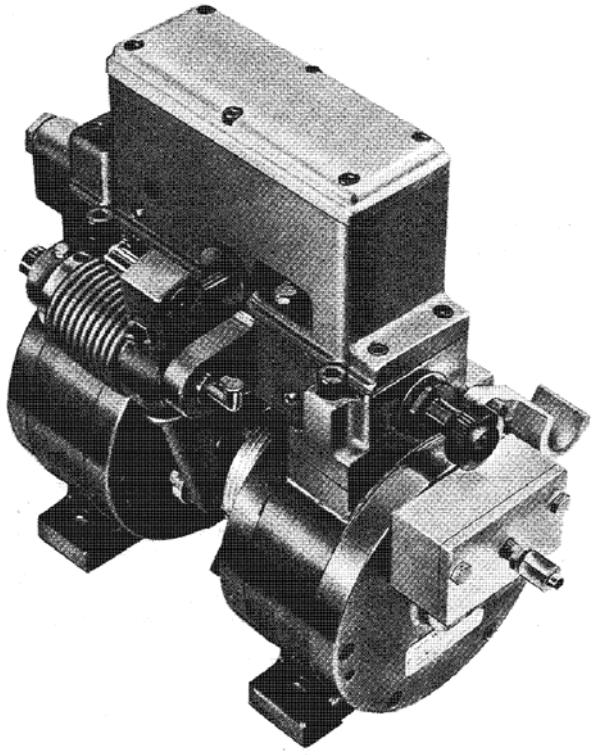
WOODWARD

Product Manual 36049
(Revision D)
Original Instructions



Control System for Controllable Pitch Marine Propellers

Operation Manual

IMPORTANT

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DEFINITIONS

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

WARNING

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, be sure to check the *publications page* on the Woodward website:
www.woodward.com/publications
The current revision and distribution restriction of all publications are shown in manual *26311*.

The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

NOTICE

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Contents

Illustrations and Tables

Chapter 1.
General Information

This manual provides description, operation, maintenance, and replacement parts information for the pitch control assembly. To better understand how the pitch control assembly operates, this manual ties together the components necessary to form an automatic pitch control system for a controllable pitch marine propeller.

The pitch control system offers:

- Control of engine speed
- Selection of any one engine to serve as the “lead” unit, thus permitting equal distribution of operating hours among the engines
- Single lever control, from the pilot house or other location, which provides stepless remote control of engine speed setting, reversal of propeller pitch control, and manual control of propeller pitch over a small power range (inching)
- A load control scheme that acts upon the propeller pitch setting mechanism to produce a prescribed engine load for each engine speed setting (thus, the single lever control in effect controls the horsepower output of the engine). The same load control curve is followed for both directions of propulsion
- Prevention of continuous engine overloading or underloading
- Provision for readily blocking all automatic features to permit manual adjustment of the pitch control assembly and speed setting for emergency operation

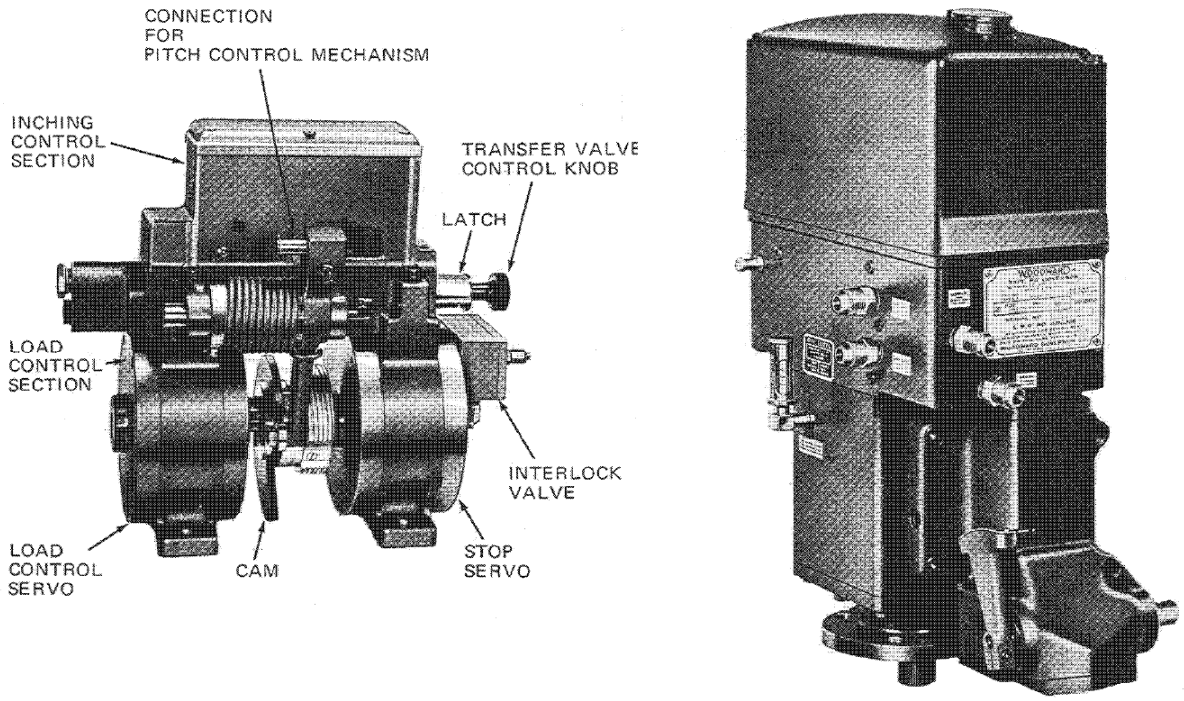


Figure 1-1. Pitch Control Assembly and Typical PG Governor

The pitch control system envisions two or more engines being operated in parallel to drive a common propeller shaft and permit selection of any engine as "lead" unit. A governor on the "lead" unit operates the pitch control assembly. Since normal operating conditions are not likely to require all engines to operate at all times, judicious selection of the "lead" unit will, over a long period of time, permit all engines to operate approximately the same number of hours.

The pitch control system consists of the following components. See Figure 1-2 for an interconnecting diagram illustrating the connections between components.

PG Governor—The governor used in this pitch control system is one of the many configurations in which pressure compensation can be furnished. The primary function of the governor is to control engine speed. It accomplishes this by positioning the fuel pump racks to give the engine the fuel needed to maintain a desired speed.

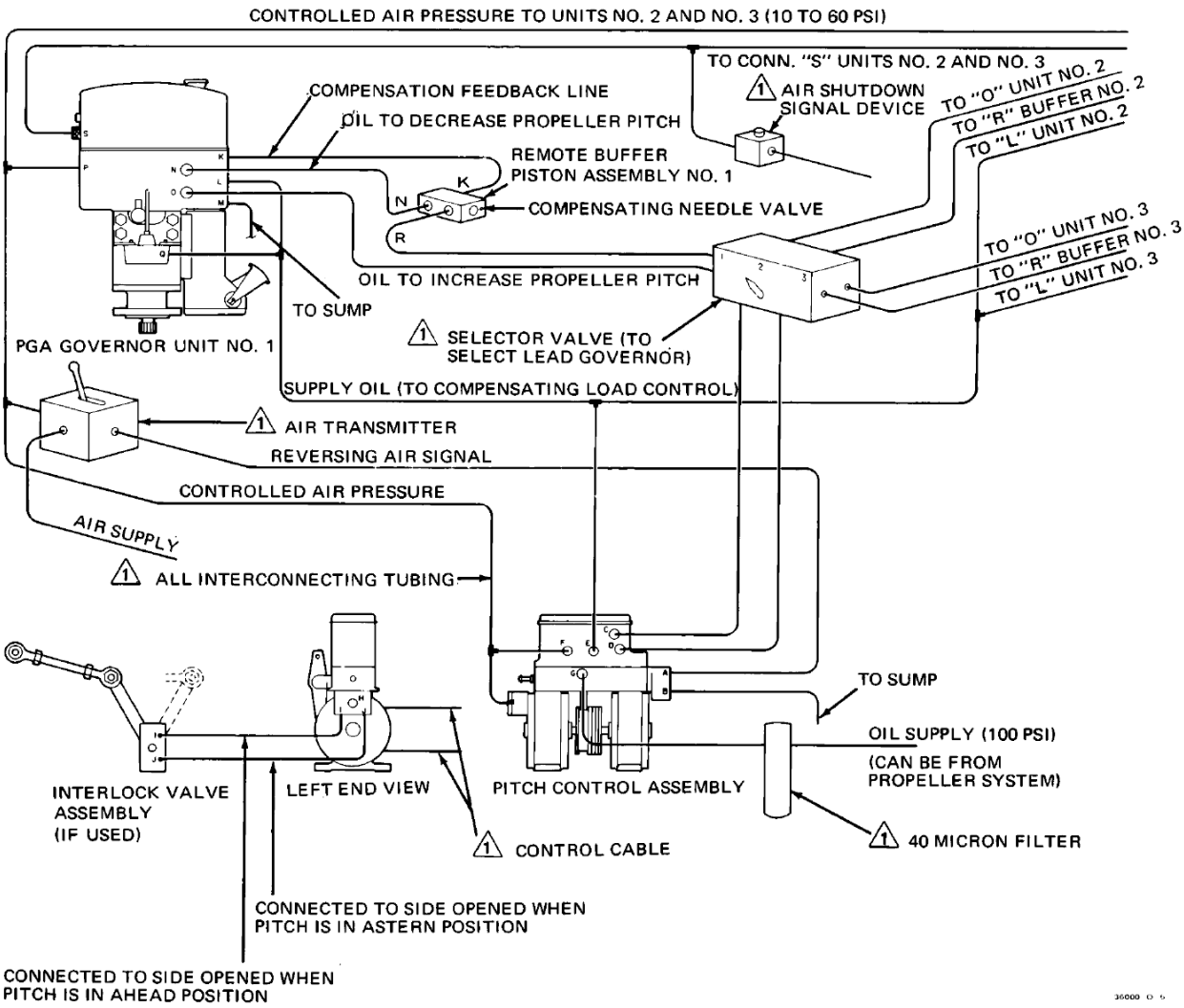


Figure 1-2. Typical Pitch Control System Interconnecting Diagram

LEGEND AND NOTES FOR FIGURE 2

REF. LTR.	FITTING SIZE	TUBING DIAMETER	USED FOR CONNECTION TO:
A	.562-18UNF-2B	.375 O.D.	SEND REVERSING AIR SIGNAL (FROM AIR TRANSMITTER)
B	1.312-12UNF-2B	1.000 O.D. *	TO SUMP
C	.750-16UNF-2B	.750 O.D. *	SELECTOR VALVE (OIL FROM CONN. "N")
D	.750-16UNF-2B	.750 O.D. *	SELECTOR VALVE (OIL FROM CONN. "O")
E	.750-16UNF-2B	.750 O.D. *	SUPPLY OIL FOR "L" (LOAD CONTROL PILOT VALVE) AND FOR "Q" (FLOW CONTROL VALVE)
F	.562-18UNF-2B	.375 O.D.	AIR TRANSMITTER
G	1.062-12UN -2B	.750 O.D.	SUPPLY OIL (CAN BE FROM PROPELLER SYSTEM)
H	.562-18UNF-2B	.375 O.D.	AIR TRANSMITTER
I & J	.438-20UNF-2B	.250 O.D.	INTERLOCK VALVE ASS'Y (CONN. "I") & (CONN. "J")
K	.438-20UNF-2B	.250 O.D.	BUFFER PISTON (CONN. "K")
L	.750-16UNF-2B	.500 O.D. *	SUPPLY FROM PROPELLER PITCH CONTROL (CONN. "E")
M	.750-16UNF-2B	.500 O.D. *	DRAIN TO PROPELLER OIL SUMP
N	.750-16UNF-2B	.500 O.D. *	TO PROPELLER PITCH CONTROL—TO DECREASE PITCH (CONN. "N" ON BUFFER PISTON)
O	.750-16UNF-2B	.500 O.D. *	TO PROPELLER PITCH CONTROL—TO INCREASE PITCH (CONN. "D")
P	.438-20UNF-2B	.250 O.D.	SPEED CONTROL AIR PRESSURE
Q	.438-20UNF-2B	.250 O.D.	SUPPLY FROM PROPELLER PITCH CONTROL (CONN. "E")
R	.750-16UNF-2B	.500 O.D. *	SELECTOR VALVE (OIL FROM CONN. "N")
S	BULKHEAD TYPE	.250 O.D.	AIR SHUTDOWN SIGNAL DEVICE (FITTING FURNISHED)

* TUBING DIAMETERS LISTED ARE MINIMUM FOR REASONABLY STRAIGHT RUNS OF 25 FEET OR LESS. USE LARGER DIAMETER LINES IF OVER 25 FEET OR WHEN SEVERAL BENDS OR FITTINGS ARE IN THE LINE.

⚠1 SYMBOL INDICATES PARTS NOT FURNISHED BY WOODWARD GOVERNOR CO.

SYMBOL INDICATES PIPING CONNECTIONS—FITTINGS ARE NOT FURNISHED BY WOODWARD GOVERNOR CO. UNLESS SPECIFIED OTHERWISE.

ALL STRAIGHT THREAD FITTINGS ARE PER MS 16142.

MOUNTING SURFACES FOR ALL UNITS MUST BE FLAT WITHIN .005 PER FOOT AND PARALLEL WITHIN .003 PER FOOT AND IN THE SAME PLANE.

Simultaneously with controlling engine speed, the governor controls the horsepower output of the engine at a given speed setting. The load control system of the governor, acting through the propeller pitch control assembly, adjusts propeller pitch—and thus engine load—to program the amount of fuel needed to maintain the set speed at each speed setting. Since horsepower is a function of speed and fuel setting, the effect is to control the horsepower output.

Woodward manual 36600 describes the basic components of the governor, and manual 36630 describes the basic load control used in this system.

Air Transmitter—The pneumatic transmitter (not furnished by Woodward) is manually operated to control air pressure to the speed setting mechanism of the governor and to the diaphragm of the inching control section of the pitch control assembly. Movement of the control lever in the AHEAD direction causes the control air pressure from the transmitter to increase over its operating range (10 to 60 psi/69 to 414 kPa). Movement of the control lever in the ASTERN direction causes air pressure to operate a reversing valve in the pitch control assembly before it increases the control air pressure over the same range.

Speed Setting Mechanism—Air pressure from the pneumatic transmitter is used to control the governor speed setting mechanism. The operating range of the speed setting mechanism is 20 psi (138 kPa) minimum and 60 psi (414 kPa) maximum. (Pressure signals from the pneumatic transmitter between 10 and 20 psi (69 and 138 kPa) have no control over engine idle speed, but are used for "inching" control through the pitch control assembly.) Woodward manual 36694 contains a description of the speed setting mechanism used in PG governor.

Speed Droop Linkage—Speed droop is needed in the PG governors to permit loads to be divided among two or more engines being operated in parallel to drive a common output shaft. Woodward manual 36621 describes the speed droop linkage of the PG governor.

Pneumatic Shutdown Assembly—The shutdown assembly can be incorporated into the system to stop the engine in response to a pneumatic pressure signal. Wood-ward Manual 36651 describes the shutdown assembly.

IMPORTANT **The normal use of the lubricating oil device in most marine applications is for alarm rather than engine shutdown.**

Lubricating Oil Alarm—An automatic shutdown or alarm device to protect the engine in the event of failure of the lubricating oil system can be incorporated into the PG governor. Woodward manual 36652 describes the lubricating oil alarm.

Selector Valve—The function of the selector valve (not furnished by Woodward) is to connect the load control hydraulic lines of the "lead" engine's governor to the pitch control assembly. The governor selected provides the input signal to the pitch control assembly. All oil supply lines to and from the other governors are closed off.

Pitch Control Assembly—The function of the pitch control assembly is to actuate the pitch setting mechanism, both manually and automatically. Refer to Chapter 2 of this manual for details of operation.

Interlock Valve—The function of the interlock valve is to reduce the governor speed setting when a reversal of propulsion direction is called for. Refer to Chapter 2 for details of operation.

Remote Buffer Assembly—The function of the remote buffer assembly is to provide stability in the load control system. Refer to Chapter 2 for details of operation.

The function of the pitch control system is to maintain a constant fuel setting for each particular engine speed under varying conditions of load (external forces acting upon the ship). As shown in Figure 1-3, there is only one value of engine fuel setting at any given engine speed (N). At any particular engine speed the fuel setting is controlled by the governor. Compensation for load variations is accomplished by controlling the pitch of the propeller.

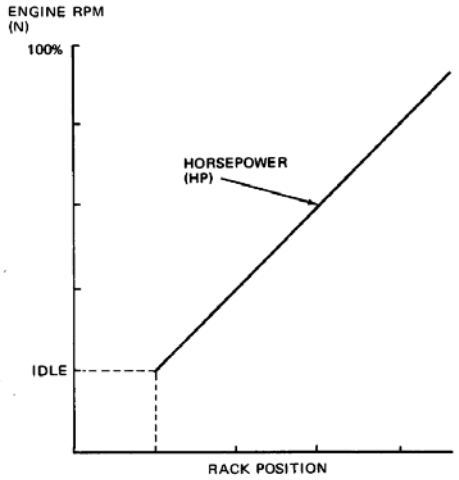


Figure 1-3. Rack Position, Engine RPM, and Horsepower Curve

Chapter 2.
Principles of Operation

General

The pitch control system, under varying conditions of load, will provide automatic control of propeller pitch. The following describes the system in the low power range (idle speed and inching control) and proceeds through AHEAD, ASTERN, and MANUAL positions of the control lever/transfer valve of the pitch control assembly. See Figures 2-1 through 2-5 for schematic diagrams of the pitch control system.

Pitch Control Assembly—The speed setting mechanism of the governor requires an air signal above 20 psi (138 kPa) for automatic control of the pitch control assembly. With an air signal from the pneumatic transmitter of 20 psi (138 kPa) or less the governor speed setting is at idle speed. In this range, control of propeller pitch (inching) is available. When the pneumatic control signal is between 10 and 20 psi (69 and 138 kPa), the pilot valve in the inching control section (see Figure 2-1) will regulate the flow of the oil to and from the load control servo to control propeller pitch. When the pneumatic control signal is above 22 psi (152 kPa), the governor load control pilot valve regulates the flow of oil to and from the load control servo.

Inching Control

The inching control consists essentially of:

- A diaphragm which positions a beam as a function of a pneumatic signal over a range of 10 to 20 psi (69 to 138 kPa)
- A beam which pivots atop a restoring link—the latter positioned by the output lever of pitch control assembly—to move a pilot valve plunger
- A pilot valve assembly which controls the flow of oil to and from the pitch control servo
- A shuttle valve which changes control of the pitch control servo from the inching control section to automatic load control by the governor when the pneumatic signal reaches 20 to 22 psi (138 to 152 kPa).

An increase in air pressure signal within the 10 to 20 psi (69 to 138 kPa) operating range forces the inching control diaphragm and diaphragm link up (see Figure 2-1). The link forces the right end of the beam up. As the beam pivots about the restoring link, it moves the pilot valve plunger down. Oil will flow from supply to the load control servo to cause an increase in load (propeller pitch increase). The movement of the pitch control mechanism raises the restoring link. With the beam now pivoting about the diaphragm link, the left end of the beam lifts the pilot valve plunger back to its centered position, thus stopping further change of propeller pitch.

Similar movements but in the opposite directions would occur were the air signal pressure decreased within the 10 to 20 psi (69 to 138 kPa) operating range.

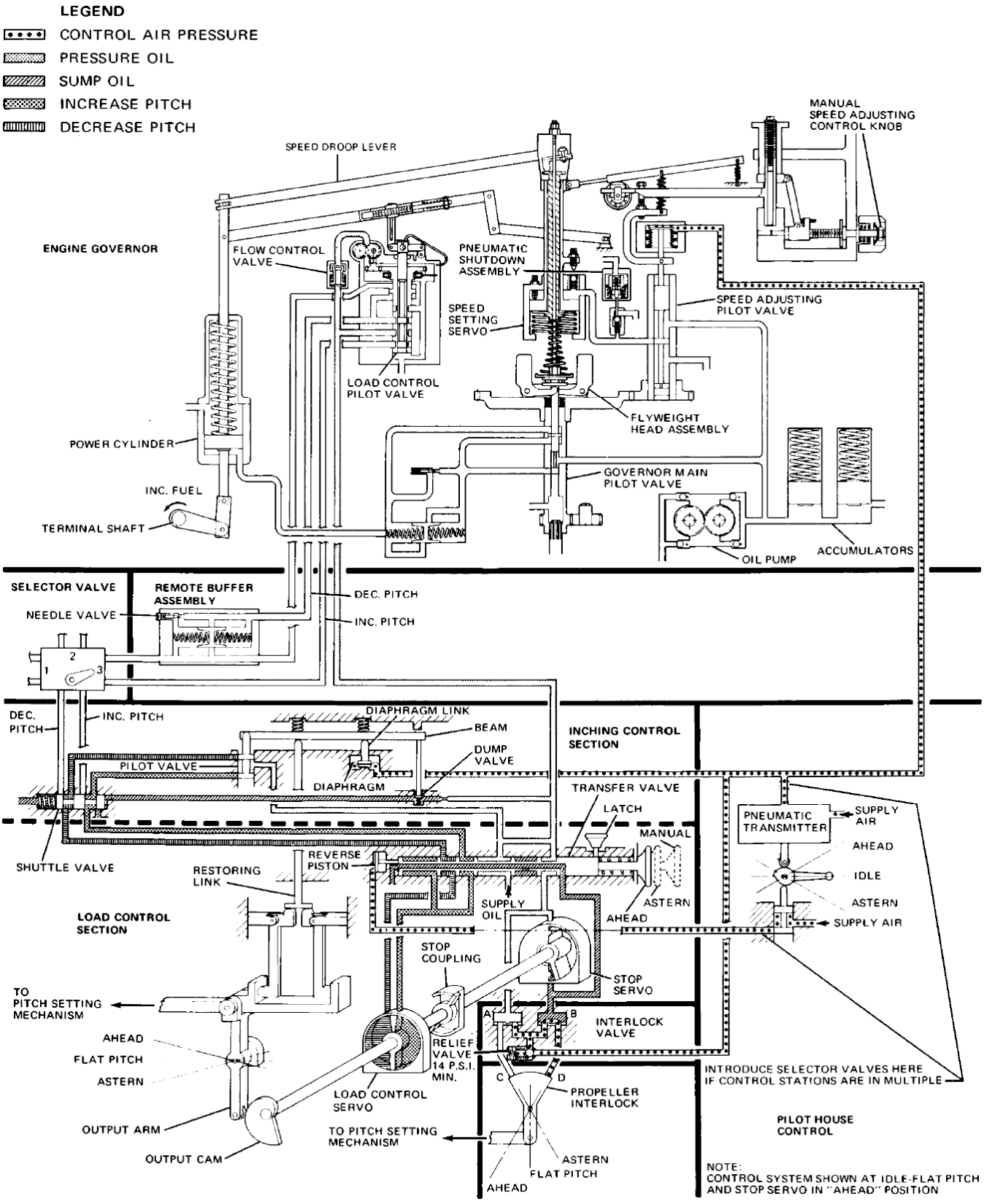


Figure 2-1. Schematic Diagram of Typical Pitch Control System

As the pneumatic transmitter control lever is moved to the full AHEAD position (see Figure 2-2), the air pressure signal exceeds 20 psi (138 kPa). This air signal operates the governor speed setting mechanism to control engine speed and position the diaphragm in the inching control section. The diaphragm forces the diaphragm link and beam up to allow the dump valve to close, thus stopping the escape of oil passing through an orifice. This oil forces the spring-loaded shuttle valve to its extreme left position. The shuttle valve closes the control line from the inching control pilot valve and opens the control lines from the load control system of the governor to the transfer valve of the pitch control assembly.

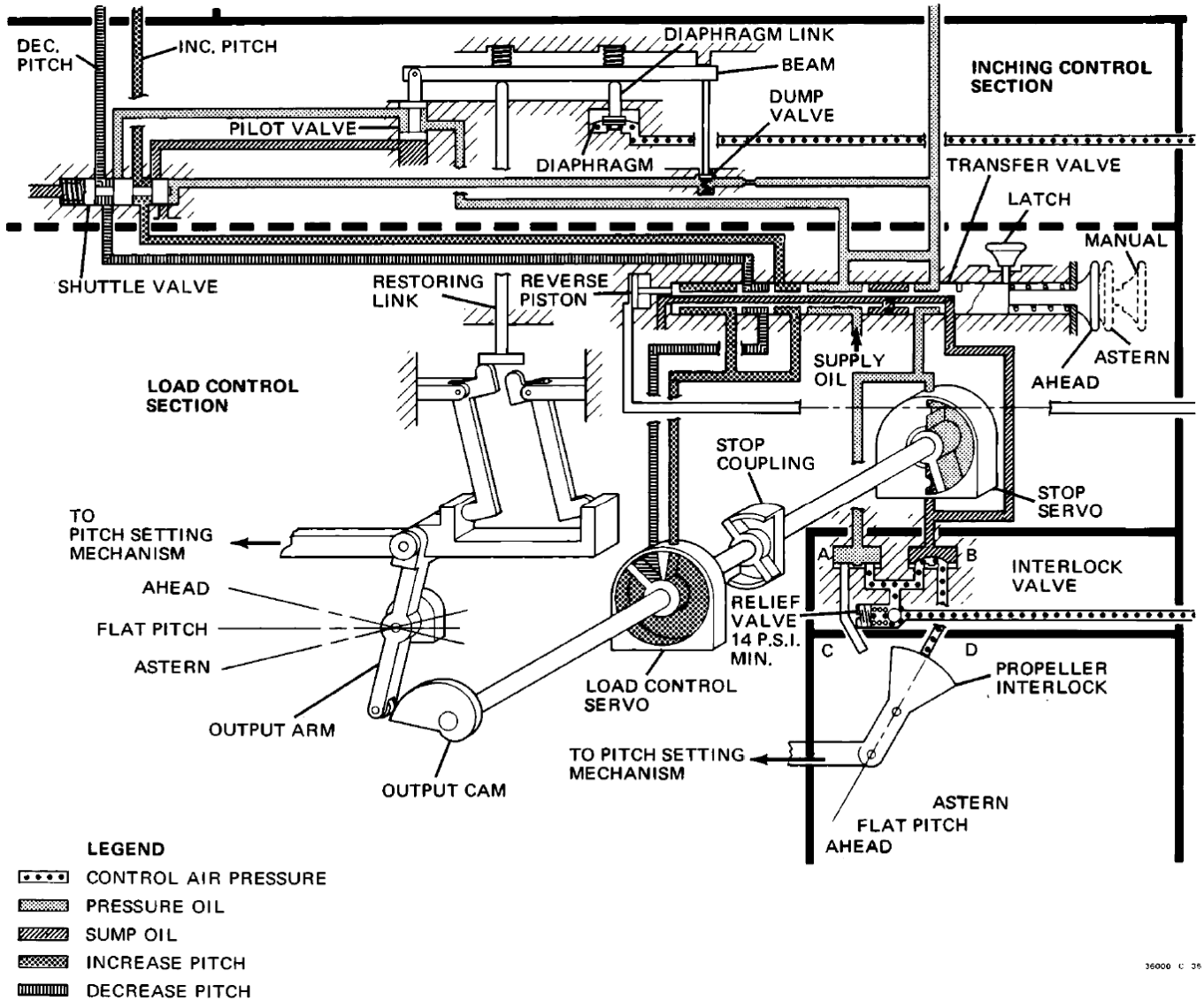


Figure 2-2. Schematic Diagram of Pitch Control Assembly Shown in Full Pitch Ahead Position

With the transfer valve in the AHEAD position, the pressure oil rotates the stop servo vane to the maximum clockwise position. The outer or cupped half of the stop coupling is attached to the same shaft as the stop servo vane. The inner or stop arm portion of the stop coupling is attached to the same shaft as the load control servo vane and the output cam. Thus, moving the load control servo vane repositions the output cam and stop arm. The output cam positions the output lever to which the propeller pitch operating mechanism attaches. The torque of the stop servo is approximately twice that of the load control servo.

As the pneumatic transmitter control lever is moved from the AHEAD position to the ASTERN position, governor speed setting is decreased by bleeding control air to the atmosphere through the propeller interlock system until the propeller is almost to the flat pitch position (see Figure 2-3). In flat pitch position the propeller interlock closes the interlock valve and pneumatic pressure increases. Air is directed to the reverse piston to move the transfer valve to the ASTERN position (see Figure 2-4) before increasing load or increasing the speed setting of the governor. As air pressure increases above 20 psi (138 kPa), the diaphragm forces the beam up to allow the dump valve to close. Oil pressure forces the shuttle valve to the left and forces the stop servo vane to its full counterclockwise position; as the stop servo rotates, the stop coupling will drag the load control servo to its flat pitch position. At the same time, through the transfer valve, the hydraulic lines to the load control servo are reversed, producing a counterclockwise movement of the load control servo vane to increase pitch in the astern direction.

When manual control of the pitch setting mechanism is desired, the transfer valve must be manually pulled out and locked into position. When the transfer valve is in MANUAL position (see Figure 2-5) the oil supply to the stop servo and load control servo is cut off and both ports are connected to drain. A drive pulley assembly can be attached to the same shaft as the output cam and driven by a cable to change propeller pitch manually.

Load Control System

The load control system incorporated in the PG governor (see Figure 2-1) adjusts the propeller pitch to bring the fuel setting of the engine to a predetermined value for each specific speed setting of the governor; thus the governor will maintain a constant engine speed under varying conditions of load (external forces acting on ship) and as a secondary function, it will maintain a definite horsepower output of the engine. The remote buffer assembly, essential to the operation of the compensated load control system, is described with the load control system.

The load control portion of the governor is designed for use in a “compensated” load control system. Compensation in a load control system enhances stability of the system by “anticipating” the end-effect of a load change in the same manner that compensation in the basic governor elements “anticipates” the end-effect of a fuel change on engine speed.

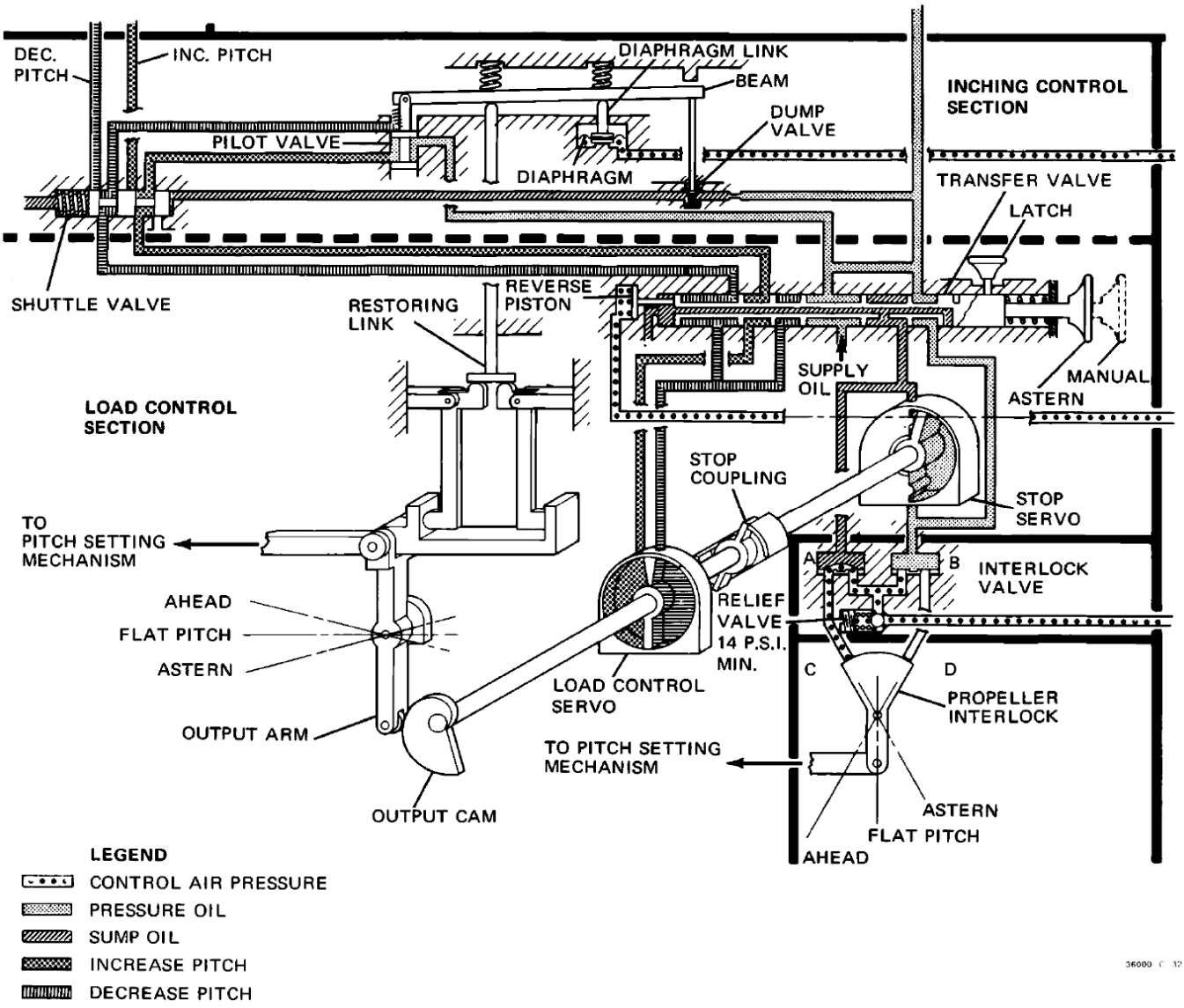


Figure 2-3. Schematic Diagram of Pitch Control Assembly Shown in Flat Pitch Astern Position

An engine does not instantly develop the new torque of which it is capable when a fuel setting change is made. Until it does, the complete effect of the new fuel setting is not reflected in the engine—and governor—speed. However, in anticipation of the ultimate effect of the fuel setting change on engine speed, pressure from the compensation system of the basic governor elements assists in re-centering the governor pilot valve plunger before the engine reaches the set speed level. Further change of the fuel setting is thus halted before the engine reaches the set speed level. As engine speed continues to respond to the change in fuel setting and accelerates (or decelerates) to the set point, the compensating pressure fades away, allowing the force from the increasing (or decreasing) speed of the rotating flyweights to keep the governor pilot valve plunger centered.

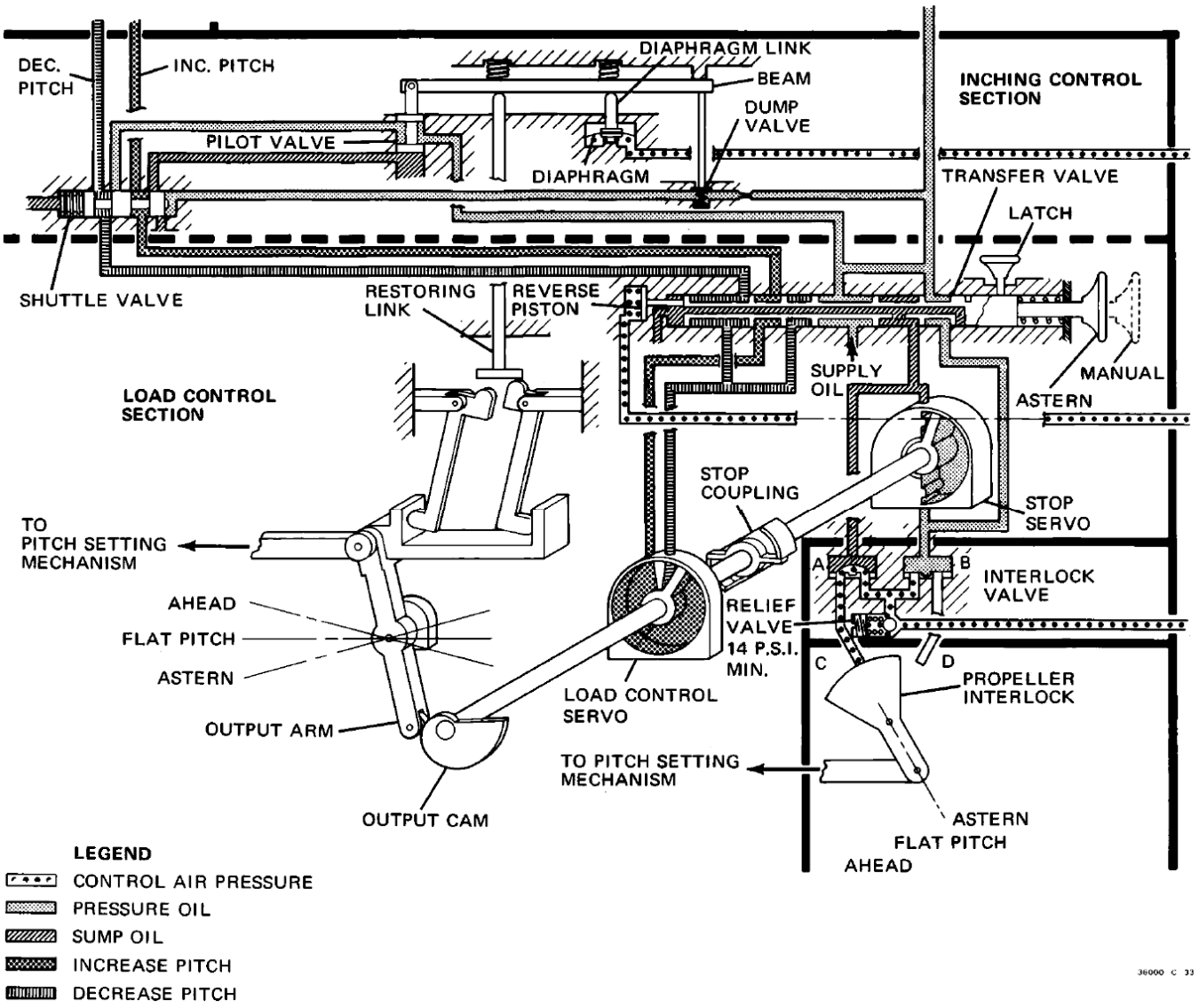


Figure 2-4. Schematic Diagram of Pitch Control Assembly Shown in Full Pitch Astern Position

In a similar fashion, compensation in the load control system of the governor stops the changing of load—in this instance, propeller pitch—before the fuel correction is completed and the governor power piston stopped. Stopping the load correction in advance of the full fuel correction enhances stability of the governed system.

Pressure oil from a source outside of the governor (such as from the propeller system) serves as the supply to the governor load control pilot valve. Oil from this same source passes through a flow control valve to rotate the gears of an oil motor atop the governor column. The oil motor rotates the load control pilot valve bushing to minimize friction between the bushing and its pilot valve plunger by providing relative rotation between the bushing and plunger. The load control pilot valve bushing is also free to move up and down in the bore in which it turns; a centering spring tends always to return it to the same elevation.

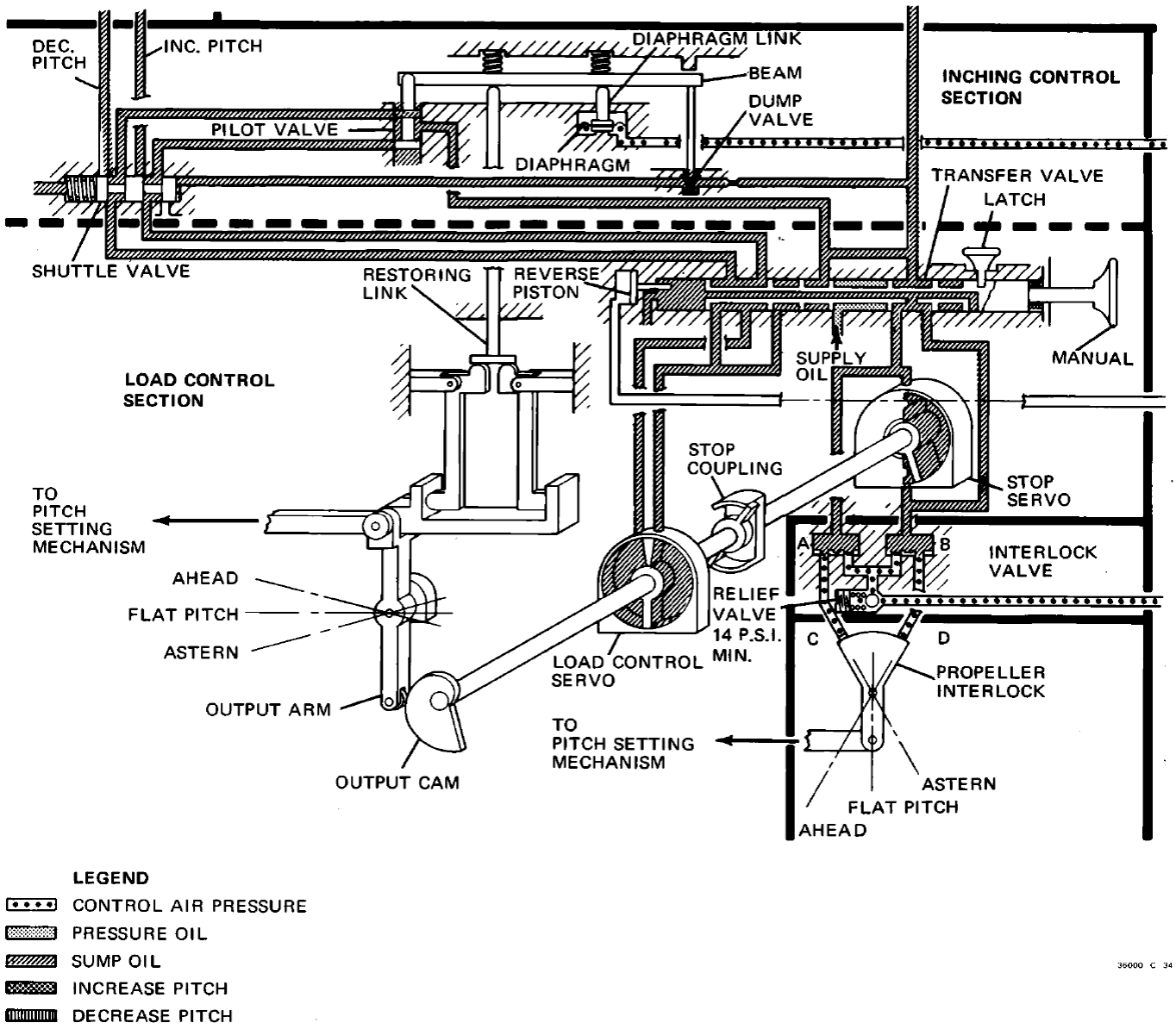


Figure 2-5. Schematic Diagram of Pitch Control Assembly Shown in Manual Position

Load Decrease—See Figure 2-1 for view of load control system and Figure g for a typical curve of control air pressure versus engine speed. For every position of the speed setting control lever there is only one tailrod position which will result in the load control pilot valve being “balanced” or “centered”. At a given control air pressure setting, the balance or centered position will be represented at some point on the curve. This point may move temporarily due to changes in load but will always seek the same “centered” point.

Assume the control air pressure has been set to obtain a given engine rpm and the load control system is stationary with the pilot valve in its “balanced” position. Engine is operating at a steady state condition. The load decreases at the propeller because of a reduction in external forces acting on the ship. The reduced load is transmitted to the engine, the engine speeds up, and through the basic action of the governor, fuel to the engine is decreased to bring it back to the desired set speed with a downward movement of the power piston.

The engine is now carrying less load than desired for the existing control air pressure setting. The movement of the power piston lowers the control linkage and thus lowers the load control pilot valve below center. When the load control pilot valve is below its centered position, oil flows from the governor through the “increase pitch” line to the load control servo in the pitch control assembly to cause an increase in propeller pitch (and, therefore, load).

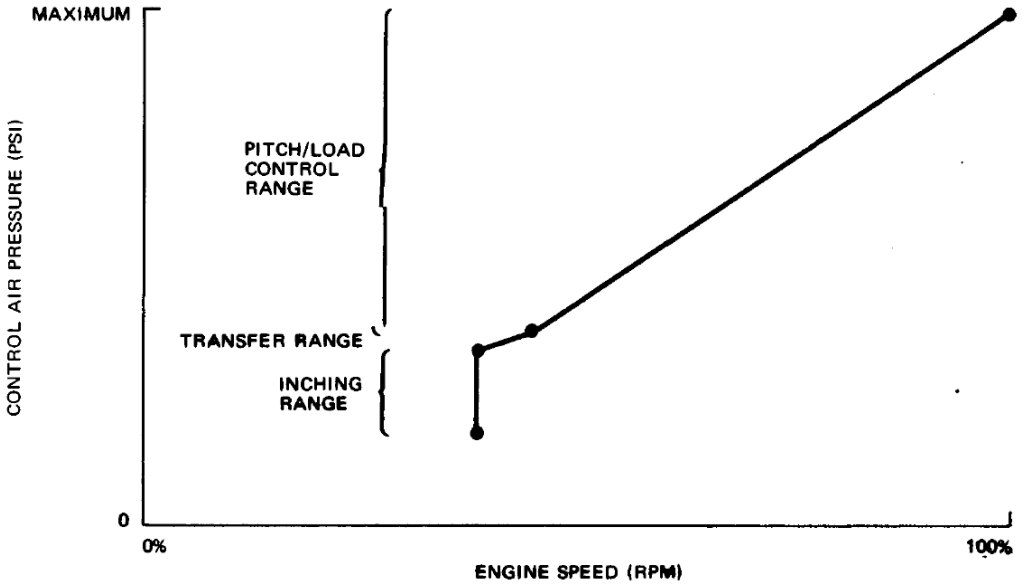


Figure 2-6. Control Air Pressure Versus Engine Speed

Oil forced from the opposite side of the servo vane flows through the pitch control assembly and selector valve assembly to the remote buffer assembly. As the oil passes through the buffer assembly, it forces the buffer piston in the direction of oil flow (to the right as shown in Figure 2-1). This movement of the piston in compressing one buffer spring while relieving the other creates a pressure differential across the buffer piston. The greater pressure is on the side of the spring relieved. With the pressure of the right side of the buffer piston transmitted to the lower side of the compensation land and the pressure from the opposite side of the piston directed to the upper side of the land, the same pressure differential existing across the buffer piston also exists across the compensation land. The net force is in a direction, in this instance, to push the load control bushing down. When it moves down so that its control ports are again covered by the control land of the pilot valve, flow of oil to change load further is halted.

With the increase in propeller pitch, the engine speed will decrease and the governor will operate to increase fuel to the engine, with an upward movement of the power piston. The increase in propeller pitch and fuel to the engine will continue until the speed of the engine has returned to the set point.

The remote buffer assembly needle valve can be adjusted so that the pressure differential across the compensation land (and buffer piston) will fade away at a rate which will allow the centering spring to move the bushing up at the same rate as that at which the pilot valve is lifted. The pitch control assembly thus adjusts propeller pitch to the desired load position—and holds it there—shortly before the governor power piston reaches the position required for the new load. By so doing, stability of the governed system is improved.

In responding to the off-speed of the engine and attempting to correct the fuel setting, the governor has operated the load control pilot valve in the direction to increase propeller pitch to suit the decreased load condition, and horsepower demand on the engine has returned to the point for the existing speed setting of the governor.

With an increase in load on the ship, the action of the pitch control system (load control system) would be the reverse of that described above.

Speed Droop—Speed droop is a characteristic common to all mechanical governors in which engine speed progressively decreases as load is added at any given control air pressure setting. See Figure 2-7 for a typical speed droop curve.

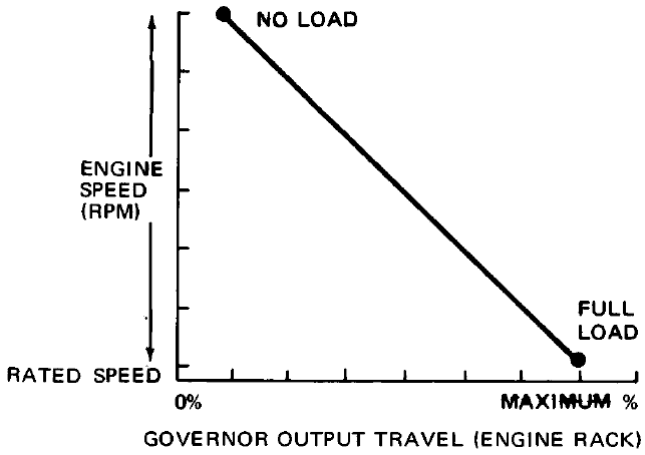


Figure 2-7. Typical Engine Speed Droop Curve

Propeller Interlock—The propeller interlock, shown schematically in Figures 2-1 through 2-5 (if used), aids in stopping the motion of a ship with a controllable pitch propeller as quickly as possible. This is accomplished by stopping positive propulsion and increasing negative propulsion as fast as possible without cavitation. As the control lever is moved from AHEAD to ASTERN or vice versa, governor speed setting is reduced until the propeller has moved to almost flat pitch. At this position governor speed setting starts to increase.

The propeller interlock consists of two pairs of pneumatic valves. When one valve of a pair is open, the second is closed. The pair denoted as “A” and “B” is operated by reversing the position of the transfer valve in the inching control; the block containing these valves is attached to the pitch control assembly. The pair designated “C” and “D” is controlled by the propeller pitch setting mechanism; this assembly is located remotely from the pitch control assembly.

In the AHEAD position, valves “A” and “0” are closed and the others open. In the ASTERN position, valves “B” and “C” are closed and the others open. In neither case is speed control air opened to atmosphere.

If, while running ahead, the reversing mechanism is operated, valve “B” will close as valve “A” opens. Since valve “C” is open at the same instant, the speed control air will bleed to atmosphere, dropping to the value set on the relief valve. Thus speed can be reduced to idle—or some other value if experience so indicates—where it will stay until the propeller approaches flat pitch and closes valve “C”. Speed may now rise at the rate permitted by the speed adjusting system. A similar effect results when going from the astern direction to the ahead direction.

The adjustable relief valve is located in the block containing valves “A” and “B” and mounted on the stop servo cover. It is positioned between the control air line and the interlock valves so as to limit the minimum air pressure remaining in the control air line when the interlock valves are in the bypass position. Passages connect the low pressure side of the relief valve to valves “A” and “B”. These valves consist of two cavities and a diaphragm. One side of the stop servo connects to one cavity, and the other side to the other cavity. When pressure exists in one side of the stop servo, the diaphragm is distended in the corresponding valve and blocks the exhaust port. The exhaust port of valve “A” supplies valve “C”, and the exhaust port of valve “B” supplies valve “D”.

Chapter 3. Maintenance

General

This chapter provides general maintenance procedures for the pitch control system after initial installation. It is recommended that only highly qualified maintenance personnel work on the system. Precautions must be taken when working with pressurized lines.

Lubrication

The pitch control system oil should be clean and free of foreign particles. Proper selection of the oil used in the system is necessary to realize the best performance and longest service life. The oil should have a minimum tendency to foam, retain air, form sludge, or deposit varnish. It should protect parts from corrosion, and not be detrimental to seals.

Oil contamination can cause the load control system compensating bushing to stick above or below its balance point and prevent smooth operation of the system.

Pitch Control System Checkout

Ensure that all piping within the system is properly connected and engine linkage is properly adjusted. Refer to engine maintenance instructions.

PG Governor—Installation and maintenance of the governor should be in accordance with Woodward manual 36600. The governors should have been properly adjusted on a test stand prior to installation and no further adjustments should be necessary.

Remote Buffer—Initially adjust the remote buffer needle valves to 3 turns open; final adjustment to be made at full load operation to obtain stability in the system.

Load Selector Valve and Piping

IMPORTANT

The following checkout procedure assumes that two or more engines are used for driving the propeller shaft. Perform checks as applicable to the particular installation.

1. Install 0–200 psi (0–1400 kPa) pressure gauges in the increase and decrease lines (“C” and “D” ports) at the pitch control assembly (see Figure 4-1 for location of ports). Ensure there are no leaks in the system. Pressure gauges should remain installed throughout the performance of the maintenance procedure.

IMPORTANT **Engine operation and movement of propellers through the pitch range is not required for the following checks. The connection between the pitch control assembly and pitch setting mechanism may be disconnected.**

2. Obtain system oil pressure from applicable oil system and select one engine as “lead” unit. There should be system pressure in the increase line, and no pressure (drain) in decrease line.

IMPORTANT **A tailrod jack or other special tools may be required to raise the tailrod.**

3. Temporarily lift the tailrods to raise load control pilot valves on all the governors of the engines not in the “lead”. There should be no change in pressures. Any change in pressure would indicate a malfunctioning or improperly positioned selector valve.

4. Temporarily raise the tailrod to raise the load control pilot valve of the “lead” engine. Pressure should increase to system pressure in the decrease line and drop to drain pressure in the increase line.

5. Raise the pilot valves up above the balance point for all engines. With any engine selected as “lead” engine, there should be system pressure in the decrease line and drain pressure in the increase line.

6. On engines not selected as lead engines, lower the pilot valves below the balance point by allowing the tailrods to go to the shutdown rack position. There should be no pressure change in the decrease lines and the increase lines should remain at drain pressure as each pilot valve is lowered.

7. Lower the pilot valve on the governor of the lead engine. The decrease line should drop to drain pressure and the increase line should increase in pressure.

Pneumatic Transmitter and Piping

1. Install a 0–100 psi (0–690 kPa) test quality pressure gauge in the air control line of each governor. Pressure gauges should remain installed in system throughout performance of maintenance procedure.

2. Apply air pressure and insure there are no leaks in the system.

3. Position pneumatic transmitter control lever to the full ahead position. Air pressure at each governor should be the maximum operating pressure ±0.2 psi (±1.4 kPa). (If trim valve is incorporated, operate through its full range of travel and insure a minimum pressure range is available, approximately ±2 psi/±14 kPa from specified value.)

Inching Control System Operation—Ahead and Astern

IMPORTANT

Pitch should start changing at 10 ±0.5 psi (69 ±3 kPa) (minimum pressure in the inching range) and increase as the air pressure increases. The shuttle valve should transfer out of inching between 20 and 22 psi (138 and 152 kPa) (maximum pressure in the inching range). (See Figure 2-6.) Engine operation is not required for the following checks; however, propeller oil pressure is required.

1. While monitoring control panel, slowly move the pneumatic control lever toward full AHEAD position. Between 20 and 22 psi (138 and 152 kPa), the load control system of the governor should take over and propeller pitch should have increased to its maximum position.

2. Repeat above step in ASTERN position.

3. If proper pitch in either AHEAD or ASTERN position cannot be obtained, disconnect linkage at pitch control assembly, install a pin in output lever and with a dial indicator record pitch control output lever travel.

Compare the measured value with the value specified for the installed unit. If the proper output travel is obtained but proper propeller pitch is not obtained, check the linkage between the pitch control assembly and propeller “OD” box. (Refer to the propeller maintenance procedure.)

Pitch Control System Checkout with Engines Operating (at Dock)

IMPORTANT

The governors have been adjusted on a test stand prior to installation; it should not be necessary to make any speed setting adjustment. Any movement of the range adjustment will affect the load control pilot valve adjustment points and may result in difficulties when attempting to balance the system.

1. Ensure that the control air signal to the governor is correct within ±0.2 psi (±1.4 kPa).

2. Use an electronic counter to check engine speed (see Figure 2-6).

IMPORTANT

Do not attempt to obtain precise speed setting at the dock. A deviation of ±15 rpm is permissible at the full speed air pressure setting.

3. Record the terminal shaft position when checking engine speeds under no load conditions at the dock. Governor output (terminal shaft) position may be used to determine a specified set speed.

Pitch Control System Checkout (at Sea)

When making any adjustments to the pitch control system, monitor the control air pressure for changes; also insure that the propeller pitch stays in the active range (between flat and full pitch).

IMPORTANT

Basic governor adjustments should not be disturbed except as a last resort. Check piping, load selector, valves, etc. before adjusting the governor.

Engine speed, propeller shaft speed, engine fuel pump rack, control air pressure, and the number of engines may vary between installations. Substitute values for the particular installation as applicable. Refer to applicable documentation for values.

1. Run all engines for a minimum of 30 minutes at full load prior to making any adjustments.

2. With all engines clutched to the propeller shaft use the following procedure to obtain equal load division among engines.

   a. Select one engine as lead unit (“A”).

IMPORTANT

In the pitch control range engine speed is proportional to control air pressure and engine fuel pump rack position. (See Figure 3-1.) For any control air pressure setting the engine will run at a given speed and engine fuel pump rack will be at a specific position to produce a given horsepower output.

The following procedure sets the control air pressure to maximum, checks engine or propeller shaft for rated speed, and adjusts (as applicable) for maximum fuel pump rack position. (Refer to engine instructions.)

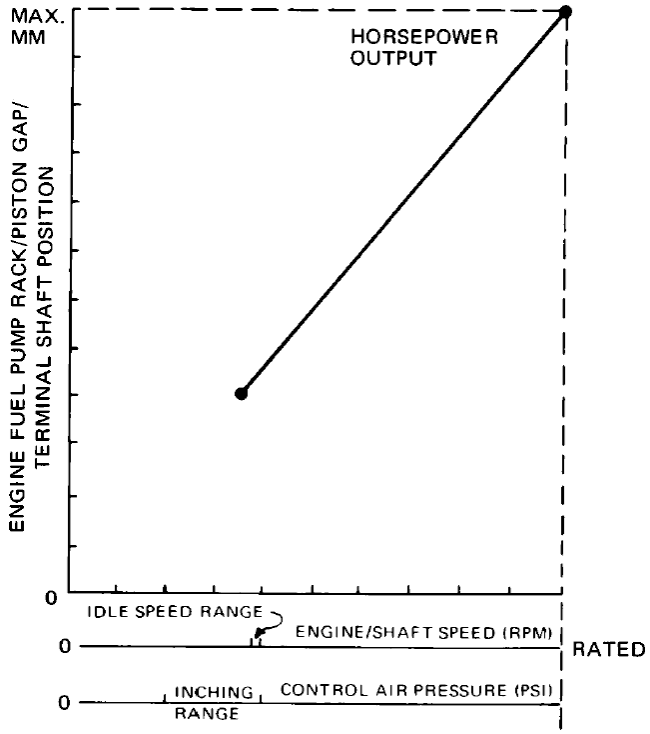


Figure 3-1. Engine Rack versus Control Air Pressure/Engine Speed

b. Adjust control air pressure to maximum operating pressure.
c. Accurately determine and record propeller shaft speed. Shaft rpm counter onboard ship may be used by recording the number of shaft revolutions occurring in one minute of elapsed time.
d. If propeller shaft speed is not at rated rpm, adjust the speed setting nut of the speed setting mechanism on the governor of the "A" engine. Do not move the speed range adjustment.
e. Ensure control air pressure is at maximum operating pressure, shaft speed is at rated rpm, and propeller pitch is between flat and full. Determine and record engine fuel pump rack of "A" engine.

IMPORTANT

If the governors are controlling properly and trim valves are available, omit steps f through n.

f. If engine rack is not at the specified fuel position, adjust load control valve eccentric on governor of "A" engine. Do not move lead screw or range adjustment. Refer to Woodward manual 36630.
g. Select a second engine (if applicable) as unit "B".
h. Adjust control air pressure to maximum operating pressure.
i. With "A" engine still in the lead adjust, if required, the speed setting nut of "B" engine to obtain the specified engine rack position on "B" engine.

IMPORTANT

When changing lead position of engines, allow a few minutes for the system to stabilize prior to making any adjustments.

j. Make "B" engine lead and record engine rack. If required, adjust load control pilot valve eccentric to obtain the specified engine rack on "B" engine.
k. Select the third engine (if applicable) as unit "C".
l. Adjust control air pressure to maximum operating pressure.
m. With "A" or "B" engine as lead adjust, if required, the speed setting nut of "C" engine to obtain the specified engine rack on "C" engine.
n. Make "C" engine as lead and record engine rack. If required, adjust load control pilot valve eccentric to obtain the specified engine rack on "C" engine.
o. Set the control air pressure to some position in the pitch control range and alternately select each engine as lead unit while monitoring control air pressure and engine fuel pump rack. The engine rack should balance at approximately the same position for each engine.
p. With ship moving forward in the pitch control range, position the control lever to the ASTERN position. If there is a hesitation in flat pitch position check for low oil pressure to the pitch control assembly or restrictions in the load control plumbing. Check the remote buffer assembly needle valve opening, the relief valve setting on the propeller oil supply, and the filter ahead of the pitch control assembly.

IMPORTANT

If it was necessary to adjust the speed setting nut on any governor in the above procedure, the low speed stop on the speed setting mechanism may require readjustment. Perform adjustment on two governors only. If all three governors are adjusted there is the danger of changing idle shaft speed.

q. Set control air pressure to some position in the inching range and operate engines in this position a few minutes.
r. If required, adjust the low speed stop screw to obtain equal engine rack on all engines.

s. Adjust the air control trim valve to its mid-position. Select an engine as lead unit “A”. Place the pneumatic control lever to the full AHEAD position. The control air pressure should be the specified full speed air pressure for the governor. Adjust the trim valve, as required, to obtain the specified pressure.

t. Accurately determine and record propeller shaft speed. Shaft rpm counter onboard ship may be used by recording the number of shaft revolutions occurring in one minute of elapsed time. If shaft speed is not at rated rpm, adjust the air control trim valve setting to obtain the correct speed; air pressure should be within 1 psi of specified pressure. If the correct speed cannot be obtained through adjustment of air pressure, check the accuracy of speed and air pressure measurements and the tightness of all air line connections. The likelihood of a wrong governor speed setting is small and should not be assumed until all other possible influences on speed have been checked. lf governor speed setting is wrong, replace governor and repeat applicable portion of checkout.

u. Ensure propeller pitch is in the active range (between flat and full pitch). Record engine full load rack position. Refer to applicable engine manufacturer’s specification data. Adjust engine linkage, as applicable, to obtain specified rack.

v. With the correct propeller shaft speed and engine rack to lead unit “A”, the same specified control air pressure applicable to lead unit “A” should be available to each governor of the drive system.

w. Select a second engine, if applicable, as lead unit “B”. Adjust control air trim valve to obtain the same speed as obtained with “A” engine in the lead. Air pressure should be correct within 1 psi of the specified full speed air pressure. Insure propeller pitch is in the active range. Record engine full load rack position. Adjust engine linkage, as applicable, to obtain specified rack.

x. Repeat steps v and w for each additional engine in the drive system.

Chapter 4.
Parts Information

When ordering replacement parts, following information be given:

- Pitch control assembly serial number and part number as shown on nameplate
- Manual number (this is manual 36049)
- Part reference number as given in the parts list, and name or description of the part

Figure 4-1 illustrates and lists all parts of the pitch control assembly. Index numbers are assigned in clockwise sequence.

Ref. No.	Part Name	Quantity
36049-1	Cover gasket	1
36049-2	Inching control housing	1
36049-3	Washer, 0.250 ID (MS35333-40)	2
36049-4	Screw, hex hd cap, 1/4-28 x 0.750 (MS35298-6)	2
36049-5	Oil cup	1
36049-6	Screw, soc hd cap, 3/8-16 x 2.250 (MS35457-71)	2
36049-7	Washer, 0.375 ID (MS351848-46)	2
36049-8	Control valve spacer	1
36049-9	Knob	1
36049-10	Diaphragm	1
36049-11	Washer, 0.250 ID (MS35333-40)	2
36049-12	Screw, hex hd cap, 1/4-28 x 4.750 (MS35304-25)	2
36049-13	Valve block cover	1
36049-14	Block valve	1
36049-15	Gasket	1
36049-16	Screw, hex hd cap, 1/4-28 x 2.500 (MS35298-1 6)	3
36049-17	Washer, 0.250 ID (MS35333-40)	3
36049-18	Outer end plate	1
36049-19	Split bushing	4
36049-20	Stop servo assembly	1
36049-21	Load spring	1
36049-22	Drive pulley assembly	1
36049-23	Roller bearing	1
36049-24	Pitch control cam	1
36049-25	Clamp plate	1
36049-26	Screw, shoulder, 0.312-24 x 0.906	1
36049-27	Washer, 0.250 ID (MS35333-40)	2
36049-28	Screw, hex hd cap, 1/4-28 x 0.750 (MS35298-6)	2
36049-29	End plate	1
36049-30	Load servo assembly	1
36049-31	Outer end plate	1
36049-32	Torsion spring pin	1
36049-33	Control valve gasket	1
36049-34	Power lever shaft	1
36049-35	Control valve manifold	1
36049-36	Screw, soc hd cap, 1 0-24 x 0.500 (MS35457-23)	2
36049-37	Washer, split lock No. 10 (AN935-10)	2
36049-38	Manifold housing cap	1
36049-39	Screw, hex hd cap, 1/4-28 x 0.750 (MS35298-6)	2
36049-40	Washer, lock, 0.344 OD	2
36049-41	Manifold housing gasket	1
36049-42	Orifice plate gasket	1
36049-43	Plate assembly	1
36049-44	Orifice plate gasket	1
36049-45	Lever shaft pin	1
36049-46	Spring spacer	1
36049-47	Plug, 0.062-27 NPTF	16
36049-48	Plug, 0.125-27 NPTF	2
36049-49	Spring	1
36049-50	Inching control cover	1
36049-51	Screw, soc hd cap, 10-32 x 0.750 (MS35458-1 3)	2
36049-52	Washer, No. 10 Shakeproof (MS35333-39)	2
36049-53	Washer, 0.156 ID	1
36049-54	Washer, lock (MS35338-42)	1
36049-55	Screw, soc hd cap, 8-32 x 0.375 (MS35457-14)	1
36049-56	Screw, soc hd cap, 1/4-28 x 1.50 (MS35458-27)	1
36049-57	Washer, 0.250 ID (MS35333-40)	1
36049-58	Control valve stop	1
36049-59	Washer, 0.375 ID (MS51848-46)	1
36049-60	Screw, soc hd cap, 3/8-16 x 1.0 (MS35457-66)	10
36049-61	Screw, shoulder, 312-18 x 1.0	1
36049-62	Washer, 0.500 OD	1
36049-63	Nameplate	1
36049-64	Screw, drive, No. 2 x 0.188 (AN 535-2-3)	2
36049-65	Taper pin	13
36049-66	Washer, lock, 0.344 OD	6
36049-67	Screw, soc hd cap, 1/4-28 x 3.0	6
36049-68	Taper pin	2
36049-69	Power lever	1
36049-70	Screw, adjusting, 3/8-32 x 1.125	1
36049-71	Nut, jam, 3/8-32	1
36049-72	Washer, No. 10 high collar lock (MS35338-43)	1
36049-73	Screw, fil hd, 10-32 x 2.125 (MS35266-72)	1
36049-74	Restoring spring bracket assembly	1
36049-75	Cotter pin, 0.060 x 0.375	1
36049-76	Taper pin	1
36049-77	Setscrew, 6-32	1
36049-78	Nut, hex (MS35650-362)	1
36049-79	Washer, lock, 0-344 OD	2

Ref. No.	Part Name	Quantity
36049-80	Screw, soc hd cap, 1/4-28 x 1.0 (MS35458-25)	2
36049-81	Cotter pin, 0.060 x 0.375	2
36049-82	Drilled pin	1
36049-83	Screw fil hd cap (ANSO2-10-22)	3
36049-84	Washer, No. 10 high collar lock (MS35338-43)	3
36049-85	Pivot pin	1
36049-86	Headed pin	2
36049-87	Washer	2
36049-88	Screw, binding, 8-32 x 0.250 (ANSO5-8-4)	1
36049-89	Washer, No. 6 (MS35333-37)	1
36049-90	Screw, soc hd cap, 6-32 x 0.375 (MS35457.7)	2
36049-91	Retainer	1
36049-92	Taper pin	1
36049-93	Washer, lock, 0.344 OD	4
36049-94	Screw, soc hd cap, 1/4-28 x 1.750 (MS35458-28)	2
36049-95	Shuttle valve spring	1
36049-96	Shuttle valve	1
36049-97	Retaining ring, 0.831 OD	1
36049-98	Link adjusting spring	1
36049-99	Needle bearing	2
36049-100	Screw, soc hd set, 8-32 x 0.312	2
36049-101	Restoring lever	2
36049-102	Oil seal, 0.750 OD	1
36049-103	Follow-up strut	1
36049-104	Restoring plunger	1
36049-105	Retaining bushing	1
36049-106	O-ring, 0.755 OD (NA51593.113)	1
36049-107	Restoring spring	1
36049-108	Pilot valve plunger	1
36049-109	Nut, hex, 10-32 (MS35650-302)	1
36049-110	Setscrew, 10-32 x 0.500	1
36049-111	Floating lever	1
36049-112	Diaphragm washer	1
36049-113	Headed pin	1
36049-114	Spring seat	1
36049-115	Floating lever spring	1
36049-116	Strut, 0.125 OD	1
36049-117	Screw, fil hd, 10-32 x 0.250 (MS35266-59)	1
36049-118	Screw, 0.312-24 coupling	1
36049-119	Nut, jam, 0.312-24 (MS35691-522)	1
36049-120	Dump valve lever	1
36049-121	Coupling spring	1
36049-122	Speed control spring	1
36049-123	Pneumatic receiver cap	1
36049-124	Dump valve plunger	1
36049-125	Diaphragm	1
36049-126	Dump valve body	1
36049-127	Keyed retainer washer	1
36049-128	Nut, 0.750-24	1
36049-129	Spring seat	1
36049-130	Retainer ring, 1.283 00	1
36049-131	Control valve housing	1
36049-132	Control valve	1
36049-133	Oil seal, 1.377 OD	1
36049-134	O-ring, 0.63000 (NA51593-111)	2
36049-135	O-ring, 1.750 OD (NA51593-222)	1
36049-136	Ball, 0.344 OD	1
36049-137	Relief valve spring	1
36049-138	Filter disk	1
36049-139	O-ring, 0.500 CD (NA51593-012)	1
36049-140	Screw, adjusting, 0.438-20	1
36049-141	Rotary shaft assembly	1
36049-142	Coupling stop segment	1
36049-143	Cable clamp	1
36049-144	Screw, flat hd, 8-32 x 0.625 (AN505-8-10)	1
36049-145	Nut, spline 8-32	1
36049-146	Floating segment	1
36049-147	Woodruff key No. 8	2
36049-148	Oil seal, 1.377 00	2
36049-149	Oil seal ring, 4.906 ID	4
36049-150	Valve insert leaf spring	6
36049-151	Needle bearing	6
36049-152	Plug, 1.00 00	2
36049-153	Rotary shaft assembly	1
36049-154	Vane insert	6
36049-155	O-ring, 0.375 CD (NA51593-010)	6
36049-156	Retainer ring, 0.831 CD	1
36049-157	Long roll pin, 0.125 00 x 0.438	1
36049-158	Reversing piston	1
36049-159	O-ring, 0.254 00 (NA51593-006)	2
36049-160	Pushrod	1
36049-161	O-ring, 0.812 CD {NA51593.1 14)	1
36049-162	Spring retainer assembly	1
36049-163	Washer, round 0.500 ID	1
36049-164	Spring, 0.688 00	1
36049-165	Pilot valve bushing plug	1
36049-166	Pilot valve spring	1
36049-167	Pilot valve bushing	1

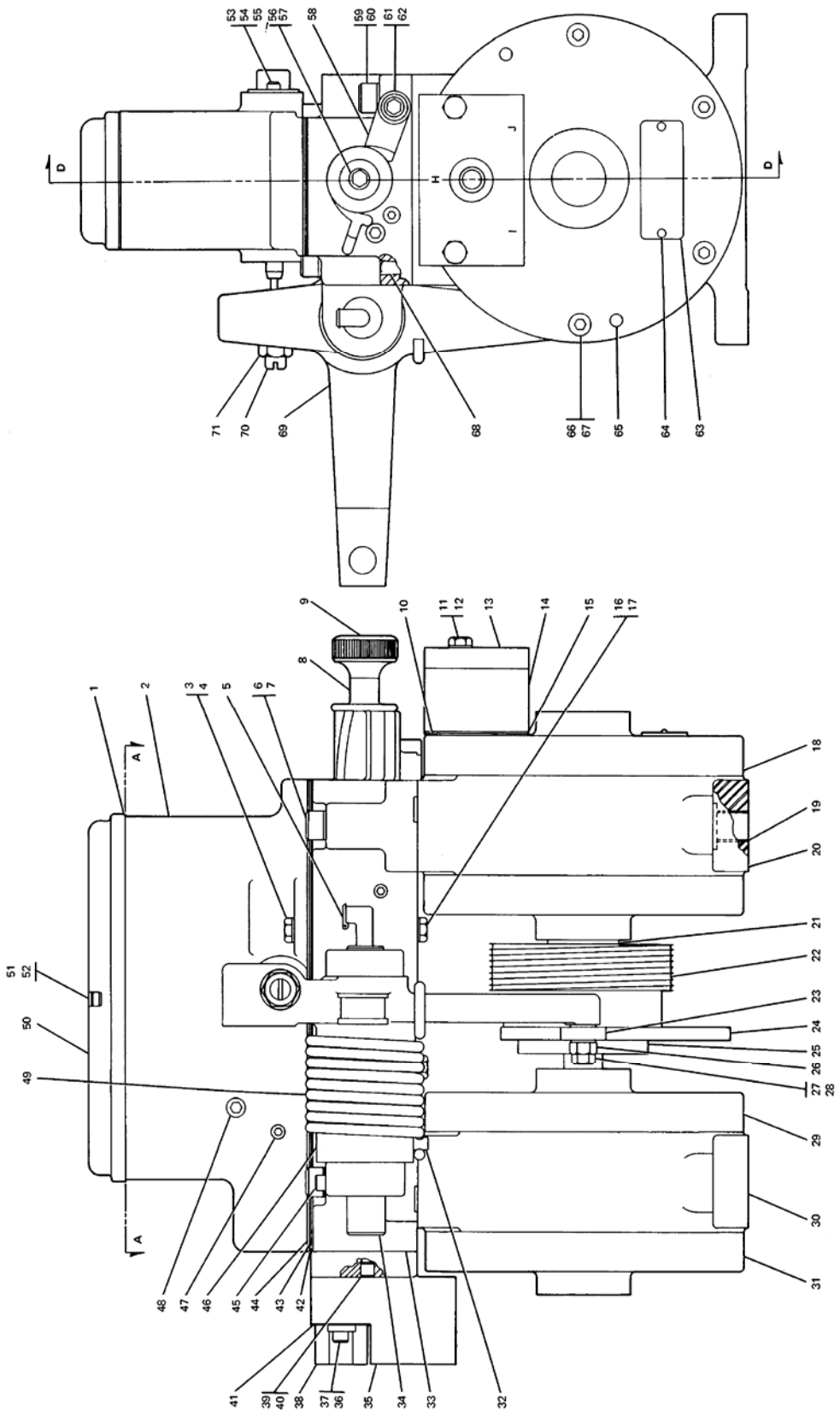


Figure 4-1a. Pitch Control Assembly Parts (1 of 2)

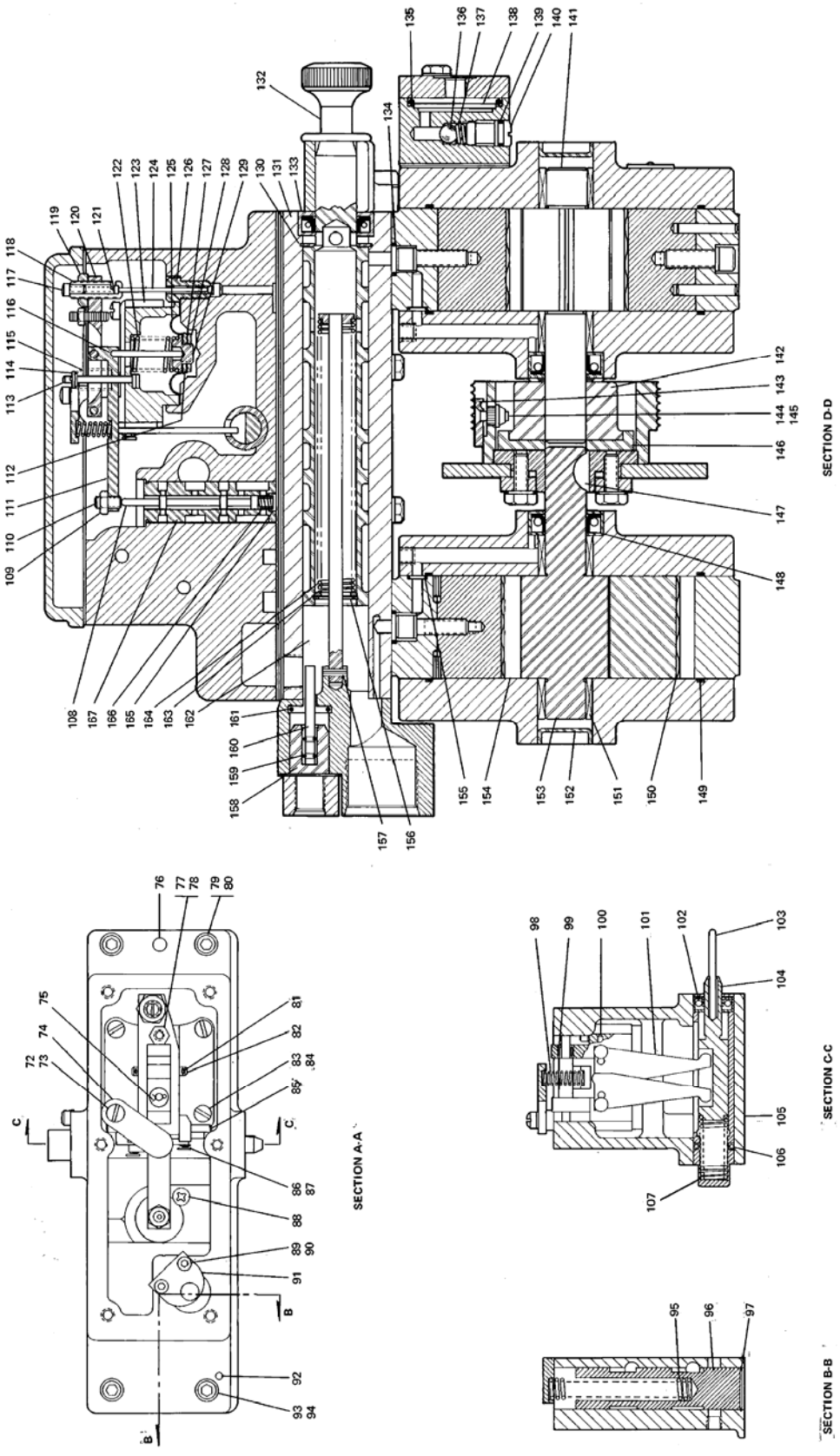


Figure 4-1b. Pitch Control Assembly Parts (2 of 2)

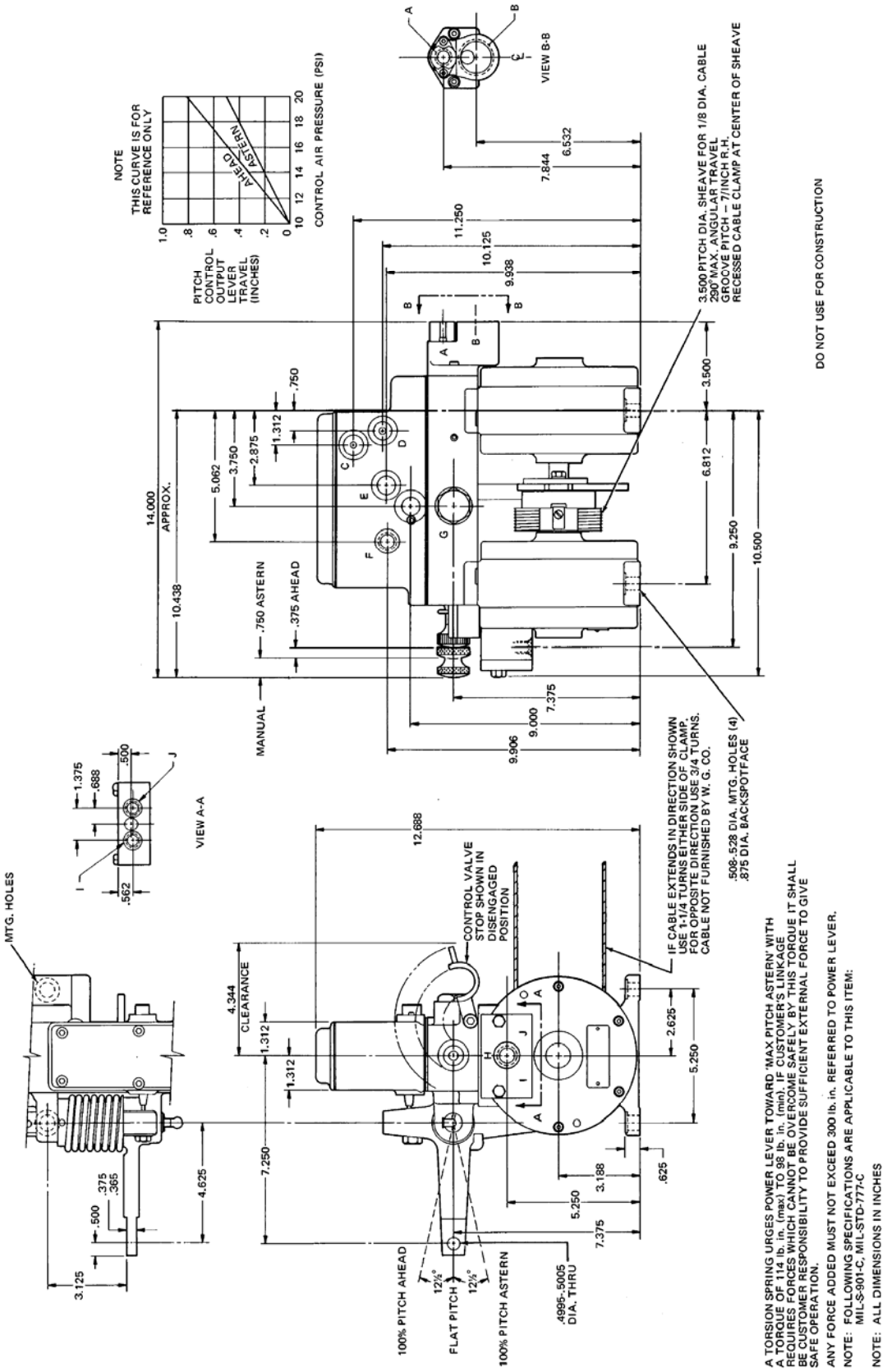


Figure 4-2. Outline Drawing of Pitch Control Assembly

Chapter 5.
Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in "like-new" condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:
- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory published at **www.woodward.com/directory**.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used In Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used In Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used In Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

For the most current product support and contact information, please visit our website directory at **www.woodward.com/directory**.

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) _____

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

_____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 36049D.

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

Email and Website—www.woodward.com

**Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.**

Complete address / phone / fax / email information for all locations is available on our website.

2012/9/Colorado