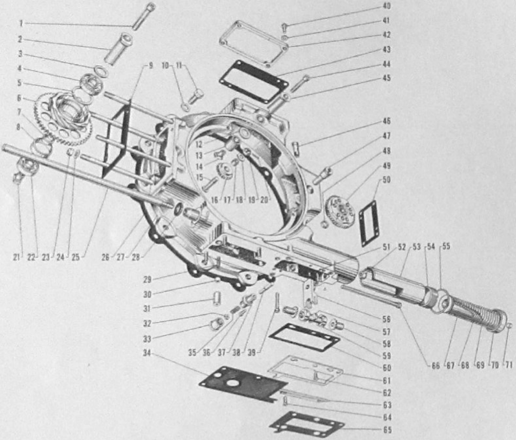


Figure 32—Extended View of Control Support Assembly

Nomenclature for Figure 32

1 GEAR SHAFT SCREW
2 DRIVE & IDLER GEAR SHAFT
3 SPACER
4 BALL BEARING
5 SNAP RING
6 GOVERNOR DRIVE & IDLER GEAR
7 INNER SPACER
8 OUTER SPACER
9 GOVERNOR-CONTROL SUPPORT GASKET
10 WASHER
11 CONTROL SUPPORT MOUNTING SCREW
12 SPACER
13 AUXILIARY SHAFT BUSHING
14 AUXILIARY SHAFT NUT
15 AUXILIARY PUMP GEAR SHAFT
16 AUXILIARY PUMP DRIVE GEAR
17 DRIVE GEAR BUSHING
18 WASHER
19 NUT
20 COTTER PIN
21 GEAR SECURING NUT
22 BALL BEARING
23 SELF-LOCKING NUT
24 WASHER
25 SERVO RACK
26 CONTROL SUPPORT GASKET
27 CONTROL SUPPORT
28 SERVO MOTOR-CONTROL SUPPORT GASKET
29 CHECK VALVE SPRING
30 CHECK VALVE BALL
31 CHECK VALVE RETAINER
32 CALIBRATING PIN WASHER
33 CALIBRATING PIN CAP
34 PITCH TRANSMITTER-CONTROL SUPPORT GASKET
35 CALIBRATING PIN SPRING
36 LOCATING SCREW
37 CALIBRATING PIN ECCENTRIC BUSHING
38 CALIBRATING PIN
39 PITCH LIMIT SOLENOID SCREW
40 AUXILIARY PAD COVER SCREW
41 WASHER
42 AUXILIARY PAD COVER
43 AUXILIARY PAD COVER GASKET
44 AUXILIARY SHAFT SCREW
45 AUXILIARY SHAFT
46 RATCHET WHEEL LOCK ASSEMBLY
47 RATCHET WHEEL SHAFT
48 SPACER
49 RATCHET WHEEL ASSEMBLY
50 WIRING HARNESS-CONTROL SUPPORT GASKET
51 SERVO RACK GUIDE PIN
52 SELF-LOCKING NUT
53 CONTROL SUPPORT LINER
54 INNER LOCK NUT
55 OUTER LOCK NUT SEAL
56 SPRING SEAT GUIDE
57 PITCH STOP SCREW
58 FEATHER & REVERSE PITCH STOP
59 HIGH & LOW PITCH STOP
60 INDEX PLATE-CONTROL SUPPORT GASKET
61 INDEX PLATE
62 INDEX PLATE SCREW
63 STOP LOCK PLATE
64 STOP LOCK PLATE SCREW
65 PITCH LIMIT SOLENOID-CONTROL SUPPORT GASKET
66 PITCH STOP SCREW SHAFT
67 SPRING SEAT
68 SERVO (INNER) SPRING
69 SERVO (OUTER) SPRING
70 CONTROL SUPPORT OUTER LOCK NUT
71 PIPE PLUG

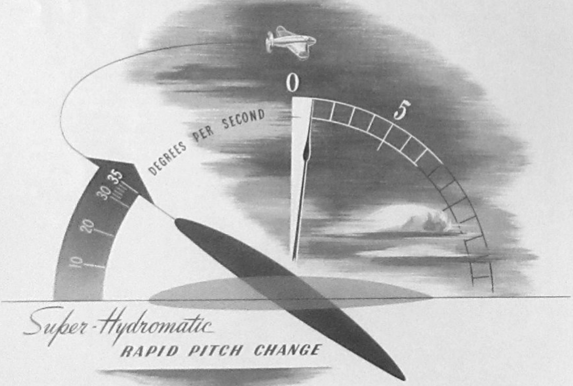
(10) CONTROL SUPPORT ASSEMBLY.

(*a*) CONTROL SUPPORT.—As shown in figure 32, the main parts of the control support assembly are: the control support; the idler gear assemblies for operating the governor, auxiliary pump, and the eccentric; and the rack and hydraulic stop arrangement. The aluminum alloy support is the foundation for mounting all control unit assemblies onto the engine nose in their proper positions. The inboard side of the support consists of a mounting surface incorporating 12 equally spaced holes. A chamber on the bottom accommodates the servo spring assembly which supplies the force necessary to move the servo rack toward the high pitch position against servo motor oil pressure. This chamber is closed by the servo spring cap. Two concentric springs are compressed between the spring guide which bears against the servo rack and the servo spring cap. The outer end of the spring guide is threaded to receive a bolt which is used to compress the springs. This precompression feature facilitates installation of the servo spring cap, and is the means of coordinating the servo rack setting with the distributor valve setting. A horizontal bronze bushing through the bottom of the support guides the servo rack. The position of the rack in the support is determined by the balance of oil pressure force against the servo piston on one side and servo spring force on the other. Centered under the support is the mounting surface for the pitch transmitter. A vertical hole in the bottom of the support permits the pitch transmitter gear to mesh with the gear teeth on the side of the rack. A hole through the vertical surface of the support above the transmitter allows oil to pass into the recess on top of the pitch transmitter for scavenging back to the sump. A check valve built into the transmitter mounting surface scavenges the oil from the transmitter reservoir. A shoulder at the front of the support is used for retention of the translating control & rotating seal assembly and for proper compression of the toroid seal. Bolt holes in the inboard side of the support provide means for securing these assemblies. On the top of the support is an auxiliary mounting surface, usually covered with a plate. The right-hand side of the support (when facing the nose) has a mounting surface and four tapped holes for the wiring harness. Two dowels serve to align the drive shaft in the harness with the auxiliary motor idler gear.

(*b*) AUXILIARY MOTOR RATCHET WHEEL ASSEMBLY.—The ratchet wheel assembly consists of an idler gear with a ratchet attached to each side. Two purposes are served by the auxiliary motor ratchet wheel assembly installed in the control support. During feathering and unfeathering operations with the engine stopped, the gear transmits auxiliary motor torque from the worm drive shaft to the eccentric in order to drive the propeller hub pump and the governor auxiliary pump. This provides oil pressure to change pitch. With the engine rotating, the torque imparted to the eccentric by the hub pump tends to drive the idler gear, and consequently the auxiliary motor, in the reverse direction. The ratchet attached to the side of the idler gear drives against its lock and prevents the gear from being turned in reverse. The spring loaded ratchet wheel lock assembly which engages the ratchet, as described above, is screwed into the support over the assembly so that the plunger rides on the ratchet. On clockwise rotation installations, the ratchet is placed so that letters stamped C-C face out from the engine. On anticlockwise installations, the letters A-A should face out.

(c) GOVERNOR DRIVE & IDLER GEAR ASSEMBLY.—On the left side of the support (when facing the nose) the governor mounting surface includes four long studs and two dowels for aligning the governor drive & idler gear assembly, mounted with bearings on a shaft through the left side of the support, with the governor drive gear shaft. The drive & idler gear assembly consists of two gears brazed together. The governor drive gear on the hub drives the governor drive gear shaft by means of this drive & idler gear assembly. The auxiliary pump drive gear and integral cam is mounted on another shaft below the idler gear and in line with the eccentric drive gear of the hub. During feathering and unfeathering operations with the engine stopped, this gear is driven by the eccentric drive gear and the cam actuates the auxiliary pump plunger.

(d) RACK AND HYDRAULIC STOPS.—Provision is made under the servo spring chamber for stopping the rack at the high pitch, low pitch, feathered, and reverse positions. Two adjustable stops are mounted on a stop screw that moves with the rack. These contact the pitch limit solenoid links, and limit the motion of the rack to the constant speed range when the pitch limit solenoid is not energized. Two other adjustable stops are screwed into the bracket. These stops are contacted by the ends of the screw on which the constant speed high and low pitch stops are mounted, and limit rack motion to the feathered and reverse settings when the pitch limit solenoid is energized. A stop lock plate is mounted against the bottom of the support in a position such that it engages notches on all four stops to lock them at the position for which they are set. The index plate provides an index for setting the stops at the desired angle. A calibrating pin assembly inserted through the rear of the control support behind the stops is used to center the servo rack.



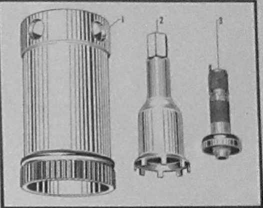
SECTION III
INSTALLATION

1. INSTALLATION TOOLS REQUIRED.

PART NO.	NOMENCLATURE	APPLICATION
61322	Hub Retaining Nut Wrench	To tighten and loosen the retaining nut.
61321	Valve Cap Wrench	To install and remove the distributor valve cap.
63098	Distributor Valve Gage	To check and adjust the distributor valve setting.
See Note	Spring Compression Bolt	To compress the servo springs during the angle adjustment procedure.

Note

The spring compression bolt is a steel 1/4 x 28 bolt, 2 inches in length and threaded full length. Because it is a common article, it is not furnished by the contractor.



1 HUB RETAINING NUT WRENCH
2 DISTRIBUTOR VALVE CAP WRENCH
3 DISTRIBUTOR VALVE GAGE

Figure 33—Installation Tools

2. PREINSTALLATION CHECKS.

a. Except for the general precautions and notes listed in the following paragraphs, installation of the propeller and the cockpit controls should be in accordance with the installation drawings for the particular aircraft. It is assumed in the following instructions that the control assembly being installed is regulated from the cockpit by a cable. On aircraft using some other governor control system, modify these installation instructions to meet the requirements of the manufacturer's specifications. It is also assumed that the correct head and pulley position is known for the particular aircraft.

b. The *Super*-Hydromatic propeller is installed as two units: the control assembly and the hub & blades assembly. However, it is necessary to partially disassemble the control assembly in order that the eccentric assembly gears on the hub may be meshed with the auxiliary gears in the control support. The entire hydraulic unit (the governor, governor head, servo motor, and solenoid pack assemblies) and the wiring harness, including auxiliary motor, must be removed.

c. The *Super*-Hydromatic pitch setting system is designed so that a fixed relationship is maintained between the control assembly and the vane motors; the blades are indexed relative to the vane motors. The servo rack mid-position corresponds to the centered position of the translating control thrust plate, the distributor valve, the vane motor, and, therefore, the midpoint of the blade pitch range. The maximum available pitch range is 120 degrees. The present model propeller has three ranges: −25 to +95 degrees, −28 to +92 degrees, and −31 to + 89 degrees. The −25 to +95 degree range will be used in the following discussion. Therefore, its mid-position is 35 degrees.

Note

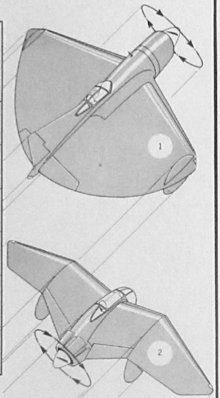
The term "pitch range" applies to the maximum range at which it is possible to set the blades. The term "pitch settings" refers to the actual angles between which the blades operate.

d. Check all visible parts for nicks, burrs, and other damage. Carefully remove such damage with a fine stone or crocus cloth.

e. Clean the propeller thoroughly to minimize the chance of foreign matter entering the system. The use of leaded or aromatic fuels should be avoided. Propellers, as shipped by the manufacturer, usually will be protected against corrosion by application of a suitable corrosion preventive on the exposed portions of both the hub & blades assembly and the control assembly. Such preventive compound should be thoroughly cleaned from the rear portion of the hub, including the eccentric assembly, pump rollers, thrust ring, etc., to minimize its absorption into the propeller oil system. Similarly, the compound should be removed from the control translating mechanism, especially the carbon rotating seal. Then thoroughly clean the control mounting surface on the engine and all parts, including the shaft, outboard of this surface.

PROPELLER INSTALLATION

	1 Right Hand Tractor Right Hand Engine	2 Right Hand Pusher Left Hand Engine	3 Left Hand Tractor Left Hand Engine	4 Left Hand Pusher Right Hand Engine
TYPE OF BLADES	Right Hand	Right Hand	Left Hand	Left Hand
VANE MOTOR PLUGGING	R-R	R-R	L-L	L-L
DISTRIBUTOR VALVE CAM	Right Hand	Right Hand	Left Hand	Left Hand
GOVERNOR BOTTOM PLATE PLUGGING	C-C	A-A	A-A	C-C
RATCHET WHEEL LOCATION	Face C Out	Face A Out	Face A Out	Face C Out
AUXILIARY MOTOR WIRING	C	A	A	C



A right hand propeller turns clockwise, and a left hand propeller turns anticlockwise, when viewed from a position in the slipstream.

A right hand engine turns clockwise, and a left hand engine turns anticlockwise, when viewed from the rear end of the engine.

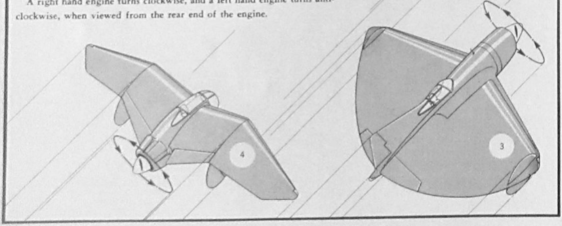


Figure 34—Chart of Plugging for Various Installations

f. Test all parts for freedom of movement. The auxiliary gears in the support, the governor drive shaft, the auxiliary pump plunger, the eccentric, and the pump rollers should be rotated by hand. The servo rack and translating control are checked when the spring compression bolt is tightened during the installation procedure. Abnormal binding due to improper fits or foreign particles will usually be revealed by this preliminary test.

g. Make certain that the control assembly and the hub & blades assembly are operating satisfactorily before installation. If necessary, run the propeller through the test procedures given in section VII.

h. *Super*-Hydromatic propellers are so designed that they may be adapted for either clockwise or anticlockwise direction of engine-propeller shaft rotation by changing internal plugging. The chart and illustration in figure 34 show the possible combinations. Vane motor and governor plugging and auxiliary drive gear direction of rotation must all be correct, otherwise malfunction of the propeller will result.

3. INSTALLATION PROCEDURE.

a. INSTALLATION OF CONTROL ASSEMBLY.

(1) Place the composition gasket against the thoroughly cleaned mounting surface of the engine nose followed by the control assembly, minus the hydraulic and auxiliary motor-wiring harness units. It may sometimes be easier to place the gasket over the control screws, and then install both. The retaining screws which hold the control onto the nose should be tightened evenly, and safetied in pairs with wire. Care must be observed not to cock the control on the nose while tightening the screws.

(2) Remove the calibrating pin cap and the pipe plug in the servo spring cap. After inserting the spring compression bolt through the opening, compress the servo spring by tightening the bolt, and at the same time, push the rack to follow this motion. Tighten far enough to allow the calibrating pin to be fully depressed. While the pin is depressed, loosen the bolt until the rack guide contacts the calibrating pin, at which time the pin is retained by the servo spring force. The rack is now in the 35-degree position.

(3) If it is necessary to change the initial setting of the hydraulic stops, the rack must be in the 35-degree position as determined by the calibrating pin; i.e., the rack guide surface contacting the calibrating pin must be in line with the "index" mark on the index plate. With the rack in this position, the stop setting can be changed to any angle indicated on the index plate. The flat sides of the constant speed stops indicate the angles at which they are set. The flat side of the reverse and feather stops in the housing indicate the angle set. To prevent the stops from

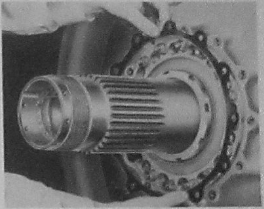


Figure 35—Installing Engine Nose Gasket

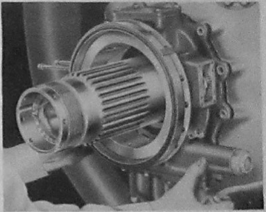


Figure 36—Installing Control Assembly

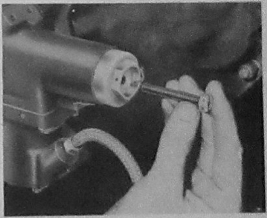


Figure 37—Inserting Spring Compression Bolt

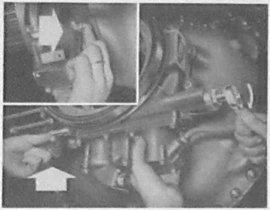


Figure 38—Tightening Spring Compression Bolt and Depressing Calibrating Pin

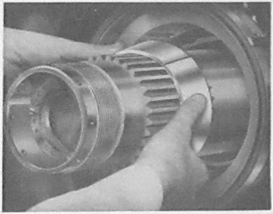


Figure 39—Installing Rear Cone

rotating, a stop lock plate fitting into slots in the stops is attached to the housing.

b. INSTALLATION OF HUB & BLADES ASSEMBLY.

(1) Remove the shaft thread protective cover and install the rear cone on the propeller shaft, moving it back until it contacts the propeller shaft thrust bearing nut. To prevent seizure of the propeller retaining nut on the propeller shaft, apply a thin film of thread lubricant meeting Specification No. AN-C-53 or clean engine oil to the shaft threads and splines.

(2) Lift the hub & blades assembly into position, making sure the hub is held so the blank spline in the hub is in line with the wide spline on the engine shaft, and that blade clearance is provided for the installation work stand. A woven strap lifting sling having straps at least two inches wide is recommended. The straps should be placed around the blade about one foot out on the airfoil section. Solid hook slings should never be used as they tend to damage the relatively thin blade airfoil section. When the engine shaft has no wide spline, install the hub & blades assembly in such a manner that the pump filler plug is on top. This will place the distributor valve on top and prevent excessive oil drainage from the hub when the distributor valve cap is removed at the time the distributor valve is adjusted.

Note

On most new engines, oil and corrosion preventives are flushed from the cylinder prior to installation of the engine on the aircraft. However, in case this has not been done and the engine is allowed to stand idle for an appreciable time after propeller installation and before engine run-up, the portion of the cylinders wiped clean of protective by rotating the propeller shaft during installation may corrode. It is therefore advisable to rotate the shaft only a minimum amount and, if possible, not at all.

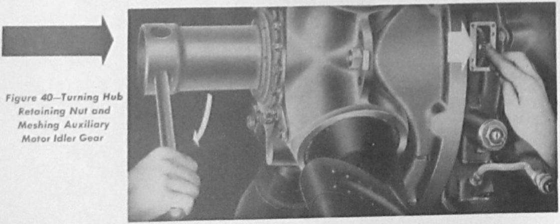


Figure 40—Turning Hub Retaining Nut and Meshing Auxiliary Motor Idler Gear

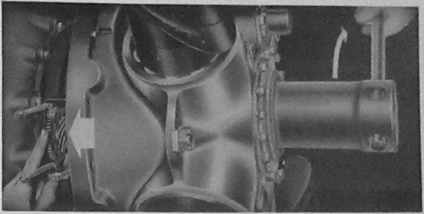


Figure 41—Turning Hub Retaining Nut and Meshing Governor Drive & Idler Gear

(3) Install the hub & blades assembly and move it back carefully onto the splined shaft until the retaining nut threads contact the engine shaft threads. Fit the retaining nut wrench into the retaining nut and a short bar into the wrench. Then turn the nut, moving the hub & blades assembly onto the shaft. As this is done, rotate the auxiliary motor idler gear and the auxiliary pump drive gear with the fingers until the gears mesh with the eccentric gear. When these have meshed, the governor drive & idler gear should be rotated as the retaining nut is turned farther onto the shaft until it is meshed with the governor drive gear. *Extreme care* must be exercised while turning the retaining nut to mesh correctly the governor drive gear and the eccentric gear with the idler gears in the control support in order to prevent gear tooth breakage. At the time of mesh, all idler gears in the control support should be checked for a slight backlash. The hub retaining nut should advance on the threads without binding or catching. If it does not, recheck both the retaining nut and the propeller shaft threads for burrs, nicks, cross threading, etc.

(4) After these three sets of gears have meshed, the retaining nut should be secured with a torque of 1500 pound-feet. While this torque is maintained, rap the bar sharply with a 4-pound hammer about one foot from the wrench. Lock the retaining nut by inserting the retaining nut lock wire through one of the small holes in the retaining nut and into a mating slot of the cover plate. Should two of these not be lined up, the nut must be *tightened* until one hole and one slot coincide. Never loosen the nut to align the locking holes. Spacing of the slots in the retaining nut with respect to the slots in the cover plate is such that alignment of a slot and hole will occur at each five degrees of rotation.

c. COMPLETION OF THE INSTALLATION.

(1) In order to set the distributor valve, the blades should be at an angle between 20 and 50 degrees. Remove

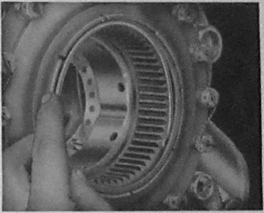


Figure 42—Inserting Retaining Nut Lock Wire

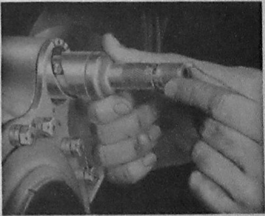


Figure 43—Checking Distributor Valve Setting

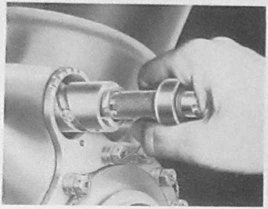


Figure 44—Adjusting Distributor Valve Position

the distributor valve cap, and check the setting of the distributor valve. Place the distributor valve GO NO-GO gage over the distributor valve bushing in such a way that the outer ring of the gage fits flatly against the end of the cam. The inner ring rests on top of the distributor valve. Then check the setting by twisting the GO NO-GO gage with the fingers. The square lug should pass over the surface marked "GO" but should interfere with the surface marked "NO-GO". Should the valve not be set correctly, it should be screwed in or out as required. If the lug is under the "GO" limit, turn the valve counterclockwise; if the lug is above the "NO-GO" limit, turn it clockwise. Reverse the gage and push it into the valve opening so that the prong on the end of the gage fits into a groove on the adjustable lock. To release the adjustable lock which is normally locked by a pin, the gage must be pushed in approximately 3/16 inch against distributor valve spring

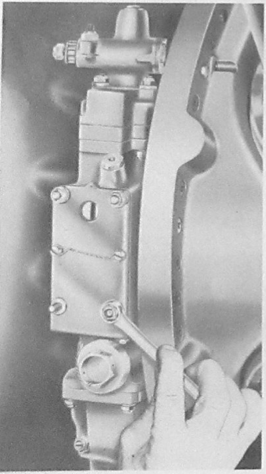


Figure 45—Tightening Hydraulic Unit in Position

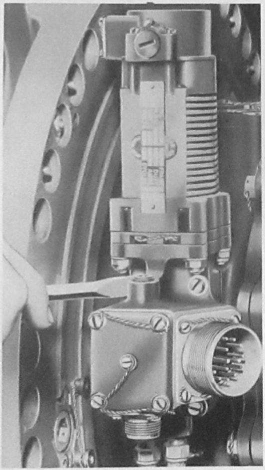


Figure 46—Tightening Wiring Harness in Position

force while the valve is turned. One full turn of the distributor valve approximately equals a .025-inch adjustment and the locking grooves occur at .003-inch intervals. After correct adjustment has been made, care must be taken to insure that the spring-loaded lock snaps into a locked position. Then check the distributor valve setting as before with the GO NO-GO gage. This is repeated until the proper setting is obtained.

(2) Replace the distributor valve cap with its toroid seal using the distributor valve cap wrench, and tighten to a torque of 50 pound-feet. Safety the cap to the cover plate with a cotter pin.

(3) Install the hydraulic unit onto the control support by mounting the governor over the four studs provided on the side of the control support, taking care that the proper gaskets are in place and that the idler gear in the bracket meshes correctly with the drive shaft. There should be a gasket between the governor and the control support and between the servo motor and the support. Draw up the self-locking nuts evenly and snugly.

(4) Attach and safety the auxiliary motor-wiring harness unit with its gasket to the control support. Then tighten and safety all electrical connections including the one to the cockpit.

(5) To adjust the pitch transmitter, the inverter must be energized by the 24-volt aircraft battery. If necessary, turn the external adjusting screws on the rear of the transmitter case until the pitch indicator indicates the indexing angle of 35 degrees. Lock the adjusting screws in this position by tightening the self-locking nuts. If greater adjustment is necessary, the transmitter must be lowered from the control and the gear pinion rotated by hand. The pitch indicator should now read 35 degrees; that is, the coarse hand should be midway between the 30- and 40-degree graduations and the fine hand at the 5-degree posi-

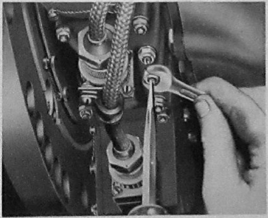


Figure 47—Adjusting Pitch Transmitter

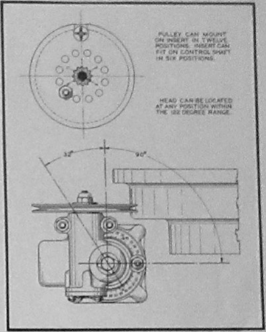


Figure 48—Chart of Head and Pulley Positions

tion. With this setting, push the transmitter carefully into position. It may be necessary to turn the shaft slightly in order to mesh the gear with the servo rack. After installation further external adjustment may be necessary.

(6) Tighten the spring compression bolt enough to relieve the load on the calibrating pin, allowing the pin to snap out into its original position. Then remove the bolt, and reinstall the pipe plug into the servo outer lock nut and safety it with wire. Then replace and safety the calibrating pin cap. Note that the calibrating pin cap should be tightened finger tight only.

(7) If the pulley is not already on the governor head, it should be installed in its correct position on the control shaft with washers on both sides to hold the pulley insert in place. If the proper position is not known, it may be determined with the aid of figures 48 and 50. The relationship between governor pulley travel in degrees and governor speed is shown in figure 49. To use this diagram, first find the governor rpm settings corresponding to the desired minimum and maximum engine rpm settings by using the formula:

Governor rpm = 2.25 × propeller-engine ratio × engine rpm.

To obtain the pulley travel required, subtract the reading corresponding to minimum governor rpm from the reading for maximum governor rpm. The zero pulley location is arbitrarily set at 1200 governor rpm; however, this is not absolute and, in most cases, only the range is desired, not the actual pulley position. The pulley position must permit the governor to operate through its required range (from the low rpm setting to the high rpm setting as established by the external adjustment screws) with the cable always tangent to the pulley on both sides of the cable clamp. Whenever the pulley is removed from the control shaft, its position relative to the insert and the insert position relative to the shaft should be noted to avoid the necessity of redetermining the right position. It is good practice to remove the pulley only, leaving the insert on the control shaft. This minimizes the chances of loss and, at the same time, requires only one noting of position. After the pulley has been installed, put on the self-locking pulley securing nut and tighten it snugly.

(8) Turn the pulley to its high rpm position and move the cockpit control to a point 1/8 inch from its high rpm position. Secure the control cable to the pulley by tightening the cable clamp over it. This operation locates the cockpit control angular travel range with respect to the pulley rotational range so that full governor control is usually possible. In some cases, the pulley travel may be so short that two stop pins are required in order to have contact with both rpm adjustment screws.

(9) The control cable should never be excessively tight as this may result in undue wear on the control shaft. Satisfactory operation is usually obtained when the cable is under a tensile load of approximately 20 pounds. In adjusting cable tension, it is necessary that allowance be made for movement of the engine on its mount. Certain installations compensate for this engine motion by a constant load device at some convenient point in the system.

(10) Remove the hub sump filler plug (or depress the plunger of the filling adapter of the spinner) and fill the sump with Pennsylvania Crude SAE No. 10 oil. Under extreme low temperature conditions where congealing is a factor, the use of Univis No. 60 oil is recommended. Replace and safety the plug or release the plunger. Assuming that the control has been oil tested or that it has not been disassembled after removal, no oil need be added to it when installed as the scavenge pump fills the unit.

(11) Install the spinner nose cap (if used). The retaining screws are held by self-locking nuts.

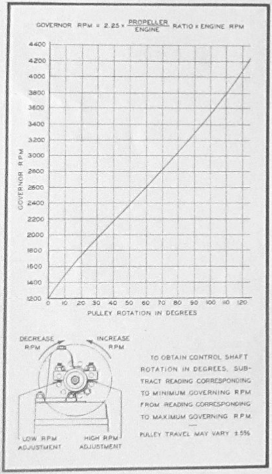


Figure 49—Pulley Travel Chart

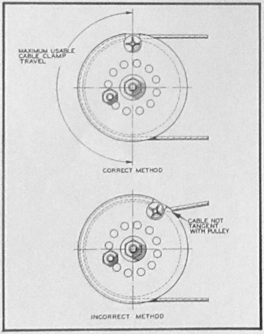


Figure 50—Chart of Cable Clamp Travel

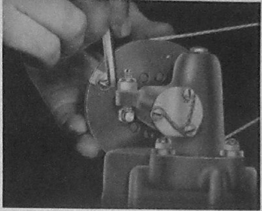


Figure 51—Tightening Cable Clamp

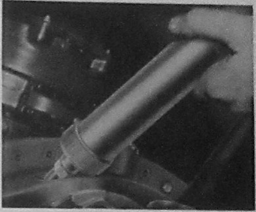


Figure 52—Filling Hub Sump

(12) In order to completely fill the hub and control hydraulic systems, run the engine for five minutes and exercise the propeller through its constant speed range. Stop the engine and check both sumps. If necessary, add oil to the hub sump, and replace the filler plug. This check should be repeated until the hub sump will accept no more than five ounces of oil.

4. CONTROL ADJUSTMENTS.

a. GENERAL.—The control system should permit the pilot to set the desired rpm accurately and conveniently, and when once adjusted, to have a non-creeping setting. The total pulley travel required for any installation is that which will give minimum rpm at one extreme, and take-off rpm at the other. The maximum governor rpm is set to give engine take-off rpm and the minimum is set at 40 percent of this value, unless otherwise specified. The total travel of the cockpit control should be so regulated as to give the total angular range required at the governor plus about 1/8-inch *pinch* at each end of the quadrant.

b. GROUND TEST.—It is assumed that the hydraulic low pitch stops in the propeller are set low enough to permit the engine to turn take-off rpm on the blocks at take-off manifold pressure. The low pitch limit should never be adjusted so low that it will be impossible to maintain flight in case the propeller goes to full low pitch. The high pitch setting should permit level flight without excessive manifold pressure, since the blades will assume the high pitch position if the control oil force fails to act upon the servo piston.

Note

With some installations, and depending upon the altitude of the field, the engine will just turn take-off rpm on the ground. This condition makes ground adjustment of the governor high rpm setting impossible since the tachometer

Note—Continued

would continue to indicate a correct governor take-off setting regardless of how much the actual governor setting exceeded the proper high rpm limit. Also, if the installation will not turn rated take-off rpm on the blocks, ground adjustment of the governor high rpm setting is impracticable. In both of the preceding cases, the governor setting should be adjusted by the flight test procedure described later in this section.

(1) If, with the low pitch hydraulic stop correctly set and the cockpit control in the high rpm position, the engine speed increases as the throttle is opened until it approaches the rated take-off rpm, the propeller blades are in full low pitch, and the governor may be incorrectly adjusted to govern at a higher rpm than required. To check the adjustment of the linkage and the governor unit, pull the cockpit lever back slowly until the engine tachometer indicates a drop in rpm. This shows that the governor unit is operating correctly and can be set to govern at the indicated rpm. Move the cockpit lever forward slightly until the tachometer reads the rated take-off rpm, and then without further adjustment of the propeller controls, shut down the engine. Turn the high rpm adjustment screw until it just touches the pulley stop pin, and then lock this screw. One turn of the high rpm adjustment screw will change the speed setting approximately 60 engine rpm. If the correct setting cannot be obtained within the limit of this screw adjustment, reposition the stop pin in the pulley. Moving the pulley stop pin into an adjacent hole changes the angular relationship 30 degrees and the take-off setting about 750 engine rpm. It may also be necessary to reindex the pulley on the control shaft or on the insert in order to avoid stretching the cable. Readjust the control linkage so that the cockpit lever is within 1/8 inch of its high rpm position when the pulley stop pin is against the high rpm adjustment screw. This setting should be the

take-off rpm setting for the installation; however, minor adjustments may be required after flight test.

Note

If engine speed exceeds the proper high rpm setting when the cockpit control is moved into the high rpm position, it is possible that the governor setting is too high, and the blade angle setting too low. To check, reduce the throttle, move the governor control into the high rpm position, and then shut down the engine. Check the low blade angle by using a protractor at the blade reference station. The blade reference station is the 42-inch station in propellers of 14 feet diameter or less, and the 72-inch station in propellers of a greater diameter. If the low pitch stop is incorrectly set, remove the pitch limit solenoid assembly and the stop lock plate, reset the low pitch stop, and then reinstall the plate and the pitch limit solenoid. To adjust the take-off setting, follow the instructions described in this paragraph.

(2) If, with the cockpit control at the high rpm position, the engine does not turn rated take-off rpm on the blocks but does respond to a slight reduction in control setting, it is an indication that the unit is governing but the setting of the governor high rpm adjustment screw is either too low, or the cockpit lever is reaching its full travel toward the high rpm position without the pulley stop pin contacting the high rpm screw. In the first case, readjust the high rpm screw to the proper setting. In the second case, hold the cockpit control in the high rpm position (allowing for 1/8-inch pinch), loosen the pulley cable clamp, rotate the pulley until the stop pin contacts the adjustment screw, and finally retighten the cable clamp. This procedure should be continued until the full take-off rpm is obtained. In extreme cases, it may be necessary to relocate the pulley stop pin one hole clockwise from its original position. This will increase the engine rpm setting approximately 750 rpm; one turn of the adjustment screw will change the rpm setting approximately 60 rpm. It should be noted that loss in engine power brought about by poor carburetion, fouled plugs, etc. may also be evidenced by the inability to obtain take-off rpm, and these factors should be taken into consideration.

(3) It is generally unnecessary to adjust the low rpm setting unless the pulley or pulley stop pin is reindexed. It should be noted here that the low rpm setting is usually 40 percent of the take-off rpm setting. Adjustment is made at the low rpm screw on the governor head.

c. FLIGHT TEST.

(1) Some installations do not turn take-off rpm on the blocks. In these cases, the low pitch blade angle setting in the propeller is such as to prevent obtaining take-off rpm at take-off manifold pressure during ground run-up, and it is necessary to make the control system adjustments after a test flight. This is accomplished by initially setting the governor high rpm adjustment on the test rig at take-off rpm position, and jogging the cockpit lever in flight until the engine turns full take-off rpm as indicated by the tachometer. When this speed has been obtained, land the airplane without disturbing the control from this position. Then reset the high rpm adjustment screw until it just touches the pulley stop pin, and readjust the linkage system until this pulley setting is attained with the cockpit control lever 1/8 inch from its high rpm position.

(2) If take-off rpm cannot be obtained in the test flight with the cockpit control in the high rpm position, it is an indication that the unit is governing at some lower-than-take-off rpm. Under these conditions, it will be necessary to land and readjust the high rpm stop on the governor to compensate for the difference between take-off rpm and the actual rpm.

5. REMOVAL PROCEDURE.

a. REMOVAL OF SPINNER.—Unscrew the 12 nose cap retaining screws and remove the spinner nose section. The shell and bulkhead are removed after the hub has been removed from the shaft.

b. REMOVAL OF HUB & BLADES ASSEMBLY.

(1) Remove the retaining nut lock wire.

(2) Raise the hub & blades assembly until the sling is just about supporting its weight, but is not lifting the shaft.

(3) Install the retaining nut wrench into the nut, and insert a bar through the wrench holes. Turn the wrench in an anticlockwise direction, backing the hub & blades assembly off the engine shaft.

(4) After the threads have disengaged, carefully pull the hub & blades assembly off the shaft. Replace the retaining nut lock wire and remove the rear cone.

c. REMOVAL OF CONTROL ASSEMBLY.

(1) Unsafety and unscrew the large AN connector which is attached to the wiring harness.

(2) Cut the safety wire and unscrew the 12 cap screws which secure the control support to the engine nose. Carefully pull the complete control assembly off the engine nose section.

(3) Remove the gasket and keep it with the control assembly.

SECTION IV
OPERATION

1. PRINCIPLES OF OPERATION.

a. GENERAL.—The control assembly and the hub & blades assembly are hydraulically operated units with an independent oil system, and are inter-connected by a mechanical translating mechanism through which control action is relayed to the hub & blades assembly. The design of the *Super*-Hydromatic propeller is such that there are eight operating conditions available: constant speed, lock pitch, increase pitch, decrease pitch, feather, unfeather, reverse, and unreverse. These are regulated by the actions of the various subassemblies in the control assembly. The hub & blades assembly responds to these requirements by the use of only three conditions: constant pitch, increase pitch, and decrease pitch. Therefore, to describe operation of the complete propeller, each of the three hub & blades conditions is associated with the corresponding control conditions.

(1) HUB & BLADES MECHANISM. (See figure 55.)—The hydraulic system in the hub has a self-contained oil supply independent of engine oil. Attached to the back end of the barrel is a pump sump *(43)* incorporating eight individual pump assemblies *(49)* radially mounted about the propeller shaft axis. Each pump assembly consists of a two-stage cylinder *(53)* and piston *(54)* and a first- *(52)* and second-stage *(41)* check valve. The lower end of each cylinder is forked to take a needle bearing roller assembly *(48)* and a return ring *(47)*. As the hub rotates, these rollers run against a stationary eccentric cam *(46)* which imparts to the pistons a reciprocating motion. The return ring running outside the rollers and between the piston forks bears against the rollers, thus keeping them in contact with the eccentric at all times. As the pistons reach the high portion of the eccentric, the rollers force the ring outward and at the same time, the ring pulls the pistons and rollers in the position diametrically opposite, against the low side of the eccentric. The rollers are held in the piston forks by shafts inserted through the forks and the inner races. As the pump rotates, oil from the lubricating and sump relief *(42)* valves is centrifugally thrown against the inside walls of the sump where it is picked up by the first stage of the piston and pumped through the first-stage check valve into the main sump. This has the effect of supercharging the sump to assure a full charge of oil to the second-stage piston chamber at all times. The sump pressure is kept relatively constant by means of the sump relief valve. The oil is then pumped from the second-stage through a check valve and into a high pressure manifold *(44)*. The manifold connects all eight pumps and discharges through the pump strainer bolt *(50)* into the distributor valve assembly from which it is metered through the barrel oil passages into the vane motors *(65)* where oil pressure in the vane motor chambers is converted into blade twisting moment. Maximum pumping pressure is determined by a high pressure relief valve *(55)* connected to the manifold. Oil pressure is the principal force utilized in moving the blade *(67)* from a high to a low blade angle or vice versa. Integral with the base of each blade vane *(66)* is a bevel gear through which the blades of the propeller are synchronized by a bevel connecting gear *(64)*. A bronze cam drive gear *(63)* directly attached to the bevel connecting gear is meshed with the distributor valve cam *(61)* through an idler gear *(62)*. Changes in the blade pitch are transmitted to the distributor valve sleeve *(59)* through this gear and cam linkage. Axial motion is imparted to the distributor valve sleeve by the cam through a roller-type cam follower *(60)* as the blades change pitch. The slope of the cam is a right-hand helix divided into three parts: reverse, constant speed, and feathering ranges.

(2) CONTROL MECHANISM. (See figure 54.)—Blade angle change can be controlled automatically with the constant speed control set to govern at a given rpm regardless of changes in flight conditions. The propeller is placed under automatic control by setting the cockpit switches to the "constant speed" position. At this position the lock pitch solenoid *(22)* remains open and all other solenoid valves remain closed so that oil is metered to or from the servo chamber *(19)* by the action of the governor pilot valve and sleeve only. Any change in engine speed affects the position of the governor fly-weights *(5)*, which in turn changes the position of the pilot valve sleeve *(6)*. Manual control is obtained by the operation of solenoid valves installed in the control hydraulic system to regulate oil flow to and from the servo motor chamber. These solenoids are identified as the lock pitch solenoid, the decrease pitch solenoid *(23)*, the increase pitch solenoid *(25)*, and the bypass solenoid *(24)*. These solenoids are connected to control switches in the cockpit which operate the solenoids in selected combinations to perform the desired functions. An additional solenoid in a separate housing known as the pitch limit solenoid operates stop links *(30)* which limit the constant speed operating range of the servo rack *(27)*. If operation beyond this range is desired, the solenoid is energized to pull the stop links down and allow the required rack movement. The stops *(29, 32)* hold the plunger down until the rack again returns to the constant speed range. Thus, it is necessary to energize the solenoid to go beyond the constant speed

range but it is not necessary to have it energized to stay beyond nor to return to the constant speed range. The lock pitch solenoid operates a valve in the oil line between the governor and servo chamber *(19)*. During normal governing operation, the valve is open and oil flows as directed by the governor, but, when energized manually, the valve is closed. This shuts off the line and disconnects the governor from the system. The decrease pitch solenoid regulates a valve in the line between the servo chamber and the governor oil pump. This valve is normally closed; when energized, it opens and admits oil directly from the governor gear pump *(16)* to the servo chamber. The increase pitch solenoid operates a valve in the line from the servo motor to the solenoid (lower) sump. This valve is normally closed; when energized, it opens and allows oil in the servo chamber to drain to the solenoid sump. The bypass solenoid controls a line around the needle valve *(21)* which normally restricts flow to and from the servo motor when the increase and decrease pitch solenoids are energized as described above. It is energized only during operations outside the constant speed range in order to open the bypass line and increase the rate of oil flow to and from the servo chamber. Oil pressure, built up by the gear pump, moves the servo piston and the servo rack, and consequently actuates the translating control towards a lower pitch position. Blade angle change required by the control is dependent upon the hub hydraulic system, which derives its pressure from the piston pumps. Both the control and the hub hydraulic systems depend upon the rotation of the hub during normal operation. Providing for instances when the hub is not rotating, such as in feathering or unfeathering, an electric auxiliary motor *(40)* performs two functions: to drive the eccentric which actuates the pump supplying high pressure oil to the hub system, and to drive an auxiliary plunger-type pump in the governor supplying oil pressure for the control system.

(3) HYDRAULIC UNIT. (See figure 53.)—The hydraulic unit contains the governor assembly with governor head, the servo motor assembly, and the solenoid pack

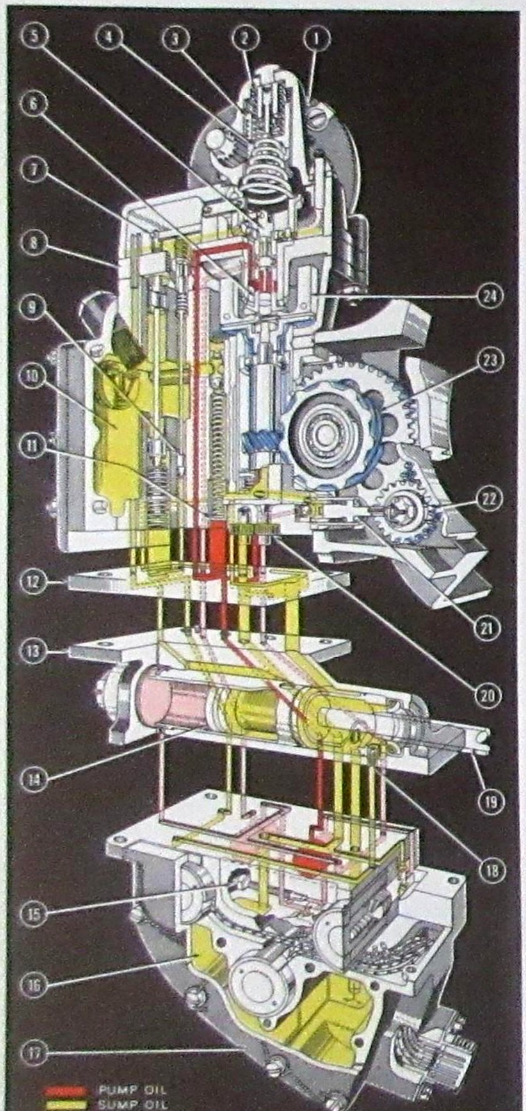


Figure 53—Hydraulic Unit Oil Flow Diagram

Nomenclature for Figure 53

1. PULLEY
2. BALANCING SPRING
3. SPEEDER RACK
4. SPEEDER SPRING
5. PILOT VALVE
6. PILOT VALVE SLEEVE
7. COMPENSATING PISTON
8. GOVERNOR AND HEAD ASSEMBLIES
9. COMPENSATING NEEDLE VALVE
10. UPPER SUMP
11. ACCUMULATOR RELIEF VALVE
12. BOTTOM PLATE
13. SERVO MOTOR ASSEMBLY
14. SERVO PISTON
15. SOLENOID NEEDLE VALVE
16. LOWER SUMP
17. SOLENOID PACK ASSEMBLY
18. SCAVENGE CHECK VALVE
19. SERVO RACK
20. GEAR PUMP
21. AUXILIARY PUMP
22. AUXILIARY PUMP DRIVE GEAR
23. GOVERNOR DRIVE & IDLER GEAR
24. FLY-WEIGHTS

assembly. Figure 53 is intended to show the oil passages in the hydraulic unit in detail. The gear pump *(20)*, driven by the governor drive gear *(23)* in the control support, boosts oil from the upper sump *(10)* to that pressure required for operation of the servo piston *(14)*. An accumulator relief valve *(11)* limits the operating pressure of the pump and at the same time stores a small quantity of oil under pressure. Pump oil is metered by the pilot valve sleeve *(6)* actuated by the fly-weights *(24)* past the pilot valve *(5)*, and then flows down through the governor bottom plate *(12)*, through the solenoid pack assembly, and up to the chamber at the servo piston *(14)*. The speed at which the governor operates is regulated by the position of the speeder rack *(3)* which is controlled by the pulley position *(1)*. The pilot valve sleeve position is determined by the opposing forces of the speeder spring and the fly-weights. The adjustable balancing spring *(2)* is provided to return the rack to approximately the cruising rpm position in case of control cable failure. The compensating piston *(7)* is acted upon by oil from the chamber behind the servo piston. Due to the mechanical linkage between the compensating piston and the pilot valve, a motion of the servo piston causes a motion of the pilot valve. The system is designed so that the pilot valve tends to follow the motion of the pilot valve sleeve, and thus to stabilize the control action. The needle valve *(9)* meters oil from the compensating piston chamber to the upper sump, and thereby regulates the rate of compensating action. The auxiliary piston type pump *(21)* is connected through a passage in the servo motor housing and solenoid pack to the servo chamber. This pump acts only during the feathering and unfeathering operations to furnish a source of high pressure oil with the engine stopped. The solenoid valves control the flow of oil from the governor gear pump to the servo chamber for the various operating conditions of the control assembly. The bypass solenoid needle valve *(15)* meters the flow of oil past the bypass solenoid valve, and thereby regulates the rate of manual pitch change.

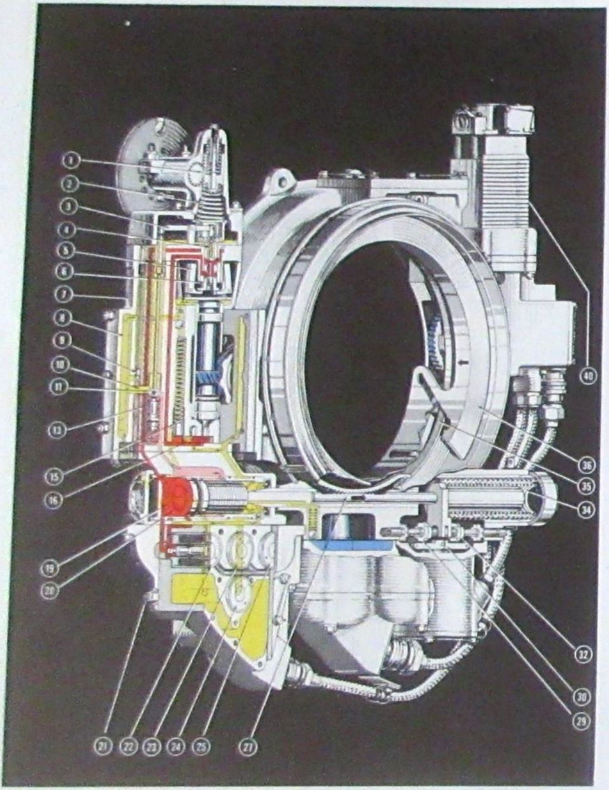
(4) LUBRICATION SYSTEM.—Lubrication of those parts not directly immersed in or filled with oil is provided from two sources. The lubricating valve on the inboard end of the barrel sprays oil at a low pressure onto the eccentric outboard bearing. From that point the oil travels back between the eccentric and the barrel boss. It is thrown outward by centrifugal force. In doing this, it contacts the governor drive gear, the thrust segments, the pump rollers, and the bearing surfaces of the eccentric and return ring. It is collected in a groove on the pump ID, picked up by the piston, and delivered to the first-stage check valve and thence to the sump again. The second source is from the governor upper sump. The oil enters the fly-weight head chamber, drains down through the shaft bearings, and out onto the governor drive & idler gears. It then descends to the servo rack and scavenge sump. Action of the rack in conjunction with two check valves scavenges the oil back to the upper sump. The control rack of the offset control which bears against the thrust plate is lubricated by sump oil.

b. DETAILED OPERATION.—Since one hub & blades operating condition may result from several control operating conditions, in the following discussion the operation of the hub & blades assembly is described completely for its first control condition only.

(1) DECREASE PITCH.—This condition of the hub & blades assembly (shown in figure 55) may result from one of several control assembly conditions: governor underspeed, manual control to decrease pitch, unfeathering, or reversing. These are described in the following paragraphs.

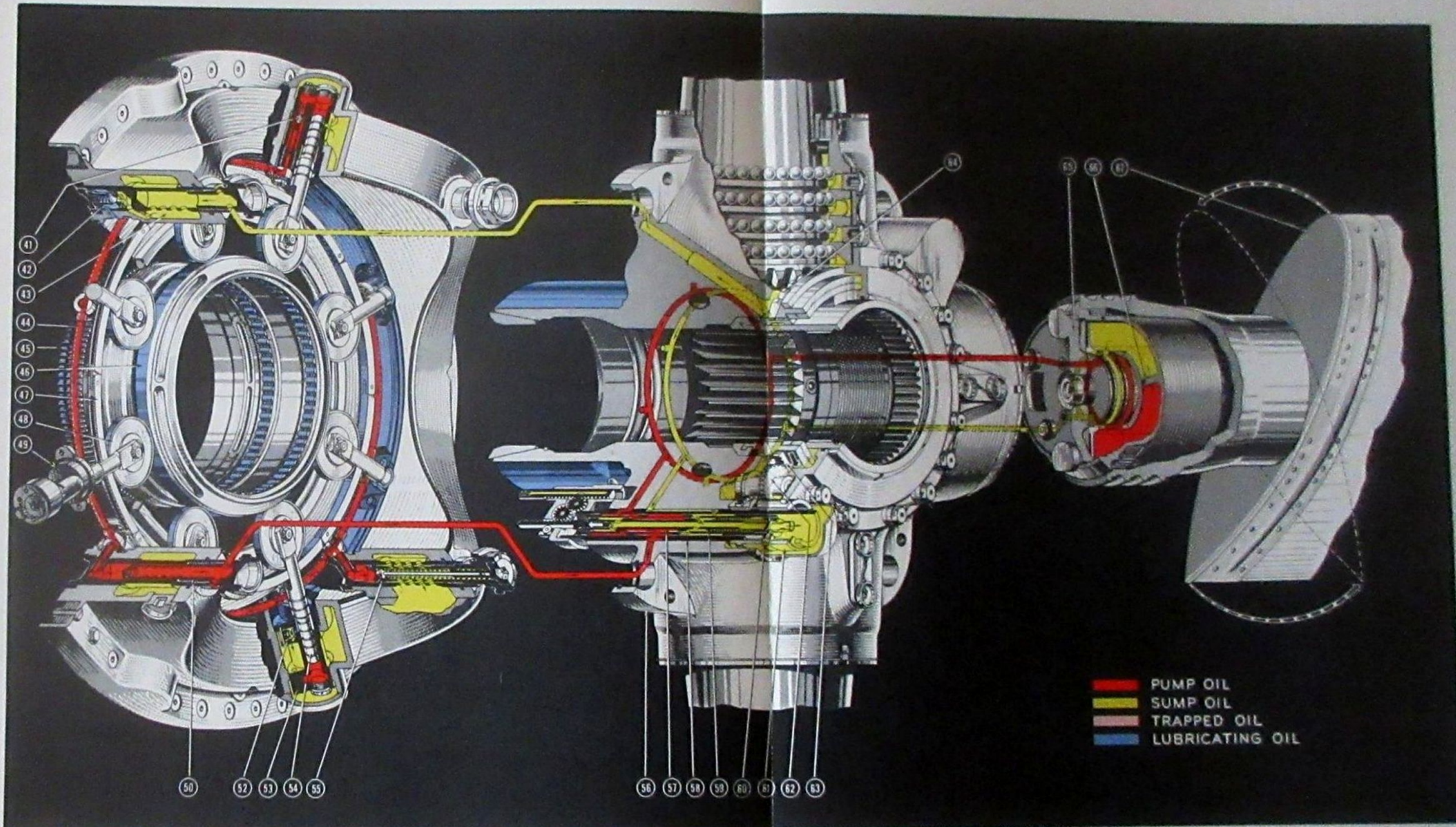
(a) UNDERSPEED—GOVERNOR CONTROL. —Underspeed operation of the control is shown in figure 54 together with the decrease pitch hub & blades condition. Figure 56 is a schematic diagram of the control operation only. This condition may momentarily exist when engine speed drops below the on-speed rpm setting as a result of the changed air flow over the propeller blades due to decrease of aircraft forward speed at the beginning of a climb. It may also exist when the throttle or manifold pressure selector is moved toward the closed position, or when the governor control is moved toward increase rpm position. The arrow represents the direction in which the blades will move to reestablish the on-speed condition.

1. CONTROL ACTION.—When engine speed drops below the rpm for which the governor *(7)* is set, the resulting decrease in centrifugal force allows the fly-weights *(5)* to move inward under the force of the speeder spring *(2)*, thus lowering the pilot valve sleeve *(6)*. This connects the governor oil pump line through the open lock pitch solenoid *(22)* with the servo chamber *(19)*, and moves the servo piston *(20)* and the servo rack *(27)* toward the low pitch position against servo spring force. The servo rack actuates the translating control *(35)*, moving the thrust plate *(36)* inboard. As the servo piston moves toward low pitch, the volume of the compensating chamber behind the servo piston is decreased, and the oil is forced up below the compensating piston *(11)*. This causes the piston to move upward compressing the upper centering spring *(13)*. Motion of the compensating piston is determined by the displacement resulting from servo piston travel, the cut-off to the governor sump *(10)*, and to a small degree by the opening at the needle valve *(9)*. Through the compensating link *(3)*, the pilot valve *(4)* is moved downward, following the pilot valve sleeve, which was initially lowered by the fly-weights. This corrects for overcontrol of the governor due to the extreme rate of pitch change. The valve is slowly centered by the



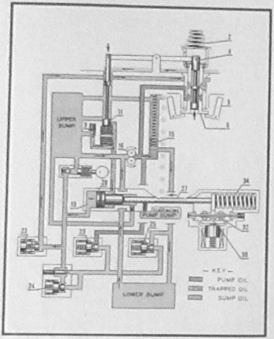
1 SPEEDER SPRING ADJUSTING RACK
2 SPEEDER SPRING
3 COMPENSATING LINK
4 PILOT VALVE
5 FLY-WEIGHT
6 PILOT VALVE SLEEVE
7 GOVERNOR
8 UPPER SUMP
9 COMPENSATING NEEDLE VALVE
10 COMPENSATING PISTON UPPER PORT
11 COMPENSATING PISTON
13 COMPENSATING PISTON UPPER SPRING
15 ACCUMULATOR RELIEF VALVE PISTON
16 GOVERNOR PUMP
19 SERVO PISTON CHAMBER

Figure 54—Control Operating Diagram—Underspeed Condition



20 SERVO PISTON
21 BYPASS NEEDLE VALVE
22 LOCK PITCH SOLENOID
23 DECREASE PITCH SOLENOID
24 BYPASS SOLENOID
25 INCREASE PITCH SOLENOID
27 SERVO RACK
29 LOW PITCH STOP
30 STOP LINKS
32 HIGH PITCH STOP
34 SERVO SPRINGS
35 TRANSLATING CONTROL INNER RACE
36 DISTRIBUTOR VALVE THRUST PLATE
40 AUXILIARY MOTOR
41 HIGH PRESSURE CHECK VALVE
42 SUMP RELIEF VALVE
43 PUMP SUMP
44 HIGH PRESSURE MANIFOLD
45 GOVERNOR DRIVE GEAR
46 ECCENTRIC
47 PISTON RETURN RING
48 PUMP ROLLER
49 CYLINDER ASSEMBLY
50 PUMP STRAINER BOLT
52 LOW PRESSURE CHECK VALVE
53 PUMP CYLINDER
54 PISTON
55 HIGH PRESSURE RELIEF VALVE
56 BARREL
57 DISTRIBUTOR VALVE
58 DISTRIBUTOR VALVE BUSHING
59 DISTRIBUTOR VALVE SLEEVE
60 VALVE CAM ROLLER
61 DISTRIBUTOR VALVE CAM
62 CAM IDLER GEAR
63 CAM DRIVE GEAR
64 CONNECTING GEAR
65 CENTER POST
66 BLADE VANE
67 BLADE

Figure 55—Hub & Blades Operating Diagram—Decrease Pitch Condition



2 SPEEDER SPRING
4 PILOT VALVE
5 FLY-WEIGHT
6 PILOT VALVE SLEEVE
9 COMPENSATING NEEDLE VALVE
11 COMPENSATING PISTON
15 ACCUMULATOR RELIEF VALVE PISTON
16 GOVERNOR PUMP
19 SERVO PISTON CHAMBER
20 SERVO PISTON
22 LOCK PITCH SOLENOID
23 DECREASE PITCH SOLENOID
24 BYPASS SOLENOID
25 INCREASE PITCH SOLENOID
27 SERVO RACK
30 STOP LINKS
32 HIGH PITCH STOP
34 SERVO SPRINGS

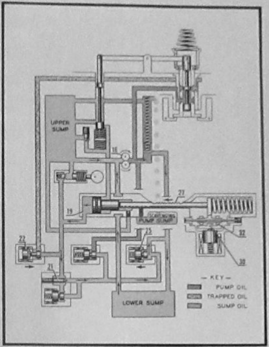
Figure 64—Control Schematic Operating Diagram—Overspeed Condition

ton moves toward high pitch, the volume of the compensating chamber behind the piston is increased and oil is drawn down from beneath the compensating piston *(11)*, thereby allowing sump oil to push the piston downward. Motion of the compensating piston is determined by the displacement resulting from servo piston travel, the cut-off to the governor sump, and to a small degree by the opening at the needle valve. Through the compensating link *(3)*, the pilot valve is moved upward and is slowly permitted to lower by oil metering through the compensating needle valve *(9)* from the governor sump. Since no solenoids are energized, the decrease pitch *(23)*, increase pitch *(25)*, and bypass solenoid *(24)* valves are closed and have no effect on the oil in motion. The servo rack is restrained in the constant speed range by the hydraulic stop *(32)* contacting the stop link *(30)* should there be any tendency for the rack to move beyond the high pitch stop setting when operating in the extreme range limit. As engine speed decreases, the pilot valve sleeve is lowered by the speeder spring force acting against the decreased centrifugal force exerted by the governor fly-weights. As the fly-weights are lowered, the port between the pilot valve and sleeve decreases, metering oil flow from the servo chamber. This, in conjunction with the pilot valve being returned to its centered position by action of the compensating piston centering spring and oil metering past the compensating needle valve, causes the sleeve and valve to return rapidly to the on-speed position. In this position, oil metering past the pilot valve land maintains only enough pressure in the servo chamber to hold the servo rack (and the translating control) stationary against the force of the partially compressed servo spring.

2. HUB & BLADES ACTION.—Movement of the thrust plate *(36)* forces the distributor valve *(57)* outward against the hub sump oil pressure and spring force acting on the valve. The displacement of the valve uncovers the sleeve *(59)* outboard port and permits high pressure oil to be pumped through the oil passages in the barrel and center posts *(65)* into the vane motor high pitch chambers. Here the pressure rapidly builds up until sufficient force is exerted against the blade vanes *(66)* to move the blades *(67)* into a higher pitch. A greater pressure is required to force the blades toward the high pitch position than toward low pitch since the centrifugal twisting moment which tends to turn the blades toward low pitch must be overcome. The oil is drained from the low pitch chambers of the vane motors back to the pump sump *(43)* through the distributor valve sleeve inboard port. As the blades turn to a higher angle, the connecting gear *(64)* through the cam drive *(63)* and idler gear *(62)* rotates the cam *(61)*, thus moving the distributor valve sleeve outboard to follow the distributor valve to the constant pitch condition. With all forces in equilibrium, the blades are hydraulically held in their new position.

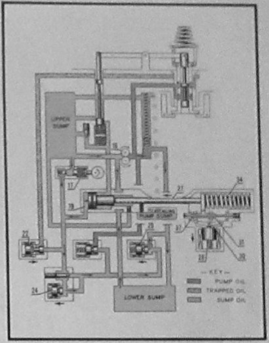
(b) INCREASE PITCH—MANUAL CONTROL.—When it is desired to manually increase propeller blade angle, the cockpit control switches are moved to the increase pitch position. As a result, the lock pitch solenoid *(22)* and the increase pitch solenoid *(25)* are energized, closing the solenoid valves. This condition of control operation is shown schematically in figure 65.

1. CONTROL ACTION.—Energizing of the lock pitch solenoid in effect removes the governor from the system. Energizing the increase pitch solenoid opens the oil line from the servo chamber *(19)* to the solenoid



16 GOVERNOR PUMP
19 SERVO PISTON CHAMBER
21 BYPASS NEEDLE VALVE
22 LOCK PITCH SOLENOID
25 INCREASE PITCH SOLENOID
27 SERVO RACK
30 STOP LINKS
32 HIGH PITCH STOP

Figure 65—Control Schematic Operating Diagram—Increase Pitch Condition



16 GOVERNOR PUMP
17 AUXILIARY PISTON PUMP
18 SERVO PISTON CHAMBER
22 LOCK PITCH SOLENOID
24 BYPASS SOLENOID
25 INCREASE PITCH SOLENOID
27 SERVO RACK
28 PITCH LIMIT SOLENOID
30 STOP LINKS
31 STOP SCREW
34 SERVO SPRINGS
37 FEATHER STOP

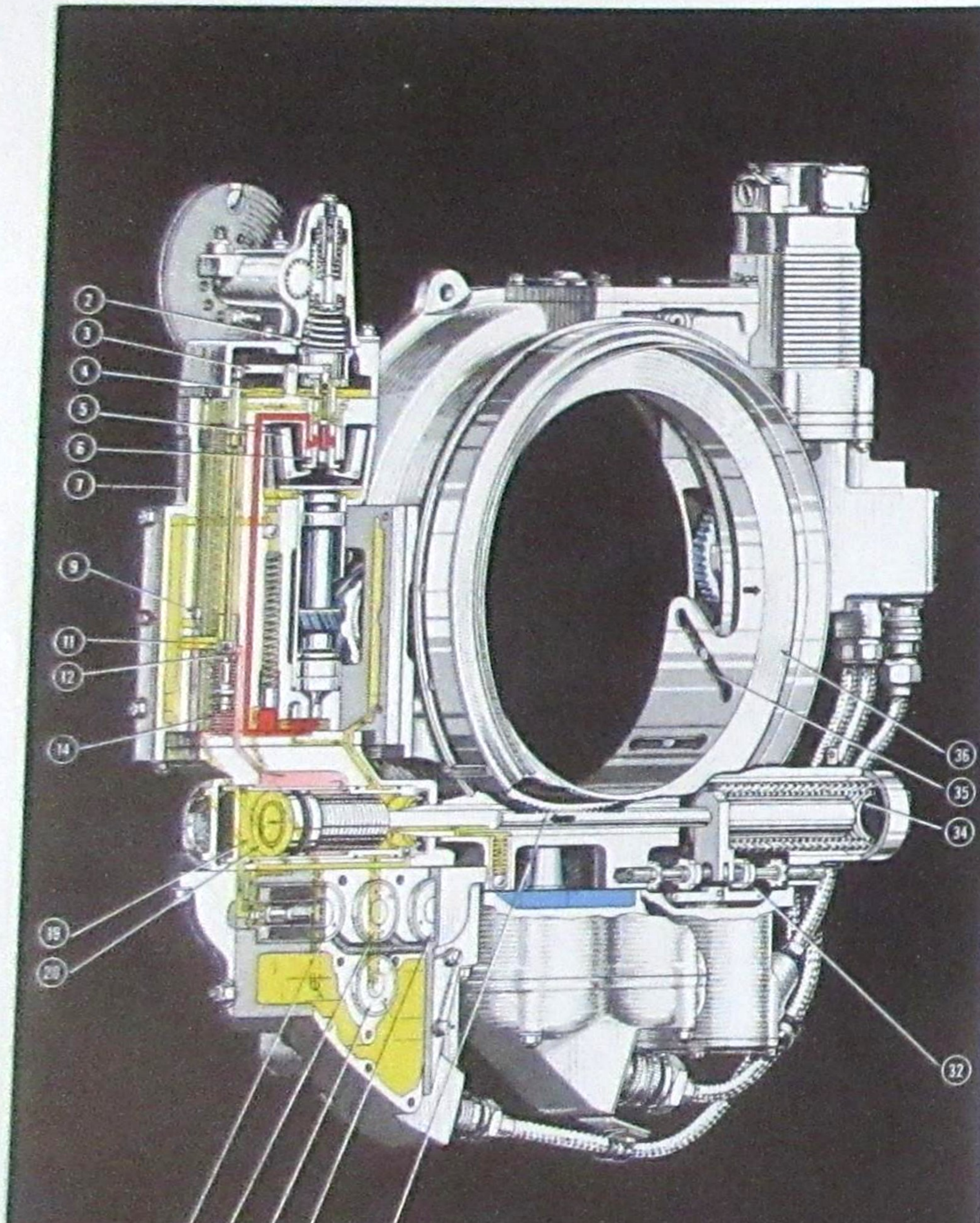
Figure 66—Control Schematic Operating Diagram—Feathering Condition

(lower) sump. Thus, oil from the servo chamber meters through the needle valve restriction *(21)* and is drained to the lower sump, allowing the servo rack *(27)* to be moved toward the high pitch position by servo spring force. Through the action of the servo rack on the translating control, the thrust plate is moved outboard to call for a higher blade angle. The thrust plate will continue to move outboard until it is stopped by the high pitch stop *(32)* contacting the pitch limit solenoid stop link *(30)* or until the position of the cockpit switches is changed.

2. HUB & BLADES ACTION.—This action is the same for all control conditions which move the translating control thrust plate in an outboard direction.

(*c*) FEATHERING—MANUAL CONTROL.—When the cockpit control switches are moved to the feather position, the lock pitch solenoid *(22)*, the increase pitch solenoid *(25)*, the pitch limit solenoid *(28)*, the bypass solenoid *(24)*, and the auxiliary motor *(40)* are energized. This is shown in figure 66.

1. CONTROL ACTION.—The stop links (30) of the pitch limit solenoid move down to allow the servo rack *(27)* to pass beyond the constant speed range. If the engine is not rotating, the auxiliary motor drives the eccentric to actuate the auxiliary piston type pump *(17)* in the governor but the oil thus pumped is bypassed through the increase pitch solenoid valve to dump into the lower sump. Oil from the servo chamber *(19)* drains through the open increase pitch and bypass solenoid valves, enabling the servo springs *(34)* to force the servo rack toward high pitch. The rack moves beyond the constant speed range and is stopped by the end of pitch stop screw *(31)* contacting the feather stop *(37)* in the control support. Movement of the rack forces the thrust plate to the extreme outboard position to call for the feathered blade angle. If the engine is rotating, control operation is the same except the auxiliary motor is prevented from operating when it is stalled by the torque of the eccentric gear acting through the idler and worm gears. A ratchet and lock arrangement prevents the idler gear from being turned in reverse by the propeller. Since the eccentric does not rotate, the auxiliary pump does not operate and the governor gear pump *(16)* is driven by the governor drive gear on the hub as in normal operation. Oil pumped by

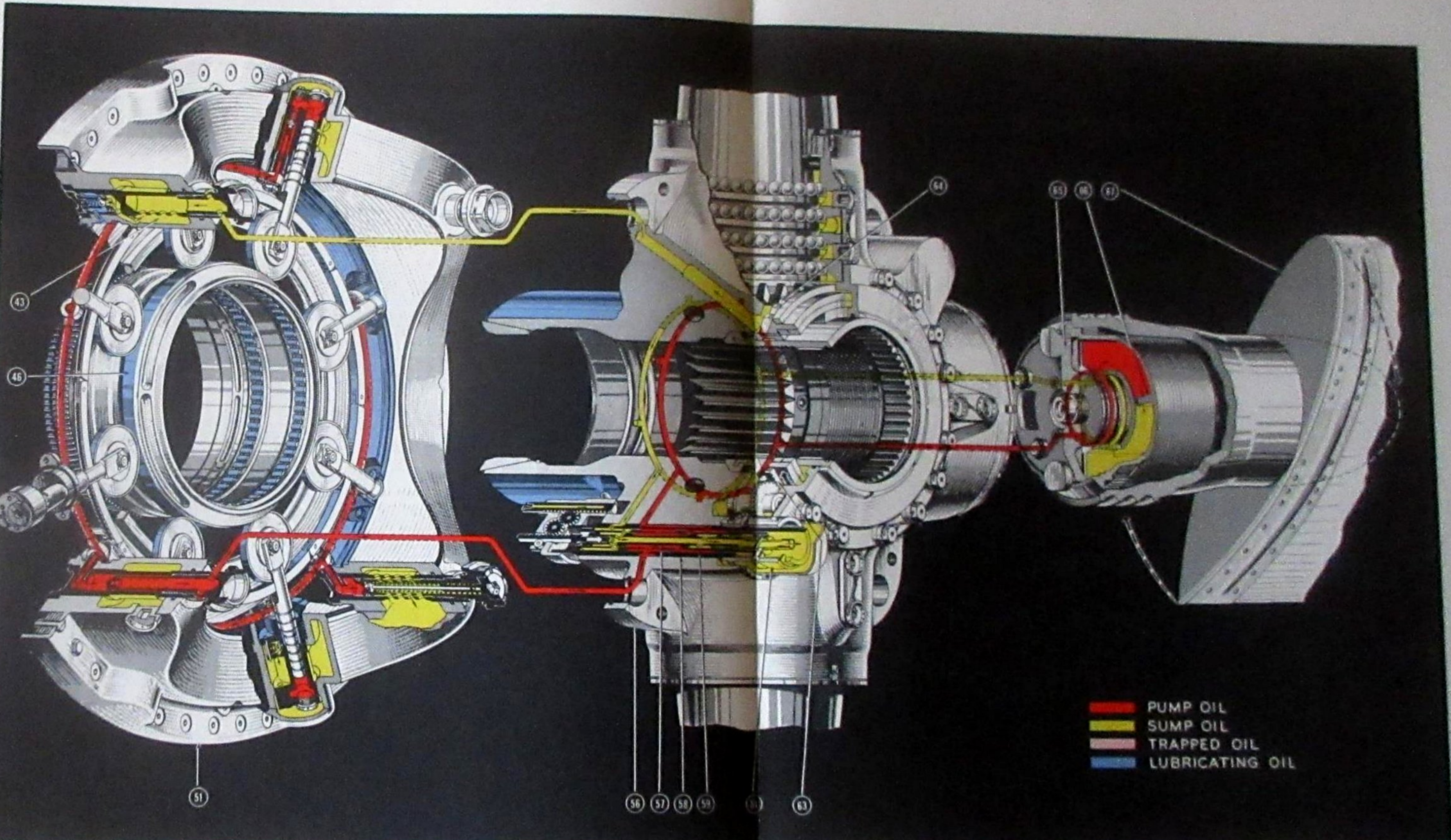


ER SPRING
NSATING LINK
VALVE

5 FLY-WEIGHT
6 PILOT VALVE SLEEVE
7 GOVERNOR

9 COMPENSATING NEEDLE VALVE
11 COMPENSATING PISTON
12 COMPENSATING PISTON LOWER PORT

Figure 67—Control Operating Diagram—Overspeed Condition



14 COMPENSATING PISTON LOWER SPRING
19 SERVO PISTON CHAMBER
20 SERVO PISTON
22 LOW PITCH SOLENOID
23 DECREASE PITCH SOLENOID
24 BYPASS SOLENOID
25 INCREASE PITCH SOLENOID
27 SERVO RACK
32 HIGH PITCH STOP
34 SERVO SPRINGS
35 TRANSLATING CONTROL INNER RACE
36 DISTRIBUTOR VALVE THRUST PLATE
45 PUMP SUMP
46 ECCENTRIC
51 PUMP ASSEMBLY
56 BARREL
57 DISTRIBUTOR VALVE
58 DISTRIBUTOR VALVE BUSHING
59 DISTRIBUTOR VALVE SLEEVE
61 DISTRIBUTOR VALVE CAM
63 CAM DRIVE GEAR
64 CONNECTING GEAR
65 VANE MOTOR CENTER POST
66 VANE MOTOR BLADE VANE
67 BLADE

Figure 68—Hub & Blades Operating Diagram—Increase Pitch Condition

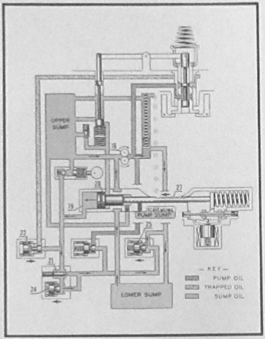
the gear pump is bypassed through the increase pitch solenoid valve to the lower sump.

2. HUB & BLADES ACTION.—As the thrust plate is released from its constant speed range and allowed to move to the feathered position, it forces the distributor valve into an extreme outboard position. The hub & blades action is the same as for previous increase pitch operation. When the engine is not operating, pressure is developed by the action of the eccentric being revolved by the auxiliary motor. When the engine is operating, the action is as above except that high pressure oil is obtained in the normal way by the pump rotating about the stationary eccentric.

(d) UNREVERSING—MANUAL CONTROL.—The cockpit control switches are moved to the unreverse position, energizing the lock pitch solenoid *(22)*, the increase pitch *(25)* solenoid, and the bypass solenoid *(24)*.

1. CONTROL ACTION.—Energizing of the lock pitch solenoid closes the oil line between the pilot valve and the servo chamber, removing governor control from the system. Energizing the increase pitch solenoid allows oil from the servo chamber *(19)* to drain rapidly through the open bypass solenoid *(24)* to the lower sump. By eliminating the needle valve restriction *(21)*, the servo rack *(27)* is allowed to move rapidly toward high pitch under servo spring force. Through the translating control, the thrust plate is moved outboard to call for a positive blade angle. When the control switches are returned to governing, the propeller returns to the rpm for which the governor is set.

2. HUB & BLADES ACTION.—This is again the increase pitch action. Fast operation is important as the blades must pass through flat pitch rapidly enough to prevent the engine from overspeeding excessively.



16 GOVERNOR PUMP
19 SERVO PISTON CHAMBER
20 SERVO PISTON
21 BYPASS NEEDLE VALVE
22 LOCK PITCH SOLENOID
24 BYPASS SOLENOID
25 INCREASE PITCH SOLENOID
27 SERVO RACK

Figure 69—Control Schematic Operating Diagram—Unreversing Condition

2. OPERATION INSTRUCTIONS.

a. GROUND TESTS.—The procedures outlined in this section are suggestions for operation of the *Super*-Hydromatic model 4260 propeller. To account for various changes in this procedure which are peculiar to any given installation, consult the engine or aircraft manufacturers' handbooks.

(1) GOVERNING ACTION TESTS.

(a) Start the engine with the cockpit governor control in the high rpm position, warming it up in accordance with engine operating instructions. When the engine is started, hub sump oil pressure is directed into the low pitch chambers of the vane motors. This pressure moves the blades to the angle for which the low pitch hydraulic stops of the control are set. With the blades in this position and the actual engine rpm lower than that for which the governor is set, engine rpm varies with engine horsepower output. Under this condition, the magnetos may be checked at suitable power by watching the tachometer for a drop in rpm as the magneto switch is turned. On installations incorporating the lock pitch feature, the blades can be locked at any desired pitch within the constant speed range for the above magneto check.

(b) After completing the engine warm-up period, the governor control should be exercised several times between the minimum and maximum rpm settings to insure filling all propeller oil passages.

(c) Move the governor control to the high rpm position, advance the throttle, and make the customary check of engine manifold pressure against engine rpm.

(d) Check governing by setting the engine throttle and governor control to obtain about 30 inches M.P. and 2000 engine rpm. The propeller should hold on-speed within ±5 rpm of the setting.

(e) When governing at about 2000 engine rpm, check possibilities of sluggish operation by reducing the throttle to obtain 1200 rpm; then move the throttle rapidly to 30 inches M.P. The propeller should settle out at 2000 rpm within five seconds without overspeeding more than 250 rpm.

(2) FEATHERING AND UNFEATHERING TESTS.

CAUTION

When the engine is rotating, the feathering or unfeathering switch should never be held closed for longer than ten seconds, because the auxiliary motor is stalled by the torque of the rotating pump, and it may become overheated.

(a) Complete ground test of governing action as outlined in paragraph 2.a.(1) of this section. With the engine operating at approximately 1500 rpm and 22 inches Hg. manifold pressure, move the cockpit controls to the feather position. When the propeller has reached the feathered position, engine rpm will have decreased to approximately 500.

Note

Torching at the exhaust outlet may occur with some engines. Usually the engine will continue to run after the propeller has been completely feathered on the ground.

(b) Immediately after the feathering test has been satisfactorily completed, move the cockpit control switches to the governing position. The control will be in an underspeed condition and will return the engine to the speed for which the governor is set.

(c) If the engine stalls when the propeller is feathered, move the switches to the unfeather position and hold them while the blades unfeather, but never for longer than 10 seconds at one time.

(d) The above method of testing feathering operation with the engine running has several important advantages not obtainable when feathering is carried out with the engine stationary.

1. The hub pump is operated by rotation of the hub rather than by operation of the auxiliary motor, with the result that a greater rate of oil flow is obtained and pitch change is more rapid.

2. The feathering test is made with the oil at a higher temperature which approaches more closely the conditions under which the propeller would be feathered in flight.

(3) LOCK PITCH TEST.

(a) While running the engine at any desired manifold pressure and rpm setting, move the cockpit control switches to the lock pitch position. The pitch indicator should hold its position without wavering.

(b) As the governor control is advanced or retarded with the throttle fixed, engine rpm should not change and there should be no motion of the pitch indicator hands.

(c) Move the control switches to the governing position.

(4) REVERSING AND UNREVERSING TESTS.

CAUTION

Since propeller thrust is to be reversed, additional precautions must be taken to prevent movement of the aircraft in the rearwards direction. The propeller should not be run excessively in reverse pitch on the ground as lack of cooling air will probably cause the engine to overheat.

(a) Set the throttle and governor controls at approximately 22 inches Hg. manifold pressure and 1500 engine rpm.

(b) Move the cockpit control switches to the reverse position. As the blades move to the reverse angle, the pitch indicator will indicate the angle attained.

(c) To unreverse, move the cockpit control switches to the unreverse position for two seconds, then to governing. The propeller should return to the governing speed originally set.

b. FLIGHT TESTS.

(1) FEATHERING PROCEDURE.

(a) EMERGENCY FEATHERING PROCEDURE.—Operating the controls in accordance with the procedure outlined below permits feathering the propeller in the shortest possible time.

1. Move control switches to feather position.
2. Turn off auxiliary supercharger.
3. Turn off fuel booster pump.
4. Move throttle to closed position.
5. Set mixture control to idle cut-off position.
6. Turn off fuel supply to engine.
7. Turn off ignition switch after engine stops.
8. Turn off generator switch.

(b) PRACTICE OR TEST FEATHERING PROCEDURE.—To avoid hydraulic lock and excessive oil cooling in the lower engine cylinders, keep to a minimum the length of time the propeller is left in the feathered position during these tests.

1. Turn off auxiliary supercharger.
2. Reduce rpm and manifold pressure.
3. Move control switches to feather position.
4. Turn off fuel booster pump.
5. Move throttle to closed position.
6. Set mixture control to idle cut-off position.
7. Shut off fuel supply to engine.
8. Turn off ignition switch after propeller has stopped turning.
9. Turn off generator switch of engine with feathered propeller.

Note

If this test indicates that the feathered angle of the blades is incorrect, it will be necessary to

Note—Continued

adjust the feather stop in the control assembly. Remove the pitch limit solenoid from the support, and the stop plate which holds the hydraulic stops at the desired angles. Adjust the feather stop as required. Then replace the stop plate and pitch limit solenoid. It is also necessary to reset the mechanical stop ring to an angle one to five degrees higher than the feathered angle.

(2) UNFEATHERING PROCEDURE.

(a) Move control to minimum rpm position.

(b) Open throttle to starting position.

(c) If engine is stopped, move cockpit control switches to unfeather position, and hold in place only until propeller starts to windmill.

(d) Turn on ignition switch after propeller has turned several revolutions.

(e) Turn on fuel supply.

(f) Turn on fuel booster pump.

(g) After fuel pressure is attained, move mixture control to auto-rich position and adjust throttle to proper manifold pressure for engine warm up.

(h) Turn on generator.

(i) Allow engine to warm up at low rpm.

c. FLIGHT OPERATION.

(1) GENERAL.—Flight operation of the *Super*-Hydromatic propeller is normal in all respects. All changes in propeller and engine controls should be made smoothly.

Note

If the power and rpm are to be increased, increase the governor control first and then the engine throttle. If power and rpm are to be decreased, reduce the throttle first and then the governor control. This should prevent excessive manifold pressure.

(2) COLD WEATHER OPERATION.—The use of Pennsylvania Crude SAE No. 10 oil in the propeller is satisfactory for normal operation. Under extreme low temperature conditions where congealing is suspected, Univis No. 60 oil or its equivalent is recommended. Since the propeller has an oil system independent of the engine, the engine oil dilution system has no effect on the propeller.

SECTION V

SERVICE INSPECTION, MAINTENANCE AND LUBRICATION

1. SERVICE TOOLS REQUIRED.

PART NO.	NOMENCLATURE	APPLICATION
61322	Hub Retaining Nut Wrench	To tighten and loosen hub retaining nut.
61321	Distributor Valve Cap Wrench	To tighten and loosen distributor valve cap.
63098	Distributor Valve Gage	To check correct setting of the distributor valve when blades are at the 35-degree angle.

2. SERVICE INSPECTION.

Note

Inspection periods established for Army Air Forces and Navy service organizations are not identical. Therefore, the inspection periods specified in this section in terms of hours consist of two figures, i.e., 25-30 Hour Inspection. The first figure indicates the Army Air Forces inspection period, and the second the comparable Navy inspection period. In accordance with T. O. No. 00-20A-2, a summary of the period inspections prescribed below will be entered by Army Air Force Personnel on the Master Airplane Maintenance Forms maintained in the back of Form 41B for the airplanes affected.

—COLUMN NO. 28—
PROPELLERS AND ACCESSORIES

a. PREFLIGHT INSPECTION.

(1) With the engine running at reduced throttle, set the control switches for constant speed and operate the propeller control three or four times through its entire range and check pitch change by means of the pitch indicator, or by changes of rpm and manifold pressure.

(2) Place the control switches for lock pitch at an intermediate blade angle position. Increase and decrease the governor control setting. There should be no change in blade angle setting and rpm should remain constant.

(3) With the propeller set for constant speed operation at 2000 rpm, move the throttle back until the speed drops to 1900 rpm. Then burst it rapidly from the 1900 rpm position to full open. Engine speed should not exceed 2300 rpm and should return to 2000 rpm within five seconds.

Note

The time limit given for each of these operations is the *maximum* allowable. If the operation requires any longer to perform, it is an indication

Note—Continued

of malfunctioning and the propeller should be stopped for a check immediately. This also applies to the time limits given in the following pre-flight checks.

(4) Move the control switches into the reverse position with the throttle set for about 22 inches of manifold pressure and the governor set for about 1500 rpm. The blades should attain reverse position within two seconds. Place the switches into the unreverse position. The blades should move to the governing range within two seconds.

(5) With the propeller governing at 2000 rpm and the engine at about 25 inches of manifold pressure, feather the propeller. The time required to feather should not exceed five seconds. Keep the engine running and set the switches to governing. The engine speed should return to 2000 rpm. The time required to unfeather should not exceed five seconds.

(6) Using manual control with approximately 30 inches Hg. manifold pressure, throw the control switches into positions of increase pitch and decrease pitch. Observe the tachometer for correct response to each position.

b. DAILY INSPECTION.

(1) BLADES.

(a) Inspect all blades for bends, nicks, cracks, raised edges, etc. Repair according to the procedure given in paragraph 3. of this section.

(b) In the case of aircraft operating near salt water, wash the blades thoroughly with clean (fresh) water, dry completely, and then apply a thin film of clean engine oil at the end of each day's operation.

(c) If propeller roughness has been reported, check all blade angle settings by using a bubble protractor at the blade reference station. If necessary, check the track of each blade.

(d) Leakage out of a blade tip vent hole shall be cause for immediate inspection and repair.

(2) SPINNER.—Check the spinner shell attaching screws for looseness. Examine the spinner shell for nicks, cracks, or other damage. If traces of oil leakage are found, remove the spinner nose cap and examine the propeller sealing surfaces.

(3) HUB ASSEMBLY.

(a) Check all external cotter pins, safety wire, etc.

(b) Visually check for oil leakage at the pump attaching bolts, pump to hub seal, cover plate, and rotating

seal. Usually small leaks can be stopped by tightening the securing nuts or screws. If the cause is unknown, test the propeller for the source of leakage according to the instructions in paragraph 3. of this section.

Note

If the propeller has just recently been installed and filled with oil, spilled oil may appear. This should not be misinterpreted as leakage.

(*c*) Check the hub oil level with the sump plug at its highest point. Add Pennsylvania Crude SAE No. 10 oil as needed to fill the sump.

(4) CONTROL ASSEMBLY.

(*a*) Test the control system for backlash, lost motion, and soundness of rigging and adjust as necessary.

(*b*) Visually inspect the hydraulic unit for oil leakage between the parting surfaces of the units. Tightening the nuts or screws will generally stop minor leaks. Test as in paragraph 3. if the cause is unknown.

(*c*) Propeller operation keeps the control sump full of oil. Check the oil sump level through the sight glass after the first few minutes of operation. The oil level should be visible.

c. 25-30 HOUR INSPECTION.

(1) Check for deterioration of markings on both propeller blades and hub. Repair them as required.

(2) Check the spinner attaching screw holes for elongation. Inspect for dents, nicks, or other like damage, and for loose rivets.

d. 50-60 HOUR INSPECTION.—Repeat all previous inspections.

e. 100-120 HOUR INSPECTION.

(1) Remove the hub & blades assembly from the shaft. If this is done with the blades between 20 and 50 degrees, reinstallation will be facilitated.

(2) If oil leakage is apparent at the rotating seal, remove the thrust ring assembly from the pump and the rotating seal assembly from the translating control, and repair according to paragraph 3. of this section.

(3) Remove the distributor valve cap, the valve assembly, and the cam. Examine the valve sleeve for galling, and smooth with crocus cloth as necessary. If galling is excessive, replace the sleeve. Check the distributor valve for freedom of movement, after washing the assembly and drying thoroughly. If the valve sticks, disassemble it from the sleeve, and repair.

(4) Remove and clean the strainer bolt. Then reinstall the bolt using a torque of 50-55 pound-feet.

(5) Inspect the rear cone and its seat for galling and metal pick-up.

(6) Check the pump for freedom of movement by rotating the eccentric.

(7) Examine the control idler gears for freedom of movement and wear. Detach the hydraulic unit and the auxiliary motor-wiring harness unit preparatory to reinstallation of the hub & blades assembly.

(8) Reinstall the hub & blades assembly and check the distributor valve setting according to the procedure in section III.

f. 200-240 HOUR INSPECTION.

(1) Remove the hub & blades assembly and the control assembly from the engine.

(2) Disassemble and overhaul both assemblies according to the procedure given in section VI.

(3) After completing the overhaul, reassemble and reinstall the propeller.

g. ENGINE CHANGE INSPECTION.—Perform the 200-240 Hour Inspection as this is a convenient time.

h. SPECIAL INSPECTIONS.—As soon as possible after the propeller strikes or is struck by an object, it should be completely examined. All stressed steel parts should be magnetically inspected according to the instructions given in section VI.

3. MAINTENANCE.

a. HUB ASSEMBLY.

(1) Minor leakage can usually be remedied by tightening the securing bolts or by the installation of the correct new gaskets. If the source of leakage is unknown, the following test is recommended: wash the hub assembly thoroughly and wipe as dry as possible. Apply a light pasty mixture of Bon Ami or its equivalent and water over all points of suspected leakage or over all external surfaces if desired. Allow the mixture to dry until most of the water has evaporated. Then operate the engine for several minutes, changing blade pitch through two cycles. Shut down the engine and examine the hub for oil leaks which will be readily noticeable against the white mixture. Clean off the remaining mixture and repair the source of leakage.

(2) If leakage is due to a damaged rotating seal thrust ring, the surface of the ring must be lapped on a circular surface plate of the proper diameter. Local repair should not be attempted. Be certain that a perfect surface is produced. Breaks in the solder joint holding the thrust ring to its retainer should be carefully repaired.

(3) The distributor valve and valve sleeve are paired by serial number and must be kept together. The shape of the lands is precisely ground and should not be altered during cleaning. For this reason only crocus cloth should be used on the lands. Do not use a coarser abrasive.

(4) Metal pick-up from galling on the rear cone and cone seat should be removed with fine emery cloth.

(5) The hub & blades assembly should be full of oil when the sump filler hole is at its highest point. Fill with Pennsylvania Crude SAE No. 10 oil.

b. BLADE ASSEMBLY.

(1) Due to the construction of this blade, all nicks and abrasions shall be considered satisfactory unless the sponged synthetic rubber filler is exposed. Ordinary wear on the leading edge will expose the copper fillet; this is acceptable. Excessive abrasion shall be cause for replating of the blade.

(2) There shall be no buffing, filing, or mechanical working of the blade for any reason, except as noted in paragraph (3) below.

(3) Raised edges of nicks and scratches may be removed by the use of a coarse stone and fine emery *only*.

(4) Blades shall be magnetically inspected periodically according to the procedure in section VI, paragraph 3.

(5) The blade shall be rejected if a dent has a depth greater than 1/7 the distance from the lowest point of the dent to the nearest point of tangency with the undamaged surface of a straight-edge bridging the dent.

(6) If the blade is thought to be bent or twisted, check face alignment according to paragraph 3. b. of section VI.

(7) Each blade should be marked with 1/2-inch letters and numbers between the 8- and 24-inch station on the camber side to include the following: serial number, part or drawing number, and maximum and minimum blade angle settings. The foregoing data should be painted, stenciled, or rubber stamped on the blades, and in no instance should these markings be indented or cut into the metal. The markings should be protected with a coat of spar varnish or clear lacquer.

(8) Blades should be painted to agree with local requirements. No decorative markings are placed on military blades; however, manufacturers' trade marks are not considered decorative and are required on the camber side of each blade.

c. SPINNER ASSEMBLY.

(1) Nicks should be eliminated with fine emery cloth, being certain that each nick is completely removed. Cracks through the surface are cause for rejection of the damaged part. Dents can be hammered out by the use of a rubber mallet and a properly shaped supporting block.

(2) Enlarged screw holes are generally cause for replacement of the part. Loose rivets should be carefully removed and new rivets put in.

d. CONTROL ASSEMBLY.

(1) Minor leakage can usually be remedied by tightening the securing nuts or screws, or by installing new gaskets. If the source of leakage is unknown, the following test is recommended: wash the control assembly thoroughly and wipe as dry as possible. Apply a light pasty mixture of Bon Ami or its equivalent and water over all points of suspected leakage or over all external surfaces, if desired. Allow the mixture to dry until most of the water has evaporated. Then operate the engine for several minutes, changing blade pitch through two cycles. Shut down the engine and examine the control for oil leaks which will be readily noticeable against the white mixture. Clean off the remaining mixture and repair the source of leakage.

(2) If leakage is apparent at the rotating seal, there may be several causes: a scratch or nick in the surface, a cracked ring, or a damaged toroid seal. The surface should be lapped on a surface plate until it is perfectly flat. If the ring is cracked, the assembly must be replaced. Likewise, a new toroid seal should be used if this is the cause.

(3) On a cable system, the tension adjustment should be regulated to give about 20 pounds pull in the cable. An allowance must be made for an increase in cable tension due to engine movement on its mount. On a rigid control system, adjust the linkages to provide positive control without imposing an excessive load on the control shaft. With either system the loading should be sufficient to provide positive control and freedom from lost motion, but not heavy enough to cause undue wear on the control shaft. The cockpit governor control quadrant should be tight enough to prevent its creeping during operation, but not so tight as to prevent ease of movement when the rpm setting is changed.

(4) The electrical connections must be securely mounted and free from signs of chafing. The large cable from the control to the cockpit must be adequately protected as it passes through the aircraft structure.

(5) If the oil level of the control assembly should not be visible through the sight glass after a few minutes of operation, stop and inspect the propeller according to the procedure in section VI.

4. LUBRICATION.

a. All moving parts of the *Super*-Hydromatic propeller are lubricated by the oil in the mechanism. As long as the sumps are full and the propeller functions properly, sufficient lubrication is provided.

b. Use Pennsylvania Crude SAE No. 10 oil in the propeller. Univis No. 60 or its equivalent is recommended for use at extreme low temperature conditions.

5. SERVICE TROUBLES AND REMEDIES.—The following information in its condensed table form lists the troubles, the probable causes, and the remedies most frequently encountered in *Super*-Hydromatic propeller servicing work. It is to be understood that some of these troubles might also be the result of malfunctioning of the engine or other accessories in the aircraft. This information supplemented by a thorough understanding of the principle of operation of the propeller should make trouble-shooting relatively simple. Careful and accurate determination of the troubles, their related causes, and remedies will reduce to a minimum the time required for servicing and will aid in extending the life of the equipment.

CAUTION

Many of the following remedies must be performed by partial disassembly of the propeller. This shall be accomplished only in an overhaul shop and shall never be attempted during line maintenance.

TROUBLE	PROBABLE CAUSE	REMEDY
SLUGGISH BLADE MOVEMENT TOWARD HIGH PITCH.	Excessive internal or external leakage of vane motor.	See "VANE MOTOR LEAKAGE."
	One or more pump high pressure check valves sticky.	Test for open high pressure check valves as per section VII, paragraph 1. Remove faulty cylinder assembly from pump and examine valve for impurities lodged on the seat or burrs on valve seat.
	Sticky distributor valve.	Disassemble and clean.
	Improper relationship between compensating piston and pilot valve.	Turn compensating piston fork *out* in increments of 1/4 turns until proper action is obtained.
SLUGGISH BLADE MOVEMENT TOWARD LOW PITCH.	Faulty servo piston seal.	Replace seal.
	Leaky auxiliary pump check valve.	Clean valve and valve seat.
	One or more pump high pressure check valves sticky.	Test for open high pressure check valves as per section VII, paragraph 1. Remove faulty cylinder assembly from pump and examine valve for impurities lodged on the seat or burrs on the valve seat.
	Improper relationship between compensating piston and pilot valve.	Turn compensating fork *into* piston in increments of 1/4 turns until proper action is obtained.
	Sticky distributor valve.	Disassemble and clean.
BLADES STUCK IN HIGH PITCH.	Distributor valve stuck in high pitch position.	Remove distributor valve and examine for burrs. Remove burrs with crocus cloth. Check for freedom of movement in distributor valve extension assembly. Inspect ID of cam for scoring.
	Translating control assembly bound in high pitch position.	Disassemble assembly and clean up any burrs that may be present. Remove any foreign material from rollers.
	Check valve of auxiliary pump stuck open.	Remove auxiliary pump and clean thoroughly.
	Governor pump drive shaft broken at gear pump.	Replace drive shaft and check for binding of gears.
	Increase pitch solenoid valve stuck open.	Replace or repair solenoid.
	Compensating piston stuck in drain position.	Remove governor head and free piston. If burrs are present on piston liner or compensating piston, remove with crocus cloth.
	Servo piston stuck in high pitch position.	Remove piston and examine. Remove any burrs or foreign material. Check liner for galling.
	Accumulator relief valve piston stuck open.	Remove piston and clean.

TROUBLE	PROBABLE CAUSE	REMEDY
BLADES STUCK IN LOW PITCH.	Three or more pump high pressure check valves sticky.	Test for open high pressure check valves as per section VII, paragraph 1. Remove faulty cylinder assembly from pump and examine valve for impurities lodged on seat or burrs on valve seat.
	High pressure relief valve stuck open.	Disassemble and clean valve of any foreign matter. Remove any burrs on valve seat or stem.
	Excessive leakage in vane motors.	See "VANE MOTOR LEAKAGE."
	Distributor valve stuck in low pitch.	Remove valve and examine for burrs. Remove burrs and check clearances.
	Broken return ring.	Examine pump for any seized piston in the cylinders. Remove and correct. Replace return ring.
	Ratchet wheel lock stuck in up position.	Remove lock assembly and examine for burrs.
	Decrease pitch solenoid stuck open.	Replace or repair solenoid.
	Servo piston stuck in low pitch position.	Remove piston and examine. Remove any burrs or foreign material.
INABILITY TO OBTAIN LOW RPM SETTING.	Hydraulic stop not set at a sufficiently high blade angle.	Remove pitch limit solenoid and reset high pitch hydraulic stop. One full turn of stop is equivalent to approximately two degrees of blade angle. Mechanical stop ring must be reset on non-feathering propellers.
	Low rpm external stop on governor head improperly set.	Adjust stop correctly. One full turn of stop is approximately equivalent to 60 rpm.
	Governor pulley improperly indexed.	Reset pulley.
	Incorrect adjustment of cockpit control system.	Adjust cockpit control system.
	Erroneous reading tachometers, manifold pressure gage.	Calibrate instruments.
INABILITY TO OBTAIN HIGH RPM SETTING.	Hydraulic stop not set at a sufficiently low blade angle.	Remove pitch limit solenoid and reset low pitch hydraulic stop. Mechanical low pitch stop ring must also be reset on non-reversing propellers.
	High rpm stop on governor head improperly set.	Adjust stop correctly. One full turn of stop is approximately equivalent to 60 rpm.
	Governor pulley improperly indexed.	Reset pulley.
	Incorrect adjustment of cockpit control system.	Adjust cockpit control system.
	Low engine power.	See engine manual.
	Erroneous reading tachometers, manifold pressure gage.	Calibrate instruments.
OVERSPEEDING.	Compensating needle valve closed too far.	Back off needle valve in increments of 1/12 turns until proper adjustment has been obtained.
	Improper relationship of compensating piston and pilot valve.	Back compensating piston fork out in increments of 1/4 turns until proper action is obtained.
	Sticky servo rack.	Check for correct meshing of servo rack and pitch transmitter and of rack with translating control. Remove any burrs.
	Dirt or foreign matter under needle valve seat.	Remove needle valve and clean seat.
	Hub not full of oil.	Fill hub with oil.

TROUBLE	PROBABLE CAUSE	REMEDY
UNDERSPEEDING.	Improper relationship of compensating piston and pilot valve.	Turn compensating piston fork *in* in increments of 1/4 turns.
	Leaky servo piston seal.	Replace seal.
	Governor sump not full.	Repair scavenging pump.
SUDDEN DECREASE IN RPM BUT GOVERNING AT NEW SPEED.	Pulley cable slipped in clamp.	Set pulley cable correctly and tighten clamp.
	Governor head twisted in subhead.	Properly locate head and tighten hold-down nuts securely.
	Compensating piston stuck in up position allowing oil to drain.	Remove governor head and free plunger. Clean plunger of any burrs that may be present.
HUNTING.	Hub not full of oil.	Fill hub with oil.
	Governor sump not full.	Repair scavenging pump.
	Compensating needle valve open too far.	Close valve in increments of 1/12 turns until hunting ceases.
	Sticky compensating piston.	Remove piston and clean.
	Sticky distributor valve.	Remove distributor valve assembly and clean.
INABILITY TO FEATHER.	Inoperative pitch limit solenoid.	Check wiring for broken leads. Clean solenoid plunger.
	Hydraulic stop improperly set.	Set stop to correct angle. Reset high pitch mechanical stop ring if necessary.
	Aircraft batteries low.	Recharge batteries.
	Faulty wiring system.	Check wiring system pertaining to control.
	Excessive vane motor leakage.	See "VANE MOTOR LEAKAGE."
	Insufficient pump pressure.	Disassemble pump assembly and check for inoperative high and low pressure check valves.
INABILITY TO UNFEATHER.	Inoperative auxiliary motor.	Check motor for broken leads.
	Auxiliary pump check valve stuck in open position.	Remove auxiliary pump and clean out valve and seat.
	Faulty servo piston seal.	Replace seal.
	Faulty wiring system.	Check and repair wiring system.
	Aircraft batteries low.	Recharge batteries.
	Decrease pitch solenoid inoperative.	Repair or replace solenoid.
	Excessive vane motor leakage.	See "VANE MOTOR LEAKAGE."
	Distributor valve stuck in high pitch.	Remove and clean.
INABILITY TO REVERSE.	Inoperative pitch limit solenoid.	Check wiring for broken leads. Clean solenoid plunger.
	Hydraulic stop improperly set.	Set stop to correct angle. Reset mechanical stop ring if necessary.
	Governor pump drive shaft broken at gear pump.	Replace drive gear shaft and check for binding of gears.
	Faulty servo piston seal.	Replace seal.
	Auxiliary pump check valve stuck in open position.	Remove auxiliary pump and clean.
	Inoperative decrease pitch solenoid.	Repair or replace solenoid.
	Accumulator relief valve piston stuck open.	Remove piston and clean.

TROUBLE	PROBABLE CAUSE	REMEDY
INABILITY TO REVERSE (Cont.)	Broken electrical connection.	Trace continuity of wiring used in reversing.
	Sticky distributor valve.	Disassemble and clean.
INABILITY TO UNREVERSE.	Inoperative increase pitch solenoid.	Repair or replace solenoid.
	Excessive vane motor leakage.	See "VANE MOTOR LEAKAGE."
INABILITY TO HOLD LOCK PITCH.	Lock pitch solenoid stuck open.	Trace continuity of lock pitch wiring. Repair or replace solenoid.
	Leaky auxiliary pump check valve.	Remove and repair pump.
	Faulty servo piston seal.	Replace seal.
	Excessive leakage of vane motors.	See "VANE MOTOR LEAKAGE."
PROPELLER ROUGHNESS.	Leaky blade plug.	Return blade to Contractor for repair.
	Blades not set at same angle.	Readjust blades within .2 degree of each other.
	Propeller unbalanced.	Correct balance.
	Spark plugs or ignition faulty.	Consult engine manual.
	Engine failure.	Feather propeller.
HIGH OIL CONSUMPTION (NO EXTERNAL LEAKAGE)	Faulty seal between engine-propeller shaft and nose thrust plate.	Consult engine manufacturer.
EXTERNAL LEAKAGE.	Damaged gaskets, seals, or mating surfaces.	Replace gaskets or repair as required.
PITCH INDICATOR NOT RECORDING CORRECT BLADE ANGLE.	Broken electrical connection.	Trace through the wiring system and repair any broken connection.
	Pitch transmitter not synchronized with the blade angle.	Readjust pitch transmitter.
	Magnetic unit or inverter inoperative.	Replace faulty unit.
	Faulty pitch indicator.	Repair or replace instrument.
VANE MOTOR LEAKAGE.		
Leakage past dowel seals.	Damaged seals.	Replace seals.
Leakage around pipe plugs.	Plugs backing out and are not staked.	Tighten plugs and stake in position.
	Oil control pin preventing pipe plug from being screwed all the way in.	Remove pipe plug and drive in pin all the way. Replace pipe plug.
Leakage past end plate gaskets.	Damaged gasket.	Replace gasket.
Leakage around the cover nut seal.	Damaged seal.	Replace seal.
Leakage past top and bottom plates.	Damaged plates.	Lap plates on flat surface until damage is removed. Do not go below the dimension given in the applicable clearance chart.
	Plates not seating properly.	Check all related dimensions and correct.
Leakage past strip seals.	Damaged seals.	Replace seal.
Leakage past center post seals.	Damaged seals.	Check for sharp corners on barrel vane. Remove corners and replace seals, being careful to place them over the post without twisting.

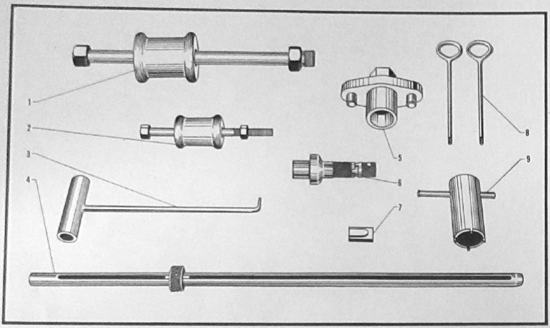


Figure 70—Overhaul Tools

1 VANE MOTOR HAMMER
2 PUMP CYLINDER HAMMER
3 BLADE PACKING RETAINING RING TOOL
4 BLADE BEARING BALL LOADING TOOL
5 VANE MOTOR COVER NUT WRENCH
6 DISTRIBUTOR VALVE SLEEVE GAGE
7 TRANSLATING CONTROL GAGE
8 LIFTING EYE BOLTS
9 SERVO INNER LOCK NUT WRENCH

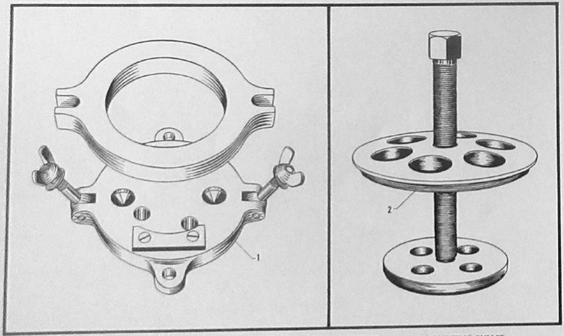


Figure 71—Overhaul Tools

1 VANE MOTOR HOLDING FIXTURE
2 ECCENTRIC PULLER

SECTION VI

DISASSEMBLY, INSPECTION, REPAIR, AND REASSEMBLY

1. OVERHAUL TOOLS REQUIRED.

PART NO.	NOMENCLATURE	APPLICATION
61321	Distributor Valve Cap Wrench	To tighten and loosen distributor valve cap
61322	Hub Retaining Nut Wrench	To tighten and loosen hub retaining nut.
63098	Distributor Valve Gage	To check and adjust setting of distributor valve.
SS-1	Distributor Valve Sleeve Gage	To check distributor valve sleeve setting.
SS-3	Preload Fixture	To determine preload of connecting gear and vane motor.
SS-4	Vane Motor Holding Fixture	To hold vane motor during assembly.
SS-5	Blade Bearing Ball Loading Tool	To load balls into retention races.
SS-6	Vane Motor Hammer	To insert and remove vane motor.
SS-7	Eccentric Puller	To remove eccentric from barrel.
SS-8	Vane Motor Cover Nut Wrench	To tighten and loosen vane motor cover nut.
SS-10	Pump Cylinder Hammer	To remove pump cylinder from pump housing.
SS-11	Lifting Eye Bolts	To remove connecting gear group.
SS-12	Translating Control Gage	To locate translating control in the mid-position.
SS-26	Servo Inner Lock Nut Wrench	To tighten and loosen servo inner lock nut.
SS-27	Torque Wrench (15 pound-feet)	To tighten vane motor jack-screw.
SS-28	Steel Bar	To use with hub retaining nut wrench.
SS-29	Blade Packing Nut Wrench	To tighten and loosen blade packing nut.
SS-30	Propeller Balancing Unit	To test horizontal balance of the propeller.
SS-31	Torque Wrench (150 pound-feet)	To tighten vane motor cover nut.
SS-32	Assembly Bench	To support hub & blades during assembly.
SS-33	Hub Test Unit	To test hub operation.
SS-34-60	Assembly Sleeve (SAE No. 60)	To fit hub shaft bore for use on assembly bench.
SS-35	Vane Motor Checking Fixture	To check centered position of vane motor.
SS-36	Tool Box	To hold assembly tools.
SS-37	Master Balancing Hub	To hold blades for balancing.
SS-38	Control Test Unit	To test control operation.
PE-105	Protractor	To check blade angles at assembly.
M-462	Hoisting Sling	To lift hub & blades assembly.
M-470	Rear Cone Lapping Tool	To repair rear cone and seat.
M-706	Spline No-Go Gage	To check barrel splines.

2. DISASSEMBLY.

a. DISASSEMBLY OF HUB & BLADES INTO SUBASSEMBLIES.

(1) With the hub & blades assembly suspended in the sling, remove the rotating seal thrust ring assembly. This will prevent damage to the ground surface of the ring.

(2) Remove the retaining nut lock wire and the cover plate bolts and spacers. Remove the cotter pin and take off the distributor valve cap with the valve cap wrench. Carefully tap the sides of the cover plate with a non-metallic hammer to loosen the cover and lift off both cover plate and gasket.

(3) Lift out the cam drive idler gear. Pull out the connecting gear assembly, the stop sleeve, and the retaining nut together with the front cone, seal, and spacer.

(4) Release the snap ring which holds the distributor valve cam onto the bushing. Using the distributor valve gage as a turning tool, unscrew the valve from the offset control. This is done by inserting the prong of the tool into one of the locking serrations, depressing enough to clear the lock pin, and turning anticlockwise. Lift out the valve and the cam.

(5) After taking out the jack-screw access hole plugs, loosen the jack-screws by rotating them *clockwise* as far as possible. The jack-screw has a 1/4-inch hollow hex head. This will permit each blade to be pushed inward far enough to move the balls from the running races into the loading races.

(6) Loosen the screws which retain the loading hole cover plates. Do not completely remove the plates as they will hold in the bearing balls if a blade moves inward during the next operation.

(7) Install the assembly sleeve, and replace the front cone and retaining nut, turning the nut down onto the sleeve. It is convenient to release the pump retaining bolt snap rings and locks at this time since the pump will be

removed when the hub & blades assembly is inverted. Then turn the hub & blades assembly outboard side down, and place it on the post with the retaining nut wrench installed in the nut to act as a spacer between the assembly post base and the outboard side of the barrel.

CAUTION

A spacer must be used to prevent damaging of the distributor valve bushing.

(8) Remove the blade packing nuts (or the halves of the retaining rings), the tab lock rings, and the packing washers. Carefully pull out the blade packings (either the toroid or the chevron type).

(9) With a non-metallic mallet, tap each blade at the tip, knocking it toward the center line of the hub as far as it will go. This puts the balls in the loading races. Take off the loading hole cover plates and remove the balls from their races in the blade and the barrel. This can be facilitated by blasting air into the races to loosen the balls, or by working them with a soft wire. When all balls are removed from the races, pull out the blades and lay them on a clean padded surface.

(10) Take out the lock pin assembly which secures the governor drive gear to the barrel boss. Place the end plate of the eccentric remover inside the rear end of the barrel with its curved edge down. Screw the other plate into the governor drive gear. Tighten the screw until the eccentric assembly is free and can be removed by hand.

(11) Unscrew the pump attaching bolts and lift the pump assembly off the barrel. If the pump sticks, tap it with a non-metallic mallet.

(12) Remove the two retaining screws and take the lubricating valve & offset control assembly off the barrel. Lift off the gasket and screen.

(13) Take the barrel off the post, and remove the retaining nut with the cone and the sleeve.

b. DISASSEMBLY OF HUB & BLADES SUBASSEMBLIES.

Note

It should generally be unnecessary to disassemble each hub & blades subassembly unless malfunctioning of the unit is evident. Freedom of movement of the parts can be determined by external examination. The following disassembly procedures are given as much as possible in order of the minimum desired tear-down. However, for magnetic inspection of certain parts, it is necessary to disassemble them from their subassembly. These parts are: barrel, blade, cover plate, connecting gear, stop rings, vane motor center posts, blade vane, barrel vane, cylinder, pump roller, manifold, return ring, eccentric, governor drive gear, and stop sleeve.

(1) DISASSEMBLY OF DISTRIBUTOR VALVE ASSEMBLY.—Tap out the pin which holds the cam roller to the lug of the distributor valve sleeve. Remove the pin in the distributor valve lock and separate the parts. It is not necessary to do this last step unless replacement of a part is required.

(2) DISASSEMBLY OF CONNECTING GEAR ASSEMBLY.—Separate the connecting gear from the stop sleeve. Remove the high and low pitch stop rings and the cam drive gear with the preload shims, if used.

(3) DISASSEMBLY OF ECCENTRIC ASSEMBLY.—Pull the three thrust segments out of the governor drive gear and remove the gear. With the eccentric outboard side down, slip a piece of shim stock between the rear bearing cage and the eccentric. This forces the rollers out of the eccentric race as the shim is moved around the bearing. A coat of light grease will aid in holding the rollers. Carefully lift the bearing cage out. The rollers may fall out as the cage clears the eccentric. Remove the other bearing in a similar manner.

(4) DISASSEMBLY OF VANE MOTOR ASSEMBLY.

(a) Turn each jack-screw from its vane motor. Inserting the vane motor hammer into the jack-screw hole, drive out each vane motor from the blade shank.

(b) Secure the vane motor in the holding fixture. Remove the cotter and clevis pin from the cover nut, and, with the cover nut wrench, unscrew the cover nut from the center post. Take the vane motor out of the fixture, and tap the center post out of the blade vane. Remove the strip seals from each vane.

Note

The micro-adjusting ring should not be removed from the blade vane without first noting its scribe mark position relative to the "O" mark on the blade vane so as to permit replacing it in the same position.

(c) Remove the barrel vane from the center post by striking the end of the center post sharply on a wood or soft metal surface. Remove the seals and bottom end plate from the center post. The barrel and blade vanes are numbered in pairs and should be kept together.

(5) DISASSEMBLY OF OFFSET CONTROL ASSEMBLY.

(a) Remove the shaft centering spring and washer and lift the idler gears with the two washers from the shafts. It is generally unnecessary to remove the shafts and the rack roller from the housing. Pull the extension rack and the control rack out of their operating positions.

(b) Unscrew the lubricating valve plug and shake out the ball and spring.

(6) DISASSEMBLY OF PUMP ASSEMBLY.

(a) Place the pump outboard side down on a wooden surface. Remove the sump filler plug. Bend down the tabs on the pump roller shaft nut lock washers. Remove the nuts and the roller shafts. Slide the rollers out of the piston forks being very careful not to lose the bearing needles. It is good practice to keep the parts of each pump assembly together.

(b) Collapse the piston return ring and lift it out of the pump. Remove the 10 bolts which secure the high pressure manifold to the pump and take out the manifold. Eight of the securing bolts also serve as high pressure check valve plugs in the individual pumps, and should be replaced in the pump cylinders (after removal of the cylinder from the pump) to prevent loss of the check valve parts.

(c) Unscrew the two nuts that hold each cylinder to the housing. Insert the pump cylinder hammer into the manifold bolt hole in each cylinder, and tap the cylinder out of the pump housing. Replace each manifold bolt in its proper position in its cylinder. Remove all cylinder gaskets from the pump housing.

(d) Take out the cotter pin and unscrew the sump relief valve assembly. Tap out the lock pin and separate the parts.

(e) To disassemble the individual pumps, first pull out the piston. Unscrew the high pressure check valve plug and shake out the spring and plunger. Remove the brass pin holding the low pressure check valve in position and tap out the aluminum retainer. Again shake out the spring and valve disc. Remove the piston plug and the check valve plug.

(f) To disassemble the high pressure relief valve, unscrew the valve plug from the bolt. Since the spring is highly compressed, this should be done very carefully. Do not stand in line with the plug as it is removed. Usually the valve and spring will come out with the plug and the parts should be separated.

c. DISASSEMBLY OF CONTROL INTO SUBASSEMBLIES.

(1) Remove the hydraulic unit from the control support by first disconnecting the cable connection at the solenoid pack, and then unscrewing the four self-locking nuts on the side of the governor body which secure it to the support. The complete hydraulic unit consisting of the governor, servo motor, and solenoid pack can then be removed from the support. Unscrew the four self-locking nuts securing the head to the governor, and separate the two assemblies. If there is a tendency for the parts to stick, tap them lightly with a non-metallic hammer. Remove the servo motor from the governor after unscrewing the eight attaching self-locking nuts securing the two assemblies. Unscrewing the six self-locking attaching nuts on the bottom of the solenoid pack allows the solenoid pack to be separated from the servo motor.

(2) Disconnect the electrical cables at the pitch transmitter and pitch limit solenoid. Remove the four fillister head screws attaching the wiring harness to the support and take off the auxiliary motor-wiring harness unit. To remove the auxiliary motor from the wiring harness, it is first necessary to remove the large AN connector and the ground terminal cover plate from the wiring harness and disconnect the auxiliary motor leads. Then unscrew the four self-locking nuts securing the motor to the wiring harness, and separate the parts.

(3) To remove the pitch transmitter, unscrew the three self-locking nuts and the screw securing the pitch transmitter to the support. Be careful not to damage the pinion gear. Take out the three screws securing the pitch limit solenoid to the support and detach the unit.

(4) Remove the three screws securing the translating control to the support and lift out the unit.

d. DISASSEMBLY OF CONTROL SUBASSEMBLIES.

Note

It should generally be unnecessary to disassemble each control subassembly completely unless malfunctioning of the unit is evident. The freedom of movement of internal parts and the continuity of electrical connections can be determined externally. The following disassembly procedures are given as much as possible in order of the minimum desired tear-down.

(1) DISASSEMBLY OF GOVERNOR HEAD ASSEMBLY.

(a) Remove the three self-locking nuts and the clamps securing the governor head to the subhead, and separate the two parts.

(b) Turn the pulley counterclockwise until the teeth of the speeder rack are unmeshed; then pull the rack assembly from the head. Disengage the adjustment screw from the lock nut. Remove the lock spring from the groove on the lock nut.

(c) Unscrew the nut securing the pulley to the shaft and remove the outer washer, pulley with insert, and inner washer from the shaft. Usually it is undesirable and unnecessary to remove the stop pin and the cable clamp from the pulley.

(d) Remove the three fillister head screws holding the end cover in place; lift off the end cover, and push out the control shaft with its thrust washers and the end cover bushing. Pull the oil seal from the recess in the head opposite the end cover. If desired, unscrew the high and low rpm screws from the supporting ears on the head.

(2) DISASSEMBLY OF GOVERNOR ASSEMBLY.

(a) Lift the speeder spring from the spring seat. Take the safety wire out of the pins of the compensating linkage and the linking arms to allow removal of the pins, linking arms, and pilot valve. Disassemble the needle valve locking unit by removing the safety wire from the top of the needle valve and taking off the washer, spring, and the hexagonal locking key. Unscrew the needle valve. Then remove the two screws securing the controlet to the governor body and lift the controlet from the body. Press the spring seat and the pilot valve sleeve from the ball bearing.

(b) Withdraw the drive gear shaft bushing locking screw from the side of the housing, and pull the bushing along with the complete fly-weight head assembly from the body. Take out the synthetic seal. Separate the fly-weights from their hinge pins, if necessary. Unscrew the self-locking nut securing the fly-weight head to the drive gear shaft and separate the two parts. By pressing on the top of the shaft, the lower bearing, bellows assembly, drive gear shaft, and upper bearing can be pushed out.

(c) The four screws securing the governor bottom plate to the body are taken out in order to remove the pump gears, the accumulator relief valve piston, spring, and spacer, and the compensating piston assembly. Unscrew the self-locking nut of the compensating piston to separate the sleeve and upper spring. To remove the check valve from the fly-weight head recess, insert a long rod through the accumulator relief valve hole and tap out the sleeve and ball.

(d) Remove the filler plug and gasket from the filler plug hole and unscrew the sump retainer with a straight-sided screw driver. Take the sump cover from the body, and then the sight glass retainer, sight glass, and gasket from the cover.

(3) DISASSEMBLY OF SERVO MOTOR ASSEMBLY.

(a) Unscrew the outer and inner lock nuts, and push out the piston with a drift. Remove the toroid seal from the piston. Tap the scavenge check valve out of the housing.

(b) Hook a bent rod into the compensating oil hole in the liner and tap out the liner. Remove the three seals. Pull the seal & expander assembly from the inner end of the housing.

(4) DISASSEMBLY OF SOLENOID PACK ASSEMBLY.

(a) Detach the cover and gasket from the housing. Loosen the screws attaching the electrical connector to the housing. Unsolder the attached wires and remove the connector.

(b) Pull out the pin locking the end bell of each solenoid. Unscrew the end bells from the cores. This allows the coils and shells to be lifted from the housing. Separate the cores, gaskets, plungers, and springs from the housings. Keep the parts of each solenoid valve together.

(c) Unscrew the needle valve and lock nut from the housing.

(5) DISASSEMBLY OF PITCH TRANSMITTER ASSEMBLY.

(a) Loosen the four nuts securing the cover to the case and carefully pull the two sections apart.

(b) File off the peened end of the taper pin securing the fixed pinion to the shaft. Drive out the pin and remove the pinion. Pull the driven gear and shaft from the case and push out the taper pin securing the gear to the shaft to separate the two parts. Remove the washer and the oil seal.

(c) Unscrew the self-locking nut to disassemble the shaft and washer from the idler gear assembly. File and drive out the taper pins of the large and the small driven gears, and remove the gears from their transmitter drive shafts. Separate the AN connector from the cover, pull the connector out, and unsolder the wires.

(d) Lift the two magnetic units from the cover, being careful not to damage the wires. Remove the self-locking nuts and washers from the adjusting pinions and pull the pinions from the cover.

(6) DISASSEMBLY OF PITCH LIMIT SOLENOID ASSEMBLY.

(a) Remove the three fillister head screws and washers from the top of the solenoid. Take out the link pin safety wire and unscrew the link pins. Remove the plunger, links, and washers.

(b) Dismantle the AN plug on the shielded cable and unsolder the attached leads. Unscrew the cable from the housing. After screwing the four cover screws and washers, remove the cover plate and gasket.

(c) Remove the pin locking the core assembly to the bushing and unscrew the core assembly from the bushing. Separate the core plug, spring, and stop pin from the core. Pull the coil assembly from the bushing exercising care in handling the wires, and press the bushing from the housing.

(7) DISASSEMBLY OF WIRING HARNESS ASSEMBLY.

(a) After taking off the cover plate, unscrew the center ground terminal retaining screw, and separate the plate from the common ground wires. Detach the AN connectors and pull the connectors forward to expose the soldered connections. These are removed by melting the solder at each terminal.

(*b*) Drive out the worm gear & sleeve assembly carefully with a non-metallic drift inserted through the slot in the housing. Remove the auxiliary motor coupling. Separate the upper bearing from the worm. Pull the lower bearing from the housing with a small flanged tool hooked through the shaft hole and under the inner race.

(8) DISASSEMBLY OF AUXILIARY MOTOR ASSEMBLY.

(*a*) Unscrew the two micarta brush retainers on either side of the head, and remove the brush assemblies.

(*b*) Take the cover plate with its gasket off the top of the housing. The phenolic wire support is loosened by removing the two inner screws and lock washers after which the four wires can be detached from the support. After removing the four screws, the head is pulled off the body, care being taken to not damage the wires.

(*c*) Detach the bottom plate and pull the rotor assembly from the housing. Press off both bearings and the collar under one bearing.

(9) DISASSEMBLY OF CONTROL SUPPORT ASSEMBLY.

(*a*) Remove the stop lock plate and index plate. Unscrew the shaft supporting the stop screw and drop out the stops. Detach the feather and reverse stops.

(*b*) Unscrew the calibrating pin cap. Remove the locating screw and press out the calibrating pin bushing.

(*c*) Remove the pipe plug in the servo spring cover nut. Insert the spring compression bolt through the hole and screw it into the spring guide. Tighten the bolt to compress the spring and remove the spring load on the cap before unscrewing the cap. (The bolt is a 1/4 x 28 bolt 2 inches long.) Unscrew the self-locking nut securing the spring seat guide to the end of the rack. Slide the rack out of the support.

(*d*) Pull out the check valve bushing by hooking a flanged tool through the bushing and under the seat. Remove the ball and spring.

(*e*) Unscrew the ratchet wheel lock assembly from the support. To disassemble the unit, depress the plunger partially and press out the pin. Releasing the plunger allows the unit to come apart.

(*f*) Unscrew the shaft to remove the auxiliary motor ratchet wheel assembly. Unscrew the auxiliary pump gear shaft to remove the gear from the assembly. Unscrew the governor drive & idler gear assembly screw, and remove the gear assembly.

(10) DISASSEMBLY OF TRANSLATING CONTROL & ROTATING SEAL ASSEMBLY.

(*a*) Remove the cotter pins securing the rotating seal. This will allow the carbon ring assembly to be removed from the outer race flange. Remove the 16 springs.

(*b*) Bend down the tab locking the stop in the outer race and remove the stop.

(*c*) Position the rollers so they are at the enlarged radii of their slots and tap them from the assembly.

(*d*) Align the half hole in the thrust ring with that in the inner ball race and allow the balls to drop out. This can be facilitated with an air blast or a pointed tool. The inner race and thrust plate are then separated.

3. CLEANING, INSPECTION, TESTING, AND REPAIR.

a. CLEANING.

(1) Upon disassembly of the propeller all parts shall be thoroughly washed with an approved mild cleaning solvent. Under no circumstances shall a wire brush or an abrasive compound be applied. The internal passages shall be blown clear with compressed air to insure that they are open and free of foreign particles.

(2) If the parts are to remain idle for some time before reassembly and use, they shall be protected by an approved anti-corrosion compound.

(3) All parts must be completely free of oil and wiped dry of cleaning fluid before inspection.

b. INSPECTION.

(1) SCOPE.—All propeller parts shall be given a close visual examination and, in addition, some more highly stressed parts shall be magnetically inspected. The propeller as a unit is satisfactory if it fulfills the test requirements of section VII, and passes the following inspection procedures.

(2) VISUAL INSPECTION.

(*a*) HUB ASSEMBLY.

1. Carefully inspect all parts for wear, galling, metal pick-up, cracks, nicks, and burrs. Check all threads for rough edges and irregularities. This damage shall be repaired according to the procedures in paragraph 3.c. of this section.

2. Examine all gaskets and seals for deformation and deterioration.

3. Thoroughly check all plated and painted surfaces for damage exposing the bare metal.

4. Carefully inspect all the fits and clearances listed in the applicable clearance chart (figure 72) and its tabulation (table I). The dimensions to the left of the bracket are manufacturing tolerances, and the dimension to the right is the limiting fit allowable for service use. An interference fit is indicated by the letter "T," and a loose fit is designated by the letter "L."

5. Check pertinent subassemblies for freedom of movement.

6. Check all internal passages for cleanliness. Use clean compressed air.

TABLE I
(See Figure 72)

ITEM	CLEARANCE	REMARKS
1	.0010L .0027L } .004L	Clearance between eccentric and rollers.
2	.0005L .0025L } .0025L	Clearance between offset control housing and control rack.
3	.001L .003L } .005L	Clearance between barrel and lock pin.
4	See Remarks	Clean and lap cone seats as required. The distance between cone seat gage diameters (front gage diameter is 5.359 inches and rear gage diameter is 5.500 inches) shall not be reduced below 8.420 inches.
5	.0000T .0025T } .0000T	Fit between governor drive gear and barrel. Select parts to maintain this fit.
6	.001L .007L } .010L	Clearance between governor drive gear and lock pin.
7	.003L .006L } .015L	Clearance between thrust segment and eccentric.
8	.0005L .0011L } .0011L	Clearance between pump inner roller and roller shaft.
9	.0000L .0006L } .0006L	Clearance between piston fork and roller shaft.
10	.0015L .0065L } .010L	Clearance between piston fork and pump outer roller.
11	.012L .018L } .025L	Clearance between piston fork and return ring.
12	.0000L .0045L } .007L	Clearance between pump roller and piston return ring. This shall be measured when assembled with zero clearance at the roller diametrically opposite.
13	.003L .007L } .007L	Clearance between vane motor cover nut and blade vane. Replate the cover nut to maintain clearances.
14	See Remarks	Evidences of end plate wear shall be removed by lapping. The minimum thickness (measured at point of maximum thickness) shall be .245 inch.
15	.0000L .0010L } .0010L	Clearance between oil control pin and center post. Replate if vane motor does not pass leakage tests of section VII.
16	.001L .003L } .006L	Clearance between blade vane and vane motor center post thrust ring.
17	See Remarks	Retaining nut threads shall not be below the pitch diameter limit of 4.1825 inches as measured by the proper gage. This is a Class II fit.
18	.001L .003L } .005L	Clearance between barrel and vane motor center post.
19	See Remarks	Check splines with HSP M-706 gage or its equivalent. Gage shall enter full length of all splines and show no perceptible looseness.
20	.002L .006L } .010L	Clearance between stop sleeve and blade connecting gear.
21	.0005L .0020L } .004L	Clearance between idler pin and idler gear.
22	.0005T .0015T } .0005T	Fit between barrel and idler gear pin.
23	.002L .006L } .010L	Clearance between distributor valve cam and distributor valve bushing.
24	See Remarks	The distributor valve and sleeve are manufactured in pairs. They are satisfactory as long as the hub & blades assembly meets the test specifications of section VII.

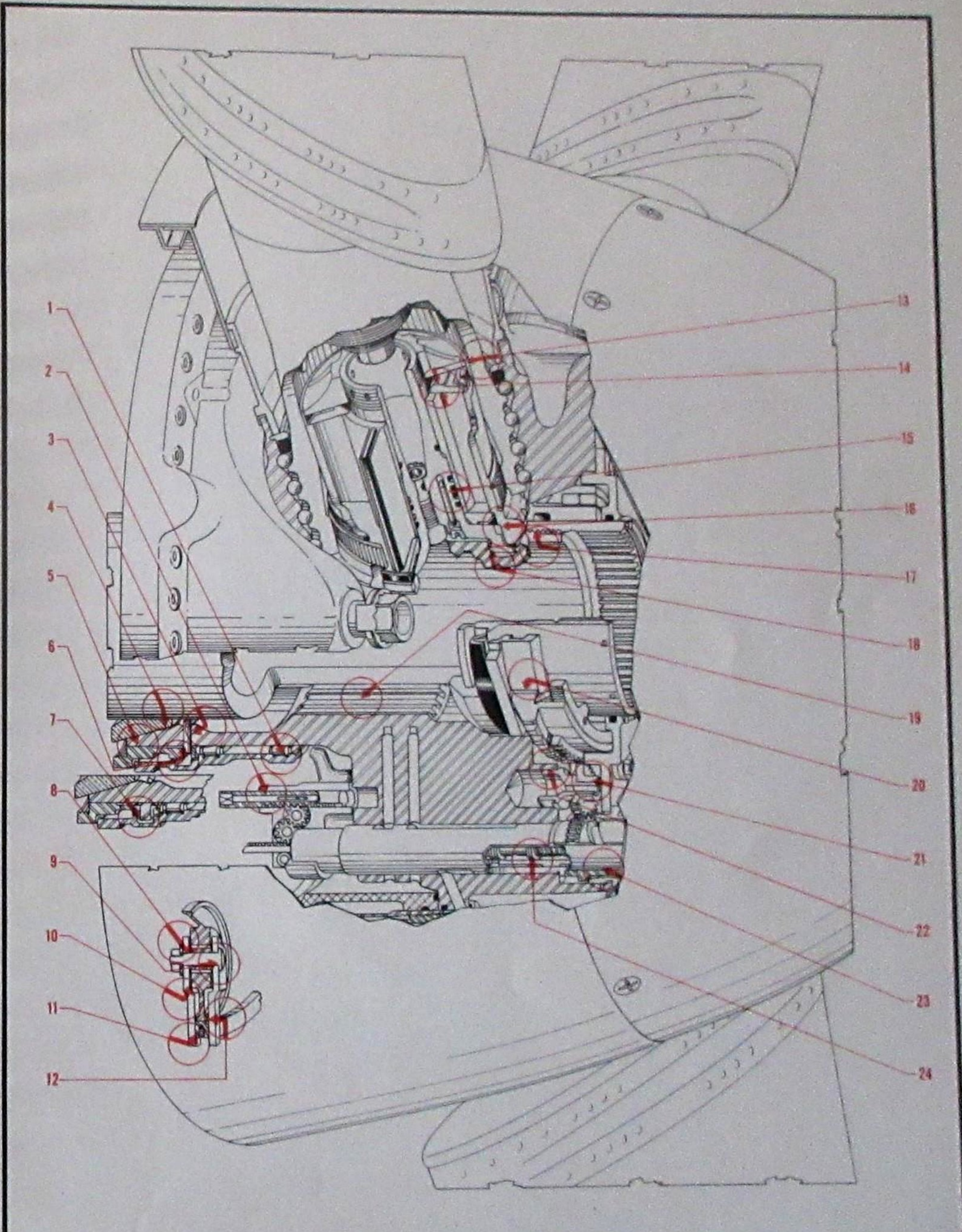


Figure 72—Hub Clearance Chart

TABLE II

(See Figure 73)

ITEM	CLEARANCE	REMARKS
1	.0010L } .0025L } .005L	Clearance between control shaft and flanged bushing.
2	.001L } .003L } .006L	Clearance between speeder rack and rack bushing.
3	.0010L } .0025L } .005L	Clearance between control shaft and end cover bushing.
4	.0005L } .0028L } .0065L	Clearance between compensating piston and upper liner.
5	.0005L } .0013L } .002L	Clearance between compensating piston and lower liner.
6	.0002L } .0010L } .0015L	Clearance between relief valve piston and relief valve bushing.
7	.0006L } .0015L } .0025L	Clearance between pump gears and governor body, and between the pump gears and the bottom plate.
8	.0005L } .0015L } .003L	Clearance between servo piston and piston liner.
9	.0002L } .0010L } .0015L	Clearance between pilot valve and pilot valve sleeve.
10	.0002L } .0010L } .0015L	Clearance between pilot valve sleeve and controlet bushing.
11	3.656 3.658	Distance from toe of fly-weights to bottom of lower bearing.
12	.0002L } .0010L } .0015L	Clearance between auxiliary pump plunger and auxiliary pump bushing.
13	See Remarks	Minimum thickness of rotating seal shall be .800 inch.
14	.0004L } .0018L } .0025L	Clearance between servo rack and servo rack bushing.

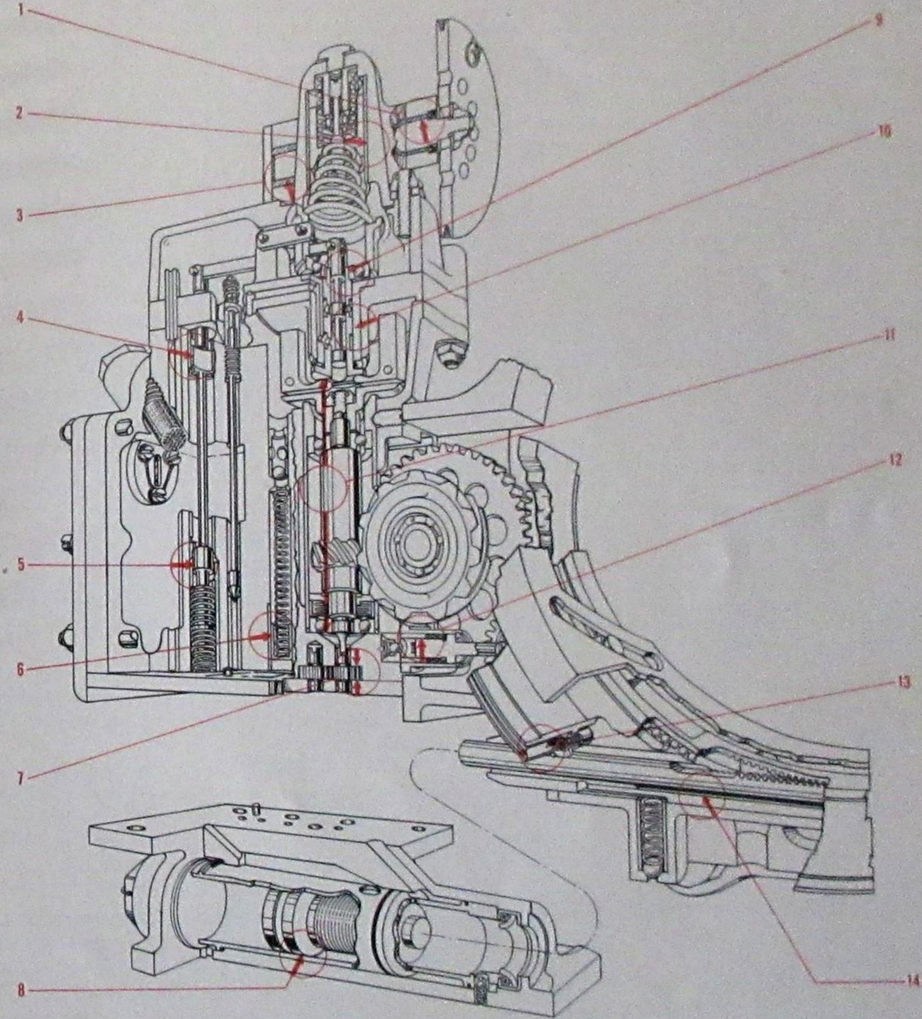


Figure 73—Control Clearance Chart

(*b*) BLADE ASSEMBLY.

1. Carefully examine the external surfaces for nicks, burrs, dents, and cracks. These shall be repaired as in paragraph 3.c. of this section. Any damage which exposes the sponged rubber filler shall cause the blade to be scrapped. The blade shall be rejected if any dent has a depth greater than 1/7 the distance from the lowest point of the dent to the nearest point of tangency with the undamaged surface of a straight edge across the dent.

2. Face alignment shall be checked according to the following table. Deviations beyond the specified limits shall cause rejection of the blade.

TABLE III

BLADE STATION (INCH)	NOMINAL FACE ALIGNMENT (INCH)	SERVICE TOLERANCE (INCH)
36	+.150	±.156
48	—.206	±.172
60	—.509	±.219
72	—.824	±.250

Note

Face alignment is the minimum distance between the face side and the blade center line. For the 2C15B1 blade, the center line passes through the exact center of the blade shank, but is outside of the blade at the tip. In the second column of the preceding table, a "+" indicates that the imaginary center line is inside of the blade, while a "—" indicates that it is outside of the blade. Face alignment must be measured with the blade shank held parallel with the checking table.

3. Examine the painted surface for damage exposing the bare metal. Repair as directed in paragraph 3.c. of this section.

4. Check the balancing plug for leakage and looseness. This is usually indicated by leakage out of the core vent hole at the tip during operation.

5. Leakage out of the *shell* vent hole (not the *core* vent hole) shall cause rejection of the blade.

(*c*) SPINNER ASSEMBLY.

1. Visually inspect for nicks, burrs, cracks, and dents. Damage which goes through the shell shall cause rejection of the part.

2. Examine the attaching screw holes for elongation. More than 20 percent elongation of screw hole diameter shall cause rejection of the part. Check rivets for looseness.

(*d*) CONTROL ASSEMBLY.

1. Carefully inspect all parts for wear, galling, metal pick-up, cracks, nicks, and burrs. Check all threads for rough edges and irregularities. This damage shall be repaired according to the procedures in paragraph 3.c.

2. Examine all gaskets and seals for deformation and deterioration.

3. Thoroughly check all plated and painted surfaces for damage exposing the bare metal.

4. Inspect all the fits and clearances listed in the applicable clearance chart (figure 73) and its tabulation (table II). The dimensions to the left of the bracket are manufacturing tolerances, and the dimension to the right is the limiting fit allowable for service use. An interference fit is indicated by the letter "T," and a loose fit is designated by the letter "L."

5. Check pertinent subassemblies for freedom of movement.

6. Test all internal passages for cleanliness.

7. Inspect all wiring for continuity of the circuits. Refer to the wiring diagram in figure 186.

(3) MAGNETIC INSPECTION.

(*a*) SCOPE.—The parts listed below shall be magnetically inspected in accordance with Specification No. AN-QQ-M-181a-2, and then carefully examined to determine whether any fatigue cracks have developed.

Barrel	Eccentric
Barrel Vane	Governor Drive Gear
Blade	Manifold
Blade Vane	Piston
Center Post	Pump Roller
Connecting Gear	Return Ring
Cover Plate	Stop Ring
Cylinder	Stop Sleeve

Three types of magnetization are used; direct magnetization, induced magnetization using a bar, and induced magnetization using a solenoid. For the first two types a calibration procedure is required; this is described in the following paragraph. For solenoid type magnetization a definite amperage of current through the coil is needed.

(*b*) CALIBRATION. — The equipment and method employed will be calibrated by means of the calibration piece shown in figure 74, details 1, 2, 3, 4, and 5. The equipment may be calibrated at one of three levels of current density depending upon the part to be inspected in a particular inspection unit.

1. PROCEDURE.—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 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 shall be used to magnetize a bar, and the continuous method of applying indicating solution shall be used. 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. EQUIPMENT.

a. Equipment used to inspect parts of large cross-sectional areas shall be adjusted and the technique employed such that piece No. 5 will show no accumulation of indicating powder, piece No. 4 will just faintly show an accumulation of indicating powder, and piece No. 3 will show a definite accumulation of indicating powder. If the unit is operating in a normal manner with continual magnetization, these results should be obtained at approximately 2000 amperes. This is called the No. 4 calibration in table IV.

b. Equipment used to inspect parts of small cross-sectional areas shall be adjusted and the technique employed such that piece No. 1 will show a faint accumulation of indicating powder, and piece No. 2 will show no accumulation. If the equipment is operating in a normal manner, these results should be obtained at approximately 500 amperes. This is called the No. 1 calibration in table IV.

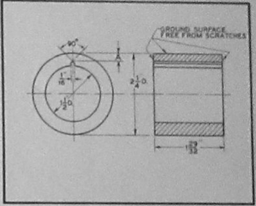


Figure 74—Calibration Test Piece

DETAIL NO.	A ± .001 INCH
1	.200
2	.240
3	.260
4	.275
5	.290

TABLE IV

PART	DIRECT MAGNETIZATION		INDUCED MAGNETIZATION (BAR)		INDUCED MAGNETIZATION (SOLENOID)		REMARKS
	Use	Calibration	Use	Calibration	Use	Amperes	
Barrel	Yes	See Remarks	Yes	See Remarks	No	No	Use a nominally 4000 ampere unit at full capacity. Magnetize barrel in two directions, contacting both pairs of opposite barrel arms.
Barrel Vane	Yes	No. 4	Yes	No. 4	No	No	
Blade	Yes	No. 4	No	No	Yes	4000	Remove plating at tip for direct magnetization. For induced magnetization give successive fluxes with the coil placed initially over the retention races and at 24-inch intervals along the blade.
Blade Vane	Yes	No. 4	Yes	No. 4	No	No	Contact sides of vane at gear end with contact outside the gear area.
Center Post	Yes	No. 4	No	No	Yes	2000	
Connecting Gear	Yes	No. 4	Yes	No. 4	No	No	
Cover Plate	Yes	No. 4	Yes	No. 4	No	No	Contact plate 90 degrees from the projecting ring.
Cylinder	Yes	No. 4	No	No	Yes	2000	
Eccentric	Yes	No. 4	Yes	No. 4	No	No	
Governor Drive Gear	Yes	No. 4	Yes	No. 4	No	No	
Manifold	No	No	Yes	No. 4	No	No	
Piston	Yes	No. 4	No	No	Yes	2000	
Pump Roller	No	No	Yes	No. 1	Yes	500	Hold roller flat in the solenoid coil.
Return Ring	No	No	Yes	No. 4	No	No	
Stop Ring	No	No	Yes	No. 4	No	No	Up to ten rings at once may be magnetized.
Stop Sleeve	Yes	No. 4	Yes	No. 4	No	No	Contact flat surfaces on opposite sides.

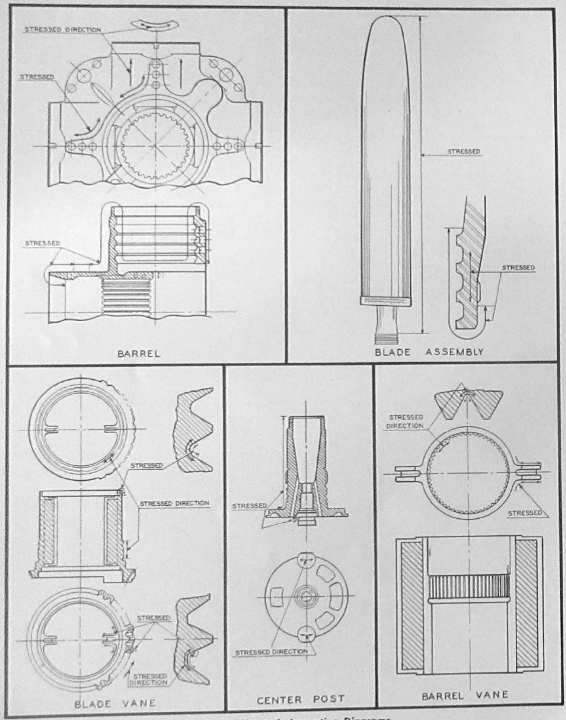


Figure 75—Magnetic Inspection Diagrams

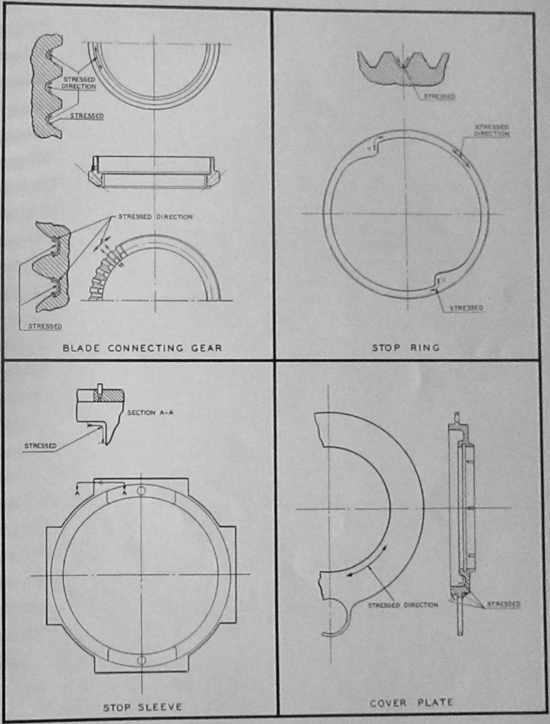


Figure 76—Magnetic Inspection Diagrams

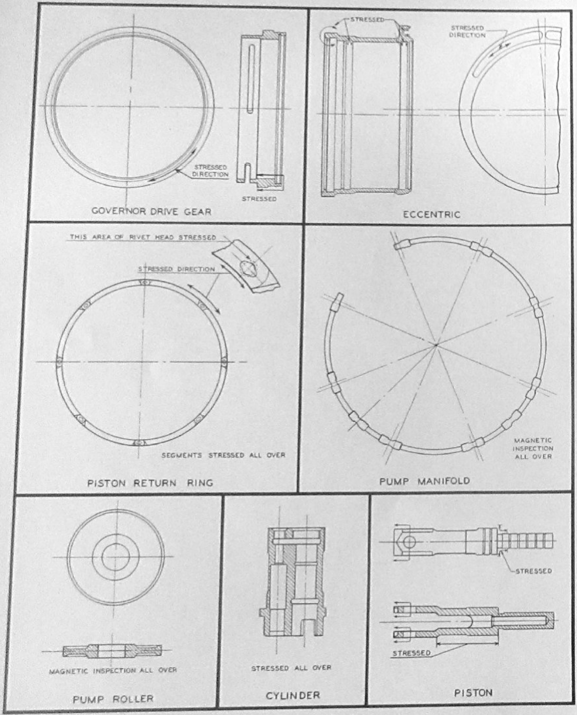


Figure 77—Magnetic Inspection Diagrams

(*c*) MAGNETIZATION PROCEDURE.

1. Table IV lists the parts according to the types of magnetization to be used. The accompanying figures illustrate the particular points to be carefully checked on each part.

2. The usual good practice for magnetic inspection shall be followed. The contacts of the units shall be copper braid or its equivalent to minimize burning due to poor contact.

3. Unless otherwise specified, the continuous immersion method shall be used. However, the residual magnetism method may be used if the other is unavailable.

4. For induced magnetization with a bar, a brass bar shall be used.

(*d*) 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 will be those locations on a part which are subject to comparatively high vibratory stresses, while "unstressed" portions are those of 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.

1. For areas subject to low vibratory stresses ("unstressed").

a. Irregular heavy patterns having a length greater than 1/4 inch.

b. Straight heavy continuous indications following grain lines and having a length greater than one inch.

2. For areas subject to high vibratory stresses ("stressed").

a. Indications parallel (±45 degrees) to a "stressed" direction and having a length greater than 1/4 inch; also any indications located less than 1/16 inch apart in a transverse direction relative to a "stressed" direction.

b. Indications perpendicular (± 45 degrees) to a "stressed" direction.

c. REPAIR

(1) SCOPE.—Each propeller part which inspection has found damaged or worn must be replaced or repaired according to the following procedures. Certain parts, such as the distributor valve and distributor valve sleeve, must be replaced in matched pairs, if replacement of one is required. The propeller shall be considered satisfactory if it fulfills the test requirements of section VII and the clearance requirements as specified in the applicable clearance charts.

(2) HUB ASSEMBLY.

(*a*) GENERAL REPAIRS.

1. Those metal parts which are galled, nicked, or burred shall be carefully repaired with a fine stone and crocus cloth. Be very careful not to remove too much material, and yet to completely eliminate the damage. Clean up all threads with a suitable file or stone, and be sure to remove any sharp edges and burrs. Certain parts require more caution in repairing; the distributor valve and sleeve, the barrel and blade vanes, and the piston and cylinder are matched in pairs, and repair of one part may make the assembly unsatisfactory. These exceptions are noted in the following discussion.

2. It is good practice to replace all gaskets and seals unless they are in very good condition. Synthetic toroid seals should be satisfactory unless cut or stretched. Sometimes a distorted synthetic seal will regain its shape if boiled in water for a few minutes.

3. Replate all parts on which the plating is excessively damaged so as to interfere with the operation and protection of the propeller. Damaged painted surfaces shall be touched up with the proper type of paint.

(*b*) BARREL.

1. If the idler gear pin is loose, remove it being careful not to damage the barrel recess in which it fits. Then shrink in a new pin. If the pin is otherwise satisfactory, it shall be copper plated to obtain the desired fit.

2. If the distributor valve bushing is loose, the barrel shall be returned to the Contractor for repair. Field replacement shall not be attempted.

3. Cone seats showing wear on 20 percent or more of the area shall be resurfaced by grinding. The grinding shall be accomplished in such a way that the axis of the cone seat will be maintained coincident with the spline axis. This can best be accomplished with a fixture that centers on the sides of the splines. If, in order to resurface the cone seats properly, material must be removed to an extent that will make the cone seat gage length less than that shown as item 4 of the clearance chart, the barrel shall be scrapped.

(*c*) PUMP.

1. If a pump roller is worn so that the clearance specified in item 10 is exceeded, it shall be replated with silver to obtain the proper clearance. Plate only the surface which contacts the piston fork.

2. Replace any loose rivets in the return ring. Take care that the heads of each rivet do not project out of the sides of the return ring. Magnetically inspect the ring after repair.

3. If the pump bushings are damaged in such a way that the housing is not injured, they may be replaced according to the following procedure: pack the damaged bushing with dry ice and then when it has shrunk, press it carefully out of the housing. If the housing is damaged during this operation, it must be replaced. Pack the new replacement bushing with dry ice. When it has shrunk, insert it into the housing with a gasket between the bushing flange and the pump housing, and a synthetic toroid seal in the annulus at the outboard end of the bushing hole in the housing. Secure the bushing in place with two screws tightened evenly.

Note

The drain bushing is between arm wells Nos. 1 and 2. There is a locating pin to align the parts correctly. The strainer bushing is between the Nos. 2 and 3 arm wells with its tapped hole facing towards the pump center line. The high pressure relief valve bushing fits between arm wells Nos. 3 and 4 with its tapped port facing toward the pump center line. The de-icer bushing is located between arm wells Nos. 4 and 1.

(*d*) ECCENTRIC.

1. If the bearing cage does not retain the rollers, it may be repaired, if desired, by slightly bending the lugs on the ID of the cage.

2. If the cam track of the eccentric is worn locally beyond the clearance limits, the eccentric shall be replaced.

(*e*) THRUST RING.

1. Small scratches on the thrust ring bearing surface shall be repaired by lapping on a circular surface plate of the proper diameter. A perfect surface must be produced. Local repair shall not be attempted.

2. If the solder is damaged, it shall be carefully repaired. Use only soft solder.

(*f*) LUBRICATING VALVE & OFFSET CONTROL.

1. Replace any parts excessively worn. Do not confuse a loose fit with wear as the assembly, when detached from the barrel, is quite loose in its movement.

2. Make certain that the passage in the control rack is open.

(*g*) DISTRIBUTOR VALVE

1. No repair other than polishing with crocus cloth shall be made on the distributor valve. Each land on the valve is very carefully machined during manufacture. Take care to maintain the shape of the corners of the lands. Each valve is mated with a valve sleeve, and neither part of this pair shall ever be used without the other.

2. A bent valve or valve sleeve shall be replaced. No straightening of parts is permitted.

(*h*) VANE MOTOR.

1. Wear of the end plates shall be repaired by lapping the plates. Do not reduce the thickness of the plate to less than .245 inch.

2. The cover nut shall be replated with copper to maintain the clearance specified in item 13. Plate only the previously plated surfaces.

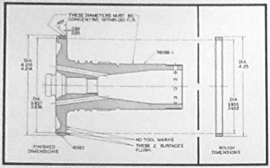


Figure 78—Repair of Center Post Thrust Ring

3. If the bronze ring on the center post is worn beyond the limiting clearance, it shall be repaired according to figure 78. The worn ring shall be carefully turned off. Extreme care must be taken not to damage the center post. Then heat the new ring uniformly and place in position. After the part has cooled to room temperature, machine the assembly to the dimensions shown.

4. Pull out the oil control pins and plate with copper to the desired fit if leakage past the pins is indicated during the test procedures of section VII. Replace and restake the pipe plugs.

(*i*) CONNECTING GEAR & STOPS.—If the bronze bushing on the connecting gear is excessively worn, it shall be repaired as shown in figure 79. The worn bushing shall be carefully turned off, using extreme care not to damage the connecting gear. Then shrink the new bushing into position, and machine it to the proper dimensions.

(3) BLADE ASSEMBLY.

(*a*) GENERAL REPAIRS.

1. Due to the construction of the blade, there shall be no buffing, filing, or mechanical working of the blade for any reason except as noted below.

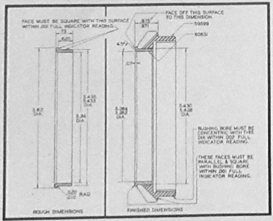


Figure 79—Repair of Connecting Gear Bushing

2. All nicks and abrasions shall be considered satisfactory unless the sponged synthetic rubber filler is exposed. Ordinary wear and abrasion on the leading edge will expose the copper fillet and shall be acceptable. Excessive abrasion shall be cause for replating of the blade. Consult the Contractor before attempting to replate.

3. If desired, raised edges of nicks and scratches may be carefully removed by the use of a coarse stone and fine emery *only*.

(b) PAINTING.—Carefully touch up minor damage to the painted surface. Blades requiring complete repainting shall first be stripped of the remaining paint and then painted according to the following procedure.

1. All surfaces to be repainted shall be thoroughly cleaned immediately before the application of the priming coat. Likewise, for the application of the two topcoats, care shall be taken that the preceding coat does not become soiled.

2. The blade shall receive a three-coat application: one priming coat and two topcoats. Mask those portions not to be painted by any appropriate method.

3. The primer shall be Black No. S-682A (made by the Zapon Division of Atlas Powder Corporation) or its equivalent. The priming coat shall be applied thinly. A heavy coat shall be avoided.

4. Allow the priming coat to set for at least 30 minutes at normal room temperature or a lesser time at elevated temperature in a dust-free atmosphere.

5. Apply the first topcoat so that it covers the priming coat uniformly and completely. The topcoat shall be a non-specular lacquer conforming to Specification No. AN-L-21 and thinned with cellulose nitrate thinner conforming to Specification No. AN-TT-T-256. They shall be thoroughly mixed before applying.

6. Allow the first topcoat to dry thoroughly and apply the second topcoat in a similar manner.

7. Unless otherwise specified, a warning stripe of non-specular orange-yellow paint shall be applied to both sides of the blade over one coat of primer if the surface is not already painted. The stripe shall extend from the tip to a point four inches from the tip for propellers 15 feet in diameter or less; and to a point six inches from the tip for propellers of larger diameter.

8. Unless otherwise specified, a stripe of non-specular orange-yellow paint shall be applied at the reference station on the face side of the blade. This stripe shall be $1/8 \pm 1/32$ inch wide and $2 \pm 1/4$ inches long. The stripe shall be perpendicular to the blade center line and centered on the surface.

9. The use of paint to obtain balance of the assembled propeller which has been previously balanced shall be permitted where facilities for propeller disassembly and balancing are not available. The operation of propellers which are painted while assembled shall be checked on an engine for smooth running and unbalance due to paint shall be corrected by adding paint as required.

10. The balance of separate painted blades shall be corrected by the use of paint only. All blades shall be balanced against a master blade. Where elevated temperatures are used to accelerate drying, balance shall not be attempted until the blades cool to approximately room temperature. The tolerance in the plus direction (blade heavier than master) shall be zero. The tolerance in the minus direction (blade lighter than master) shall be within the correction afforded by one balance washer installed on the balance plug.

(c) REPAIR OF BLADE BALANCING PLUG. —This plug is vulcanized in place and must be repaired by the Contractor. Return the blade to the Contractor through the proper channels.

(4) SPINNER ASSEMBLY.—Carefully smooth out all damage with fine emery cloth. Shallow dents shall be repaired by pounding out with a rubber mallet and a properly shaped block. Be sure the block gives support to all areas surrounding the dent. Replace loose rivets with oversize rivets in accordance with good aircraft sheet metal repair practice.

(5) CONTROL ASSEMBLY.

(a) GENERAL REPAIRS.

1. Those metal parts which are galled, nicked, or burred shall be carefully repaired with a fine stone and crocus cloth. Be very careful not to remove too much material, and yet to eliminate completely the damage. Clean up all threads with a suitable file or stone, and be sure to remove all sharp edges and burrs. Any exceptions are noted in the following discussion.

2. It is a good practice to replace all gaskets and seals unless they are in very good condition. Synthetic toroid seals should be satisfactory unless cut or stretched. Sometimes a distorted synthetic seal will regain its shape if boiled in water for a few minutes.

3. Replate all parts on which the plating is damaged so as to interfere with the operation and protection of the control. Painted surfaces that are damaged shall be touched up with the proper type of paint.

4. Repair or replace all damaged electrical wires. After repair, test each circuit for continuity.

(b) OTHER REPAIRS.

1. Replacement of the speeder rack bore liner shall not be attempted if it is worn beyond the clearance limit. The control shaft flanged bushing may be pressed out and a new one installed if it becomes excessively worn.

2. Repair of the magnetic units in the pitch transmitter shall not be attempted. Replace if damaged. Repair or replace any parts which cause the solenoid valves to stick or become inoperative.

3. Replace the auxiliary motor brushes if they are worn irregularly. Clean the commutator and check for freedom of movement. If the field or armature is damaged, the auxiliary motor shall be overhauled by an electrical repair depot.

4. If the rotating seal is scratched or nicked, it shall be lapped on a surface plate to obtain a perfect surface. The thickness shall not be reduced below the minimum specified in item 13 of the applicable control chart. If the seal is cracked, it shall be replaced as an assembly.

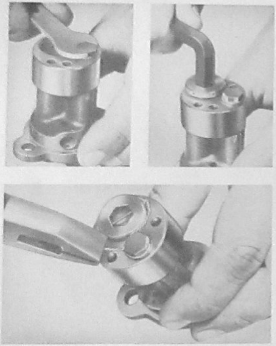


Figure 80—Installing and Safetying Check Valve Plug and Piston Plug Into Cylinder

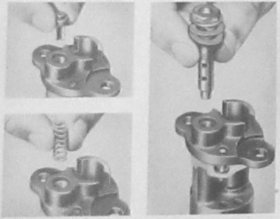


Figure 81—Installing High Pressure Check Valve Plunger, Spring, and Manifold Bolt

4. REASSEMBLY.

a. GENERAL.

(1) The following assembly procedure for the *Super*-Hydromatic propeller is planned so that first the subassemblies are reassembled, and tested if necessary. Then the complete assembly is put together. The propeller is comprised of two units: the hub & blades assembly, and the control assembly.

(2) All parts should be thoroughly cleaned. A film of propeller oil should be spread on the contacting surfaces of the parts. It is assumed that the parts have been carefully inspected, and that any damaged parts have been repaired or replaced.

(3) The model described has all of the control subassemblies that are possible to use. Certain models do not incorporate all of the features and, therefore, have cover plates instead of the pertinent subassemblies.

b. ASSEMBLY OF HUB & BLADES ASSEMBLY.

(1) ASSEMBLY OF PUMP ASSEMBLY.—The pump assembly can be separated into interchangeable subassemblies for convenience in handling during final assembly. These subassemblies include a housing, eight in-

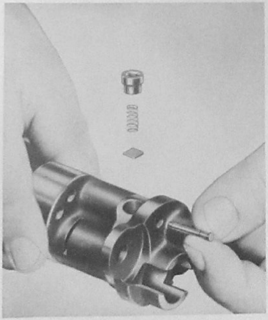


Figure 82—Assembling Low Pressure Check Valve—Composite View

dividual pumps, a high pressure manifold, a high pressure relief valve, a strainer bolt, attaching bolts, a sump relief valve, and a return ring.

(a) First, assemble the individual pumps.

1. Insert the small check valve plug and the larger piston plug into the end of the cylinder and tighten them securely. This piston plug should be installed after the check valve plug so that the latter can be properly tightened. Safety the two plugs together with wire.

2. Drop the fluted check valve plunger into the high pressure chamber followed by a spring. The parts should be installed so that the flutes project into the end of the chamber with the spring behind the plunger. Insert the manifold bolt with its two copper gaskets over the spring to retain the spring and plunger in position. Do not tighten this bolt as it will be removed later when the high pressure manifold is installed.

3. Drop the small square micarta disc into the first-stage check valve chamber making sure it lies flat on its seat. The spring should be placed over the disc and retained in position by an aluminum plug. Care should be taken that the spring does not become cocked in the chamber during installation of the retainer. A brass pin is inserted through the cylinder over the aluminum retainer to lock all parts of the check valve in place. Slightly bending the end of the pin prevents it from backing out.

(b) Place a copper gasket over the two attaching screws in each cylinder flange recess. Install a completed cylinder assembly into each cylinder bore of the pump so that the piston chamber faces toward the outboard side of the pump and the check valve chamber lies toward the inboard side of the pump. It is good practice to install each cylinder in its original bore. In some cases the cylinder may be a light drive fit in the housing and use of the pump cylinder hammer will facilitate seating it. Lock the cylinder assembly into position with two self-locking nuts screwed onto the studs.

(c) Place the pump with its outboard side down and remove the manifold bolts from the cylinders. Lay the high pressure manifold in place so that the open gap falls between arm wells Nos. 1 and 4. The high pressure manifold is a brazed ring assembly and no attempt should be made to disassemble it. Carefully aligning the manifold with the cylinders, insert the thick copper spacer behind the manifold where it joins the high pressure relief valve bushing and insert a short manifold bolt with a copper gasket to attach the parts. Insert a similar bolt with gasket and spacer at the strainer bushing. Screw the eight cylinder manifold bolts into position placing a copper gasket behind and in front of each connection of the manifold with the cylinder. Then tighten all the manifold bolts snugly. Safety the bolts with lock wire as shown.

(d) Insert a piston into each cylinder making sure that the serial number appearing on the piston head corresponds with the serial number etched on the end of the cylinder. Lay the return ring assembly in the piston forks. This can be most easily done by first collapsing the ring, then expanding the ring when it is placed inside the pump and between the piston forks. Care should be taken to insure that the forked end of each segment of the return ring will follow through the piston fork last when the pump rotates in the direction specified for the installation. On a clockwise rotation propeller, the return ring also travels in the clockwise direction.

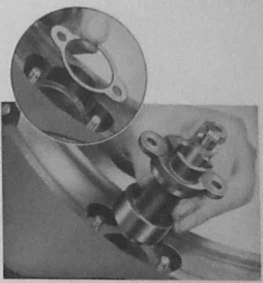


Figure 83—Installing Gasket and Cylinder Assembly Into Housing

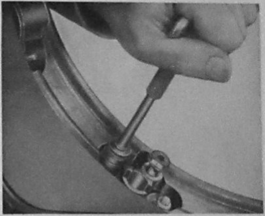


Figure 84—Tightening Self-Locking Nuts Onto Cylinder Studs

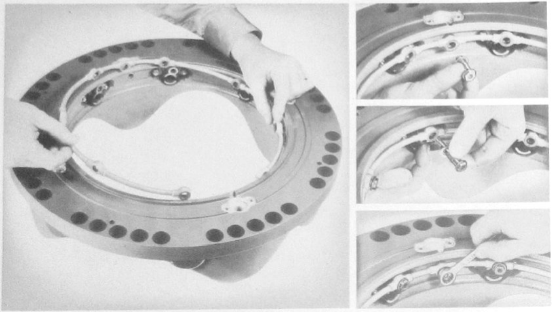


Figure 85—Installing High Pressure Manifold Onto Pump Housing

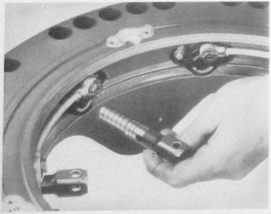


Figure 86—Inserting Piston Into Cylinder

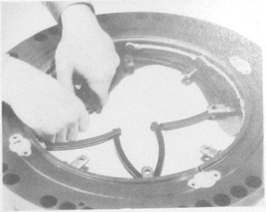


Figure 87—Installing Return Ring

(e) The pump rollers are most easily assembled by inserting eight or nine bearing needles in the outer race, then placing the inner race over these needles, and inserting the remaining needles. Place each roller assembly into the fork from which it was removed, and insert a roller shaft through the fork and roller from the inboard side of the pump. This puts the head of the roller shaft on the inboard side of the pump. Install a star lock washer on the end of each shaft and lock the assembly together with the hex nut. Bend two prongs of the star washer over the nut to safety the parts in position.

(f) To assemble the sump relief valve, drop the check ball into the valve housing so that it seats itself. A seat can be insured by sharply tapping the ball in the housing with a soft drift. After placing the spring over the check ball, install the screw over the housing and lock

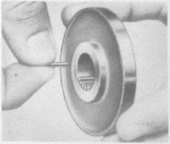


Figure 88—Placing Bearing Needles Into Pump Roller

Figure 89—Inserting Inner Race Into Roller

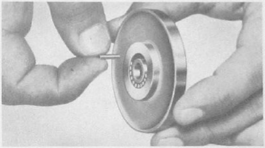


Figure 90—Inserting Remaining Bearing Needles

it in position with a small steel pin through the aligning holes in the housing and screw. Place a copper gasket onto the valve and slip a synthetic toroid seal over the end of the valve. The assembled sump relief valve should then be installed into the end of the drain bushing of the pump assembly and safetied with wire.

(*g*) Insertion of the filler plug and gasket completes the pump assembly. On spinner installations, the filler plug is replaced by an oil filler assembly.

(*h*) To assemble the high pressure valve assembly, place a small toroid seal over the end of the valve stem. After installing a spacer ring over the stem and onto the conical valve, these parts should be inserted into the bolt. Insert the valve spring into the bolt and over the valve stem. Place the plug with gasket and required shims into the bolt, compressing the spring at the same time. Place the two toroid seals in position on the bolt. The valve should be tested according to section VII prior to its assembly into the hub.

Figure 91—Installing Roller Assembly Into Piston Forks

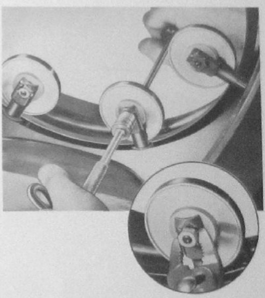


Figure 92—Tightening and Safetying Pump Roller Shaft Nut

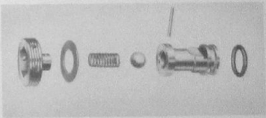


Figure 93—Assembling Sump Relief Valve Assembly—Composite View

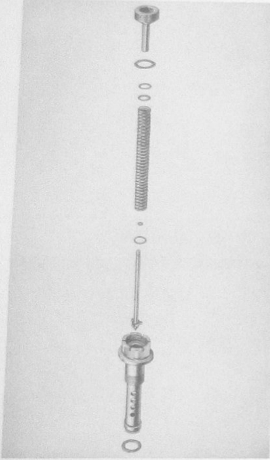


Figure 94—Assembling High Pressure Relief Valve Assembly—Composite View

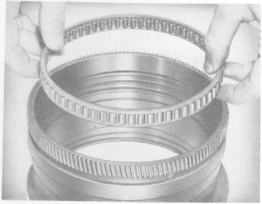


Figure 95—Installing Bearings Into Eccentric

Figure 96—Placing Governor Drive Gear Inside Eccentric

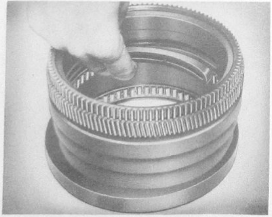


Figure 97—Inserting Thrust Segments

(2) ASSEMBLY OF ECCENTRIC ASSEMBLY.

(a) Insert the bearing rollers into their brass cages and coat the assemblies with a light grease to prevent the rollers from falling out. Press the rollers in, i.e., so that the outside diameter of the bearing assembly will be the smallest possible, and install the assembly into the eccentric. Once into position, the bearings are retained there by pushing the individual rollers out against the eccentric wall so that the inside diameter of the bearings is as large as possible.

(b) Place the governor drive gear inside the eccentric and insert the three thrust segments. This will hold the governor drive gear and eccentric together.

(c) Leave the assembly with its end down until ready for assembling onto the barrel.

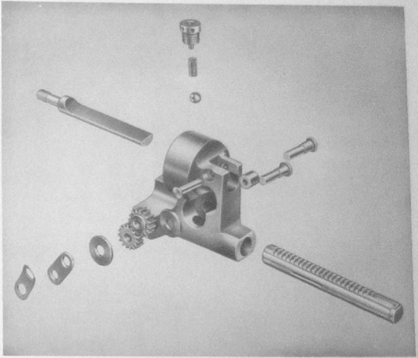


Figure 98—Assembly of Offset Control Assembly—Composite View

(3) ASSEMBLY OF LUBRICATING VALVE & OFFSET CONTROL ASSEMBLY.

(a) Drop the lubricating valve ball into the hole and tap lightly with a soft drift to seat. Place the spring on top of the ball and screw the retaining plug into the housing. Safety the plug with a cotter pin.

(b) Drive the two gear shafts into the housing with the small end extending through the gear pockets. Slip the extension rack roller into the slotted end of the housing and push the roller shaft through its slot in the housing and over the roller with the small end facing the opposite from the gear shafts. Safety the shaft with a cotter pin. Drop a nitrided washer over the control rack gear shaft (nearer to the valve nozzle). Push in the control rack with the self-lubricating plug in its end facing opposite the flat mounting surface of the housing. Slide the control rack gear (with no shoulders) over the shaft and mesh it with the rack. The gear will rest against the washer. Slide the extension rack into its slot with the flat side against the roller and the threaded end facing the housing mounting surface.

(c) With the non-threaded end of the extension rack held .585-.610 inch from the end of the button in the control rack, push the extension rack gear (with shoulders) over its shaft and mesh it with its rack and the other gear. Place the other nitrided washer on top of the control rack gear. Drop the shaft centering washer over the two gear shafts and put the gear retaining spring on top of the washer with the center of the spring bearing against the washer. Safety the two gear shafts with cotter pins.

(d) Test the lubricating valve according to section VII. Check the racks for freedom of movement.

(4) ASSEMBLY OF VANE MOTOR ASSEMBLY.

(a) At the bottom face of the center post base there are four holes, each hole connecting with either a high or low pitch oil groove cross hole. The two holes nearest the dowel bushings are identified by the letters "L-L" and the other two are identified by letters "R-R". With a brass drift, drive and seat two steel oil control pins into either set of holes depending upon propeller rotation.

1. For a right-hand tractor propeller on a right-hand engine, the posts are plugged "R-R".

2. The posts on a right-hand pusher propeller mounted on a left-hand engine are plugged "R-R".

3. For a left-hand tractor propeller on a left-hand engine, the posts are plugged "L-L".

4. The posts on a left-hand pusher propeller mounted on a right-hand engine are plugged "L-L".

(b) Into each one of these four holes, insert a hollow head pipe plug to seal off internal oil pressure. Sufficient force is to be applied to the plug to insure an

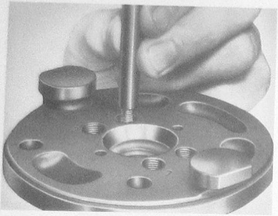


Figure 99—Inserting Oil Control Pin

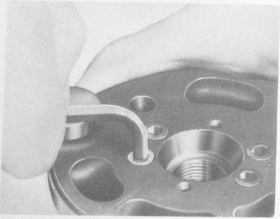


Figure 100—Inserting Pipe Plug

oiltight fit. The four pipe plugs should be flush with or below the bottom, and then staked in position. If they protrude above the surface, they should be filed off smooth. The two plugs in the vane motor covering closed oil passages (either "R-R" or "L-L") should be stamped with a line for identification.

(c) Place a small toroid seal, to prevent leakage past the dowels, on each dowel bushing.

(d) The two lower seals for the center post have a slightly larger diameter than the upper seal and are installed first. To facilitate placing and seating of seals, they may be stretched slightly. When in position, seals should not be twisted and should be able to turn in their grooves with a slight force. Lay the strip seals in the slots on the fins of the barrel and blade vanes.

(e) Hold the barrel vane with its oil ports down, and with the wide spline properly located, guide it into the blade vane taking care that the strip seals are not cut in the process. The fins should be approximately 90 degrees from each other to facilitate assembly. The assembly should then be turned over and the bronze bottom end plate placed in position such that its flat surface bears against the fins. The bottom end plate can be identified by its larger ID when compared with the top end plate. Place the gasket spring over the plate and the gasket on the spring. Center the parts carefully about the plate.

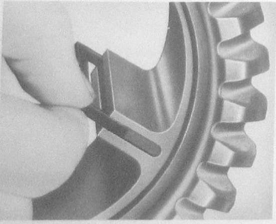


Figure 101—Installing Strip Seals on Blade Vane

Figure 102—Installing Barrel Vane Into Blade Vane

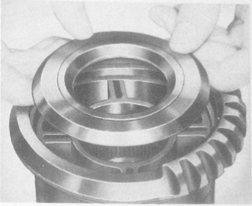


Figure 103—Installing Bottom End Plate on Blade Vane

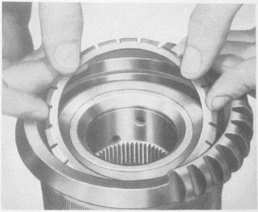


Figure 104—Installing End Plate Gasket Spring

(*f*) Pick up the assembly, holding all parts in their relative positions, and slip it over the center post so that the fins of the barrel vane lie along the center line of the center post lugs, and the gear segment on the blade vane is positioned 180 degrees from the dowel bushings. The wide tooth on the inner splines of the barrel vane should mesh with the blank space in the splines of the center post when assembled in the above position. Seat the barrel vane on the center post by hammering down on the upper end of the vane with a drift which will not mar the surface. Place the top end plate over the post with the flat side bearing against the fins. Center the gasket with its spring over the plate and press it between the plate and wall of the blade vane. Fit the cover nut seal over the center post threads and down against the top end plate. The cover nut should be turned onto the threads and tightened with a torque of 100 to 125 pound-feet using the cover nut wrench until a hole in the nut is aligned with one of the corresponding holes in the top of the center post. A clevis pin is then inserted through the post and cover plate and safetied with a cotter pin.

Figure 105—Installing End Plate Gasket

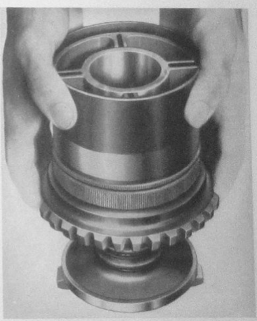


Figure 106—Installing Barrel and Blade Vane Assembly Over Center Post

(*g*) Slip the micro-adjustment ring over the splines of the blade vane so that the scribe mark on the top of the micro-adjustment ring is aligned with the "0" graduation mark on the blade vane. Safety it with a snap ring placed around the blade vane and above the micro-adjustment ring. The jack-screw assembly is assembled as a separate unit being interchangeable with any vane motor assembly.

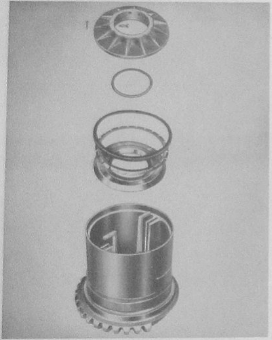


Figure 107—Installing Top End Plate Seals and Cover Nut—Composite View

Figure 108—Installing Micro-Adjustment Ring

Figure 109—Installing Micro-Adjustment Ring Snap Ring

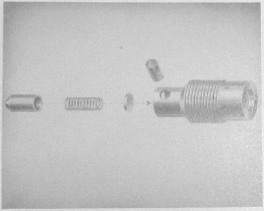


Figure 110—Assembling Vane Motor Jack-Screw—Composite View

(b) To assemble the jack-screw, drop the small steel washer into the well of the screw housing. Place the spring with the plunger onto the washer and push the latch through the side hole of the screw until it snaps into position, thus holding the assembly together and acting as a lock for the jack-screw in the vane motor. This assembly can now be installed.

(i) Oil test the vane motor as in section VII.

(5) ASSEMBLY OF OFFSET CONTROL TO BARREL.

(a) Lift the barrel, and while it is suspended, insert the assembly sleeve in the splines. Lock it in position with the front cone and retaining nut. Tighten the retaining nut by hand so that the sleeve is firmly held. Turn the barrel upside down and lower the assembly over the

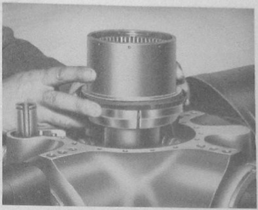


Figure 111—Installing Retaining Nut Group

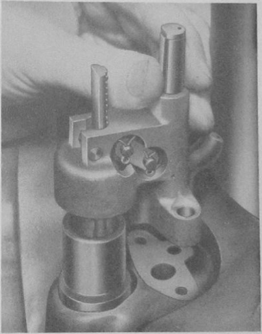


Figure 112—Installing Lubricating Valve & Offset Control to Barrel

post, placing the retaining nut wrench as a spacer between the post base and the barrel.

(b) Place the lubricating valve strainer and gasket over the pad of the barrel adjacent to the distributor valve bushing. The shape prevents misalignment.

(c) Slide the lubricating valve & offset control over the distributor valve bushing onto the pad and secure it in place with two screws. Safety the screws together.

(6) ASSEMBLY OF PUMP TO BARREL.

(a) Coat the outer edge of the pump to hub sealing surface with light grease. A similar coating of grease is given to the mating surface on the barrel. The synthetic rubber pump & hub seal is placed onto the pump surface and is pressed firmly in place with the fingers. Clean off all excess grease around the seal. Into the annulus of each web of the barrel place a toroid seal.

(b) Lay the pump assembly down over the barrel so that the blade wells will match the corresponding barrel arms; i.e., No. 1 well will be over No. 1 arm, etc. Check the position of the seal to make sure it lies in its correct place. Insert the pump bolts, with a seal under the head of each bolt, into the barrel webs so that they are placed in the following positions.

1. Install the pump drain bolt between No. 1 and No. 2 blade arms.

2. Install the pump strainer bolt assembly between No. 2 and No. 3 blade arms.

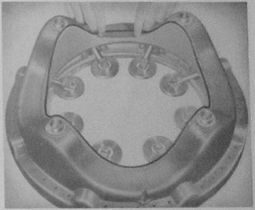


Figure 113—Installing Pump and Hub Seal Onto Pump

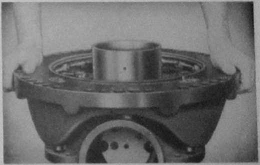


Figure 114—Placing Pump Assembly Onto Barrel

3. Install the high pressure relief valve bolt assembly between No. 3 and No. 4 blade arms.

4. Install the pump retaining bolt or de-icer bolt between No. 4 and No. 1 blade arms.

Note

Tighten each bolt evenly with a torque of 50-55 pound-feet. This is more easily accomplished when the hub is turned outboard side up. At this point, it is satisfactory to tighten the bolts only so snugly as to prevent the pump & hub seal from being displaced.

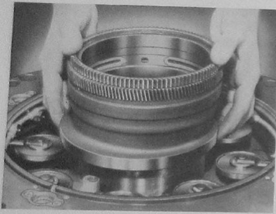


Figure 115—Lining Up Locking Pin Holes

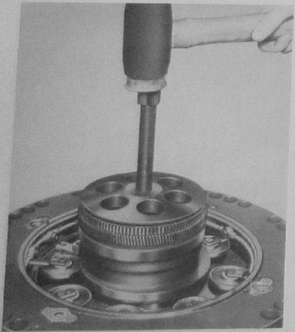


Figure 116—Installing Eccentric Assembly With Tool

(7) ASSEMBLY OF ECCENTRIC TO BARREL.

(a) The governor drive gear is a light drive fit over the barrel boss and, with the eccentric assembly, is driven onto the barrel boss taking care that the eccentric engages with each pump roller. To assure that the governor drive gear is driven on squarely, the eccentric remover plate and bolt may be used to knock the assembly into place. The locking pin hole in the hub boss and the slot in the governor drive gear must be lined up before starting to drive on the assembly. The bevel on the end of the eccentric should guide the rollers onto the cam surface. As it enters the rollers, the eccentric should be rotated by hand, while at the same time the governor drive gear should be driven into position. This will prevent binding and damaging of the rollers. Be very careful not to catch any roller. The governor drive gear is driven down until its back face is flush with the back of the barrel boss.

(b) Lock the entire eccentric assembly to the barrel with the lock pin assembly inserted from the inside of the barrel. If proper procedure was used in installing the eccentric, the pin will be a light drive fit into the barrel and governor drive gear.

(8) ASSEMBLY OF VANE MOTORS INTO BLADES.

(a) Slide the chevron type blade packings (if used) over the blade butt so that the follower ring of the blade packing is installed on the blade shank first with the open end of the "V" facing toward the blade butt. Two chevron type packing rings are then installed facing the same direction and the header ring is installed last.

(b) On installations incorporating the threaded type barrel arms, a toroid packing is used instead of the chevron type and the procedure differs slightly. Place the

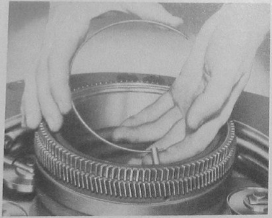


Figure 117—Installing Lock Pin Assembly

retaining sleeve (for spinner installations) or the packing nut (for non-spinner installations) and then the lock washer over the blade shank so that the threaded portion of the nut faces towards the blade butt. Slip the large toroid packing over the shank.

(c) Install the vane motor into the blade as follows, according to the type of installation specified: For a tractor propeller on a right-hand engine the blade vanes have the etched line on the base aligned with the arrow stamped "trailing" on the blade butts. For a pusher propeller on a left-hand engine the blade vanes have the etched line on their base aligned with the arrow stamped "face" on the blade butts. For a tractor propeller on a left-hand engine the blade vanes have the etched line on their base aligned with the arrow stamped "trailing" on the blade butts. For a pusher propeller on a right-hand engine the blade vanes have the etched line on their base aligned with the arrow stamped "face" on the blade butts.

(d) Each blade should be electrically etched on the bevel face of the butt with the number corresponding to the number on the barrel arm into which it is to be assembled. The vane motor assembly of that blade should also be electrically etched on the bevel face of the blade vane 180 degrees away from the gear segment with the number corresponding to the number on the blade to which it is assembled, and the micro-adjustment ring on the vane motor should be similarly marked.

(e) If the vane motor is tight, the vane motor hammer may be used to tap it into position. Then install the jack-screw so that it does not protrude beyond the bottom face of the vane motor.

(9) ASSEMBLY OF BLADES INTO HUB.

(a) Carefully lift the hub and sleeve off the assembly post and turn this assembly over, removing the retaining nut wrench from the post. Replace the hub on the post in its normal position (outboard side up).

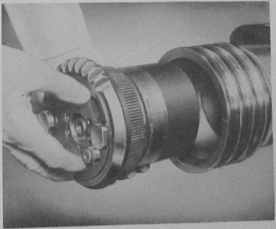


Figure 118—Installing Vane Motor Into Blade

(b) Lift each blade into its corresponding arm bore, i.e., No. 1 blade into No. 1 arm bore, etc. and work the blade in slowly making sure that the torque lugs and oil transfer dowels seat properly in the matching holes in the bottom of the barrel arm. Push the blade toward the barrel as far as it will go and insert the bearing balls into the outer race only. It is essential that each retention race holds exactly 46 balls. Loading of the balls is best done using the loading tool which holds the proper number of balls.

(c) Pull each blade by hand into the "running" position. This places the balls into the running race, rather than the loading race.

(10) CHECKING BLADE ANGLES.

Note

The blade reference station is the 42-inch station of blades having a basic diameter of 14 feet or less and the 72-inch station of blades having a

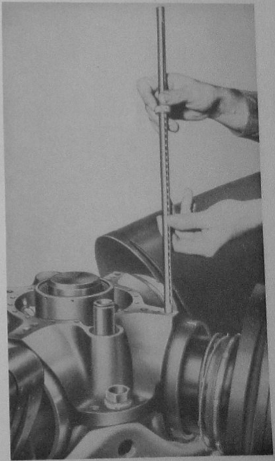


Figure 119—Loading Blade Retention Races

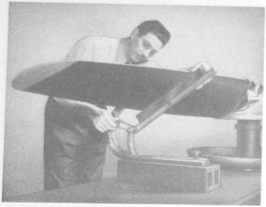


Figure 120—Setting Blade Angles

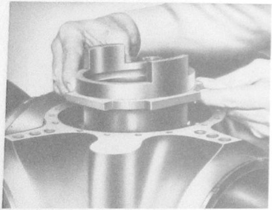


Figure 121—Installing Stop Sleeve

Note—Continued

basic diameter greater than 14 feet. In the assembled 4260 propeller, the reference station is 42-7/16 or 72-7/16 inches from the hub center line.

(a) Set each blade to the specified angle 60 degrees below the high angle of the pitch range. Currently, there are three pitch ranges used: —25 to +95 degrees, —28 to +92 degrees, and —31 to +89 degrees. For the following discussion it is assumed that the —25 to +95 degrees range is used, and in this case the specified angle is 35 degrees.

(b) Install the stop sleeve over the retaining nut, locating it by means of the pin on the sleeve and the matching hole in the barrel. Slide the blade connecting gear over the stop sleeve such that the 35-degree graduation mark on the connecting gear is aligned with the scribe mark on the front face of the barrel 180 degrees from the distributor valve bushing. Assemble the low pitch stop in the splines of the connecting gear. With the specified blade angle graduation set on the blank tooth of the gear, the specified stop angle is visible from the front face of the barrel. Assemble the high pitch stop in the splines of the connecting gear to the specified high blade angle which is set at the blank tooth of the connecting gear.

Note

The low pitch mechanical stop ring should be set one degree below the lowest hydraulic stop setting. The high pitch mechanical stop ring should be set five degrees above the highest hydraulic stop setting if possible, but at least one degree above.

(c) Place two preload shims of [illegible] inch each over the connecting gear. This will assist in the preload

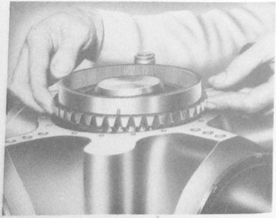


Figure 122—Installing Blade Connecting Gear

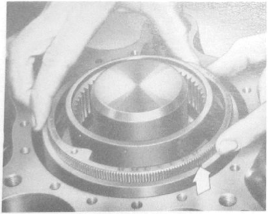


Figure 123—Assembling Low Pitch Stop

check. Set the cam drive gear over the connecting gear so that the "0" graduation on the drive gear meshes with the wedge pin in the connecting gear at the 35-degree marking. Then install the cover plate gasket and the preload fixture (shown in figure 131). Secure the fixture with four screws tightened evenly. This applies a load on the blades holding them firmly in place. Shake each blade at the tip to insure seating. Each blade in turn for twice around the propeller should be shaken.

(*d*) Check the blade angle again at the reference station. With one blade set at 35 degrees, the other blades must be within 0.1 degree of this setting. If the blade angles are unequal, remove the incorrectly set blades and adjust the vane motors.

(*e*) To remove the blades, detach the preload fixture, lift out the connecting gear and stops, and push the blades in so that the balls are located in the loading races. Using a small diameter rod through the packing cavity, shift the balls so that they may be removed through the loading holes with a magnetic rod or screw driver. Then pull out the blades.

(*f*) To adjust the blades, remove the snap ring which locks the micro-adjustment ring in position. Slide the ring off the teeth. Turn it toward "A" (marked on the vane motor) to decrease or toward "B" to increase blade angle for right-hand rotation propellers. Adjustments in 2-tooth increments indexes the blade in .05-degree steps. Indexing an odd number of teeth results in a setting approximately 1-1/2 degrees more than intended. Adjustments to a maximum of 3 degrees may be obtained in turning the micro-adjustment ring through 720 degrees. Reinstall the vane motor into the blade.

(*g*) Install the blades again and load the four races in each blade. Place each blade packing into the space between the barrel arms and the blade shank and seat it evenly and carefully by tapping with a brass rod.

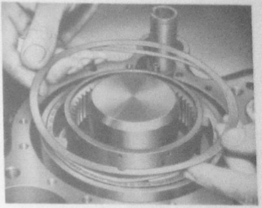


Figure 125—Installing Preload Shims

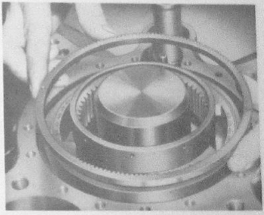


Figure 126—Installing Cam Drive Gear

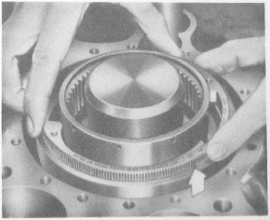


Figure 124—Assembling High Pitch Stop

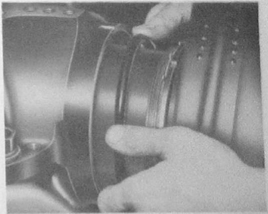


Figure 127—Installing Blade Packing

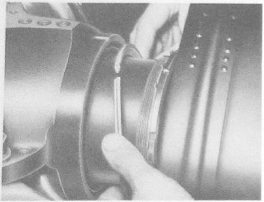


Figure 128—Inserting Blade Packing Washer

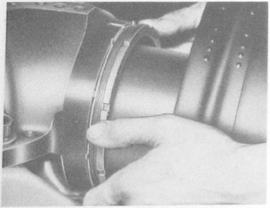


Figure 129—Tightening Blade Packing Nut

Insert the packing washer. The chevron type blade packing is held in position by a packing washer placed outside of the blade packing and held with the two-piece blade packing retaining ring inserted into the groove of each barrel arm bore. On threaded arm installations, seat the toroid packing, followed by the two-piece packing washer, and screw into each arm socket the spinner sleeve with tab lock washer. On installations not requiring the spinner, use a packing nut with the tab type lock washer which is placed between the nut and the barrel and tighten the nut securely. Lock the nut by bending the tabs into the barrel slot and the nut slots.

(h) Remove the retaining nut and front cone. Lift the hub assembly far enough above the assembly sleeve to clear the tapped holes in the barrel spline. Turn the jack-screw in the base of the vane motor in an anticlockwise direction and force the blade outward in the barrel arm until the balls fall in their running raceways. Apply a torque of 15 ± 1 pound-feet to the jack-screw.

(i) The pipe plug is screwed into each tapped hole of the barrel in back of the jack-screw to seal barrel oil from the engine shaft. Lower the propeller onto the sleeve and reassemble the front cone and retaining nut with the retaining nut packing and retainer lying between the cone and the shoulder of the nut. Tighten the retaining nut on the sleeve.

(11) CHECKING PRELOAD.

(a) Set the blades at 35 degrees and install the connecting gear with the stops and the preload fixture as before.

(b) With a depth micrometer measure the distance from the top of the preload fixture to the cam drive gear through the holes in the fixture. The lowest reading is used in the calculation. For example, assume a reading of 1.050 inch. Measure the distance from the bottom

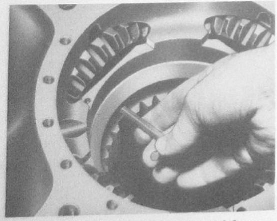


Figure 130—Tightening Vane Motor Jack-Screw

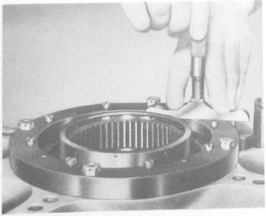


Figure 131—Measuring Preload Depth

flange of the cover plate to the gasket sealing surface. Add this dimension (for example, .378 inch) to the thickness of the preload fixture upper flange (.700 inch). (This fixture dimension is etched on the OD of the flange.) Subtract the micrometer reading (1.050 inch) from the combined fixture and cover plate dimension (1.078 inch). This is the test preload in the hub. Now subtract this value (.028 inch) from the thickness of shims already present (.040 inch). This value (.012 inch) is the amount above zero preload. Add the specified interference value (.002 ± .003 inch) to the last dimension to obtain the thickness in shims required. Use the minimum number of shims to add up to this value. These shims range in thickness from .005 to .020 inch.

Example:

Cover Plate	.378
Preload Fixture	.700
Combined Value	1.078
Micrometer Reading	1.050
Test Preload	.028
Shim Thickness Present	.040
Test Preload	.028
Zero Preload	.012
Specified Interference	.002 ± .003
Shim Thickness Required	.014 ± .003

(*c*) Remove the preload fixture and the cam drive gear. Install the required amount of shims, and replace the cam drive gear.

(12) ASSEMBLY OF DISTRIBUTOR VALVE INTO HUB.

(*a*) Drop a washer over the slotted end of the valve onto the shoulder. Seat the spring over the valve onto the washer, and assemble the lock over the spring. To attach the parts, align the pin holes in the lock with the slot in the valve and insert a pin through the holes. Push the valve into the valve sleeve, thereby compressing the spring and allowing the cam pin with its roller to be inserted through the sleeve lug, locking the valve assembly through the sleeve. The cam roller must be sufficiently loose to rotate freely. Remember that the distributor valve must be paired with the distributor valve sleeve having the same serial number.

Figure 133—Installing Distributor Valve Assembly and Cam Into Hub

(*b*) Place the cam over the valve assembly with the cam roller in the slot, and insert the distributor valve assembly into the distributor valve bushing so that the drive lug on the sleeve enters the slot. Secure the valve in position, turning the valve onto the extension rack of the offset control using the distributor valve gage as a wrench; then turn the valve cam down over the bushing until it bottoms on the bushing shoulder. Align the scribe mark on the upper end of the valve cam with the scribe mark on the top of the valve bushing, make sure that the

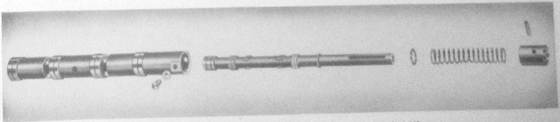


Figure 132—Assembly of Distributor Valve—Composite View

blades are at 35 degrees, and install the idler gear onto its pin, meshing it with both the cam drive gear and the valve cam. Fasten the snap ring onto the bushing and over the valve cam, locking the cam in place.

(c) The distance from the top of the distributor valve cam to the top of the distributor valve sleeve should be adjusted to .729 ± .0015 inch. This dimension is checked by means of the valve sleeve gage, or by a depth micrometer. This adjustment is obtained by indexing the cam drive gear in either direction from the wedge pin on the connecting gear assembly. Markings on the cam drive gear represent actual change in the height of the distributor valve sleeve in increments of .001 inch. A negative setting of one tooth will lower the height of the sleeve lug .002 inch from its original position.

(13) COMPLETING THE ASSEMBLY.

(a) Place the cover plate with gasket into position, and draw it down with the 16 screws and spacers, tightening each screw evenly. Safety the screws in pairs. Install and safety the loading hole cover plates. Install the distributor valve cap with its seal. It is not necessary to safety the cap until after installation.

(b) It is suggested that the hub & blades assembly be suspended or put back on the assembly post with the rear of the pump facing the operator. To install the thrust ring, place the synthetic toroid seal around the OD of the ring plate. Align the slots in the flange with

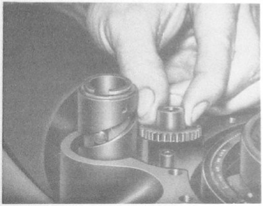


Figure 134—Installing Idler Gear Into Position

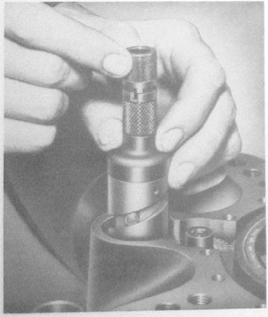


Figure 135—Checking Distributor Valve Sleeve Setting

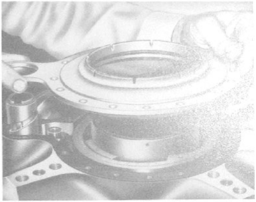


Figure 136—Installing Cover Plate

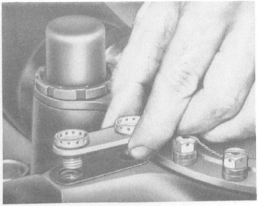


Figure 137—Installing Loading Hole Cover Plate

the threaded holes in the pump housing and press the assembly onto the back of the pump assembly so that the seal will fit into the matching groove. This fit of seal into groove can be facilitated by "feeding" the seal into the groove with the aid of a screw driver. The extension rack extends into the thimble-like cup. Insert the eight retaining screws into the slots of the flange and into the pump housing. Safety the screws with lock wire.

(14) CHECKING BLADE TRACK.—This is more easily accomplished before installing the thrust ring while the assembly is on the assembly post. Rotate the hub & blades assembly so that the blade tips pass closely by a fixed point. The tips shall track within 1/2 inch of each other.

(15) BALANCING THE ASSEMBLY.

(a) The complete hub & blades assembly (minus the spinner, but including the spinner mounting tubes and oil filler pipe) shall be statically balanced with the assembly centered on its cone seats and mounted with the plane of the blades horizontal on an approved balancing machine having a sensitivity of 0.25 ounce-inch per 100 pounds of hub weight. Final balance shall be obtained by adding lead washers in holes on the outer edge of the pump housing.

(b) Balancing shall be performed with the sump full of oil, and with the blades set at 35 degrees. In addition, a balance weight shall be attached to the eccentric at a point 180 degrees from the highest point of the eccentric. This weight is 1.68 pounds.

Note

Since the sump must be completely full of oil during the balancing procedure, it is more convenient to balance after testing of the assembly. At that time the assembly will be full.

(c) If the horizontal balancing machine is not available, the vertical balance procedure using accurate knife edges shall be accomplished. The hub & blades assembly shall be considered to be in balance if it shows no persistent tendency to rotate, or if rotation can be stopped or reversed by the application of a moment of .0005 inch times the weight of the assembly.

c. ASSEMBLY OF CONTROL ASSEMBLY.—The control consists of 10 subassemblies, nine of which mount onto the control support assembly, which in turn mounts about the propeller shaft onto the engine nose.

(1) ASSEMBLY OF GOVERNOR HEAD ASSEMBLY.

(a) Install the thrust washers on each side of the gear on the control shaft with the chamfers adjacent to the gear. Assemble the shaft into the head and install the end cover bushing. The end cover is next installed; three fillister head screws hold it in place and these are safetied. Place the synthetic oil seal over the opposite end of the shaft with the groove facing into the head and over this fits the pulley inner washer.

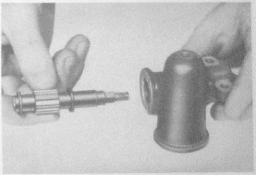


Figure 139—Installing Control Shaft and Thrust Washers

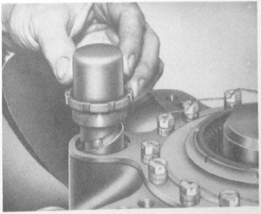


Figure 138—Installing Distributor Valve Cap

Figure 140—Inserting End Cover Bushing

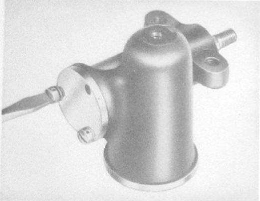


Figure 141—Tightening End Cover Plate

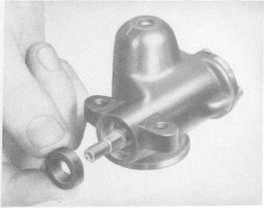


Figure 142—Installing Control Shaft Oil Seal

(b) Insert the cable clamp into the slot in the pulley and secure it by means of its screw and nut. The stop pin, washer, and nut are assembled into the stop pin hole designated for the installation. The stop pin extends through the pulley on the side opposite the index numbers. Assemble the pulley insert into the control pulley with the indicator line on the insert lining up with the specified groove in the pulley. Install the pulley assembly on the shaft with the indicator line on the insert matching the line on the end of the shaft. Next fit the pulley outer washer against the pulley and secure the pulley assembly to the shaft with the self-locking nut.

(c) Snap the lock spring into the groove on the balancing spring lock nut. Fit the adjustment screw through the rack, place the balancing spring into the rack opening, and turn the screw partially into the lock nut, compressing the spring. The compression of this spring is adjusted while setting the balancing rpm. Screw the plug with its locking washer into the top of the head.

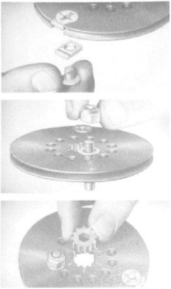


Figure 143—Attaching Cable Clamp, Stop Pin, and Insert

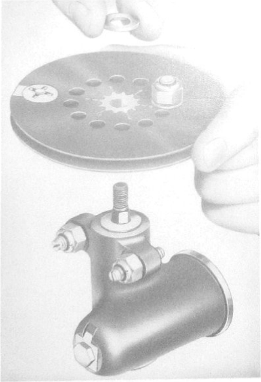


Figure 144—Installing Pulley Assembly

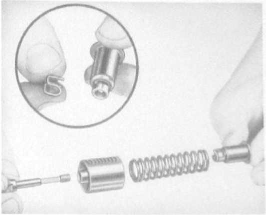


Figure 145—Assembling Speeder Rack and Balancing Spring—Composite View

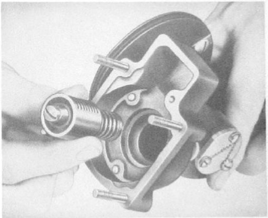


Figure 146—Installing Speeder Rack and Balancing Spring Group

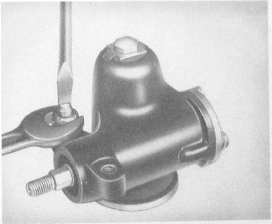


Figure 147—Installing RPM Adjustment Screw

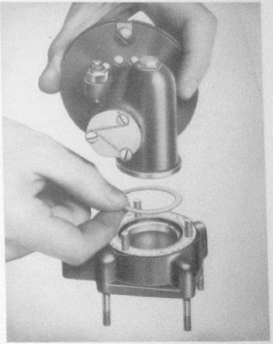


Figure 148—Assembling Head Onto Subhead

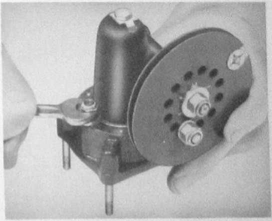


Figure 149—Tightening Head to Subhead

(*d*) Fit the rack assembly into the head with the double tooth on the end of the rack meshing with the blank tooth of the control shaft gear. The rack should slide freely when the pulley is rotated. Screw the two self-locking nuts onto the high and low rpm adjustment screws, and turn the screws into the supporting bosses. These screws are adjusted during governor tests.

(*e*) Assemble the head assembly to the subhead, positioning the indicator mark on the head with respect

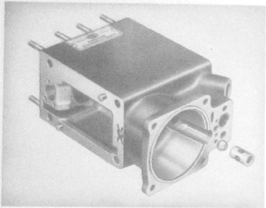


Figure 150—Installing Sump Check Valve

to the subhead dial graduations as specified. Clamp washers and self-locking nuts fitting over the studs are used to secure the head to the subhead.

(2) ASSEMBLY OF GOVERNOR ASSEMBLY.

(a) Drop the check valve ball into the hole in the fly-weight cup and press in the check valve sleeve with the seat extending upward. Care must be taken to prevent the sleeve from collapsing as it is being assembled and the ball must be free within the sleeve as checked by shaking or tipping the body.

(b) The accumulator relief valve is next assembled into the body. Insert the spring and place the accumulator piston over the spring.

(c) The pump gears should be installed with the notched ends of their shafts entering the shaft holes in the body.

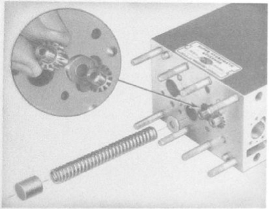


Figure 151—Installing Relief Valve and Pump Gears

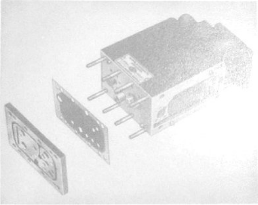


Figure 153—Installing Governor Bottom Plate

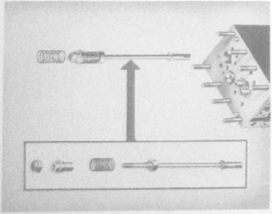


Figure 152—Installing Compensating Piston—Composite View

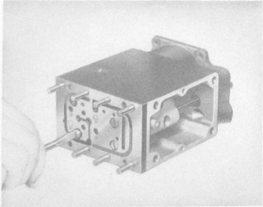


Figure 154—Tightening Governor Bottom Plate

(*d*) Over the lower end of the compensating piston, install one compensating spring and the retainer sleeve. Screw a self-locking nut onto the end of the plunger against the sleeve. Insert this assembly through the governor body and set the other compensating spring around the lower end of the shaft.

(*e*) Aluminum plugs are pressed into the governor bottom plate to determine the direction of oil flow. The holes marked "C-C" are plugged for a clockwise rotating propeller and "A-A" are plugged for an anticlockwise rotating propeller. Fit the governor bottom plate over the gear shafts and locating dowels, and retain it by four screws.

(*f*) To assemble the fly-weight head assembly, press the bearing into the drive gear shaft bushing until it bottoms against the bushing shoulder. Insert the threaded end of the drive gear shaft through the bearing and press the shaft into position, seating the upper shoulder of the shaft against the inner bearing race. Place the bellows oil seal over the lower end of the shaft so the carbon ring will ride against the shaft shoulder. Press a bearing into the lower end of the bushing and onto the bottom of the drive shaft, seating the inner race against the lower shaft shoulder. Fit the fly-weight between the prongs of the head and insert a hinge pin through each prong and fly-weight. Lock the assembly with safety wire inserted into both ends of each pin. Then set the fly-weight head assembly over the threaded end of the shaft with a sufficient thickness of shims between the upper ball bearing and the fly-weight head to give a height of 3.657 ± .001 inches measured from the bottom of the lower bearing to the toe of the collapsed fly-weights. Lock the units together with a self-locking nut over the end of the shaft. The drive gear shaft and head assembly must rotate freely in the bushing.

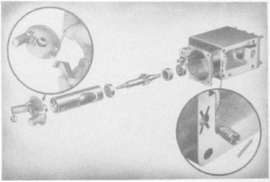


Figure 155—Assembling and Installing Fly-Weight Head Assembly Into Governor—Composite View

(*g*) Press the fly-weight head assembly into the governor body with the opening for the gear facing the bracket opening. Screw a set screw through the body into the conical depression near the top of the drive gear shaft bushing. Line up a slot across the top of the set screw with one of the slots in the body, and lock the screw with a locking key. Use sealing wax to hold the locking key in position.

(*h*) To assemble the controlet assembly, insert the pilot valve sleeve into the controlet. Press the spring seat bearing onto the top of the pilot valve sleeve and the spring seat over the bearing.

(*i*) Fit the controlet assembly over a gasket placed on top of the governor body, and secure it by two screws and washers. These are safetied together.

(*j*) Screw the needle valve snugly into the body and back it out one-half turn. Lock it in this position by placing the needle valve lock over the valve and into the hexagonal hole in the controlet. Place a spring and washer over the end of the valve and secure them with safety wire or a cotter pin.

(*k*) Insert the pilot valve with its slotted pin into the pilot valve sleeve. One end of the compensation link is inserted through the opening in the spring seat and against the pin. Hold the compensating piston fork with its pin against the open end of the link, and screw the compensating piston onto the fork. The spring seat link is

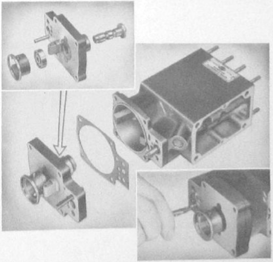


Figure 156—Assembling and Installing Controlet Assembly—Composite View

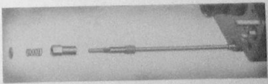


Figure 157—Installing Compensating Needle Valve —Composite View

held in place and the link pin is passed through the compensation link, fulcrum, and spring seat link. A washer is placed over each end of the pin and safety wire secures the assembly. Over the pin on the spring seat fit the other end of the spring seat link, and secure it with safety wire.

(l) The sump filler strainer should then be screwed into the sump filler hole and the filler plug and gasket screwed in over the strainer. This is not safetied until the sump has been filled.

(m) The sump cover plate is next assembled. After the sight glass gasket is positioned on the inside of the sump cover, fit the sight glass against the gasket.

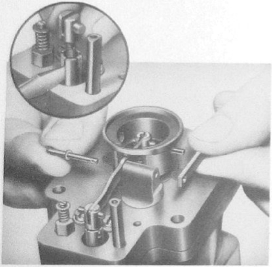


Figure 158—Installing Compensating Link System—Composite View

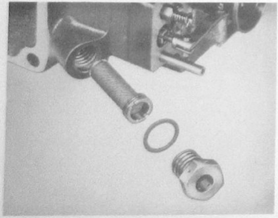


Figure 159—Installing Strainer and Filler Plug

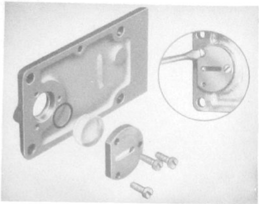


Figure 160—Installing Sight Glass Onto Sump Cover

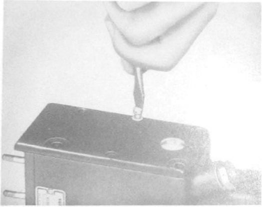


Figure 161—Installing Governor Sump Cover

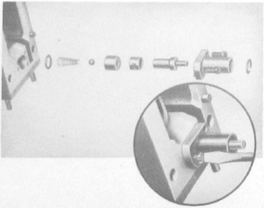


Figure 162—Assembling Governor Auxiliary Pump—Composite View

Place the sight glass retainer over the glass, and hold it by three fillister head screws which are safetied together with wire. After the sump cover gasket is placed against the mounting surface, assemble the cover to the housing with two screws which are safetied together.

(*n*) If an auxiliary pump is specified for the installation, it is assembled in the following manner: Into the pump housing assemble the snap ring, plunger, spring and bushing with the slots toward the plunger. Insert the toroid seal into the hole in the governor. Install the conical spring, ball, and seat after the seal. Assemble the housing assembly over the check valve assembly and secure it with three screws which are then safetied.

(3) ASSEMBLY OF SERVO MOTOR ASSEMBLY.

(*a*) Press into the housing the scavenging pump check valve assembly, consisting of a ball and check valve spring permanently held in the spring retainer. Into the piston liner hole in the housing press the rack oil seal assembly.

(*b*) Install three synthetic toroid seals about the piston liner outside diameter. The piston liner assembly is then pressed into the housing with the notch in the liner sleeve aligned with the check valve retainer. Install the seal in the groove on the servo piston. Insert the piston into the liner and push it far enough into the liner to insure that the smaller diameter of the piston enters the mating diameter of the liner.

(*c*) The inner lock nut is then screwed into place to secure the liner. Fit a copper gasket about this nut and screw the outer lock nut snugly onto the inner lock nut. The outer lock nut is safetied by wiring through one of the wire holes of the nut and through the wire hole provided in the servo housing.

(4) ASSEMBLY OF SOLENOID PACK ASSEMBLY.

(*a*) Screw the needle valve with its washer and lock nut into the solenoid housing. Tighten the valve against its seat; then back it out a half turn before securing it with the lock nut. This will be adjusted while checking rates of rack travel with manual control.

(*b*) The lock pitch solenoid is the first assembled. Place the gasket against the bottom of the solenoid cavity. Place the spring and the plunger & valve assembly into the cavity with the end of the spring in the groove in the seat. Locate the core assembly in such a manner that when the shell has been positioned, the wire slot in the shell mates with the groove in the housing; then secure the core assembly with three fillister head screws and lock washers. Next, install the shell into the housing with the locating slot in the shell in line with the dowel pin at the base of the core assembly. The coil assembly is placed within the shell and about the core with the electrical

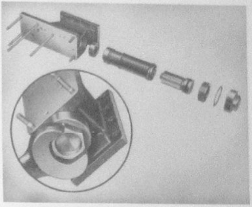


Figure 163—Assembling Servo Motor Assembly—Composite View

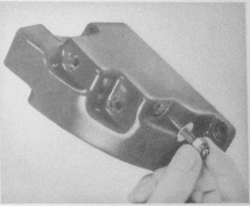


Figure 164—Installing Bypass Needle Valve

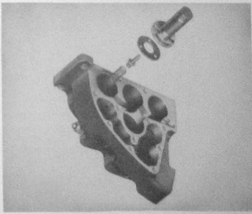


Figure 165—Assembling Lock Pitch Solenoid

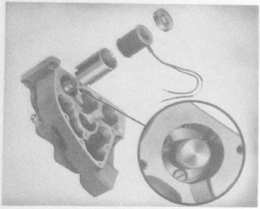


Figure 166—Installing Lock Pitch Solenoid

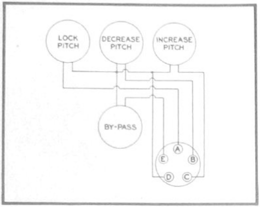


Figure 169—Solenoid Pack Wiring Diagram

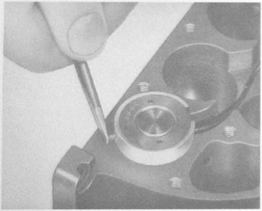


Figure 167—Inserting Lock Pin Into Lock Pitch Solenoid

wires passing through the slot in the shell and into the groove in the housing. Screw the end bell onto the core and lock it by inserting the lock pin through the holes in the shell and the end bell.

(c) The decrease pitch, bypass, and increase pitch solenoids are next installed, the procedure being similar. Place the gasket against the bottom of the solenoid cavity. Place the spring into the core and install the plunger & seat assembly onto the core on top of the spring. [illegible] the core assembly so that when the shell has been posi-tioned, the wire slot in the shell will mate with the groove in the housing. Install the assembly into the housing and secure it with three fillister head screws and lock wash-ers. The shell is next installed into the housing with the locating slot in the shell in line with the dowel pin at the base of the core assembly. Place the coil assembly inside the shell and over the core, with the wires pass-ing through the slot in the shell and into the groove in

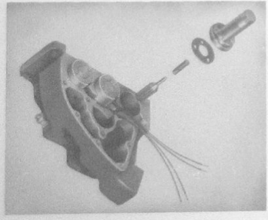


Figure 168—Installing Increase Pitch Solenoid—Composite View

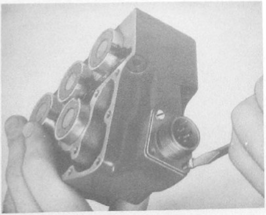


Figure 170—Attaching Electrical Receptacle

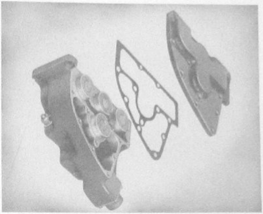


Figure 171—Installing Solenoid Pack Cover

the housing. Screw the end bell onto the core and lock it by inserting the lock pin through the holes in the shell and the end bell.

(*d*) Arrange the solenoid wires in the grooves in the housing, and pass them through the cavity and out the AN plug opening. Solder together the four ground wires to make a common ground. Then solder the wires to the proper connectors on the AN plug according to the wiring diagram shown in figure 169. Use insulating tubing over any open wiring. Secure the receptacle to the housing with four screws and safety.

(*e*) Locate the cover gasket over the open housing. Secure and safety the solenoid pack cover to the housing with 11 screws and washers.

(5) ASSEMBLY OF PITCH TRANSMITTER ASSEMBLY.

(*a*) The two adjusting pinions are installed into holes in the cover. Washers and self-locking nuts secure the pinions. These are later adjusted when setting the

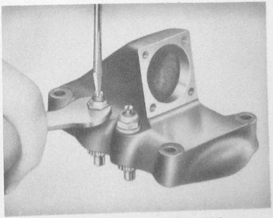


Figure 172—Installing Adjusting Pinions

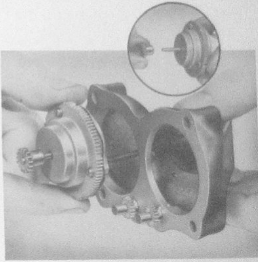


Figure 173—Assembling Magnetic Unit Into Cover (Insert shows Installing Gear Onto Magnetic Unit)

pitch transmitter during propeller installation.

(*b*) Assemble the large gear onto the low speed transmitter shaft and fit the taper pin into the hole in the gear and the shaft. The small gear fits onto the high speed transmitter shaft and is likewise secured with a taper pin. The ends of the taper pins must be pounded over to secure them.

(*c*) Set the flat springs into place in the cover and place the two magnetic units into the cover over the springs, the low speed unit being on the left when viewed from the outboard side. The teeth around the units mesh with the adjusting pinions. Extreme care must be exercised when soldering the wires to the AN connector ac-

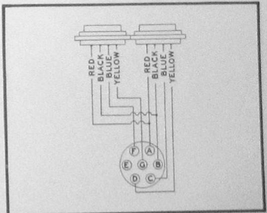


Figure 174—Pitch Transmitter Wiring Diagram

cording to the wiring diagram shown in figure 174. Fasten the AN connector securely to the cover.

(d) Place the transmitter spacer over the larger gear of the idler gear assembly and insert the shaft through the gear and the hole in the case. Secure the assembly by screwing the self-locking nut onto the threaded portion of the shaft.

(e) Assemble the shaft washer and the drive gear

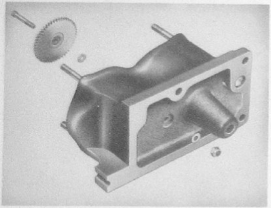


Figure 175—Assembling Idler Gear—Composite View

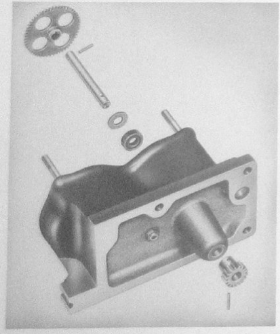


Figure 176—Assembling Pinion Gear Drive Shaft and Drive Gear—Composite View

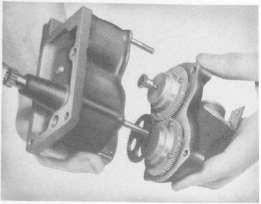


Figure 177—Installing Cover Onto Case

onto the transmitter drive shaft and secure them with a taper pin. Place the oil seal into the recess in the case about the shaft support tube. Insert the shaft through the support tube. Press the pinion gear over the end of the shaft and secure the assembly with a taper pin.

(f) Assemble the cover over the four studs in the case. Secure these with washers and self-locking nuts.

(6) ASSEMBLY OF PITCH LIMIT SOLENOID ASSEMBLY.

(a) Press the bushing into the housing [illegible] the slot with the electrical wire passage of the housing. Three screws and lock washers secure the bushing. Insert the coil assembly into the bushing with its leads fitting through the wire passage. Screw the core into the bushing and stake it in place by striking the line of separation sharply with a steel punch. Insert the stop pin into the core and place the spring against the shoulder. Insert the core plug into the hole against the spring. Screw the cover and gasket into place with four fillister head screws and washers and safety the screws.

(b) Insert the pin of one plunger link through the slot in the plunger. Install the plunger assembly into the open core assembly. Fit the slotted link into position with the open end coupling over the plunger pin. Locate

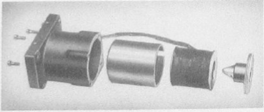


Figure 178—Assembling Pitch Limit Solenoid Core Group

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spacers on both sides of each link and screw the link pins through the housing, spacers, and links to act as hinge pins for the links. Line up the slots with the lock holes in the housing and pass safety wire through the holes in the housing and the pin slots.

(*c*) Extend the coil leads through the shielded cable and screw the cable into the housing. Solder the leads to the AN connector and attach the connector to the cable.

(7) ASSEMBLY OF AUXILIARY MOTOR ASSEMBLY.

(*a*) Press the collar onto the short shaft protruding from the rotor and press the ball bearing assemblies onto each end of the rotor shaft. Guide the field wires through the openings in the head. By means of the screw

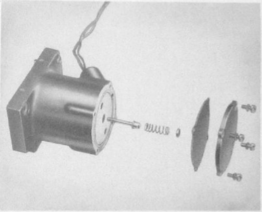


Figure 179—Assembling Plunger Group Into Housing

Figure 180—Inserting Electrical Connections

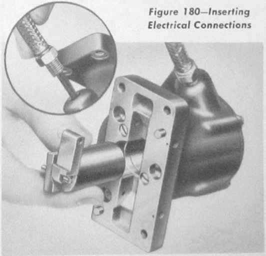


Figure 181—Inserting Stop Assembly Into Solenoid

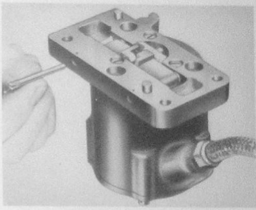


Figure 182—Installing Link Pins

provided, secure the wires to the micarta wire support according to the wiring diagram inside the head cover plate. Secure the wire support in place with two screws and lock washers. Secure the head to the housing with four screws.

(*b*) Insert the rotor assembly into the housing seating the bearing flush with the shaft into the bushing in the head. The rectangular end of the shaft then protrudes from the lower end of the housing. Guide the two external leads through the hole in the bottom plate and secure the plate to the housing. Insert the brush assemblies into the head and then the micarta brush retainers.

(8) ASSEMBLY OF AUXILIARY MOTOR-WIRING HARNESS UNIT.

(*a*) Press the small ball bearing onto the worm gear and fit the gear sleeve around the gear. The larger bearing is pressed over the other end of the shaft and the coupling is assembled with the worm. Secure the coupling by safety wire passed through the mating holes.

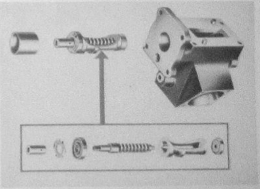


Figure 183—Assembling Wiring Harness Worm Gear Assembly—Composite View

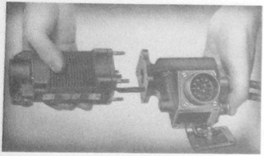


Figure 184—Attaching Auxiliary Motor

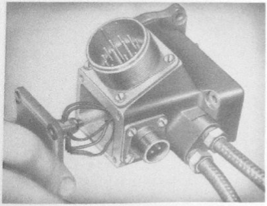


Figure 185—Attaching Electrical Cable

(*b*) Press the gear assembly into the housing with the opening in the sleeve matching the opening in the housing. A locating pin in the housing provides for proper alignment. Place the loading spring over the larger bearing with the depressed portion resting on the bearing. Place the spacer into the hole on top of the spring.

(*c*) One large AN connector, one small connector, and two cable receptacles, the auxiliary motor (if one is included in the installation) and the ground terminal cover assembly are wired together according to the wiring diagram shown in figure 186 and are secured to the wiring harness housing. Self-locking nuts secure the auxiliary motor.

(9) ASSEMBLY OF TRANSLATING CONTROL & ROTATING SEAL ASSEMBLY.

(*a*) Locate the inner ball race inside the support race assembly so the two halves of the ball bearing insert hole coincide. Insert 155 balls into the hole. Then rotate one of the races to offset the halves of the loading hole, thus retaining the balls.

(*b*) Insert the distributor valve thrust plate into the center of the races with the plate fitting within the collar. Position the races and thrust plate relative to one another so the roller holes in the races line up with respective slots in the plate. Insert five rollers through the enlarged portion of the slots and into the shaft holes in the race, and then displace the thrust plate enough to retain the rollers. Put the stop with its lock washer into the threaded hole of the inner ball race so as to retain the

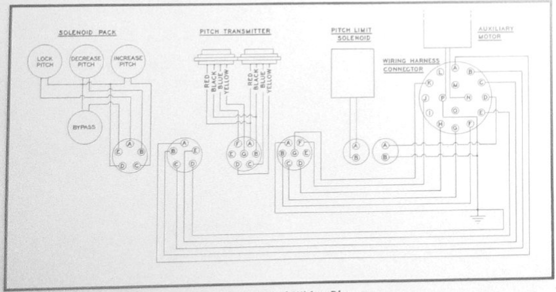


Figure 186—Control Wiring Diagram

thrust plate in a position where the roller flanges are behind the sides of the slots and the rollers are thus securely retained. Lock the stop by turning the washer tabs up and down.

(*c*) Insert the toroid seal into the groove in the carbon ring. Place the 16 springs into the cups in the support race and assemble the carbon ring onto the race, aligning the guides of the reinforcing seal with the slots in the race. Insert a cotter pin through the hole in each guide.

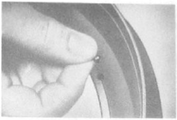


Figure 187—Inserting Bearing Ball Into Races

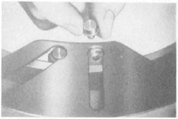


Figure 188—Installing Rollers Into Slots

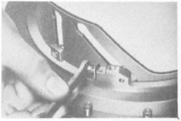


Figure 189—Tightening Thrust Plate Stop

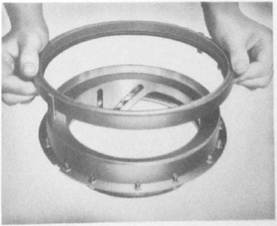


Figure 190—Assembling Rotating Seal to Thrust Plate

(10) ASSEMBLY OF CONTROL SUPPORT ASSEMBLY.

(*a*) On the right-hand side of the control support (when facing it from the outboard side) assemble the auxiliary motor ratchet wheel assembly. For a right-hand rotation propeller the wheel must be mounted so it will turn in clockwise direction, but not in an anticlockwise

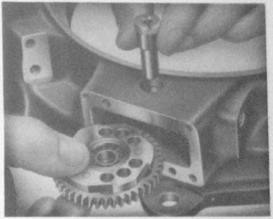


Figure 191—Assembling Auxiliary Motor Ratchet Wheel—Composite View

Figure 192—Inserting Ratchet Wheel Lock Assembly

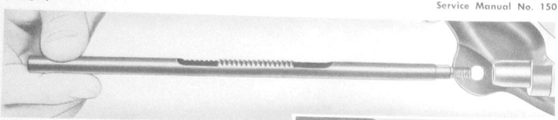


Figure 193—Inserting Servo Rack

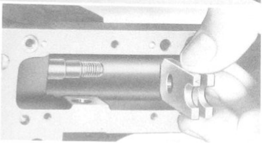


Figure 194—Installing Spring Seat Guide

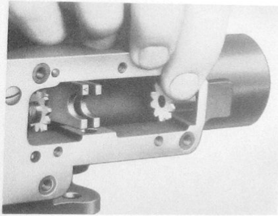


Figure 195—Inserting Reverse Stop

direction, with the lock plunger in position. In this position, the letter "C" stamped on the wheel will face outboard. For a left-hand rotation propeller, the letter "A" will face outboard. Press the bearing into the assembly. Insert the gear shaft through the housing with [illegible] on both sides of the assembly and [illegible]

(b) The ratchet wheel lock assembly [illegible] with the lock spring and plunger [illegible] the plunger sleeve. Line up the hole [illegible] plunger with the slot in the sleeve. [illegible] and press the lock pin through the slot [illegible] in the plunger. This must be pressed flush with [illegible] the sleeve surface. Screw the lock assembly into the [illegible] over the ratchet wheel until the top of the sleeve is flush with the support outer surface. Line the lock hole in the sleeve with the hole in the support by tightening and

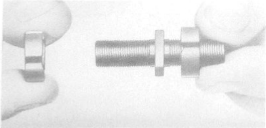
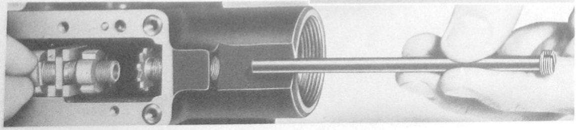


Figure 196—Assembling Pitch Stop Screw

Figure 197—Inserting Stop Screw Shaft



safety with lock wire. The ratchet wheel must rotate readily in the specified direction and the ratchet should lock against the plunger when rotation is reversed.

(c) Slide the rack into the horizontal hole along the bottom of the support, with the slot on the bottom. Place the spring seat guide into the servo spring chamber and over the small diameter on the end of the rack. Screw the self-locking nut onto the end of the rack to secure the guide.

(d) Screw the feather and reverse stops into the horizontal threaded holes in the opening under the servo spring chamber. Screw the high and low pitch stops onto the pitch stop screw with the flat sides towards the ends of the screw. Raise this stop assembly into the recess under the spring seat guide and in line with the feather and reverse stops. Fit the shaft through the support, reverse stop, stop screw, and feather stop respectively and screw it tightly into the housing.

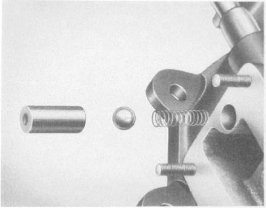


Figure 198—Inserting Scavenge Check Valve

(e) Place the ball and spring into the scavenge pump check valve bushing and press the bushing into the housing. The bottom surface of the bushing is to be flush with the support.

(f) Insert the calibrating pin into the scalloped sleeve. Place a spring over the exposed end of the pin and compress it with a washer. Secure the washer with lock wire. Set the sleeve into the housing behind the servo spring chamber. This is secured with a fillister head screw. Screw the cap over the completed assembly finger tight.

(g) Fasten the index plate to the bottom of the support. Set the spring seat guide against the index stop pin as shown in figure 200 and set the stops to the desired position by turning them with the fingers. Fasten the stop lock plate on the other side with two screws with the edge of the plate fitting into the slots in the stops. Care must be taken not to bind the stops.

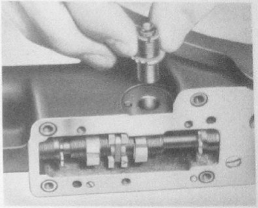


Figure 199—Inserting Calibrating Pin

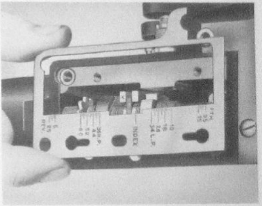


Figure 200—Installing Index Plate

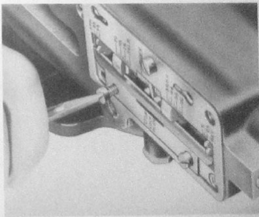


Figure 201—Installing Stop Lock Plate

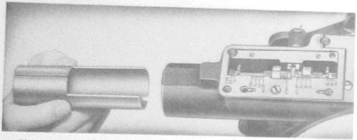


Figure 202—Installing Servo Rack Spring Liner

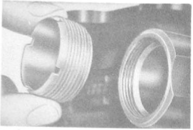


Figure 203—Installing Servo Rack Inner Lock Nut

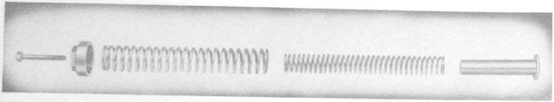


Figure 204—Assembling Servo Springs—Composite View

(h) Slide the spring liner into the housing, matching the small slot with the dowel in the support. Screw the inner lock nut into the end of the spring chamber securely against the liner.

(i) To prepare the spring assembly for installation into the chamber, the two telescoping springs should be placed over the inner spring guide. Put the cap over the other end of the springs, insert a 1/4 x 28 bolt through the hole in the cap and screw it into the inner guide, thus compressing the springs. Install the spring assembly into the chamber and screw the cap tightly onto the inner lock nut. Leave the springs compressed until the pitch limit solenoid, pitch transmitter, and translating control have been installed.

(j) To assemble the governor drive & idler gear with the support, press the larger bearing into the idler gear assembly, insert the spacer from the other side, and press the smaller bearing against the spacer. Place the flanged nut into the smaller bearing and insert the gear assembly into the recess with the larger gear toward the

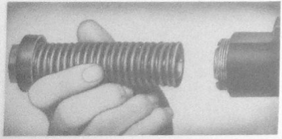


Figure 205—Installing Servo Springs Into Support

inboard side of the support. Pass the drive gear shaft from the outboard surface through the hole in the support, the bearings, the spacer between the bearings and over the nut. Insert the securing bolt through the shaft. Safety with lock wire through aligning holes in the bolt and the nut.

(k) To assemble the auxiliary pump drive gear, insert the bushing into the gear. Then with the gear in position, install the shaft and secure it with a washer and nut.

(l) To assemble the auxiliary pad shaft and cover, first insert the bushing and shaft into the support. Install the screw and tighten securely. Install and safety the cover and gasket.

(11) ASSEMBLY OF TRANSLATING CONTROL TO SUPPORT.

(a) Compress the servo springs until the calibrating pin can be depressed fully. This is approximately the mid-position. However, the exact setting is determined after the translating control is installed.

(b) Fit the translating control gage into one of the horizontal slots. Put the toroid seal around the outer ring of the translating control, and then carefully insert the unit into the control support. The center teeth on both parts (as indicated by scribed lines) should be meshed. A dowel insures alignment. If the teeth of the translating control and the servo rack do not mesh, move the rack slightly until they do mesh. It may be necessary to further compress the servo springs.

(c) Since the translating control is set at the centered position by the gage, the rack should also be in

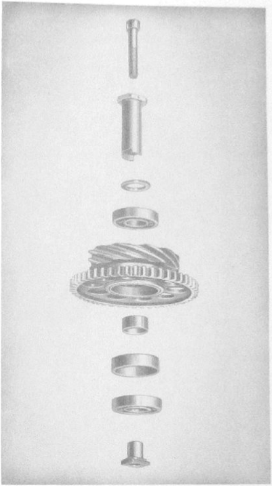


Figure 206—Assembling Drive & Idler Gear

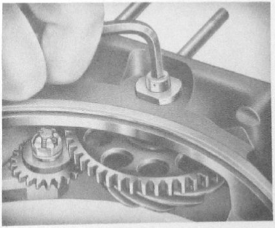


Figure 207—Installing Drive & Idler Gear

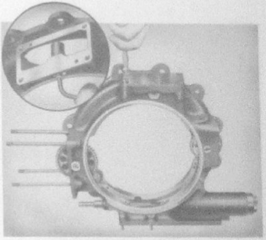


Figure 208—Installing Auxiliary Pad Shaft and Auxiliary Pad Cover Plate Into Support

that position. Loosen the calibrating pin sleeve screw and turn the eccentric sleeve until the pin (when depressed) contacts the spring guide. Then safety the sleeve in position with the screw.

(*d*) Depress the calibrating pin and loosen the spring compression bolt slightly. This allows the pin to be held down by the spring guide. Remove the translating control gage, and secure the control.

(*e*) The index line on the index plate should be aligned with the edge of the spring seat guide. If the hydraulic stops are to be reset, remove the stop lock plate at the bottom of the servo spring housing. Turn the stops as required. The position is read from the flat side of each stop. When the stops are set, put on the lock plate. Be sure that it fits into a slot on each stop.

Figure 209—Assembling Translating Control Onto Control Support

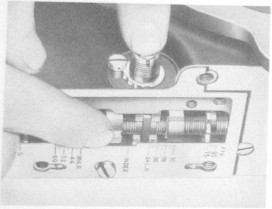


Figure 210—Adjusting Calibrating Pin

(12) ASSEMBLY OF PITCH LIMIT SOLENOID TO SUPPORT.—Install the proper gasket and then the pitch limit solenoid. Secure it with three screws and washers.

(13) ASSEMBLY OF PITCH TRANSMITTER TO SUPPORT.

(a) Carefully install the pitch transmitter with its gasket onto the support, being sure to mesh the pinion gear with the rack. Secure it with three self-locking nuts and a screw with a slotted washer which holds both this and the pitch limit solenoid.

Figure 211—Assembling Pitch Limit Solenoid to Control Support

(b) Tighten the spring compression bolt enough to release the calibrating pin. Screw on the calibrating pin cap and safety it to the sleeve holding screw. Remove

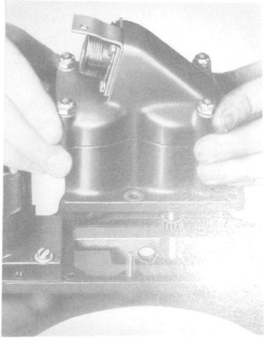


Figure 212—Assembling Pitch Transmitter to Control Support

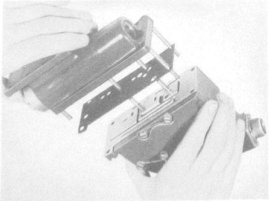


Figure 213—Assembling Solenoid Pack to Servo Motor

the spring compression bolt and install the pipe plug in the servo nut. Safety the plug to the nut.

(14) ASSEMBLY OF HYDRAULIC UNIT.

(a) Using the proper gasket, assemble the solenoid pack to the lower surface of the servo motor. Use self-locking nuts to secure.

(b) Place the speeder spring into position and assemble the governor head with its gasket onto the governor. Secure it with self-locking nuts.

(c) After placing the correct gasket and plate, install the servo motor and solenoid pack to the bottom of the governor. Self-locking nuts hold it in place.

(15) ASSEMBLY OF HYDRAULIC UNIT TO SUPPORT.—Slide the governor with the correct gasket onto the four studs of the control support pad, and secure it in position with self-locking nuts. Make certain that the seal is in place around the servo rack bushing. Care should be taken that the idler gear in the support meshes with the drive gear in the governor.

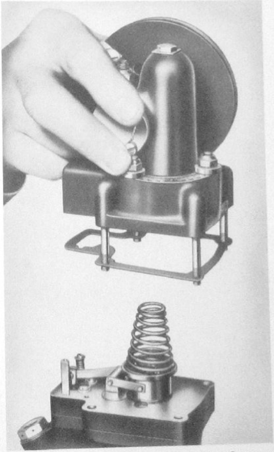


Figure 214—Assembling Governor Head to Governor

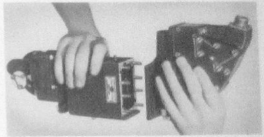


Figure 215—Installing Servo Motor Onto Governor

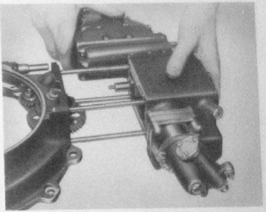


Figure 216—Assembling Hydraulic Unit to Control Support

Figure 217—Assembling Auxiliary Motor-Wiring Harness Unit to Control Support

(16) ASSEMBLY OF AUXILIARY MOTOR-WIRING HARNESS UNIT TO SUPPORT.

(a) Using the proper gasket, install the unit onto the control support pad. Four cap screws hold it in position. Be sure the idler gear in the support meshes with the drive gear in the wiring harness.

(b) Since the hydraulic unit and the auxiliary motor-wiring harness unit must be removed during the installation procedure, it is unnecessary to safety these units at this time. It is advisable to connect the electrical cables, but not to safety them.

SECTION VII

TEST PROCEDURE

1. TESTS OF HUB & BLADES ASSEMBLY.

a. GENERAL.—The following tests shall be run with Pennsylvania Crude SAE No. 10 oil at 16° to 38°C (60°-100°F). The oil used in each test must be clean and free from all foreign matter since this oil remains in the assembly. In these tests the high pressure measured shall be accurate within one percent, and the low pressure measured shall be accurate within five percent.

b. VALVE TESTS.

(1) HIGH PRESSURE RELIEF VALVE ASSEMBLY.

(a) Insert the high pressure relief valve assembly into the proper fixture attached to the test bench so that oil under high pressure will be admitted to the bottom of the valve and the oil relieved will be allowed to flow from the body of the valve. Appropriate seals must be used to keep the high pressure oil from the low pressure side.

(b) Slowly apply pressure to the valve until the pressure reaches 2800 p.s.i. At this pressure, the valve shall not pass more than one quart per minute.

(c) Raise the pressure to the maximum available with the pump used, and then decrease this to 2800 p.s.i. Again the valve shall not pass more than one quart per minute.

(d) The valve must, however, open slightly between 2800 and 3000 p.s.i.

(2) SUMP RELIEF VALVE ASSEMBLY.

(a) Install the sump relief valve assembly into the proper fixture so that oil at a low pressure can be applied to the bottom of the valve and drainage obtained from the body of the valve.

(b) Slowly apply pressure until the valve cracks open. This pressure shall be 30 ±5 p.s.i. The valve shall be fully closed at and below 15 p.s.i. Replace the spring if the opening point is not within these limits.

(3) LUBRICATING VALVE ASSEMBLY.

(a) Attach the lubricating valve assembly to the fixture with a low pressure oil line leading to the oil intake side.

(b) Slowly apply pressure. The lubricating valve shall be fully open at and above 15 p.s.i. Minimum flow shall be 28 ounces per minute at 40 p.s.i.

(c) Decrease the pressure. The valve shall be fully closed at and below 5 p.s.i.

c. VANE MOTOR TESTS.

(1) Install the vane motor in a fixture so arranged that high or low pressure oil can be alternatively admitted to the opposite chambers in the vane motor and so arranged that the blade vane can be moved by oil pressure. The vane motor cover nut shall be tightened with a torque of 100-125 foot-pounds prior to these tests.

(2) Apply a pressure to one set of chambers while the other line is open to drain. To actuate the vane motors under no load, no more than 300 p.s.i. pressure shall be necessary.

(3) Apply a pressure of 600 p.s.i. to both sides of the vanes while they are approximately centered. The maximum internal leakage of the assembled vane motor at this pressure shall not exceed 0.3 quarts per minute. Increase the pressure to 3000 p.s.i. The maximum internal leakage shall not exceed 0.5 quarts per minute.

(4) The maximum external leakage at any time shall not exceed 0.1 quart per minute. Replace the seals if leakage is excessive.

d. PUMP TESTS.

(1) Install the pump cylinder assembly in a fixture so that oil pressure can be admitted behind either the high pressure or the low pressure check valve.

(2) Apply a pressure of 3500 p.s.i. behind the high pressure check valve. No leakage shall be evident. At this same pressure no leakage shall be evident past the piston plug or check valve plug in the cylinder when the high pressure check valve is removed and the piston closes up the intake port.

(3) Apply a pressure of 35 p.s.i. behind the low pressure check valve in the cylinder. No leakage shall be evident.

(4) Apply a pressure of 3500 p.s.i to the high pressure circuit. There shall be no external or internal leakage.

e. TESTS OF COMPLETE ASSEMBLY.

(1) INTERNAL LEAKAGE.

(a) Replace the high pressure strainer bolt with a special test bolt drilled along its axis and having holes about its periphery at the web section but closed to the high pressure manifold. Attach an auxiliary high pressure oil line and gage to the above test bolt. Remove the sump filler plug and insert a drain line.

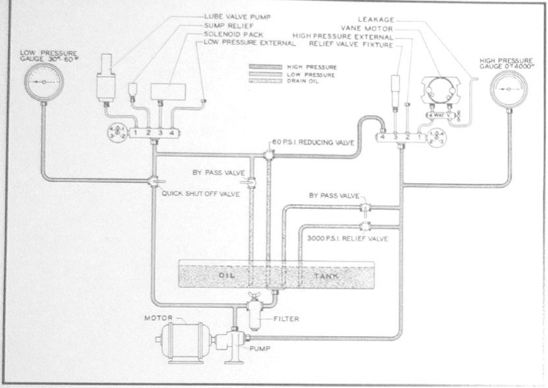


Figure 218—Oil Test Schematic Diagram

(b) Slowly apply a pressure of 2500 p.s.i. through the bolt and at the same time slowly move the distributor valve outboard to bring the blades against the high pitch mechanical stop. Leakage can be found from that amount which drains from the sump filler hole. The total internal leakage of the assembled propeller shall not exceed 2.5 quarts per minute at 2500 p.s.i.

(c) Repeat above procedure but with the distributor valve moved inboard so as to put the blades against their low pitch mechanical stop.

(2) EXTERNAL LEAKAGE.

(a) While a pressure of 2500 p.s.i. is applied to the high pressure circuit, there shall be no leakage.

(b) To test external leakage of the low pressure circuit, the sump relief valve shall be removed and a plug inserted in its place. Put the strainer bolt back. Connect a pressure line to the sump filler hole. A pressure of 100 p.s.i. is then applied to the low pressure circuit and the propeller checked for external leakage.

CAUTION

A relief valve set at 120 p.s.i. must be in the pressure line feeding the propeller for this test.

(3) BLADE ANGLE SETTINGS.

(a) First, replace the sump relief valve, and mount the hub & blades assembly on the test rig suitable for driving the eccentric.

Note

If such a rig is not available, this test may be omitted.

(b) Run the eccentric at 500 rpm and apply a pressure of 30 p.s.i to the sump. Move the distributor valve through its entire range to check for proper pitch change. The pump should be operated for five minutes.

(c) Move the distributor valve outboard to bring the blades against the high pitch mechanical stop and turn off the oil pressure. With the protractor, check the blade angles. They shall be within 0.5 degree of the specified setting and the maximum difference in angle between any two blades shall not exceed 0.2 degree.

(d) With the distributor valve moved inboard, turn off the pressure and check the blade angles against the low pitch mechanical stop with a protractor. The readings are to be within 0.2 degree of each other and within 0.5 degree of the specified angle.

(4) PUMP & HUB LEAKAGE.—Remove the assembly from the bench and attach the test fixture to the thrust ring. Apply a pressure of 5 p.s.i. to the fixture for at least one minute. There shall be no leakage between the pump and the hub.

(5) BALANCE.—Since the hub & blades assembly is now full of oil, balancing the assembly is conveniently performed at this time. Such balancing is described in paragraph 4.b.(15) of section VI. The lead washers are located in recesses at the outer edge of the pump housing.

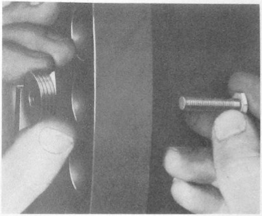


Figure 219—Inserting Balancing Washers

2. TESTS OF CONTROL ASSEMBLY.

a. GENERAL.

(1) The following tests shall be run with Pennsylvania Crude SAE No. 10 oil at 16° to 38°C (60°-100°F). The oil used must be clean and free from all foreign matter since this oil remains in the assembly.

(2) The pressures measured shall be accurate within five percent.

(3) Mount the control unit on the approved test rig using the No. 60 size drive gear and connect the large AN connector of the test rig to the wiring harness connector. A 24-volt D.C. source of power supply should be connected to the system.

(4) Fill the governor sump to the center of the sight glass with the proper oil as given in paragraph 1. of this section. In order to completely fill the sump cavities, it may be necessary to run the control for a few minutes, changing pitch several times, and then add more oil.

(5) Check the direction of rotation of the governor drive gear. For a right-hand tractor propeller, this rotation shall be clockwise when viewed from the rear of the rig. For a left-hand tractor propeller, it shall be anticlockwise when viewed from the rear.

b. COUNTERBALANCE RPM SETTING.—When, for any reason such as control cable failure, pulley torque is released, it is desirous to have engine rpm remain sufficiently high to maintain flying speed. The counterbalance spring in the head must be set to maintain within ±15 rpm of the desired setting. To adjust the spring, run the unit on governing, with no torque on the pulley, remove the plug in the governor head and with a slender screw driver, turn the adjusting screw to obtain the desired rpm for the installation. With a non-governing type variable speed test rig, set the rig speed as desired and adjust the screw in the governor head until the rack just moves toward low pitch with no pulley torque loading.

c. GOVERNOR PUMP CAPACITY.—With the governor operating at no more than 200 rpm, and the pulley set for maximum rpm, a minimum of 75 p.s.i. shall be maintained in the servo chamber.

d. RPM STOP SETTINGS.—Set the high and low rpm external stop screws by adjusting the screws with a screw driver. Check the settings by holding the governor pulley against each in turn and reading the rpm at which the control governs. Adjust the screws to provide the desired maximum or minimum settings and lock the screws by tightening the lock nuts against the cover lugs, holding the screws stationary.

e. RELIEF VALVE SETTING.—Replace the standard servo cap with a 200 p.s.i. gage and cap fitting. Move the pulley to call for 2500 governor rpm and shut off the needle valve. The rack will move to the low pitch stop, and the pressure will then rise until relieved by the accumulator relief valve. The valve shall relieve at 150-180 p.s.i. when discharging the full governor pump output.

f. EXTERNAL LEAKAGE.—Maintain full relief pressure for one minute with the governor operating at 2500 rpm and visually inspect all joints for leaks. Leakage is corrected by replacing gaskets or by tightening appropriate nuts.

g. LOCK PITCH OPERATION.—With the governor operating at 2500 governor rpm, energize the lock pitch solenoid with the servo rack in full low pitch and the pulley turned to its full low rpm position. The servo rack shall not move during a two-minute period.

h. REVERSING AND FEATHERING OPERATION.—The servo rack shall move through the following ranges within the time specified when the proper solenoids are energized with the governor operating at a fixed 2500 rpm:

Full feather to full reverse in 4 seconds.
Full reverse to full feather in 3 seconds.

i. RACK TRAVEL RATE.—This is checked with the pitch limit solenoid energized or removed. With the governor operating at 2500 rpm, move the pulley quickly from its full low rpm position to its full high rpm position. The servo rack shall move from the full feather position to the full reverse position in 2 to 3 seconds. In like manner, the rack shall move from full reverse to full feather in 1/2 to 1-1/2 seconds when the pulley is turned quickly from the high to the low rpm position. This is adjusted by adding or removing shims between the compensating piston and its fork. Adding shims slows down the rate toward low pitch.

j. PITCH INDICATION TEST.—By means of the calibrating pin, set the rack at its mid-position. The pitch indicator shall indicate within 0.5 degree of the setting. With the servo rack at the feather and reverse positions, the pitch indicator shall be within five degrees of the settings.

k. AUXILIARY MOTOR TEST.—Install the test rig eccentric drive gear. Then energize the unfeathering switches. The servo rack shall move .200 inch from the full feather position within 10 seconds. Do not operate the auxiliary motor for a period of more than 10 seconds. Excessive running may cause damage.

SECTION VIII

PARTS CATALOG INTRODUCTION

1. The Hamilton Standard *Super*-Hydromatic propeller is composed of two major assemblies: the hub & blades assembly, and the control assembly. However, in the model designation system the hub and control are grouped together while the blades have a separate designation since any blade which fits into the hub and meets all operational requirements may be used in a given hub. For this reason the blade assemblies are grouped together in Section IX

2. This Parts Catalog deals with the model 4260-3 propeller only, since that is the model currently in production. The blade designs used are either the 2C15B1-30-M or the 2C15B1-24-B. By selecting the proper blade assembly parts list in addition to the hub and control parts list, it is possible to determine the exact parts and assemblies by name and number which compose the 4260-3 propeller. The designation system is explained in the following paragraphs.

3. The model designation system for *Super*-Hydromatic propeller explains in part the type and use of the propeller. The group of numbers preceding the dash describes the basic propeller model, and the number following the dash (the dash number) indicates the minor modifications incorporated in that basic model. In the model 4260-3, the various numbers indicate the following:

a. The first number, "4", is the number of blades.

b. The second number, "2", identifies the blade shank size and is approximately equivalent to the Hamilton Standard Hydromatic "E" shank size.

c. The two numbers immediately preceding the dash, "60", is the SAE propeller shaft size.

d. The number following the dash, "3", indicates the minor modifications incorporated in the propeller. It also denotes the combination of control subassemblies and, therefore, the operational possibilities. Right-hand propellers are indicated by an odd dash number, and left-hand propellers by an even dash number. In each case an even dash number propeller is the left-hand version of the propeller bearing the next lower odd number.

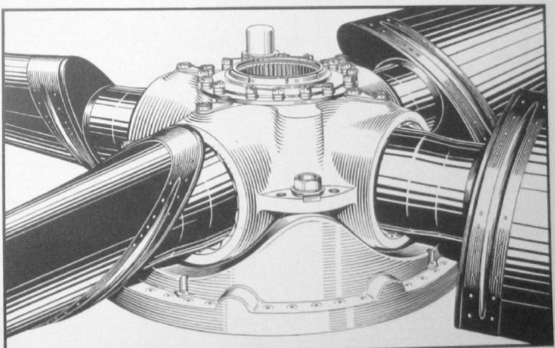


Figure 220—Hub & Blades Assembly

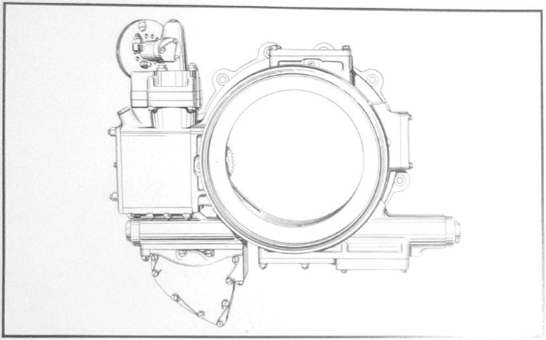


Figure 221—Control Assembly

Note

Direction of propeller rotation is determined by viewing the propeller from the slip stream, whereas direction of engine rotation is determined by viewing the engine-propeller shaft from the rear end of the engine. Right-hand propellers turn clockwise and left-hand propellers turn anticlockwise.

4. The blades are identified by a model designation stamped on the butt end of each blade. This blade designation system is similar to that of the hub and control in that it points out in part the type and use of the blade. As an example, in the model 2C15B1-24-B the numbers and letters indicate the following:

a. The first number, "2", is the blade shank size. This blade fits a hub having the same shank size.

b. The first letter, "C", specifies the activity factor which is a measure of the power absorption qualities of the blade. The letters A, B, C, etc. [illegible] factors of 55 to 65, 65 to 75, 75 to 85, etc., [illegible] of the same diameter.

c. The next two numbers, "15", is the basic design diameter of the blade to the nearest foot.

d. The second letter, "B", is the major blade design type. In this case it is a blade made of a thin shell brazed over a tubular core.

e. The next number, "1", signifies a blade for right-hand rotation, and the number "2" would be the corresponding left-hand blade.

f. The first dash number, "24", is the number of inches the propeller diameter has been reduced from the basic diameter. In this case each blade has been shortened 12 inches.

g. The second dash letter, "B", is the type of blade shell cut-off used to adapt the blade for a particular installation.

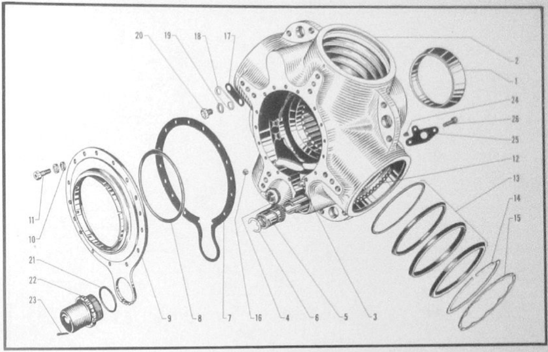


Figure 222—Barrel Group

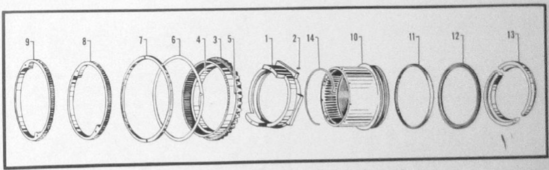


Figure 223—Retaining Nut, Connecting Gear, and Stops Group

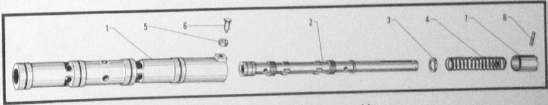


Figure 224—Distributor Valve Assembly

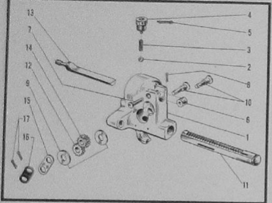


Figure 225—Lubricating Valve & Offset Control Assembly

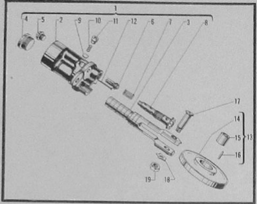


Figure 226—Pump Cylinder Group

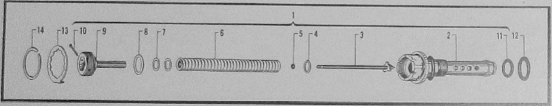


Figure 227—High Pressure Relief Valve Group

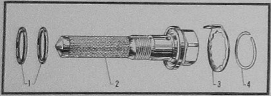


Figure 228—Strainer Bolt Group

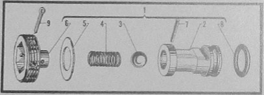


Figure 231—Sump Relief Valve Assembly

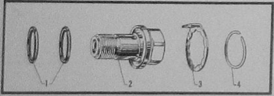


Figure 229—Drain Bolt Group

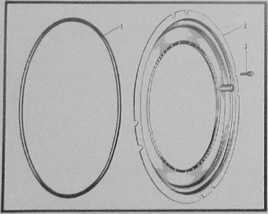


Figure 232—Thrust Ring Group

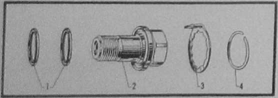


Figure 230—Dummy Bolt Group

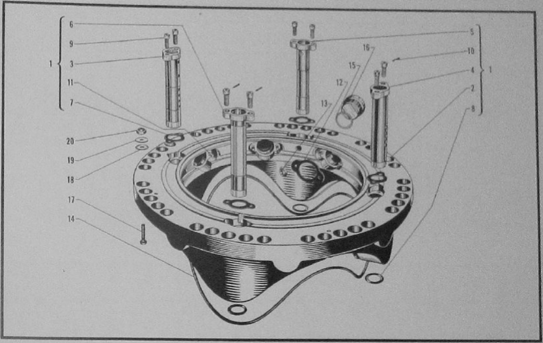


Figure 233—Pump Housing Group

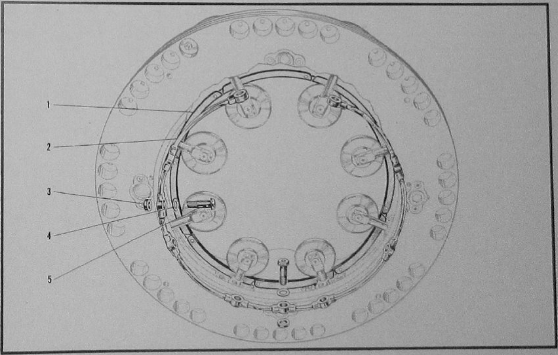


Figure 234—Return Ring and Manifold Group

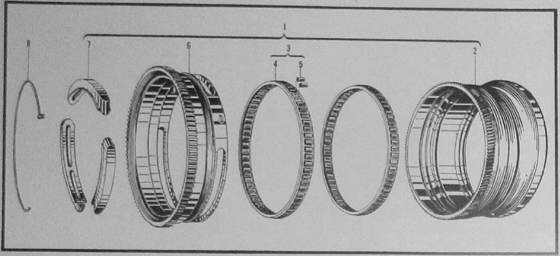


Figure 235—Eccentric Assembly

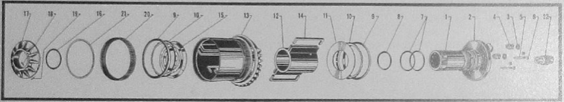


Figure 236—Vane Motor Assembly

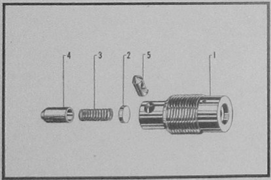


Figure 237—Vane Motor Jack-Screw Assembly

SECTION IX

GROUP ASSEMBLY PARTS LIST

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	UNITS PER ASSY.
220	62225	Hub Assembly	1
222-1	AS-93-60A	Cone—Rear	1
222-2	59456	Barrel Assembly	1
222-3	59603	Pin—Cam Drive Idler Gear	1
222-4	59610	Gear—Cam Drive Idler	1
222-5	59550	Cam—Distributor Valve	1
222-6	59529	Ring—Distributor Valve Cam Snap	1
222-7	59615	Gasket—Cover Plate & Barrel	1
222-8	62366	Seal—Cover Plate & Retaining Nut	1
222-9	62357	Plate—Cover	1
222-10	62364	Spacer—Cover Plate Bolt	32
222-11	62615	Bolt—Cover Plate	16
222-12	58097	Ball—Blade Bearing	736
222-13	58041	Packing—Blade	4
222-14	57359	Washer—Blade Packing	4
222-15	58042	Ring—Blade Packing Retaining	8
222-16	61871	Plug—Barrel Pipe	4
222-17	60256	Gasket—Loading Hole Plate	4
222-18	60257	Plate—Loading Hole	4
222-19	58343	Gasket—Loading Hole Screw	8
222-20	59587	Screw—Loading Hole	8
222-21	62437	Seal—Distributor Valve Cap	1
222-22	62436	Cap—Distributor Valve	1
222-23	AN-380-2-2	Pin—Cotter	1
222-24	63724	Strainer—Lubricating Valve & Offset Control	1
222-25	62078	Gasket—Lubricating Valve & Offset Control	1
222-26	62085	Screw—Lubricating Valve & Offset Control	2
	51218	Wire—Safety	ar
223-1	59598	Sleeve Assembly—Stop	1
223-2	59572	Pin—Stop Sleeve	1
223-3	61191	Gear Assembly—Blade Connecting	1
223-4	60831	Bushing—Blade Connecting Gear	1
223-5	60833	Pin—Blade Connecting Gear	1
223-6	59612	Shim—Preload (Max. 2)	ar
223-7	62347	Gear—Cam Drive	1
223-8		Low Pitch Stop	1
223-9		High Pitch Stop	1
		Use High and Low Pitch Stops as indicated in Tabulation.	
		L.P.S. H.P.S. Range	
		59604 59607 —25° to +95°	
		62261 62254 —28° to +92°	
		62260 62255 —31° to +89°	
223-10	59595	Nut—Hub Retaining	1
223-11	59597	Retainer—Retaining Nut Packing	1
223-12	59596	Packing—Retaining Nut	1
223-13	AS-92-60A	Cone—Front	1

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	UNITS PER ASSY.
223-14	59619	Wire—Retaining Nut Lock	1
225	63900	Lubricating Valve & Offset Control Assembly	1
225-1	63879	Housing—Lubricating Valve & Offset Control	1
225-2	51872	Ball—Check	1
225-3	62073	Spring—Lubricating Valve	1
225-4	62076	Plug—Lubricating Valve	1
225-5	AN380-2-2	Pin—Cotter	1
225-6	63892	Roller—Extension Rack	1
225-7	63899	Shaft—Rack Roller	1
225-8	AN380-1-1	Pin—Cotter	1
225-9	63897	Washer—Control Rack Gear Shaft	2
225-10	63898	Shaft—Control Rack Gear	2
225-11	63889	Rack Assembly—Control	1
225-12	63894	Gear—Control Rack	1
225-13	63891	Rack—Extension	1
225-14	63893	Gear—Extension Rack	1
225-15	63896	Washer—Shaft Centering	1
225-16	63895	Spring—Gear Retaining	1
225-17	AN380-2-1	Pin—Cotter	2
234	62247	Pump Assembly	1
233-1	59445	Housing Assembly—Pump	1
233-2	59424	Housing—Pump	1
233-3	59426	Bushing—Drain	1
233-4	59427	Bushing—Relief Valve	1
233-5	59428	Bushing—Strainer	1
233-6	61274	Bushing—De-Icer	1
233-7	58354	Gasket—Bushing	4
233-8	61393	Seal—Toroid	4
233-9	58355	Screw—Bushing Retaining	8
233-10	AN380-C2-2	Pin—Cotter	6
233-11	60338	Stud—Cylinder Assembly	16
233-12	58368	Gasket—Cylinder & Pump Housing	8
233-13	AN364-428	Nut—Self-Locking	16
233-14	59441	Seal—Pump & Hub	1
233-15	AN900-16	Gasket	1
233-16	60180	Plug—Pump Housing Filler	1
233-17	60288	Bolt—Balancing Washer	ar
233-18	60194	Washer—Balancing	ar
233-19	AN970-3	Washer	ar
233-20	AN364-1032	Nut—Self-Locking	ar
226-1	62186	Cylinder Assembly	8
226-2	59199	Cylinder } Sold in Pairs Only	1
226-3	62104	Piston } Sold in Pairs Only	1
226-4	59204	Plug—Piston	1
226-5	59203	Plug—High Pressure Check Valve	1
226-6	58360	Plunger—High Pressure Check Valve	1
226-7	58366	Spring—High Pressure Check Valve	1

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	UNITS PER ASSY.
226-8	58367	Bolt—Manifold	1
226-9	58661	Disc—Low Pressure Check Valve	1
226-10	58364	Spring—Low Pressure Check Valve	1
226-11	58365	Bushing—Low Pressure Check Valve	1
226-12	58681	Pin—Low Pressure Check Valve Lock	1
226-13	61193	Roller Assembly—Pump	8
226-14	58438	Roller—Pump	1
226-15	59439	Race—Pump Roller Inner	1
226-16	59440	Needle—Bearing	19
226-17	59645	Shaft—Pump Roller	8
226-18	58387	Washer—Pump Roller Shaft Lock	8
226-19	58462	Nut—Pump Roller Shaft	8
	51218	Wire—Safety	ar
234-1	59436	Ring Assembly—Piston Return	1
234-2	59432	Manifold—High Pressure	1
234-3	58511	Spacer—High Pressure Manifold	2
234-4	58377	Gasket—High Pressure Manifold	18
234-5	58512	Bolt—Manifold & Bushing	2
228-1	61393	Seal—Toroid	2
228-2	61535	Bolt—Pump Strainer	1
228-3	61560	Lock—Pump Bolt	1
228-4	61559	Ring—Pump Bolt Snap	1
227-1	61536	Bolt Assembly—High Pressure Relief Valve	1
227-2	61415	Bolt—High Pressure Relief Valve	1
227-3	58604	Valve—High Pressure Pump Relief	1
227-4	60026	Spacer—High Pressure Relief Valve	1
227-5	60024	Seal—High Pressure Relief Valve	1
227-6	58606	Spring—High Pressure Relief Valve	1
227-7	58605	Shim—High Pressure Relief Valve	ar
227-8	57302	Gasket—High Pressure Relief Valve Screw	1
227-9	58603	Screw—High Pressure Relief Valve	1
227-10	AN380-C2-2	Pin—Cotter	1
227-11	61656	Seal—Relief Valve Bolt	1
227-12	61393	Seal—Toroid	2
227-13	61560	Lock—Pump Bolt	1
227-14	61599	Ring—Pump Bolt Snap	1
230-1	61393	Seal—Toroid	2
230-2	61454	Bolt—De-Icer	1
230-3	61560	Lock—Pump Bolt	1
230-4	61559	Ring—Pump Bolt Snap	1
229-1	61393	Seal—Toroid	2
229-2	61455	Bolt—Drain	1
229-3	61560	Lock—Pump Bolt	1
229-4	61559	Ring—Pump Bolt Snap	1
231-1	62494	Valve Assembly—Sump Relief	1
231-2	62493	Retainer—Sump Relief Valve	1
231-3	51481	Ball—Sump Valve	1
231-4	62442	Spring—Sump Valve	1
231-5	62517	Gasket—Sump Valve	1
231-6	62492	Screw—Sump Valve	1
231-7	60185	Pin—Sump Valve Screw Lock	1
231-8	60025	Seal—Sump Relief Valve	1
231-9	AN380-C2-2	Pin—Cotter	2
235-1	62114	Eccentric Assembly	1
235-2	62106	Eccentric	1
235-3	57773	Retainer Assembly—Bearing	2
235-4	57773-1	Retainer—Bearing	2
235-5	57934	Roller—Bearing	124
235-6	60473	Gear—Governor Drive	1
235-7	60481	Segment—Thrust	3
235-8	59593	Pin Assembly—Lock	1
232-1	63785	Seal—Thrust Ring & Pump Housing	1
232-2	63790	Ring Assembly—Rotating Seal Thrust	1
232-3	63795	Screw—Thrust Ring Assembly	8
236	59100	Vane Motor Assembly	4
236-1	59099	Post—Vane Motor Center	1
236-2	61583	Ring—Center Post Thrust	1
236-3	59876	Seal—Oil Transfer Dowel	2
236-4	59875	Dowel—Vane Motor Oil Transfer	2
236-5	57719	Pin—Oil Control	2
236-6	59127	Plug—Pipe	4
236-7	59903	Seal—Center Post Lower	2
236-8	59904	Seal—Center Post Upper	1
236-9	61577	Gasket—Vane Motor End Plate	2
236-10	61582	Spring—End Plate Gasket	2
236-11	61564	Plate—Vane Motor Bottom End	1
236-12	59101	Vane—Barrel (Sold in Pairs Only)	1
236-13	59674	Vane—Blade (Sold in Pairs Only)	1
236-14	62661	Seal—Vane Strip	4
236-15	61565	Plate—Cover End	1
236-16	61579	Seal—Cover Nut	1
236-17	56988	Nut—Vane Motor Cover	1
236-18	60441	Pin—Cover Nut Clevis	1
236-19	AN380-2-2	Pin—Cotter	1
236-20	59601	Ring—Vane Motor Micro-Adjustment	1
236-21	59571	Ring—Micro-Adjustment Ring Snap	1
236-22	60569	Jack-Screw Assembly—Vane Motor	1
237-1	59512	Jack-Screw	1
237-2	60573	Slug—Jack-Screw	1
237-3	60572	Spring—Jack-Screw	1
237-4	60571	Plunger—Jack-Screw	1
237-5	60570	Latch—Jack-Screw	1

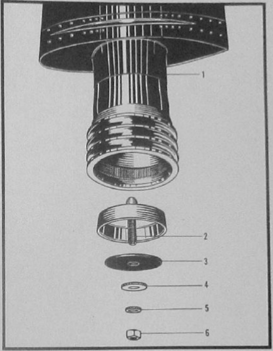


Figure 238—Blade Assembly

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	UNITS PER ASSY.
224	60577	Valve Assembly—Distributor	1
224-1	59523	. Sleeve—Distributor Valve (Sold in Pairs Only)	1
224-2	59524	. Valve—Distributor (Sold in Pairs Only)	1
224-3	60778	. Washer—Distributor Valve	1
224-4	59525	. Spring—Distributor Valve	1
224-5	57023	. Roller—Distributor Valve Cam	1
224-6	57032	. Pin—Distributor Valve Cam Roller	1
224-7	59526	. Lock—Distributor Valve	1
224-8	59527	. Pin—Distributor Valve Lock	1
238	2C15B1-30-M	Blade Assembly	4
238-1	65328	. Guard	1
238-2	50753	. Stud—Balancing Plug	1
238-3	56533	. Washer—Balancing	ar
238-4	60438	. Washer—Balancing	ar
238-5	AN935-816	. Washer—Lock	1
238-6	AN315-8R	. Nut	1
		Maximum amount of balancing washers allowable in blade. 56533 9; 60438 11	
238	2C15B1-24-B	Blade Assembly	4
238-1	65328	. Guard	1
238-2	50753	. Stud—Balancing Plug	1
238-3	56533	. Washer—Balancing	ar
238-4	60438	. Washer—Balancing	ar
238-5	AN935-816	. Washer—Lock	1
238-6	AN315-8R	. Nut	1

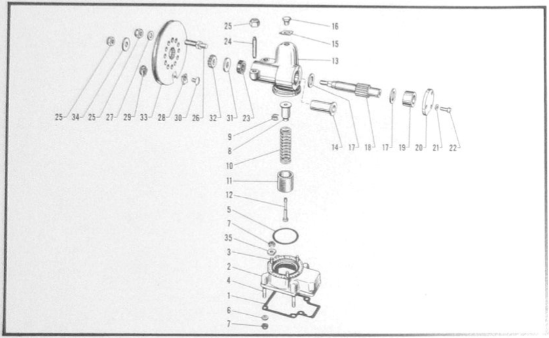


Figure 239—Governor Head Assembly

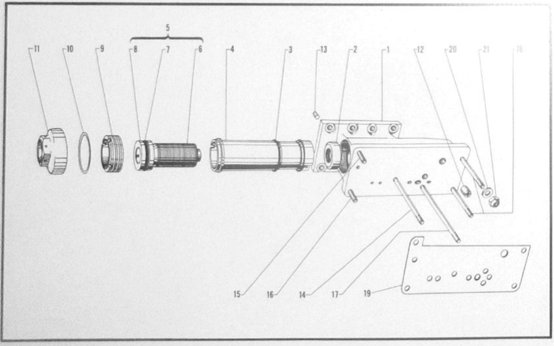


Figure 240—Servo Motor Assembly

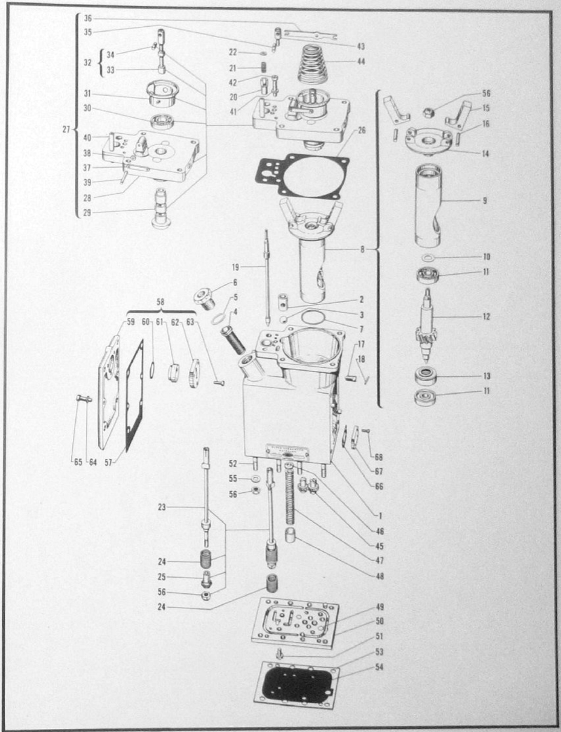


Figure 241—Governor Assembly

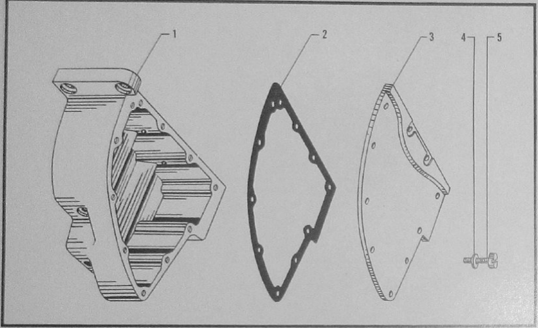


Figure 242—Lower Oil Sump Assembly

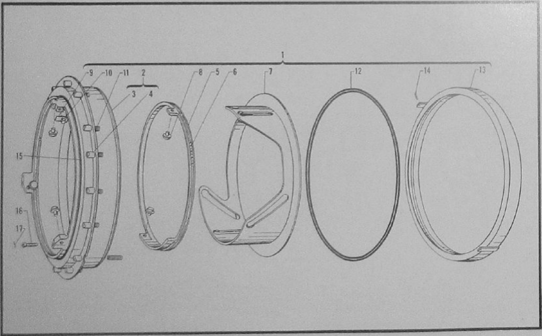


Figure 243—Translating Control Group

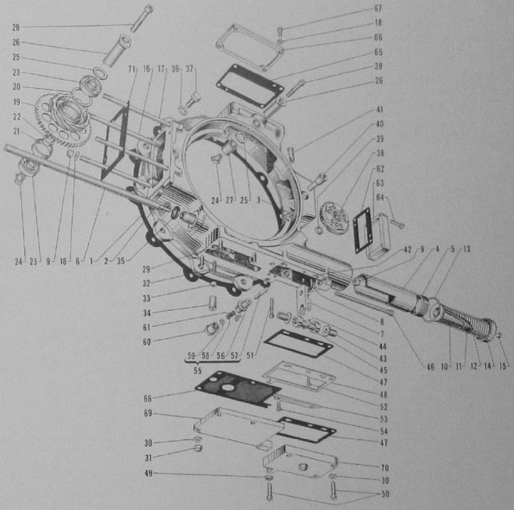


Figure 244—Control Support Group

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	UNITS PER ASSY.
221	63995	Control Assembly	1
239	59700	Head Assembly—Governor	1
239-1	58815	Gasket—Head & Governor	1
239-2	59698	Subhead	1
239-3	59726	Stud—Head & Subhead	4
239-4	59710	Stud—Subhead & Governor	3
239-5	58888	Gasket—Head & Subhead	1
239-6	AN960-10	Washer	4
239-7	AN365-1032	Nut—Self-Locking	7
239-8	59709	Nut—Balancing Spring Lock	1
239-9	59712	Spring—Lock Nut Lock	1
239-10	59706	Spring—Balancing	1
239-11	59704	Rack—Speeder Spring Adjusting	1
239-12	59708	Screw—Balancing Spring Adjusting	1
239-13	59699	Head—Governor	1
239-14	59717	Bushing—Control Shaft Flanged	1
239-15	59711	Washer—Head Plug Lock	1
239-16	59707	Plug—Head	1
239-17	59716	Washer—Control Shaft Thrust	2
239-18	59715	Shaft—Control	1
239-19	59703	Bushing—Control Shaft End Cover	1
239-20	59701	Cover—Control Shaft End	1
239-21	59702	Washer—End Cover Screw	3
239-22	503-8-8	Screw	3
239-23	59714	Seal—Control Shaft Oil	1
239-24	59713	Screw—RPM Adjustment	2
239-25	AN365-428	Nut—Self-Locking	4
239-26	59724	Pin—Pulley Stop	1
239-27	AN960-416	Washer	1
239-28	63291	Clamp—Cable	1
239-29	62978	Nut Assembly—Cable Clamp	1
239-30	59725	Screw—Cable Clamp	1
239-31	59722	Washer—Pulley (Inner)	1
239-32	59718	Insert—Pulley	1
239-33	61792	Pulley	1
239-34	59723	Washer—Pulley (Outer)	1
239-35	58909	Clamp—Head & Subhead	3
	57761	Wire—Safety	ar
240	63210	Servo Motor Assembly	1
240-1	63211	Housing—Servo Motor	1
240-2	59284	Seal—Servo Oil	1
240-3	59332	Seal—Toroid	3
240-4	63214	Liner—Piston	1
240-5	63294	Piston Assembly—Servo	1
240-6	62943	Piston—Servo	1
240-7	62986	Seal—Servo Piston	1
240-8	63273	Retainer—Servo Piston	1
240-9	59279	Nut—Piston Liner Inner Lock	1
240-10	59281	Gasket—Lock Nut	1
240-11	59280	Nut—Piston Liner Outer Lock	1
240-12	62936	Valve Assembly—Check	1
240-13	58796	Dowel	2

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	UNITS PER ASSY.
240-14	58866	Stud—Servo Motor & Solenoid Housing	1
240-15	58869	Stud—Servo Motor & Solenoid Housing	1
240-16	59278	Stud	1
240-17	59282	Stud—Servo Motor & Solenoid Housing	1
240-18	59283	Stud—Servo Motor & Solenoid Housing	2
240-19	59171	Gasket—Servo Motor & Solenoid Housing	1
240-20	AN960-10	Washer	6
240-21	AN365-1032	Nut—Self-Locking	6
	51218	Wire—Safety	ar
241	61887	Governor Assembly	1
241-1	61888	Body Assembly—Governor	1
241-2	59333	Retainer—Governor Sump Check Valve	1
241-3	52480	Ball—Governor Sump Check Valve	1
241-4	59266	Filter Assembly—Oil	1
241-5	60273	Gasket—Sump Filler Plug	1
241-6	58813	Plug—Governor Sump Filler	1
241-7	59332	Seal—Toroid	1
241-8	59268	Fly-Weight Head Assembly	1
241-9	59269	Bushing—Drive Gear Shaft	1
241-10	60278	Shim—Laminated	ar
241-11	58856	Bearing—Ball	2
241-12	58854	Shaft—Drive Gear	1
241-13	58855	Seal—Bellows Oil	1
241-14	58859	Head—Fly-Weight	1
241-15	58777	Fly-Weight	2
241-16	58861	Pin—Fly-Weight Hinge	2
241-17	59336	Screw—Drive Shaft Bushing Lock	1
241-18	59149	Key—Drive Shaft Bushing Lock Screw	1
241-19	58794	Valve—Needle	1
241-20	58805	Lock—Needle Valve	1
241-21	58806	Spring—Needle Valve	1
241-22	58807	Washer—Needle Valve Spring	1
241-23	58789	Piston—Compensating	1
241-24	58791	Spring—Compensating Piston	2
241-25	58790	Seat—Compensating Piston Spring	1
241-26	59330	Gasket—Controlet & Governor	1
241-27	61879	Controlet Assembly	1
241-28	61880	Controlet	1
241-29	58776	Sleeve—Pilot Valve	1
241-30	58760	Bearing—Spring Seat Ball	1
241-31	58810	Seat Assembly—Spring	1
241-32	59689	Valve Assembly—Pilot	1
241-33	58775	Valve—Pilot	1
241-34	59690	Pin—Pilot Valve	1
241-35	58771	Pin—Compensation Link	1
241-36	58770	Link—Compensation	1

RESTRICTED

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	UNITS PER ASSY.
241-37	58769	Link—Spring Seat	1
241-38	58773	Washer—Link Pin	2
241-39	58772	Pin—Compensation Link Center	1
241-40	59398	Dowel—Vent	1
241-41	AN960-6	Washer	2
241-42	500A6-12	Screw	2
241-43	58811	Fork—Compensating Piston	1
241-44	SK7226	Spring—Speeder	1
241-45	58795	Gear—Governor Pump	2
241-46	59334	Spacer—Relief Valve Spring	1
241-47	58787	Spring—Accumulator Relief Valve	1
241-48	58788	Piston—Accumulator Relief Valve	1
241-49	58798	Plug—Bottom Plate	2
241-50	61886	Plate—Governor Bottom	1
241-51	58782	Screw—Bottom Plate	4
241-52	61875	Stud—Governor & Servo Motor	8
241-53	59287	Shim—Governor Base Gasket	1
241-54	59288	Gasket—Governor Base	1
241-55	AN960-10	Washer	8
241-56	AN365-1032	Nut—Self-Locking	10
241-57	61884	Gasket—Governor Sump Cover	1
241-58	61885	Cover Assembly—Governor Sump	1
241-59	61883	Cover—Governor Sump	1
241-60	60277	Gasket—Sight Glass	1
241-61	60275	Glass—Sight	1
241-62	60276	Retainer—Sight Glass	1
241-63	500A-6-5	Screw	3
241-64	AN960-8	Washer	2
241-65	503-8-8	Screw	2
241-66	63406	Gasket—Auxiliary Pump Cover	1
241-67	59314	Cover—Auxiliary Pump	1
241-68	503-6-6	Screw	3
	57761	Wire—Safety	ar
	995-32-1	Wire—Safety	5
242	61640	Sump Assembly—Lower Oil	1
242-1	61639	Case—Lower Oil Sump	1
242-2	61637	Gasket—Lower Oil Sump Cover	1
242-3	61620	Cover—Lower Oil Sump	1
242-4	60740	Washer—Lower Oil Sump Cover Screw	10
242-5	503-10-8	Screw	10
243-1	63994	Translating Control Assembly	1
243-2	63787	Race Assembly—Rotating Seal Support	1
243-3	63786	Race—Rotating Seal Support	1
243-4	63782	Seat—Rotating Seal Spring	16
243-5	61601	Race—Inner Ball	1
243-6	53909	Ball	155
243-7	62140	Plate—Distributor Valve Thrust	1
243-8	60720	Roller—Distributor Valve Thrust Plate	5
243-9	61421	Washer—Thrust Plate Stop	1
243-10	61422	Stop—Thrust Plate	1
243-11	63783	Spring—Rotating Seal	16
243-12	63784	Seal—Toroid	1
243-13	63794	Rotating Seal Assembly	1
243-14	AN380-2-1	Pin—Cotter	2
243-15	61334	Seal—Toroid	1
243-16	61814	Screw—Translating Control Retaining	3
243-17	61384	Wire—Retaining Screw Lock	3
244	60553	Support Assembly—Control	1
244-1	58056	Gasket—Engine Nose	1
244-2	60566	Support—Control	1
244-3	62095	Dowel—Locating	1
244-4	61331	Liner—Control Support	1
244-5	61088	Nut—Control Support Inner Lock	1
244-6	60555	Rack—Servo	1
244-7	61436	Guide—Spring Seat	1
244-8	60348	Pin—Servo Rack Guide	1
244-9	AN365-428	Nut—Self-Locking	5
244-10	61332	Guide—Spring	1
244-11	61330	Spring—Servo Inner	1
244-12	61329	Spring—Servo Outer	1
244-13	59281	Gasket—Lock Nut	1
244-14	61174	Nut—Control Support Outer Lock	1
244-15	59127	Plug—Pipe	1
244-16	60551	Stud—Control Support & Governor	1
244-17	59305	Stud—Control Support & Governor	3
244-18	AN960-416	Washer	8
244-19	58761	Gear—Governor Drive & Idler	1
244-20	58739	Ring—Snap	1
244-21	58743	Spacer—Outer Bearing	1
244-22	58744	Spacer—Inner Bearing	1
244-23	58876	Bearing—Ball	2
244-24	60564	Nut—Drive & Idler Gear Securing	2
244-25	60743	Spacer—Governor Drive & Idler Gear	2
244-26	60563	Shaft—Drive & Idler Gear	2
244-27	60565	Spacer—Drive & Idler Shaft	1
244-28	60560	Screw—Drive & Idler Shaft	2
244-29	59278	Stud	3
244-30	AN960-10	Washer	12
244-31	AN365-1032	Nut—Self-Locking	3
244-32	59327	Spring—Control Support Check Valve	1
244-33	51872	Ball—Check	1
244-34	59298	Bushing—Control Support Check Valve	1
244-35	59696	Gasket—Control Support & Servo Motor	1
244-36	AN960-516	Washer	12
244-37	AN75-6	Screw	12

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	UNITS PER ASSY.
244-38	60547	Wheel Assembly—Ratchet	1
244-39	59323	Spacer—Rachet Wheel Shaft	1
244-40	59320	Shaft—Ratchet Wheel	1
244-41	59326	Lock Assembly—Ratchet Wheel	1
244-42	60955	Dowel—Index Plate	2
244-43	61434	Stop—Feather & Reverse Pitch	2
244-44	61437	Screw—Pitch Stop	1
244-45	61428	Stop—High & Low Pitch	2
244-46	60925	Shaft—Pitch Stop Screw	1
244-47	62961	Gasket—Index Plate	2
244-48		Plate—Index	1
		Use index plate indicated for specified pitch range.	
		Pitch Range — Index Plate	
		−25° to +95° — 61444	
		−28° to +92° — 63198	
		−31° to +89° — 63199	
244-49	59172	Washer	1
244-50	AN502-10-16	Screw	4
244-51	500-10-20	Screw	1
244-52	503-10-6	Screw	1
244-53	61424	Plate—Pitch Stop Lock	1
244-54	503-8-6	Screw	2

FIGURE & INDEX NUMBER	PART NUMBER	NOMENCLATURE 1 2 3 4	UNITS PER ASSY.
244-55	61453	Pin Assembly—Calibrating	1
244-56	61435	Bushing—Calibrating Pin Eccentric	1
244-57	61438	Pin—Calibrating	1
244-58	60944	Spring—Calibrating Pin	1
244-59	61439	Washer—Calibrating Pin	1
244-60	60940	Cap—Calibrating Pin	1
244-61	503-8-8	Screw	1
244-62	62988	Gasket—Wiring Harness Pad Cover	1
244-63	62573	Cover—Wiring Harness Pad	1
244-64	503-10-22	Screw	4
244-65	62915	Gasket—Pad Cover	1
244-66	60562	Cover—Auxiliary Pad	1
244-67	503-416-10	Screw	4
244-68	59292	Gasket—Pitch Transmitter Pad Cover	1
244-69	59386	Cover—Transmitter Pad	1
244-70	62950	Cover Assembly—Pitch Limit Pad	1
244-71	62914	Gasket—Governor-Control Support	1
	51218	Wire—Safety	ar
	57761	Wire—Safety	ar

SECTION X

NUMERICAL PARTS LIST

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
U.S. NAVY	U.S. ARMY	BRITISH			
	4013	125L	AS-92-60A	223-13	1
	4013	125L	AS-93-60A	222-1	1
	4013	125L	SK7226	241-44	1
	4013	125L	50753	238-2	4
	4013	125L	51218		ar
	4013	125L	51481	231-3	1
	4013	125L	51872	225-2	1
				244-33	1
	4013	125L	52480	241-3	1
	4013	125L	53909	243-6	155
	4013	125L	56533	238-3	ar
	4013	125L	56988	236-17	4
	4013	125L	57023	224-5	1
	4013	125L	57032	224-6	1
	4013	125L	57302	227-8	1
	4013	125L	57359	222-14	4
	4013	125L	57719	236-5	8
	4013	125L	57761		ar
	4013	125L	57773	235-3	2
	4013	125L	57773-1	235-4	2
	4013	125L	57934	235-5	128
	4013	125L	58041	222-13	4
	4013	125L	58042	222-15	8
	4013	125L	58056	244-1	1
	4013	125L	58097	222-12	736
	4013	125L	58343	222-19	8
	4013	125L	58354	233-7	4
	4013	125L	58355	233-9	8
	4013	125L	58360	226-6	8
	4013	125L	58364	226-10	8
	4013	125L	58365	226-11	8
	4013	125L	58366	226-7	8
	4013	125L	58367	226-8	8
	4013	125L	58368	233-12	8
	4013	125L	58377	234-4	18
	4013	125L	58387	226-18	8
	4013	125L	58462	226-19	8
	4013	125L	58511	234-3	2
	4013	125L	58512	234-5	2
	4013	125L	58603	227-9	1
	4013	125L	58604	227-3	1
	4013	125L	58605	227-7	ar
	4013	125L	58606	227-6	1
	4013	125L	58661	226-9	8
	4013	125L	58681	226-12	8
	4013	125L	58739	244-20	1
	4013	125L	58743	244-21	1
	4013	125L	58744	244-22	1
	4013	125L	58760	241-30	1
	4013	125L	58761	244-19	1
	4013	125L	58769	241-37	1
	4013	125L	58770	241-36	1
	4013	125L	58771	241-35	1
	4013	125L	58772	241-39	1

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
U.S. NAVY	U.S. ARMY	BRITISH			
	4013	125L	58773	241-38	2
	4013	125L	58775	241-33	1
	4013	125L	58776	241-29	1
	4013	125L	58777	241-15	2
	4013	125L	58782	241-51	4
	4013	125L	58787	241-47	1
	4013	125L	58788	241-48	1
	4013	125L	58789	241-23	1
	4013	125L	58790	241-25	1
	4013	125L	58791	241-24	2
	4013	125L	58794	241-19	1
	4013	125L	58795	241-45	2
	4013	125L	58796	240-13	2
	4013	125L	58798	241-49	2
	4013	125L	58805	241-20	1
	4013	125L	58806	241-21	1
	4013	125L	58807	241-22	1
	4013	125L	58810	241-31	1
	4013	125L	58811	241-43	1
	4013	125L	58813	241-6	1
	4013	125L	58815	239-1	1
	4013	125L	58854	241-12	1
	4013	125L	58855	241-13	1
	4013	125L	58856	241-11	2
	4013	125L	58859	241-14	1
	4013	125L	58861	241-16	2
	4013	125L	58866	240-14	1
	4013	125L	58869	240-15	1
	4013	125L	58876	244-23	2
	4013	125L	58888	239-5	1
	4013	125L	58909	239-35	3
	4013	125L	59099	236-1	4
	4013	125L	59100	236	4
	4013	125L	59101	236-12	4
	4013	125L	59127	236-6	16
				244-15	1
	4013	125L	59149	241-18	1
	4013	125L	59171	240-19	1
	4013	125L	59172	244-49	1
	4013	125L	59199	226-2	8
	4013	125L	59203	226-5	8
	4013	125L	59204	226-4	8
	4013	125L	59266	241-4	1
	4013	125L	59268	241-8	1
	4013	125L	59269	241-9	1
	4013	125L	59278	240-16	1
				244-29	3
	4013	125L	59279	240-9	1
	4013	125L	59280	240-11	1
	4013	125L	59281	240-10	1
				244-13	1
	4013	125L	59282	240-17	1
	4013	125L	59283	240-18	2
	4013	125L	59284	240-2	1

PROPERTY CLASSIFICATION U.S. NAVY	U.S. ARMY	BRITISH	PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
	4013	125L	59287	241-53	1
	4013	125L	59288	241-54	1
	4013	125L	59292	244-68	1
	4013	125L	59298	244-34	1
	4013	125L	59305	244-17	3
	4013	125L	59314	241-66	1
	4013	125L	59320	244-40	1
	4013	125L	59323	244-39	1
	4013	125L	59326	244-41	1
	4013	125L	59327	244-32	1
	4013	125L	59330	241-26	1
	4013	125L	59332	240-3	3
				241-7	1
	4013	125L	59333	241-2	1
	4013	125L	59334	241-46	1
	4013	125L	59336	241-17	1
	4013	125L	59386	244-69	1
	4013	125L	59398	241-40	1
	4013	125L	59424	233-2	1
	4013	125L	59426	233-3	1
	4013	125L	59427	233-4	1
	4013	125L	59428	233-5	1
	4013	125L	59432	234-2	1
	4013	125L	59436	234-1	1
	4013	125L	58438	226-14	8
	4013	125L	59439	226-15	8
	4013	125L	59440	226-16	152
	4013	125L	59441	233-14	1
	4013	125L	59445	233-1	1
	4013	125L	59456	222-2	1
	4013	125L	59512	237-1	4
	4013	125L	59523	224-1	1
	4013	125L	59524	224-2	1
	4013	125L	59525	224-4	1
	4013	125L	59526	224-7	1
	4013	125L	59527	224-8	1
	4013	125L	59529	222-6	1
	4013	125L	59550	222-5	1
	4013	125L	59571	236-21	4
	4013	125L	59572	223-2	1
	4013	125L	59587	222-20	8
	4013	125L	59593	235-8	1
	4013	125L	59595	223-10	1
	4013	125L	59596	223-12	1
	4013	125L	59597	223-11	1
	4013	125L	59598	223-1	1
	4013	125L	59601	236-20	4
	4013	125L	59603	222-3	1
	4013	125L	59604	223-8	1
	4013	125L	59607	223-9	1
	4013	125L	59610	222-4	1
	4013	125L	59612	223-6	ar
	4013	125L	59615	222-7	1
	4013	125L	59619	223-14	1
	4013	125L	59645	226-17	8
	4103	125L	59674	236-13	4
	4013	125L	59689	241-32	1
	4013	125L	59690	241-34	1
	4013	125L	59696	244-35	1

PROPERTY CLASSIFICATION U.S. NAVY	U.S. ARMY	BRITISH	PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUANTITY
	4013	125L	59698	239-2	1
	4013	125L	59699	239-13	1
	4013	125L	59700	239	1
	4013	125L	59701	239-20	1
	4013	125L	59702	239-21	3
	4013	125L	59703	239-19	1
	4013	125L	59704	239-11	1
	4013	125L	59706	239-10	1
	4013	125L	59707	239-16	1
	4013	125L	59708	239-12	1
	4013	125L	59709	239-8	1
	4013	125L	59710	239-4	3
	4013	125L	59711	239-15	1
	4013	125L	59712	239-9	1
	4013	125L	59713	239-24	2
	4013	125L	59714	239-23	1
	4013	125L	59715	239-18	1
	4013	125L	59716	239-17	2
	4013	125L	59717	239-14	1
	4013	125L	59718	239-32	1
	4013	125L	59722	239-31	1
	4013	125L	59723	239-34	1
	4013	125L	59724	239-26	1
	4013	125L	59725	239-30	1
	4013	125L	59726	239-3	4
	4013	125L	59875	236-4	8
	4013	125L	59876	236-3	8
	4013	125L	59903	236-7	8
	4013	125L	59904	236-8	4
	4013	125L	60024	227-5	1
	4013	125L	60025	231-8	1
	4013	125L	60026	227-4	1
	4013	125L	60180	233-16	1
	4013	125L	60185	231-7	1
	4013	125L	60194	233-18	ar
	4013	125L	60256	222-17	4
	4013	125L	60257	222-18	4
	4013	125L	60273	241-5	1
	4013	125L	60275	241-61	1
	4013	125L	60276	241-62	1
	4013	125L	60277	241-60	1
	4013	125L	60278	241-10	ar
	4013	125L	60288	233-17	ar
	4013	125L	60338	233-11	16
	4013	125L	60348	244-8	1
	4013	125L	60438	238-4	ar
	4013	125L	60441	236-18	4
	4013	125L	60473	235-6	1
	4013	125L	60481	235-7	3
	4013	125L	60547	244-38	1
	4013	125L	60551	244-16	1
	4013	125L	60553	244	1
	4013	125L	60555	244-6	1
	4013	125L	60560	244-28	2
	4013	125L	60562	244-66	1
	4013	125L	60563	244-26	2
	4013	125L	60564	244-24	2
	4013	125L	60565	244-27	1
	4013	125L	60566	244-2	1
	4013	125L	60569	236-22	4

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUAN-TITY
U.S. NAVY	U.S. ARMY	BRITISH			
	4013	125L	60570	237-5	4
	4013	125L	60571	237-4	4
	4013	125L	60572	237-3	4
	4013	125L	60573	237-2	4
	4013	125L	60577	224	1
	4013	125L	60720	243-8	5
	4013	125L	60740	242-4	10
	4013	125L	60743	244-25	2
	4013	125L	60778	224-3	1
	4013	125L	60831	223-4	1
	4013	125L	60833	223-5	1
	4013	125L	60925	244-46	1
	4013	125L	60940	244-60	1
	4013	125L	60944	244-58	1
	4013	125L	60955	244-42	2
	4013	125L	61088	244-5	1
	4013	125L	61174	244-14	1
	4013	125L	61191	223-3	1
	4013	125L	61193	226-13	8
	4013	125L	61274	233-6	1
	4013	125L	61329	244-12	1
	4013	125L	61330	244-11	1
	4013	125L	61331	244-4	1
	4013	125L	61332	244-10	1
	4013	125L	61334	243-15	1
	4013	125L	61384	243-17	3
	4013	125L	61393	227-12	2
				228-1	2
				229-1	2
				230-1	2
				233-8	4
	4013	125L	61415	227-2	1
	4013	125L	61421	243-9	1
	4013	125L	61422	243-10	1
	4013	125L	61424	244-53	1
	4013	125L	61428	244-45	2
	4013	125L	61434	244-43	2
	4013	125L	61435	244-56	1
	4013	125L	61436	244-7	1
	4013	125L	61437	244-44	1
	4013	125L	61438	244-57	1
	4013	125L	61439	244-59	1
	4013	125L	61444	244-48	1
	4013	125L	61453	244-55	1
	4013	125L	61454	230-2	1
	4013	125L	61455	229-2	1
	4013	125L	61535	228-2	1
	4013	125L	61536	227-1	1
	4013	125L	61559	227-14	1
				228-4	1
				229-4	1
				230-4	1
	4013	125L	61560	227-13	1
				228-3	1
				229-3	1
				230-3	1
	4013	125L	61564	236-11	4
	4013	125L	61565	236-15	4
	4013	125L	61577	236-9	8

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUAN-TITY
U.S. NAVY	U.S. ARMY	BRITISH			
	4013	125L	61579	236-16	4
	4013	125L	61582	236-10	8
	4013	125L	61583	236-2	4
	4013	125L	61601	243-5	1
	4013	125L	61620	242-3	1
	4013	125L	61637	242-2	1
	4013	125L	61639	242-1	1
	4013	125L	61640	242	1
	4013	125L	61656	227-11	1
	4013	125L	61792	239-33	1
	4013	125L	61814	243-16	3
	4013	125L	61871	222-16	4
	4013	125L	61875	241-52	8
	4013	125L	61879	241-27	1
	4013	125L	61880	241-28	1
	4013	125L	61883	241-59	1
	4013	125L	61884	241-57	1
	4013	125L	61885	241-58	1
	4013	125L	61886	241-50	1
	4013	125L	61887	241	1
	4013	125L	61888	241-1	1
	4013	125L	62073	225-3	1
	4013	125L	62076	225-4	1
	4013	125L	62078	222-25	1
	4013	125L	62085	222-26	2
	4013	125L	62095	244-3	1
	4013	125L	62104	226-3	8
	4013	125L	62106	235-2	1
	4013	125L	62114	235-1	1
	4013	125L	62140	243-7	1
	4013	125L	62186	226-1	8
	4013	125L	62225	220	1
	4013	125L	62247	234	1
	4013	125L	62254	223-9	1
	4013	125L	62255	223-9	1
	4013	125L	62260	223-8	1
	4013	125L	62261	223-8	1
	4013	125L	62347	223-7	1
	4013	125L	62357	222-9	1
	4013	125L	62364	222-10	32
	4013	125L	62366	222-8	1
	4013	125L	62436	222-22	1
	4013	125L	62437	222-21	1
	4013	125L	62442	231-4	1
	4013	125L	62492	231-6	1
	4013	125L	62493	231-2	1
	4013	125L	62494	231-1	1
	4013	125L	62517	231-15	1
	4013	125L	62573	244-63	1
	4013	125L	62615	222-11	16
	4013	125L	62661	236-14	16
	4013	125L	62914	244-71	1
	4013	125L	62915	244-65	1
	4013	125L	62936	240-12	1
	4013	125L	62943	240-6	1
	4013	125L	62950	244-70	1
	4013	125L	62961	244-47	2
	4013	125L	62978	239-29	1
	4013	125L	62986	240-7	1

PROPERTY CLASSIFICATION			PART NUMBER	FIGURE & INDEX NUMBER	TOTAL QUAN-TITY
U.S. NAVY	U.S. ARMY	BRITISH			
	4013	125L	62988	244-62	1
	4013	125L	63198	244-48	1
	4013	125L	63199	244-48	1
	4013	125L	63210	240	1
	4013	125L	63211	240-1	1
	4013	125L	63214	240-4	1
	4013	125L	63273	240-8	1
	4013	125L	63291	239-28	1
	4013	125L	63294	240-5	1
	4013	125L	63406	241-66	1
	4013	125L	63724	222-24	1
	4013	125L	63782	243-4	16
	4013	125L	63783	243-11	16
	4013	125L	63784	243-12	1
	4013	125L	63785	232-1	1
	4013	125L	63786	243-3	1
	4013	125L	63787	243-2	1
	4013	125L	63790	232-2	1
	4013	125L	63794	243-13	1
	4013	125L	63795	232-3	8
	4013	125L	63879	225-1	1
	4013	125L	63889	225-11	1
	4013	125L	63891	225-13	1
	4013	125L	63892	225-6	1
	4013	125L	63893	225-14	1
	4013	125L	63894	225-12	1
	4013	125L	63895	225-16	1
	4013	125L	63896	225-15	1
	4013	125L	63898	225-10	2
	4013	125L	63897	225-9	2
	4013	125L	63899	225-7	1
	4013	125L	63900	225	1
	4013	125L	63994	243-1	1
	4013	125L	63995	221	1
	4013	125L	65328	238-1	4
	4013	125L	2C15B1-24-B	238	4
	4013	125L	2C15B1-20-M	238	4

SECTION XI

STANDARD PARTS LIST

PART NUMBER	NOMENCLATURE	FIGURE & INDEX NUMBER	TOTAL QUAN-TITY
AN75-6	Screw	244-37	12
AN315-8R	Nut	238-6	4
AN364-428	Nut	233-13	16
AN364-1032	Nut	233-20	ar
AN365-428	Nut	239-25	4
		244-9	5
AN365-1032	Nut	239-7	7
		240-21	6
		241-56	10
		244-31	3
AN380-1-1	Pin—Cotter	225-8	1
AN380-2-1	Pin—Cotter	225-17	2
		243-14	2
AN380-2-2	Pin—Cotter	222-23	1
		225-5	1
		236-19	4
AN380-C2-2	Pin—Cotter	227-10	1
		231-9	2
		233-10	6
500-10-20	Screw	244-51	1
500A-6-5	Screw	241-63	3
500A6-12	Screw	241-42	2
AN502-10-16	Screw	244-50	4
503-6-6	Screw	241-68	3
503-8-6	Screw	244-54	2
503-8-8	Screw	239-22	3
		241-65	2
		244-61	1
503-10-6	Screw	244-52	1
503-10-8	Screw	242-5	10
503-10-22	Screw	244-64	4
503-416-10	Screw	244-67	4
AN900-16	Gasket	233-15	1
AN935-816	Washer	228-5	1
AN960-6	Washer	231-41	2
AN960-8	Washer	231-64	2
AN960-10	Washer	239-6	4
		240-20	6
		241-55	8
		244-30	12
AN960-416	Washer	239-27	1
		244-18	8
AN960-516	Washer	244-36	12
AN970-3	Washer	223-19	ar
995-32-1	Wire—Safety		5

SECTION XII

SERVICE TOOLS

FIGURE & INDEX NO.	NOMENCLATURE	PART NO.
245-1	Retaining Nut Wrench	61322
245-2	Distributor Valve Cap Wrench	61321
245-3	Distributor Valve Gage	63098

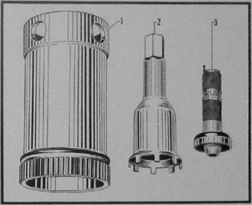


Figure 245 — Service Tools

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