PARTS CATALOG

Superior ENGINES

ATLAS Imperial DIESEL ENGINES

APPLIES ONLY TO THE FOLLOWING ATLAS ENGINES

50090 TO 50092 INCL.
50116 TO 50119 INCL.
50123 TO 50176 INCL.

US Army Corp Engrs Kewaunee – S/n 50088

BORE 9 STROKE 10 1/2

NO. CYL. 8 TYPE Marine

MODEL 45-M5X-8

WARNING

THE PARTS CATALOG SECTION OF THIS BOOK MAY CONTAIN EXTRA DATA (GROUP LISTS & SUB-ASSEMBLIES) WHICH DOES NOT APPLY TO THE ENGINES LISTED ABOVE.
USE ONLY THOSE GROUPS LISTED ON INDEX SHEET.
BEFORE USING THE PARTS CATALOG – READ CAREFULLY THE TWO INSTRUCTION PAGES IMMEDIATELY PRECEDING THE INDEX.

PRICE $10.00

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION
SPRINGFIELD OHIO U.S.A.

TABLE OF CONTENTS

The material in the Instructions has been arranged in sections each dealing with a specific subject or subdivision of the engine. The sections are arranged alphabetically and the titles and main contents are listed below.

GENERAL ENGINE DATA

The Atlas Imperial Diesel Engine described herein is of the heavy duty, solid injection, full Diesel type, designed especially for reliability and a long life of trouble-free operation. Compact, rugged construction allows a wide range of applications and accessibility of all wearing parts means simplified maintenance and dependable service. The engine incorporates the latest proven refinements of the four stroke cycle and operates as follows:

1st Stroke — On the downward or suction stroke of the piston, the inlet valve is open and pure air is drawn into the cylinder through the air inlet manifold. On supercharged engines the inlet manifold is supplied with air under slight pressure by the turbosupercharger.

2nd Stroke — On the second or compression stroke, this air is compressed which raises the air temperature to a point above the ignition temperature of the atomized fuel. Just before the piston reaches top center fuel injection starts and is completed shortly after the piston has passed the top dead center.

3rd Stroke — On the power stroke the injected fuel oil burns, increasing the pressure within the cylinder, which drives the piston down through its working stroke. Shortly before bottom center position is reached, the exhaust valve opens.

4th Stroke — As the piston returns toward the head, the burned gases are forced out through the exhaust valve port, and when the piston reaches top center, or shortly thereafter, the exhaust valve closes. Slightly before the piston reaches top center the inlet valve is opened so that at top center the engine is ready for the suction stroke and the cycle is then repeated.

The horsepower rating and the rated speed of the engines are stamped on the engine nameplate and these ratings should never be exceeded.

On the nameplate will also be found the engine serial number which should always be stated when ordering parts and in any correspondence with the factory or Sales agencies. The firing order, valve timing and the model designation will also be found on the engine nameplate. When corresponding or ordering parts it is desirable that the model number be stated also. The engine serial number is, however, more important and if the model number is not known, the number of cylinders and the bore and stroke of the engine may be stated.

SPECIFICATIONS:

BORE AND STROKE	9" x 10-1/2"
Total Displacement	6 Cyl. - 4007.8 Cu. Inches 8 Cyl. - 5343.8 Cu. Inches
Firing Order	See engine nameplate.
Maximum Speed	See engine nameplate - Do not exceed.

OPERATING PRESSURES:

Lubricating Oil Pressure	25 to 40 lbs./sq. in.
Fuel Oil	15 to 20 lbs./sq. in.
Starting Air Pressure	150 to 250 lbs./sq. in.

OPERATING TEMPERATURES:

Cooling Water	Normal Out	140° to 160° F.
	Maximum Out	170° F.
Lubricating Oil	Normal Out	150° to 170° F.
	Maximum Out	185° F.

Best operation is obtained if water and oil temperatures are maintained within their normal range. Maximum temperatures should never be exceeded. Lubricating oil temperature should preferably be measured at sump pump discharge, but it can also be measured before entering oil cooler, in which case the temperatures should be about 5° lower than those stated above.

FUEL AND LUBRICATING OILS

1. RECOMMENDED FUEL OIL SPECIFICATION

Viscosity - - - - - - - - - - - - - - - - - - -35 to 70 S.U. Seconds at 100° F.
Gravity (A.P.I.) - - - - - - - - - - - - - - -Minimum 24°
Conradson Carbon (A.S.T.M.-D189) - - - -Maximum 0.5%
Ash -Maximum 0.05%
B.S.&W. - - - - - - - - - - - - - - - - - - - Maximum 0.1%
Sulphur (A.S.T.M.-D129) - - - - - - - - - Maximum 1.0%
Ignition Quality - - - - - - - - - - - - - - - 45 to 55 Cetane Number or equivalent in other ignition index.

2. EFFECT OF FUEL PROPERTIES ON PERFORMANCE

The engine will operate saisfactorily on fuels with viscosities per above specification. It is possible to use thinner fuels but the operation is apt to be "snappy" and it may be difficult to maintain even cylinder load balance at varying loads. To insure good operation it is recommended that the viscosity be held to the specification.

The gravity is of secondary importance. A minimum of 24° A.P.I. is merely given since heavier fuels generally require special treatment, such as heating and centrituging, before they can be burned successfully.

The "Conradson Carbon" or "Carbon Residue" in the oil is an index to the amount of carbon which will form in the combustion chamber. Fuels with high "Conradson Carbon" may cause carbon to build up on the spray tips to such an extent that the fuel sprays are deflected causing poor operation and smoky exhaust. The higher the Conradson Carbon the more frequently will it be necessary to clean the spray tips. Experience also indicates that maintenance costs will be higher when fuels with high "Carbon Residues" are used.

The Ash content of a fuel is a measure of the amount of mineral material it contains. After burning the mineral residues are abrasive and it is, consequently, important that the Ash content be limited to 0.05%. If the content is higher rapid wear of cylinder liners, pistons and rings will result.

The item B.S.&W. (Bottom Sediment and Water) is an index to the fuel's cleanliness. It is good economy to use clean fuel and store it in clean tanks. Cleanliness in handling the fuel is also important (See paragraph entitled "Importance of Cleanliness in Fuel Handling" in Section N).

When the fuel oil is consumed in the engine Sulphur burns to Sulphur-dioxide. Under normal operating conditions most of this gas is ejected with the exhaust gases. If, however, temperature conditions are low enough, that is, if the engine is idling at low speed and under cold conditions, the sulphur-dioxide gas combines with condensed water vapors to form a corrosive acid which will attack metals used in the engine and exhaust system. It is consequently particularly important to hold the sulphur content low in fuels used for engines subject to variable loads with long periods of idling and also for engines subject to frequent starting and stopping.

The Cetane number of a fuel is an index of the ignition quality. Low Cetane values produce excessive knocking. Excessively high Cetane fuels cause high exhaust temperatures and smokiness of the exhaust.

Although the Flash Point does not affect the suitability of a diesel fuel it is well to specify a minimum of 150° F. since state laws and Classification Societies generally require this minimum. The Pour Point of the fuel should be at least 15° F. below the lowest temperature to which the fuel storage tank is subjected.

3. LUBRICATING OIL

We recommend that a good grade of compounded mineral oil of a detergent type be used in these engines. The oil should be stable under the temperature conditions encountered in the engine and should be resistant to oxidation, foaming and sludging. The best assurance of obtaining a suitable oil is to use only products of well-known merit, produced by responsible concerns, and used in accordance with their recommendations. Do not permit your engine to be used as an experimental unit for trying out new or questionable lubricants.

There are on the market today many good compounded oils with different degrees of detergency. As a general rule the detergency should be what the engine needs and no more as lubricating quality usually decreases with increase in detergency. A good index of detergency in a lubricating oil is the "Ash" in the oil specification and as a general rule this item should not be over 1.0%. Best results are obtained with oils having an ash content of 0.5 to 0.7%.

In normally aspirated engines when the duty is not too severe a pure or "straight" mineral oil may be used. When such an oil is used some carbon or other deposits will generally be found in the crankcase and sump tank. The amount of these deposits depend greatly on the quality of the oil which has been used and for good grades of oil the deposits are not excessive and in any way harmful to the engine. If, on the other hand, detergent type oil is used the chemicals contained in this type of oil enable it to carry the carbon or other constituents of the usual crankcase deposits in suspension. The detergent type oils also have a strong tendency to break loose and carry away any existing crankcase deposits and since there is a limit to the amount that can be carried in suspension clogging of filters and oil lines may result. It is consequently of utmost importance to thoroughly clean out the crankcase, oil lines and sump tank before changing from a straight mineral oil to a compounded oil. As an added precaution we suggest that the first batch of compounded oil be used only for about 100 hours and then drained off. These precautions apply also when changing from one compounded oil to another compounded oil of different make or brand.

If a compounded oil is used the non-corrosiveness of this oil must be looked into very carefully. In this connection the Engineering Department of the Engine Division of The National Supply Company is available for consultation and they will be glad to advise whether or not a specific oil is suitable for use in this engine.

Regarding the viscosity of the lubricating oil to be used, an oil of SAE 30 grade is recommended for normal operating temperature. If the engine is to be operated under extremely hot temperature conditions, say 110° F. or over, SAE 40 oil should be used. If the ambient temperatures are below freezing, an oil of SAE 20 rating should be used.

For low temperature operation, the pour point of the oil at the minimum starting temperature to be expected should be carefully considered, as it is most essential that the oil be sufficiently fluid so that it will flow to the pump under all conditions.

The oil day tank (standard tank) holds the proper amount of lubricating oil, and the level should be maintained between the "Half" and "Full" marks on the oil gauge when the engine is running. In regard to drainage periods we suggest that the first batch of oil be drained after about 300 hours of service. Thereafter the filter cartridges should be changed and the drainage period can be increased to approximately 1000 hours providing the filter cartridges are kept in good shape and the oil remains reasonably clean. Experience will determine when to change filter elements and oil and in this connection it should be pointed out that it is more economical to maintain the filter in good shape. However, if the oil is badly discolored and loaded with insolubles, it should be drained off before new filter elements are put in.

INSTALLATION INSTRUCTIONS

1. PREPARING THE ENGINE BED

The success of a Marine engine installation depends greatly upon the construction of the foundation and upon the care exercised in lining up the engine to the propeller shafting. Poor installations will result in excessive vibration and continual change in engine alignment. The result is poor performance and failure of vital parts. For this reason The National Supply Company cannot guarantee an engine unless the engine foundation (engine bed) is strong and rigid enough to prevent vibration and changes in alignment.

The importance of rigidity in the engine foundation cannot be over-emphasized and it must be securely fastened to the hull of the vessel so as to be virtually a part of the hull construction. For installations in old hulls, where the rigidity of the hull is questionable, the foundation should be extended fore and aft as far as possible; twice the length of the engine is suggested. Stiffeners should be fitted to prevent the foundation from twisting and weaving. In twin screw installations it is advisable that both foundations be stiffly connected and braced to each other and to the hull. Steel foundations should be welded or riveted. Avoid bolts or screws which may work loose.

When preparing the engine foundation always obtain certified outline prints. Do not use figures or cuts in bulletins or sales literature. The top faces of the foundation must be straight and should be lined up so that they are parallel to the propeller shafting. Athwartships the two top faces should be level. The foundation should be constructed so as to allow 1" to 1½" thick shims or chocks between the engine supporting flanges and the top faces.

2. INSTALLING THE ENGINE

The engine should be lowered onto the foundation and allowed to rest on the leveling screws. For wooden foundations provide steel plates of sufficient area and thickness for the leveling screws to rest on. (Min. 4" x 4" x ½" to 3/4" thick) Shift the engine sideways until the centerline of the crankshaft lines up with the centerline of the propeller shafting. Then by means of the leveling screws adjust the height until the centerline of the crankshaft exactly lines up with the centerline of the propeller shafting. Also level the base athwartships. When alignment in all planes is at hand the following check should be made.

a. Turning over shaft there should be no binding between the centering spigot and recess of the two coupling halves.

b. The faces of the coupling halves should be parallel regardless of the angle through which either or both shafts are turned. With the propeller coupling half held against the engine coupling half, but not bolted, it should not be possible to insert a 0.003 in. feeler at any point between them. Check at top and bottom and the two sides before bolting flanges together.

If engine has been installed before launching it is advisable to temporarily bolt it to the foundation at this time. It is not advisable to proceed any further before launching unless the hull is extremely rigid. When the vessel is afloat the alignment should again be checked and if found satisfactory a chock should be carefully fitted at each holding down bolt. This applies to steel foundations. In wooden foundations careful

measurements should be taken of the distance between the bottom of the engine supporting flanges and the top of the foundation. A continuous wooden shim should then be prepared and this shim should exactly fit the space between the foundation and the engine supporting flanges. The shims should be at least as wide as the supporting flanges.

After the engine is resting on the chocks or wooden shims it is advisable to check that the foundation is supporting the engine evenly over the entire length. This is best done with a #696 Starrett Strain Gage. Check the distance between the inside faces of the crankwebs with the corresponding crank on upper and lower centers. (See figure in Section F for strain gage location.) Readings for any one crank should not differ more than .002". Distortion of the last two cranks only indicates that the crankshaft is out of line with the propeller shafting. (When making this check the engine and propeller shaft couplings should be bolted together.) Check the last two cranks in the two horizontal positions also. If misalignment or uneven support is indicated determine the cause and correct.

When the final alignment has been accomplished permanent foundation bolts should be fitted. For steel foundations drill and ream for fitted bolts. Spaces between the foundation bolt chocks can then be filled with type metal.

3. SERVICE PIPING

Plan all piping carefully and use as short and direct lines as possible. To improve the general appearance of the installation, piping should be laid below the engine room floor when it is possible to do so. Removable floor plates should be provided and care should be taken that all piping is accessible.

4. FUEL AND LUBRICATING OIL PIPING

See Section N for pipe sizes and arrangement of the fuel day tank. See Section T for lubricating oil day tank connections. Pipe sizes are stated in these sections. Provide drain valves and vent valves where necessary and remove all scale and dirt from pipes and fittings before installing.

5. COOLING WATER PIPING

Locate the sea chest far enough below the water line to prevent uncovering when the vessel rolls. It should be provided with a coarse grating. Inside the hull a strainer of ample size should be provided with gate valves on each side so that it can be isolated for cleaning. For engines equipped with centrifugal circulating water pumps it is particularly important that the resistance in the sea chest, strainer and piping be as small as possible. Use as few bends as possible and do not make either suction or discharge piping longer than necessary. Locate the overboard discharge not more than 3' above the water line. All valves should be gate valves - not globe valves. Use pipe sizes called for on the outline drawing.

6. STARTING AIR PIPING

Air tanks should conform to A.S.M.E. specifications and should have ample strength for 250 lbs. per square inch pressure. Each tank should be equipped with a safety valve and a globe valve for isolation. A drain valve should also be provided at the lowest point and this valve should be accessible.

Tanks should be connected to the engine starting air header using the pipe size called for on the outline drawing. Provide a globe valve next to the engine. All valves and fittings should be of heavy pattern for at least 250 lbs. per square inch pressure. The air compressor on the engine should be connected to the tanks with pipe of the size called for on the outline drawing and valves and fittings of heavy pattern. The air compressor discharge pipe should preferably be run to the air tank. It should not be connected to the piping between the tank and the starting air header. Air compressor unloader should preferably be connected to the tank with its own piping or tubing. Under no circumstances should it be connected to the compressor discharge line.

7. EXHAUST SYSTEM

All exhaust piping should be installed in the shortest and most direct manner possible. When bends are necessary use long sweep fittings. Use the pipe size called for on the outline drawing for lengths up to 30' containing a maximum of three bends For 3 to 6 bends increase the pipe to the next nominal size and for each additional 30' length increase by one pipe size.

In order to protect the engine and piping from undue strains a length of flexible metal tubing should be installed as near to the engine as possible. It is also recommended that flanged connections be used for ease of dismantling and cleaning. For twin screw installations it is recommended that separate exhaust lines be used. If exhaust lines are combined and only one engine is running, soot and carbon will be blown into the other engine through the open exhaust valve.

OPERATING INSTRUCTIONS

1. Before the operator attempts to run the engine, he should carefully study the chapters dealing with the mechanical details, especially those of the control system (see Section R). He should also study the Westinghouse Air Brake Company equipment and should make clear to himself how it functions. A description of this equipment will be found in the Westinghouse section under "Auxiliary Equipment".

Particular attention is called to the schematic diagrams of air connections shown in the Westinghouse section referred to above. The operator should also note how the control lever functions and what happens when it is moved to the various locations for "Stop", "Start" and "Run". See that the selector lever, which is mounted on the instrument board, is in the proper location for control from the machine room. The first start should always be made with the engine controls and the operator should make sure that everything is functioning properly before attempting to control the engine from the pilot house.

Two sets of cams are mounted on the camshaft, one for AHEAD running and one for ASTERN. These cams are provided with sloping ramps which allow the cam follower rollers to slide up on any cam when the cam lobe is in front of roller when the camshaft is shifted from AHEAD to ASTERN or vice versa by the air cylinder in the control unit. The fuel cams on these engines also serve to actuate the starting air valves during the starting periods. The camshaft is positioned for AHEAD or ASTERN running by an air cylinder in the control unit as described in Section R.

The handle on the control lever is threaded on the lever in such a manner that when it is screwed down the lever is locked in position. When maneuvering is finished, the handle part should be screwed down so that the lever will not slip from the position for which it is set. After the operator has familiarized himself with the controls, in accordance with the above, the starting air can be turned on and the engine is ready for maneuvering. See that the starting air pressure is between 150 and 250 pounds per square inch.

2. TO GO AHEAD FROM STOP (See Fig. D-1)

   (a) Unscrew control lever handle and move it to "idle" position "A". Should the engine have stopped in the reverse direction of rotation, this movement of the lever will then cause the camshaft to be shifted to the position for AHEAD running. Keep the control lever handle unscrewed so that the lever can be moved freely.

(b) Move the lever to the "start" position ("B" on Fig. D-1). The engine will now start to turn over on air. A small amount of fuel will also be on at this point but this is merely done to have the fuel pump ready for fuel delivery when the air is turned off.

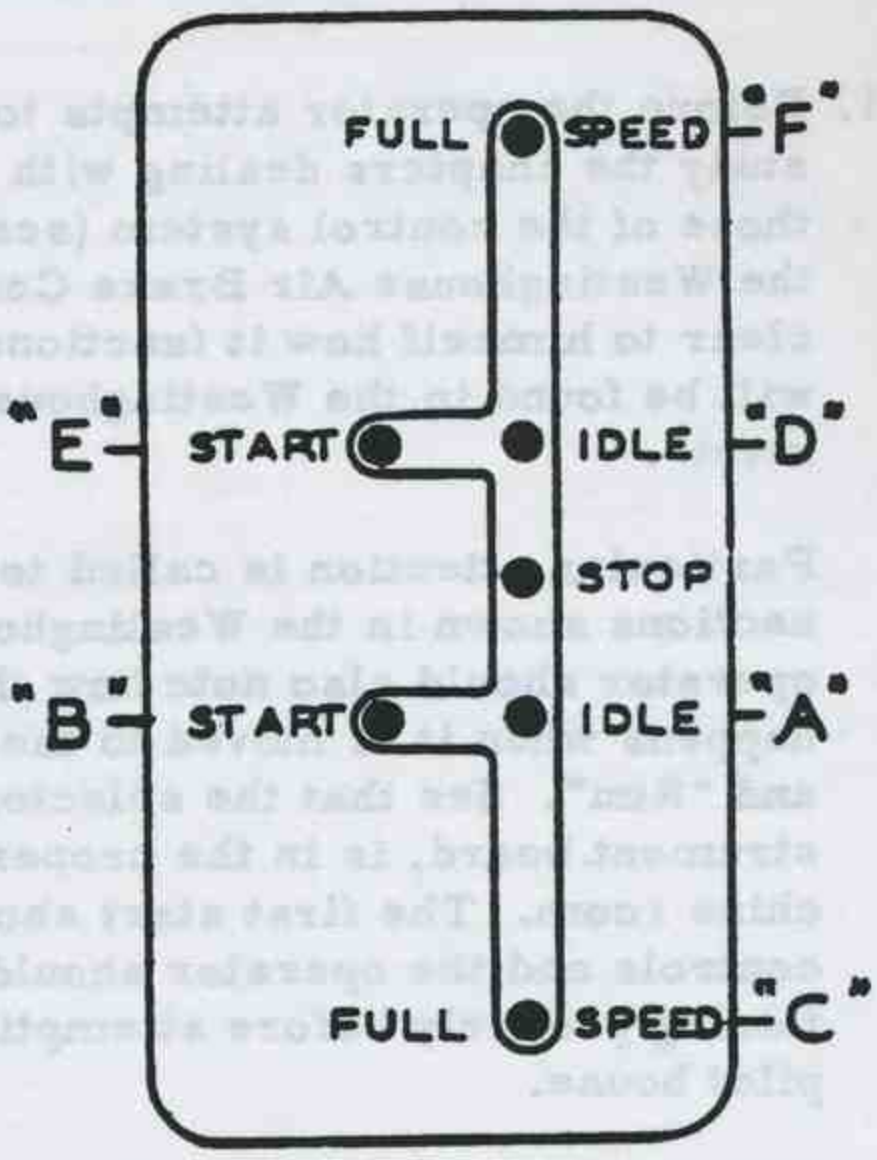


FIG. D-1

(c) As soon as the engine has reached the cranking speed move the control lever back to position "A". This movement of the lever causes the starting air to be shut off and allows the fuel pumps to deliver fuel providing the engine is turning over in the correct direction of rotation. The engine should now be turning over at the slowest speed and should be firing on all cylinders.

(d) Move control lever to the desired speed and lock it in position by screwing down the control handle.

3. TO REVERSE THE ENGINE (Normal Reversing) (See Fig. D-1)

(a) Unscrew control lever handle and return the lever to STOP. HOLD THE LEVER IN THIS POSITION UNTIL THE ENGINE HAS STOPPED.

(b) Move the lever to position "D" in the ASTERN direction and hold for a moment to give the mechanism time to shift camshaft to ASTERN.

(c) As soon as the air cylinder has moved the camshaft to its ASTERN position, move the lever to position "E". The engine will then begin to turn over on air in the ASTERN direction.

(d) When the cranking speed is sufficient, move lever back to position "D". The engine will then run ASTERN on fuel.

(e) Move the lever until the desired speed is attained and then lock it by screwing down the handle.

4. FAST OR "CRASH" REVERSING

For all normal reversing and maneuvering the directions in paragraph (3) should be followed. However, STOP (a) in paragraph (3) will require some time in order to allow the engine to come to a complete stop and in emergencies this time may not be available. A system has therefore been devised to BRAKE the engine with the starting air and then automatically start it in the direction called for. The procedure is then to move the handle in a steady motion, passing the STOP position, into the starting notch of the rotation called for.

Let us follow this operation on the maneuvering dial Fig. D-2. Control handle is at point "C". Engine is running: "FULL SPEED AHEAD". The call for "FULL SPEED ASTERN" has to be answered.

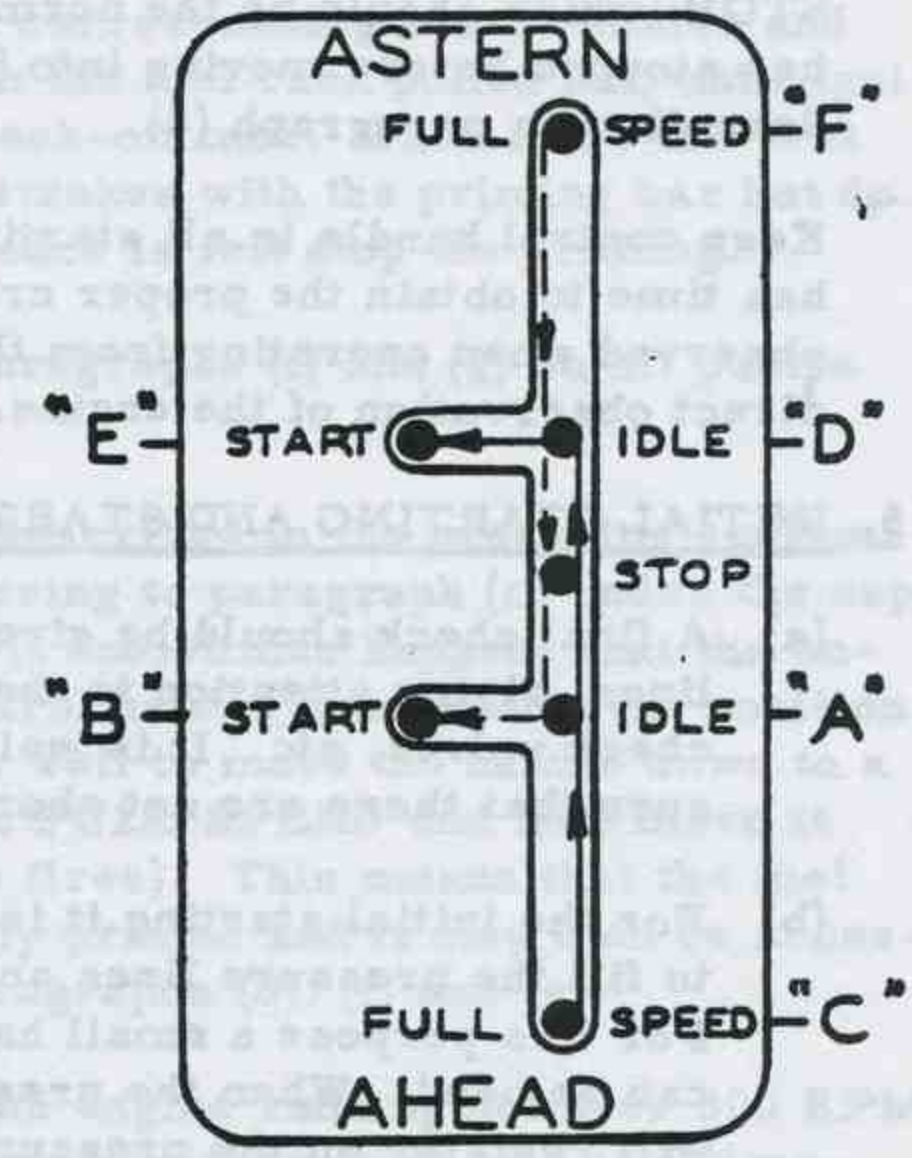


FIG. D-2

(a) Unscrew control lever handle.

(b) MOVE HANDLE with uniform motion, without hesitating at stop position, TO POINT "D" AND INTO NOTCH "E", THE STARTING POSITION FOR ASTERN ROTATION.

(c) HOLD LEVER IN THIS POSITION UNTIL STARTING AIR by the action of the air starting cam, the air starting check valve actuators and cylinder pressure release valves, WILL BRAKE THE ENGINE AND HOLD LEVER UNTIL STARTING AIR STARTS ENGINE IN ASTERN ROTATION.

(d) After engine reaches cranking speed, move control lever BACK TO THE IDLING DETENT, POSITION "D".

(e) Then move to point "F" -- FULL - SPEED - ASTERN.

NEVER BYPASS THE STARTING POSITION. Braking effort is available only at this position and only as long as engine is turning

in opposite direction to the direction called for by the control lever.

Identical operations are required from full speed astern to full speed ahead.

NOTE: Maneuver the engine either in accordance with instructions in paragraph (3) for NORMAL REVERSING or in accordance with paragraph (4) for CRASH REVERSING. Do not mix the two. For instance do not, following instructions in paragraph (3) hold the handle in STOP until the engine has almost stopped and then move it to START. Under such conditions the engine can AIR-LOCK. Either move the handle to STOP (which should be the normal procedure) and wait until the engine has stopped before moving into START or move directly to START as described in paragraph (4).

Keep control handle in all starting positions long enough until engine has time to obtain the proper cranking speed. This has to be strictly observed when operating from the remote control stand and having no direct observation of the engine.

5. INITIAL STARTING AND STARTING AFTER PROLONGED SHUTDOWN

(a) A final check should be given all fuel, air, lubricating oil and water lines, giving attention to the location and position of shut-off valves, check valves, etc. It is well to trace each system through making sure that there are not short circuits or blockages.

(b) For the initial starting it is well, although not absolutely necessary, to fill the pressure lines and passages of the lubricating oil system. For this purpose a small hand operated gear pump or piston pump can be used. When the pressure lines are full, a slight pressure will register on the pressure gauge. This procedure will insure lubricating oil pressure immediately upon starting.

(c) Prime the fuel transfer pump and the lubricating oil pressure and sump pumps.

(d) Open any valves or stop cocks between the engine and the fuel day tank and close the shut-off valve to the fuel main tank. This will insure a positive fuel head on the fuel transfer pump and fuel filter and header. Then open the compression or indicating cocks on the front side of the engine.

(e) With indicating cocks open turn the engine over on air. Do not move the control lever beyond starting position "B" (see Fig. D-1). Observe the fuel pressure on the gauge board. A couple of starts may be necessary for the fuel pressure to register and it may also be

necessary to reprime the fuel transfer pump. As soon as fuel pressure registers move the control lever to STOP.

(f) Remove the cylinder head covers and the front covers on the cylinder block thus making the fuel injection pumps and the nozzle holders accessible. Next loosen the vent plug on one fuel pump about one turn. Then insert the priming bar furnished with the tool equipment so that its pivot ledge rests on top of the valve lifter guide to the left of the pump and its extreme end is under the arm on the pump lifter which operates the air starting valve. Work the priming bar after pulling out the pump rack until fuel issues through the vent plug, then close this plug tightly.

(g) Next open the vent valve on the corresponding nozzle holder and again work the priming bar with the fuel rack pulled out, until fuel free of air issues through the leak-off tube. Then close the vent valve and give the pump a few strokes with the priming bar but do not force it. As soon as resistance is felt stop the priming.

Repeat priming procedure in paragraphs (f) and (g) on all pumps and nozzle holders.

(h) Start the engine by the method described in the preceding sections and run it at slow speed. Referring to paragraph (c) under the caption "To Go Ahead From Stop" it sometimes happens that the engine does not fire when the control handle is moved to the position for "idle" (for initial start it is well to move the handle down to a point midway between IDLE and FULL SPEED and then move it back somewhat when the engine fires). This means that the fuel injection pumps are not properly primed and it may then be necessary to repeat procedure in paragraphs (d), (f) and (g).

(i) As soon as firing starts, with the engine running not over 300 RPM, crack the vent valves on the nozzle holders open, one at a time. Then close the open valve and open the next one. This is to clear the fuel system of any residual air and eliminate any unevenness of firing. Repeat the procedure if necessary.

(k) With the engine running at 300 RPM or less <u>immediately</u> check the following:

1. Lubricating oil pressure and circulation. Observe oil level in day tank. Engine will absorb several gallons when started up.

2. Circulation of cooling water. Do not run the engine longer than two minutes or at high speed unless water circulation has started. In some instances priming of the water pump will be necessary but do not prime until the engine has cooled down.

(l) Reassemble the cylinder head covers and tighten down firmly to prevent loss of lubricating oil. Before replacing covers be sure that vent valves on nozzle holders are tightly closed. Then open the valve to the fuel main tank and speed the engine up to about 300 to 350 RPM and check the following:

1. On supercharged engines feel the water discharge line to make sure that water is circulating through the turbocharger. (It is well to open the vent valve on the discharge line to make sure that water is circulating.)

2. Oil and water leakage from external lines and fittings.

3. Hot bearings. Feel back crankcase covers at intervals to locate any hot areas which would indicate hot oil from a hot bearing.

4. Feel water jackets and manifolds for even water circulation.

5. Listen to the engine for evenness of firing and mechanical knocks.

(m) The engine should be brought up to full speed and load slowly. At each speed the items listed under (k) and (l) should be checked. The cylinder block front covers should then be replaced.

6. ROUTINE STARTING AND MANEUVERING

Always check the positions of fuel oil and water shut-off valves and make certain that no tools or the cranking bar have been left where they can interfere with flywheel or shafting. After starting up check water circulation, lubricating oil level and pressure. The formation of a habit of checking these items automatically whenever the engine is started is likely to prevent accidents and serious damage.

If reversing air maneuvering operations have not been performed as described in paragraph (3) or (4) the engine may air-lock in which case it will be impossible to start in either ahead or astern. In case this happens, set the control handle in position "B" if AHEAD running is desired and in position "E" for ASTERN running. Then quickly open and close the indicator cocks, one at a time, starting with the forward cylinder. One of the cylinders will have its starting air on and on this cylinder air will keep on issuing as long as the indicator cock is open. Close the valve and proceed to the next cylinder until the one that has its compression locked against the starting air is found. As soon as this compression has been relieved the engine will start turning over, whereupon the valve should be quickly closed. The operator should then move the control handle further to affect the desired speed of running on fuel.

7. ALARM CONTROL SYSTEM

There is an alarm cabinet for the engine room and one identical in appearance for the pilot house. Mounted on the front of each cabinet are properly labeled pilot lights for lube oil pressure, water temperature, and air pressure; push buttons for testing and stopping the alarm; alarm horn and main line power switch.

The power switch, labeled "Power On-Off", is the means of electrical connection between the source of electrical power and the alarm cabinet.

The engine is equipped with an air pressure switch set at 50 p.s.i. and connected pneumatically to the air stop cylinder. When the engine is running the stop cylinder has no pressure and the electrical contact of the above switch is closed to energize the alarm system. When air pressure is applied to the stop cylinder for stopping the engine or for maneuvering the boat, the air pressure switch opens the circuit to the alarm control. This will prevent the alarm sounding while the boat is being maneuvered and will de-energize the alarm control automatically when the engine is stopped for a longer period.

When the engine is restarted the alarm will not sound but the lube oil pressure pilot light will be illuminated. When the oil pressure builds up to normal the light will go out and the horn will become set automatically so that a future drop in oil pressure will sound the alarm.

There is another air pressure switch set at 150 p.s.i. and connected pneumatically to the main air supply. If the air supply drops below 150 p.s.i., the alarm will sound and the pilot light labeled "Air Pressure" will become illuminated and the lights on the control stand will change from green to red.

If the engine jacket water temperature becomes excessively high the alarm will sound and the pilot light labeled "Water Temperature" will illuminate.

The horn in the engine room may be silenced by pressing the button on the engine room alarm cabinet labeled "Stop Alarm". The horn in the pilot house may be silenced by the button on the pilot house alarm cabinet. But the silencing of the horn at one location does not affect the horn at the other location.

The alarm and lights may be tested either before the engine has been started or while it is running by pressing the button labeled "Test Alarm". The testing of alarm and lights at one location does not sound the alarm nor affect the lights at the other location.

The alarm control is so designed that if the alarm has been silenced for one abnormal condition, it will sound again if another abnormal condition develops even though the first has not been corrected. When the abnormal condition has been corrected the alarm resets automatically to sound again if the same condition recurs.

LOWER BASE, CRANKSHAFT AND BEARINGS

1. BASE

The cast iron base is heavily ribbed to support the main bearing saddles and to form a rigid structure upon which the engine is built. A trough extending longitudinally along the bottom serves as a drain for the lubricating oil to the scavenge pump suction strainer which is located at the flywheel end. The lubricating oil pressure header is located in the chamber formed by the base foot on the exhaust side of the engine.

2. MAIN BEARINGS

The crankshaft turns in babbitt lined steel backed bearing shells, held in place in the base by the main bearing caps. The crankshaft is located longitudinally by babbitt faces on the shells of the flywheel end bearing. The thrust clearance is .004" to .010" when new and should not be allowed to exceed .020".

The bearing shells are prevented from rotating in the base by dowels in the caps and are located fore and aft by dowel pins in the bottom of the bearing saddles which engage circumferential grooves around the outside of the shells. After removing the caps and top shells the bottom shells may be rolled out by inserting a pin in the crankshaft oil holes and barring the shaft around.

The bearing shells are of the precision type and are assembled without shims. The shells are interchangeable and do not require fitting. In case a bearing shell is worn to a point where it should be replaced all that is necessary is to remove the old shell and substitute a new one. Under no circumstances should a shell be filed, fitted or scraped when it is replaced, but care should be taken that the new shell, as well as the bearing saddle, is clean when a new shell is assembled. In an emergency it is perfectly proper to exchange the top and bottom shells on any one bearing.

The manufacturing tolerances on bases, caps, shells and crankshaft allow journal clearances of .005" to .010" on the diameter. It is, however, comparatively seldom that these extreme clearances are reached in manufacture, and clearances from .006" to .009" may be considered normal. Bearing shells should be replaced when the diametral clearance has reached .015". Clearances should be measured by means of soft lead wires or miked with the cap bolt nuts tightened down to their proper torque which is 300 to 330 foot pounds for center and intermediate bearings and 350 to 380 foot pounds for end bearings. Torque wrenches should preferably be used to ascertain these torque values. However, if such a wrench is not available the torque may be approximated by using the main bearing socket and bar furnished with the tool equipment. An average man pulling hard at the end of this bar will exert a torque of approximately 300 to 350 foot pounds. Do not under any circumstances use a sledge in tightening the main bearing bolts.

The bearing caps are all numbered and a corresponding number will be found on the lower base. Always match these numbers and always reassemble a cap in its proper place. Also note on which side the caps are numbered and do not turn the caps around when reassembling them.

3. CRANKSHAFT ALIGNMENT

The crankshaft alignment should be checked at annual overhauls or at intervals of not more than 10,000 service hours. A good idea of the alignment may be obtained by

measuring the bearing clearances with a soft lead or fuse wire. If all bearings are worn to about the same clearance the bearings will be approximately in line and if this clearance is less than .012" it will be satisfactory to leave everything alone until the next overhaul period. If the wear is uneven it is, however, best to replace all the bearing shells to make sure that the alignment is satisfactory.

The crankshaft alignment may also be checked with a gap or strain gauge as follows: Stamp two center punch marks, as shown in Fig. F-1, on all cranks. Starting with No. 1 cylinder crank, remove adjacent main bearing caps and locate the crank as near lower center as gap gauge will permit. Using jack screws between bearing journal and center frame force shaft against lower bearing half (Protect shaft with a piece of wood or sheet copper) and record the gap gauge reading. Then loosen jackscrews and bar over until crank is on upper dead center. Again tighten jack screws and record the gauge reading. Repeat on all other cranks.

Comparison of gauge measurements in upper and lower centers will indicate crankshaft alignment conditions. Normally the measurements for the cranks in top position are slightly larger than measurements for the same cranks in the bottom position. However, the difference in measurement for any one crank should not exceed .003". If this is the case, new bearing shells are indicated.

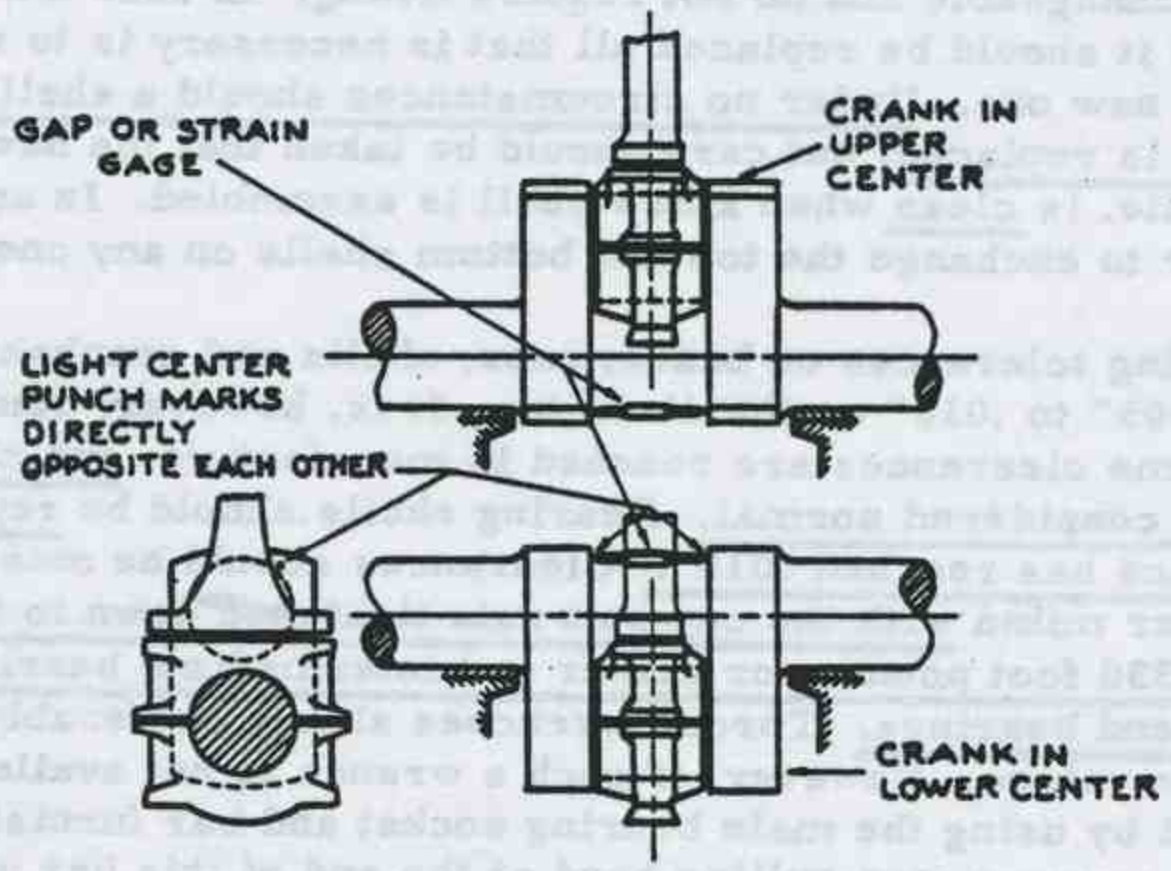


FIG. F-1

CENTERFRAME--CYLINDER BLOCK & LINER, CYLINDER HEAD & VALVES

1. CENTERFRAME

The centerframe, which rests on the engine base and supports the cylinder block, carries the camshaft bearings and forms the crankcase housing. The tie bolts are provided with nuts below the bearing saddles in the base and extend up through the centerframe and into the cylinder block, where recesses are provided in each side for the upper nuts. The centerframe is located on the base and the cylinder block on the centerframe by dowels. Crankcase sealer is used to make the joints between the three pieces, and if these joints are disturbed the oil sealer must be thoroughly scraped off and replaced by new sealer when reassembling. Glyptal Lacquer is recommended for sealer.

2. CYLINDER BLOCK AND CYLINDER LINERS

The individual liners are mounted in the cylinder block, which forms the water jacket surrounding the liners and supports the cylinder heads. A compartment on the camshaft side of the cylinder block encloses the valve lifters, push rods, starting air manifold and the fuel injection pumps and fuel header.

The cylinder liners are special alloy iron castings, heat treated to relieve stresses and secure correct hardness. They are accurately machined to close tolerances and should be handled carefully and care taken not to damage the fits at top and bottom. Spare liners should always be stored in a vertical position and should be securely fastened down if stored on board ship. The water seal at the bottom of the liner consists of two rubber grommets which should always be replaced with new ones whenever a liner is pulled.

When lowering a liner into place, use liquid soap or grease the grommets freely with cup grease and use care to enter the grommets into the cylinder fit or they may be pinched and damaged. The liner has from .002" to .005" clearance in the cylinder at both top and bottom fits and no difficulty should be encountered in installing a new liner. A paper gasket .010" thick is used for the upper water seal between the liner and cylinder, and a new gasket should always be used when replacing a liner. The fits and shoulders on both liner and cylinder should be carefully scraped and wiped clean to assure a water tight joint. Care must be taken not to damage these shoulders, as a water leak will result. Dowels in the tops of the liners engage keyways in the centerframe and assure correct orientation of the liners.

3. CYLINDER HEAD

The individual cast iron cylinder heads are carefully designed for strength and uniform cooling. The area above the liner is fully water jacketed, and a housing extends out from the camshaft side of the head to mate with the opening in the top of the push rod compartment in the cylinder block. The six cylinder head bolts are studded into the cylinder block, and the head is centered by a spigot which engages a counterbore in the top of the liner. A 1/32" thick copper gasket under the spigot forms the gas seal, and soft cork gaskets around the push rod compartment opening and cylinder head studs make oil tight seals at these points and still allows the head to be pulled down tightly on the copper gasket. Brass bushings screwed into the tops of the cylinder block and extending up into drilled holes in the head carry the cooling water into the head. They are sealed by rubber grommets, which should always be replaced by new ones when a head is pulled.

When replacing a head, carefully wipe all dirt from the lower surface and thoroughly clean both sides of the copper gasket, as well as the surfaces of the head and liner which bear against it. Always use care to protect the spigot on the bottom of the head as nicks and scratches will result in a leaky joint. Place heads on wooden blocks, never on concrete floor or steel deck, and use care that spare heads are not damaged in storage and handling. Covers over the tops of the heads fully enclose the valve rockers and push rods.

4. INLET AND EXHAUST VALVES

The one piece forged steel inlet and exhaust valves seat directly in the head and are guided in replaceable cast iron bushings pressed into the head. The inlet and exhaust valves are identical and interchangeable.

Two concentric valve springs are used on each valve. They are centered by the valve guide and are held in place by a retainer which is secured to the valve stem by means of a split taper collar. Depressing the retainer against the spring permits removal of the collar and disassembly of valve and springs.

If valve faces are badly pitted they should be refaced on a lathe, as excessive grinding to remove pits will wear down the seats in the heads unnecessarily and will also cut a groove in the valve face. Badly pitted seats should also be refaced with a seat reamer before grinding, taking particular care to keep the seat concentric and square with the bore of the guide. After refacing, the valves should be ground in lightly. Valve guides should be replaced if excessively worn, and new guides must be reamed to .750 - .7505 diameter after pressing in.

5. STARTING AIR CHECK VALVE

The starting air check valve is seated directly in the head. The clearance in the valve guide should be .0015" to .003" and the lift 1/8" to 5/32". The lift can be adjusted by means of the castle nut on top of the valve stem. Be sure that this nut is properly cotter pinned. Use 1/8" x 1-1/4" long cotter pin. If valve guide is replaced ream the hole .625" - .6255" diameter after pressing in.

6. STARTING AIR CHECK VALVE - ACTUATOR

The air starting check valve actuator consisting of a piston, which rests on top of the air starting check valve and is guided with a laped fit in a cylinder, serves for the application of the starting air engine braking device.

7. CYLINDER PRESSURE RELEASE VALVE

The cylinder pressure release valve is mounted by means of an adaptor directly to the cylinder head exhaust side. The spring loaded valve is actuated by air during reversing from the pneumatic control system. If valve should tend to stick, valve and piston should be cleaned from carbon and dirt deposits.

8. CYLINDER COMPRESSION RELIEF OR SAFETY VALVE

The compression relief valve is mounted to the pressure release valve adaptor. The valve spring is set to relieve pressure at approximately 1200 p.s.i. Do not allow this valve to blow or leak for any length of time as the valve and valve seat will then surely be damaged and the spring is apt to become annealed and lose its tension. If this has happened and the valve does not seat tightly it should be reground and a new spring applied.

A bronze bushing for the piston pin is pressed in the upper end of the rod. If this bushing is replaced it must be reamed to allow a piston pin clearance of .002" to .003". Care must be taken to keep the reamed hole exactly parallel with the foot of the rod. One of the holes connecting the inner and outer grooves in the bushing should be exactly in line with the hole in the connecting rod.

6. CONNECTING ROD BEARINGS

The crankpin boxes are steel castings, accurately bored, and are equipped with loose bearing shells. These shells are bronze backed and care should be taken that backs of shells and bores of boxes are absolutely clean when assembling. The shells project above the faces of the crankpin box halves .002" to .0035" but are squeezed down flush when the connecting rod bolts are tightened up. Bearing clearances should be .005" to .008" when new, and shells should be replaced when the clearance has reached .012". When clearances are measured, the connecting rod bolt nuts should be torqued up to 175 to 200 foot pounds. Soft lead wire may be used or bore can be measured with inside mikes.

The bearing shells are of precision type and interchangeable. Under no circumstances should a shell be filed, fitted or scraped when it is replaced. All that is necessary is to remove the old shell and substitute a new one. Be sure that all parts are clean when assembling.

The two crankpin box halves are held together by bolts so that the connecting rods and connecting rod bolts can be removed without disturbing the bearings. These bolts are a close fit in the two box halves and serve as dowels. Always mark these bolts before removal so that they can be put back in the same place from which they were removed. Do not mix them up.

7. CONNECTING ROD BOLTS

The connecting rod bolts, fitting in reamed holes, hold the two halves of the crankpin boxes together and to the foot of the rod. The nuts should be kept pulled up tightly to a torque of 175 to 200 foot pounds. It is recommended that all connecting rod bolts be replaced every two years, assuming the engine to have had continuous service during that time, say 8000 hours or more. Replacing bolts as suggested above is cheap insurance against the possibility of wrecking an engine through connecting rod bolt failure. Replace cotter pins carefully, always using new cotter pins. Be sure that they are a close fit in the hole and bend the ends back tightly against the sides of the nut. If this work is left to inexperienced mechanics it should be very carefully inspected at the completion of the job. Always replace rods, bearings and pistons in the cylinders from which they were removed. All parts are numbered.

PISTON AND CONNECTING ROD

1. PISTON - Naturally Aspirated Engines

The pistons which are of the one-piece, solid-skirt type are made of high grade cast iron and are heat treated to relieve stresses and to obtain proper hardness. The piston is ground straight, that is, without taper, from the bottom up to the ring belt. The clearance in the liner is .009" to .011". The head of the piston being exposed to high temperatures is given a larger clearance, .050" to .055".

The piston pin bearing is lubricated by force feed, the oil being conducted from the main bearings through the crankshaft up through the rifle drilled connecting rod. The outside and the inside of the piston pin bushing are provided with annular grooves and these are connected by a series of holes allowing the oil to lubricate the piston pin.

2. PISTON - Supercharged Engines

The pistons in supercharged engines are cooled by means of lubricating oil from the force feed system. In this case the lubricating oil cooler is larger to cope with the increased heat load. The pressure oil is delivered to the piston pin on both the non-supercharged and the supercharged engines in exactly the same manner, that is, through drilled holes in the connecting rod and crankshaft and through grooves in main and connecting rod bearing shells. The supercharged engine and the non-supercharged have, however, piston pins of different construction.

Referring to Fig. K-1, the piston pin is hollow with plugged ends. It has two holes in the center which allow the oil to enter the inside of the pin from the connecting rod oil hole, and the two annular grooves and connecting holes in the bushing. Consequently the inside of the piston pin is always supplied with oil under pressure.

Another series of holes close to the end of the piston pin also connect the inside of the pin with the outside. At least one of these holes on one side of the pin registers with a drilled hole in the piston leading to a closed chamber immediately under the piston crown (See Section A-A on Fig. K-1). Another drilled hole in the piston allows the oil to drain back to the crankcase after it has cooled the piston crown. This last mentioned hole should never be plugged or restricted in any way.

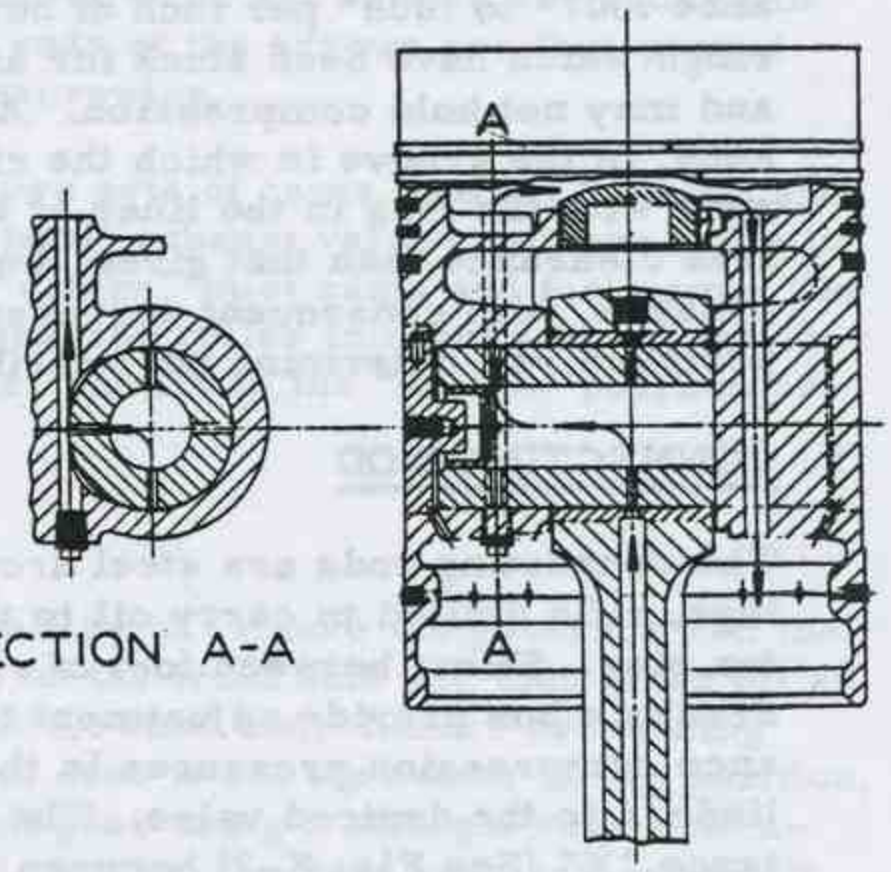


FIG. - K-1

The skirt on the supercharged piston is ground with a slight taper of approximately .003" in the length of the skirt. The clearance in the liner at the bottom of the skirt is .010" to .012". In this case also the head of the piston is given a larger clearance, i.e. .060" to .065".

3. PISTON PIN

Floating type piston pins are retained in the piston by means of snap rings in the naturally aspirated engine and by means of cast iron plugs which are pressed into a counterbore in the piston on supercharged engines. A tapped hole is provided in each plug to permit removal. After one plug is removed the other one may be removed by inserting a rod or bar thru the piston pin and tapping lightly with a hammer. When replacing these plugs always be sure to line up the dowel pin with the slot in the piston. It is advisable to replace the plugs in the same counterbore from which they were removed. This type of pin should be fitted with a clearance of .0015" to .0025" in the piston.

4. PISTON RINGS

Six rings are used per piston, an oil ring above and below the piston pin and four compression rings. Always assemble the oil rings with the bevel up, to slide over the oil film on the upstroke and scrape it down on the return. When overhauling pistons, thoroughly clean all carbon from rings and grooves and top of piston. Fuel deposit on the piston skirt can best be dissolved with cleaning solvent or paint remover. Be sure all oil drain holes in the oil rings grooves are open.

Check rings for side clearance in grooves and end clearance, as measured in place in the liner. Side clearance should be .005" to .007" on top compression rings and .004" to .006" for all other rings and end or gap clearance .005" per inch of bore diameter for the top ring. For the other rings the gap clearance should be .003" per inch of bore diameter.

Rings should be discarded when the side clearance exceeds .008" and the end clearance .007" to .008" per inch of bore diameter. It is also a good policy to discard any rings which have been stuck for any length of time as they are apt to be out of round and may not hold compression. Always check new rings, measuring the side clearance, in the groove in which the ring is to run, with feeler gauge, and the end clearance with the ring in the liner at the smallest diameter. Never install rings with less clearance than that given above. As the oil rings wear the width of the flat increases, with consequent decrease in width of bevel and oil scraping ability. Experience will determine permissible wear without excessive oil pumping.

5. CONNECTING ROD

The connecting rods are steel drop forgings, rifle drilled to carry oil to the piston pins. Shims between foot of rod and crankpin box provide adjustment to balance compression pressures in the cylinders to the desired value. The distance "X" (See Fig. K-2) between the top of the piston and the top of the liner should be .300" for the naturally aspirated engine. For the supercharged engine distance "X" should be .100". When taking measurement "X" the piston should be at top dead center and the cylinder liner must be securely clamped down into the cylinder. The cylinder block hold down nuts must also be tight when making this adjustment.

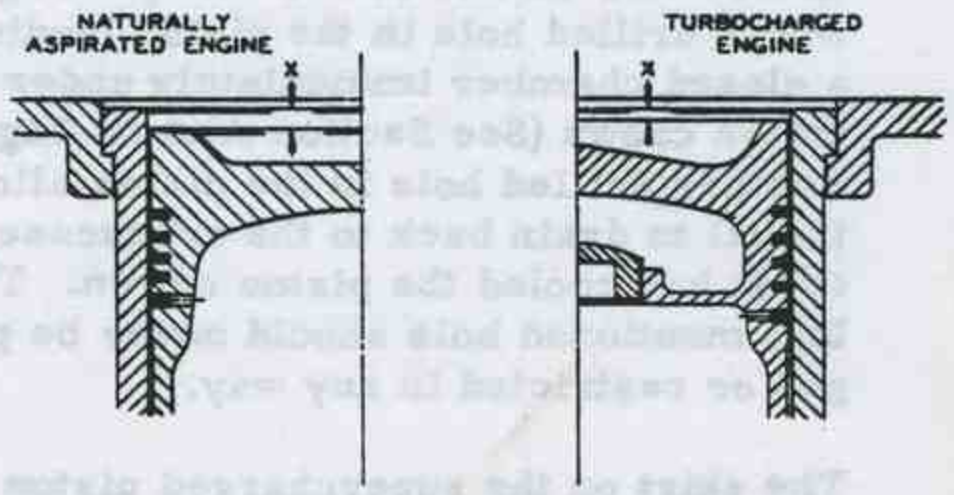


FIG. K-2

CAMSHAFT AND VALVE OPERATING GEAR

1. CAMSHAFT

The camshaft is made of 2" ground steel shafting. The keyways in the shaft are indexed for the firing sequence stamped on the engine nameplate. Number 1 cylinder is located at the forward end of the marine engines or at the end opposite the flywheel on stationary engines.

2. CAMSHAFT BEARINGS

The camshaft bearings are accurately machined, cast iron blocks with pressed-in babbitt lined steel backed bushings. Bearing bore in bushing is 2.004" - 2.005" diameter, which allows a running clearance of .004" to .006". The bearing blocks are held in machined recesses cut in the webs of the centerframe and are secured by capscrews which also hold the oil header.

The camshaft thrust on stationary engines is carried by the bearing opposite the flywheel end. On marine engines the thrust is taken by the muff on the shifter level in the control unit at the forward end.

3. CAMS

The cams are accurately ground to shape after being case hardened. The fuel cam also serves to actuate the starting air valve. All cams are a sliding or light tap fit on the camshaft and are held in position by fitted keys. Longitudinally cams are secured by dog point set screws which enter the camshaft to a depth of 1/8". After cams have been located in the proper position at the factory the set screws are spotted in the camshaft and the screws tightened up. The ends of the screws are then peened over into slots milled in the cams to prevent unscrewing.

On direct reversible marine engines there are two sets of cams, one for "ahead" and one for "astern" running. The "ahead" and "astern" exhaust valve cams are made in one piece, and this is also true of "ahead" and "astern" inlet cams and fuel cams. The cam lobes are provided with slanted ramps so that the roller followers can climb the cam lobes when the camshaft is shifted from the "ahead" to the "astern" position or vice versa.

4. CAMSHAFT REMOVAL

In order to remove the camshaft it is first necessary to remove the governor and fuel transfer pump housing. The centerframe doors on the front side are then taken off as well as the lower cover on the control unit at the forward end. Before proceeding further, number one piston should next be barred over to its top center firing position, and a line should then be scribed on the camshaft gear using a straight edge held against the front face of the gear housing. This is so that the cam gear and camshaft can again be assembled in the correct position relative to the crankshaft.

The camshaft gear should then be removed whereupon the crankshaft can be taken out after the capscrews holding the bearing blocks and oil manifold have been removed. The bearing blocks are a snug fit in the centerframe recesses and the shaft should be moved out evenly along its entire length.

5. VALVE LIFTERS AND PUSH RODS AND ROCKERS

Referring to Fig. L-1 the steel valve lifters work in cast iron guides bolted to the top of the centerframe. Clearance between lifters and guides is .0015" to .003". The lifters are provided with roller bearinged roller followers, the rollers forming the outer race of the bearings. A hardened pin extending thru the lifter forms the inner race. The floating pin fits snugly in the lifter, the clearance being .0005" to .001" and is held in place by the lifter guide. The roller extends through slots in the lifter guides and is thus held in alignment with the cams.

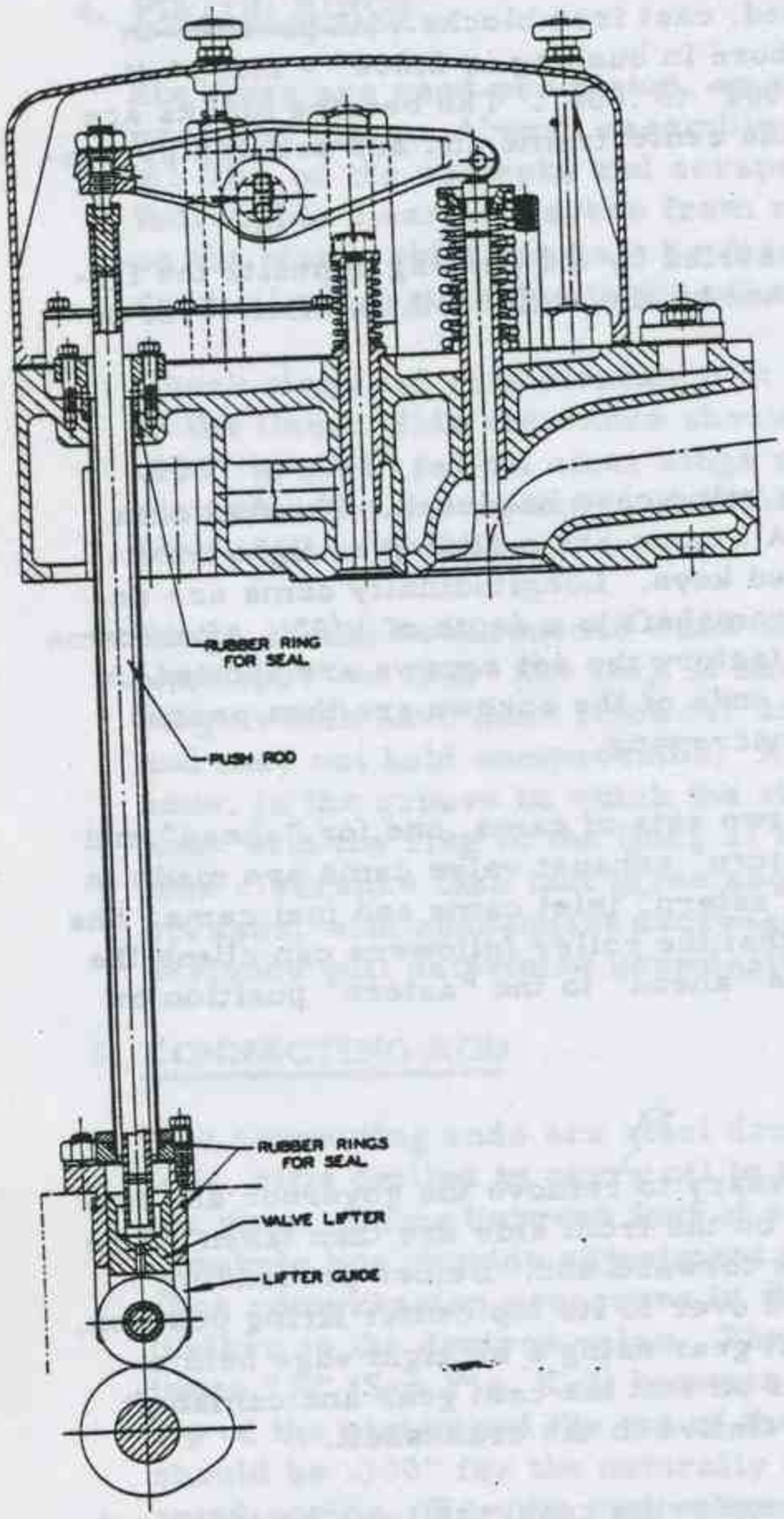


FIG. L-1

The inlet and exhaust push rods are fabricated from seamless steel tubing of 7/8" diameter. Steel ends are pressed into the tubing, the lower end being rounded to fit into the lifter and the upper end forming a socket to receive the adjusting screw in the rocker. The push rods are enclosed by steel tubes which lead the lubricating oil down from the cylinder heads to the crankcase. Rubber grommets at the upper and lower ends clamped by glands at the upper ends and by plates at the lower ends form oil tight seals confining the oil within the tubes. Drilled holes in the lifters allow the oil to drop down on the lifter rollers and cams furnishing lubrication of these parts.

The valve rockers are fulcrumed on shafts supported by brackets bolted to the top of the cylinder head. The shafts are secured in place in the split bracket by clamping down of the hold down bolt on the split side. The shafts are drilled for lubrication, the various holes being located by the nipple on top through which the oil is introduced. The shaft shoulder should be up against the face of the bracket. (see Fig. L-1)

The rockers are drilled for lubrication of the push rod end and are provided with a trough to lead oil to the valves. A small amount of oil is fed to this trough by the oil hole on top. The rocker bronze bushing has a clearance of .0015" to .003" on the shaft.

6. CAM OPERATED STARTING AIR VALVES

The cam operated starting air valves, one for each cylinder, are built into the starting air manifold. When there is no air pressure in the manifold the push rod and valves are held out of engagement with the arm on the fuel pump lifter by the spring at the lower end of the push rod. When, however, starting air pressure is admitted to the manifold the pressure over the area of the valve stem forces the valve down on its seat and likewise lowers the push rod against the above mentioned

spring. As the camshaft rotates, the push rod and valve will then be actuated by the fuel cam by means of the arm on the fuel pump lifter and will follow the cam from the moment the valve is lifted off its seat until it is again seated.

Consequently, starting air will be admitted to the cylinders at the proper time and in the proper sequence. The check valves in the cylinder heads prevent combustion gases from entering the starting air passages. These valves are described in Section H.

7. VALVE TIMING - NON-SUPERCHARGED ENGINES

The correct valve timing for the engine is given in the following table.

Starting Air Valve Opens - - Top Center
Starting Air Valve Closes - -50 to 55° B.B.C
Inlet Valve Opens - - - - - - - 7-1/2° B.T.C.
Inlet Valve Closes- - - - - - - 35° A.B.C.
Exhaust Valve Opens - - - - 35° B.B.C.
Exhaust Valve Closes - - - - 7-1/2° A.T.C.
Fuel Pump Port Closing- - - See engine name plate.

8. VALVE TIMING - SUPERCHARGED ENGINES

Starting Air Valve Opens - - Top Center to 5° A.T.C.
Starting Air Valve Closes- - 55 to 60° B.B.C.
Inlet Valve Opens - - - - - - - 75° B.T.C.
Inlet Valve Closes- - - - - - - 40° A.B.C.
Exhaust Valve Opens - - - - 50° B.B.C.
Exhaust Valve Closes - - - - 65° A.T.C.
Fuel Pump Port Closing- - - See engine name plate.

9. STARTING AIR VALVE TIMING

(a) Remove the plug over starting air pilot valve for Cylinder No. 1 and hold valve down firmly on its seat.
(b) Spot piston at top center on non-supercharged engine and 2° to 5° after top center on supercharged models at end of the compression stroke. Adjust the push rod so that the valve is just opening. Check the closing point, which should fall within 5° of the position given in the table. On supercharged engines be sure that the air start valve closes before the exhaust valve opens.
(c) Adjust and record starting air valves for the other cylinders as above.

10. TIMING GEAR TRAIN

The camshaft is driven from a gear on the crankshaft by means of an intermediate gear. The crankshaft gear is split, and is held in place on the shaft by split collars clamped over each end of the gear.

The intermediate gear is ball bearinged on a pin which is part of a forged steel bracket bolted to the inner face of the gear housing. The bracket is positioned and doweled to the gear housing to allow .008" to .011" backlash between the crankshaft and camshaft gears.

Section L

The intermediate gear and bracket can be removed as a unit through the opening on top of the gear housing after the camshaft gear has been removed. If this is done be sure to note the location of the crankshaft and camshaft gear before disassembly so that these parts can be properly reassembled in their proper relationship.

FUEL SYSTEM

The complete fuel system may be conveniently divided into two parts, the fuel supply system and the fuel injection system. The fuel supply system is made up of the fuel transfer pump, the fuel day tank and the fuel filter and header, while the fuel injection system includes the fuel injection pumps, the fuel spray valves and the connecting tubing.

1. IMPORTANCE OF CLEANLINESS IN FUEL HANDLING

The fuel injection pumps and fuel spray valves have been referred to as the heart of the Diesel engine and the proper functioning of these parts is necessary for the successful operation of the engine. These pumps depend upon lapped plungers working in cylinders with clearances measured in hundred thousandths of an inch and it is vital that the fuel entering these parts be kept free of any grit or foreign matter. The engine is equipped with filters for this purpose but it is also necessary for the operators to use every possible care in getting clean fuel oil and in keeping it clean until it is delivered to the engine. Fuel tanks and piping should be thoroughly cleaned when installed and should be kept covered at all times.

The cartridges in the fuel filter should be periodically replaced approximately every 500 to 1000 hours of operation. The best filters obtainable will be useless if dirt is introduced into the fuel after it has passed through them, and it is therefore of great importance that every effort be made to protect the fuel pipes after the filter during repairs and overhauls. Cleanliness in handling fuel, piping and injection equipment is of vital importance and will pay good dividends in trouble-free operation. Many times mysterious and expensive pump and fuel spray valve troubles have been traced to careless handling of fuel and carelessness in storing and installing spare parts.

2. FUEL TRANSFER PUMP

The fuel transfer pump, which is located on the housing bolted to the front side of the gear housing at the aft end of the engine, delivers a continuous supply of fuel to the engine and day tank from the main storage tank. It is rotary type gear pump, similar in construction (but smaller in size) to the lubricating oil pumps described in Section S. On direct reversible marine engines the rotary gear type fuel transfer pump is reversible. Consequently fuel is delivered irrespective of direction of rotation.

From the transfer pump fuel is delivered to the filter and then to the fuel header supplying the fuel injection pumps. The fuel header is located in the front compartment of the cylinder block which also contains the fuel injection pumps.

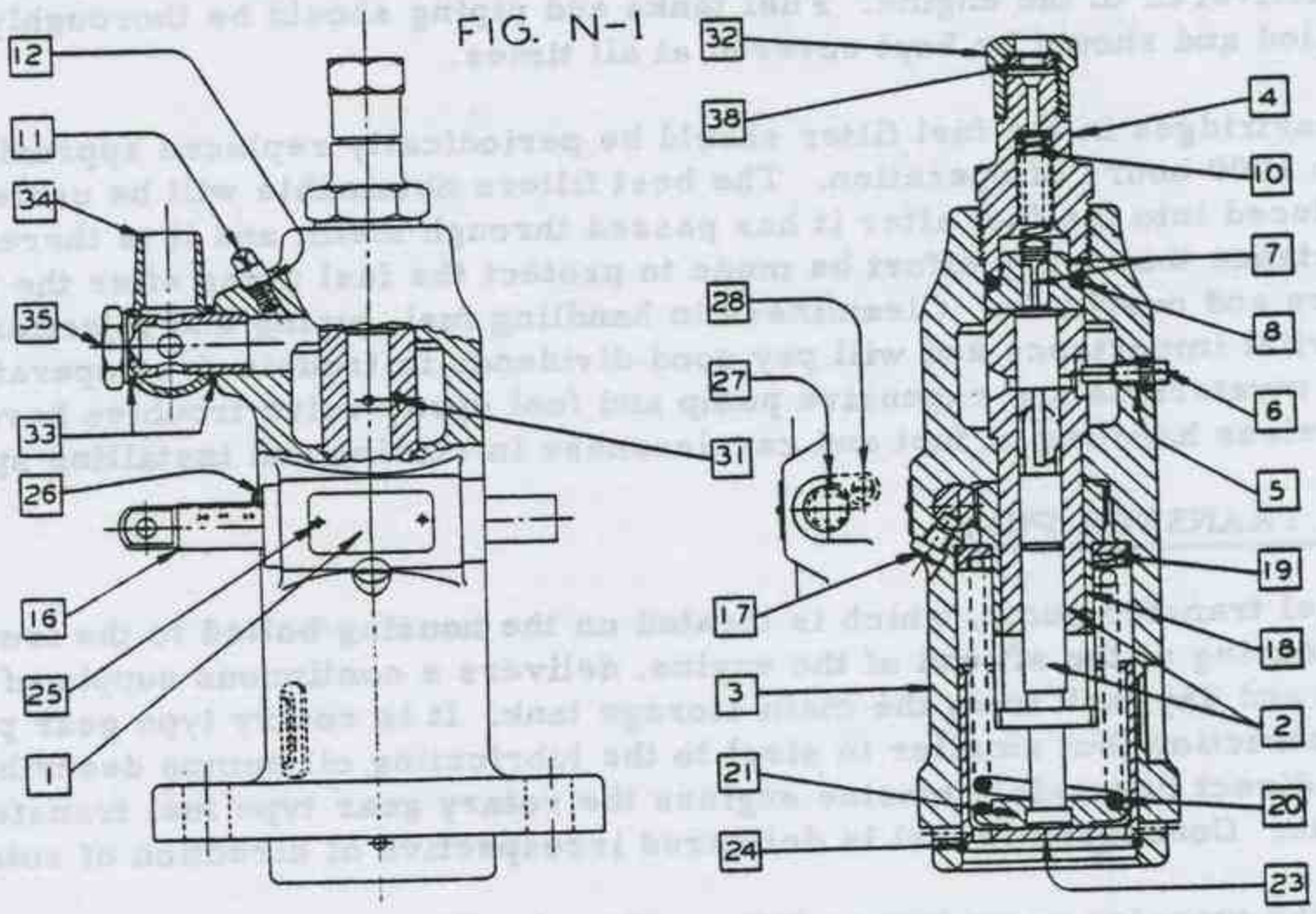
Piping diagrams showing the hook-up between main storage tanks, fuel transfer pump and day tank are furnished when the engine is sold. The pipe and tubing sizes shown on the diagram should be adhered to.

3. THE INJECTION PUMPS are made by the American Bosch Corporation, Springfield, Massachusetts. The construction of these pumps is shown in Fig. N-1. The plunger guide (23) is held against the engine tappet by return spring (20) which also holds the plunger (2) against the inner face of the plunger guide (23) by means of the lower spring seat (21). These parts are reciprocated by the fuel cam of the engine. During the up stroke the plunger first closes the inlet port of the fuel pump barrel and begins to deliver fuel through the delivery valve (7). As the plunger continues to rise, a helical groove in the plunger surface (metering helix) uncovers the inlet port, ending delivery of fuel through the delivery valve, thus terminating injection into the

engine cylinder. As the plunger continues to rise, fuel is expelled out of the pump barrel through the grooves cut in the plunger surface and the inlet port into the suction chamber of the pump housing (3). When the plunger reaches the end of its up stroke it is returned to its lower position by the return spring (20) at a rate determined by the engine fuel cam. On the downstroke it uncovers the inlet port and the fuel flows into the pump barrel under the action of the vacuum formed when the plunger descends, and the pressure in the supply line.

The quantity of fuel delivered to the engine cylinder is controlled by rotating the plunger so that the helical metering groove uncovers the inlet port earlier or later during the upstroke. This is accomplished by the control rack (16) engaging with teeth on the control sleeve (18) which is slotted at the lower end. The slots engage with a cross bar of the plunger. The control rack is connected to the engine controls and governor.

FIG. N-1



ITEM PART NAME

1. PLATE, name
2. PLUNGER and BARREL ASSEMBLY, 17.0 mm dia. plunger
3. HOUSING, pump
4. HOLDER, delivery valve
5. GASKET, barrel locating screw
6. SCREW, barrel locating
7. VALVE ASSEMBLY, delivery
8. GASKET, delivery valve holder
10. SPRING, delivery valve
11. SCREW, bleeder
12. GASKET, bleeder screw
16. RACK, control
17. SCREW, control rack
18. SLEEVE, control

ITEM PART NAME

19. SEAT, plunger spring — upper
20. SPRING, plunger
21. SEAT, plunger spring — lower
23. GUIDE, plunger — slidable
24. RING, split
25. SCREW, nameplate
26. SHIM, control rack pointer
27. POINTER, control rack
28. SCREW, control rack pointer
31. PLUG, lead
32. NUT, delivery nipple
33. GASKET, fuel inlet union
34. UNION, fuel inlet
35. SCREW, retaining
38. WASHER, delivery nipple nut

4. PUMP INSTALLATION AND TIMING

A high grade fuel oil filter is installed in the suction line leading to the pump. Care must be taken during installation that no dirt or other foreign matter enters the pump or the suction line connecting it to the filter. The bleeder screw (11) permits bleeding of the air out of the pump and suction line.

Timing windows are provided on the side of the pump housing and a circular timing mark on the plunger guide (23). When pumps are mounted on the engine, the timing mark on the plunger guide should appear at the lower end of the housing window when the fuel cam tappet rides on the base circle of the cam. When the tappet is in its highest position, the mark on the plunger guide must never go beyond the upper edge of the housing windows. Otherwise, damage will occur to the pump.

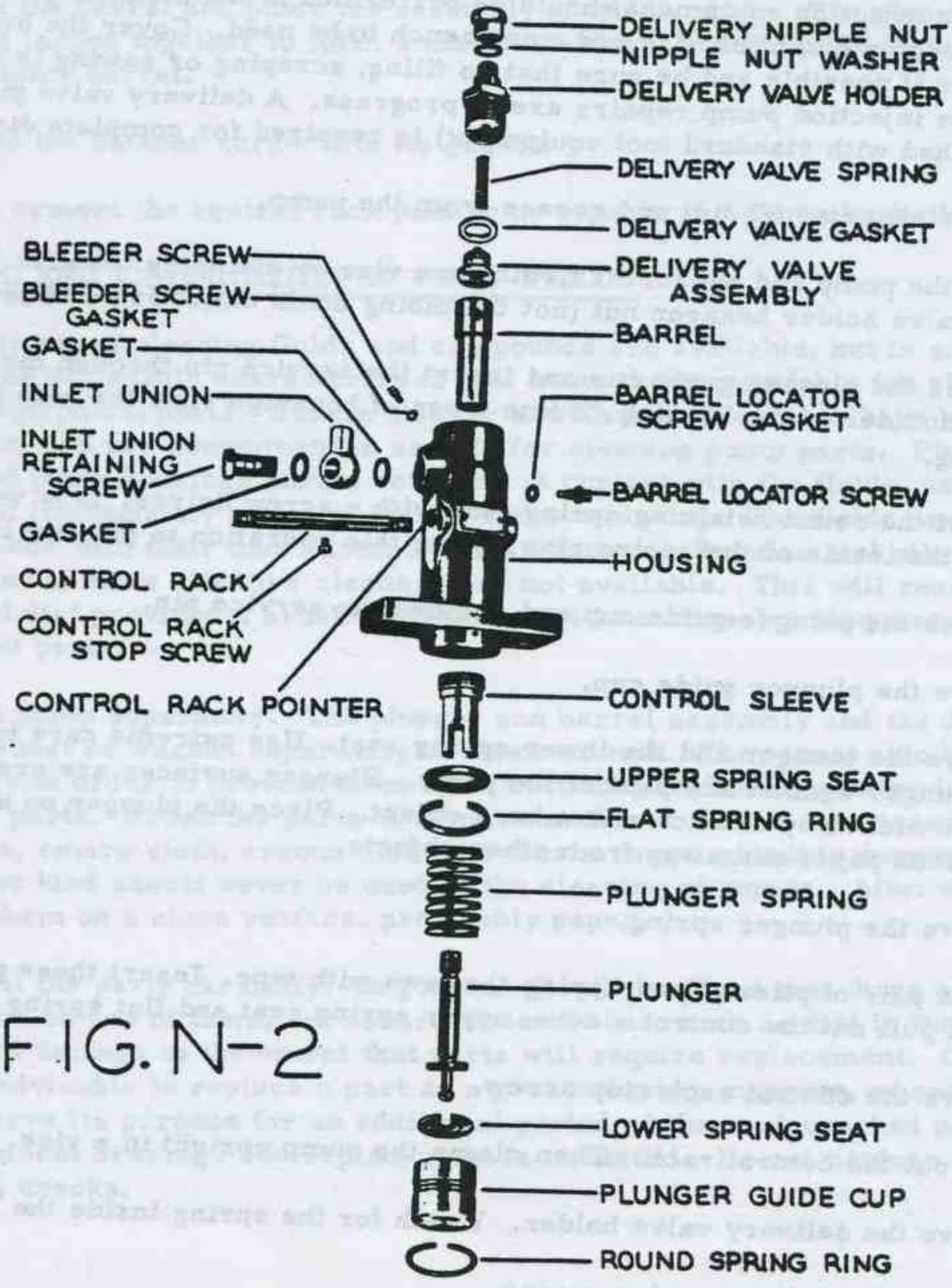


FIG. N-2

Timing marks are provided on the side faces of the housing windows. When the circular mark on the plunger guide registers with the mark, the inlet port is closed and actual pumping has begun. Since the pump lag, that is, the time elapsing between the beginning of the actual pumping at the pump and the actual delivery of fuel from the nozzle orifices, varies with different engines, it is necessary to determine by actual test the flywheel position at which the timing marks on the pump should register in order to obtain the desired engine performance. Thereafter this flywheel position can be used for timing the pumps in original installation and in field service. This timing is stated on the engine nameplate.

5. DISASSEMBLY OF PUMPS (See Figs. N-1 and N-2)

All work on injection equipment should be performed in the cleanest location possible. Thoroughly clean the vise and work bench to be used. Cover the bench with clean paper if possible and be sure that no filing, scraping or sawing is done on the bench while injection pump repairs are in progress. A delivery valve puller tool (not furnished with standard tool equipment) is required for complete disassembly.

a. Remove all external dirt and grease from the pump.

b. Invert the pump and support it firmly in a vise by clamping the vise jaws on the delivery valve holder hexagon nut (not the tubing union nut). Use soft jaws.

c. Depress the plunger guide cup and insert the service pin through the hole in the locating shoulder of the housing. Some types of housings have the hole located inside the housing.

d. Pry out the round retaining spring ring with a screw driver. It is well to keep the thumb on the inside of the spring ring during this operation to prevent loss of the ring.

e. Depress the plunger guide cup and remove the service pin.

f. Remove the plunger guide cup.

g. Remove the plunger and the lower spring seat. Use extreme care to prevent striking the plunger against any part of the pump. Plunger surfaces are precision lapped and can be nicked by contact with a hard object. Place the plunger on a bench preferably on clean paper and away from other objects.

h. Remove the plunger spring.

i. Mask a pair of pliers by wrapping the jaws with tape. Insert these pliers in the pump and pull out the control sleeve, upper spring seat and flat spring ring.

j. Remove the control rack stop screw.

k. Slide out the control rack. Then clamp the pump upright in a vise.

l. Remove the delivery valve holder. Watch for the spring inside the holder.

m. Remove the delivery valve spring.

n. Screw the delivery valve puller tool over the threaded end of the valve body. When the puller bottoms, back it off 1/2 turn. Hold the center post and tighten the puller nut to remove the body and gasket from the housing. The delivery valve and delivery valve body are lapped together to form a mated assembly and the valve must be kept with the same body.

0. Remove the barrel positioning screw and gasket. This screw also acts as a spill deflector.

Certain types of pumps have a second spill deflecting screw and gasket on the opposite side of the housing in which case it must also be removed.

p. Push the barrel out from the bottom through the top of the housing. Insert the plunger in the barrel and place the assembly on clean paper. The plunger and the barrel are lapped together to form a mated assembly and the plunger must be kept with this same barrel.

q. Remove the bleeder screw with its gasket.

r. Do not remove the control rack pointer or remove the shims beneath it.

6. CLEANING AND EXAMINATION OF PUMP PARTS

A large variety of cleaning fluids and compounds are available, but in some cases they have objectionable characteristics that make them unsuitable for cleaning fuel injection equipment parts. Bendix cleaner and Karbonoff cleaner have been found satisfactory and are recommended as safe for cleaning pump parts. Plunger springs and painted pump housings should not come in contact with the fluids, as their action will almost immediately soften paint and remove plating. The fluids are to be used in accordance with their manufacturers' instructions. Regular fuel oil may be used as a cleaner if more effective cleaners are not available. This will readily remove grease and dirt provided a brush is used, but will not dissolve lacquers formed on the internal parts.

Wash each pump separately. The plunger and barrel assembly and the delivery valve assembly must be washed separately in clean solvent. They must also be handled individually in order to prevent them from becoming nicked by coming in contact with other parts. Brush the parts to remove stain and dirt, if necessary. Hard or sharp tools, emery cloth, crocus cloth, jeweler's rouge, grinding compounds, or abrasives of any kind should never be used in the cleaning of pumps. After washing the parts lay them on a clean surface, preferably paper.

Examine all the parts carefully. In general, it will be found that there has been only minute wear on any of them, but abnormal conditions, such as dirt in the fuel may have caused damage to the extent that parts will require replacement. Occasionally, it may be advisable to replace a part as a precautionary measure, whereas, actually it might serve its purpose for an additional period of time. A cracked part is a warning of imminent breakage and replacement is essential. Do not confuse surface stains with actual cracks.

PLUNGER AND BARREL ASSEMBLY: Preferably examine with the aid of a magnifying glass. Fine scratches, scuff marks and a dull appearance of plunger surfaces indicates considerable wear, invariably due to abrasives in the fuel oil. Such wear, particularly on the upper portion of the lapped surface above the helix, greatly reduces the accuracy of delivery and affects engine performance. Plungers in this condition must be replaced. Figure A shows an enlarged illustration of a plunger badly worn by abrasives in the fuel oil to the extent that it is necessary to install a new plunger and barrel. Figure B illustrates a plunger that has seen considerable service but is still in good operating condition. The plunger and barrel are a mated assembly and must always be replaced as an assembly, never individually.

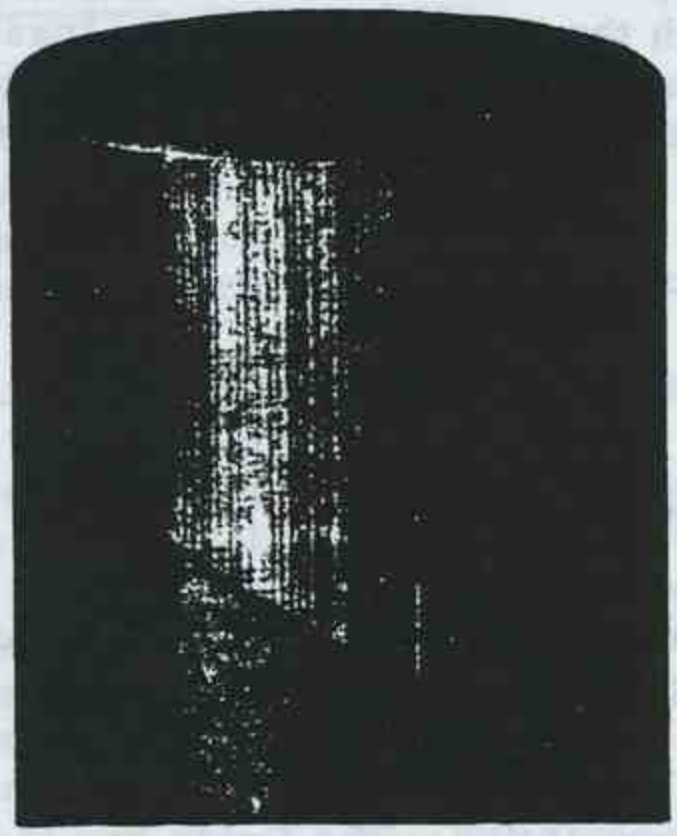


Figure A

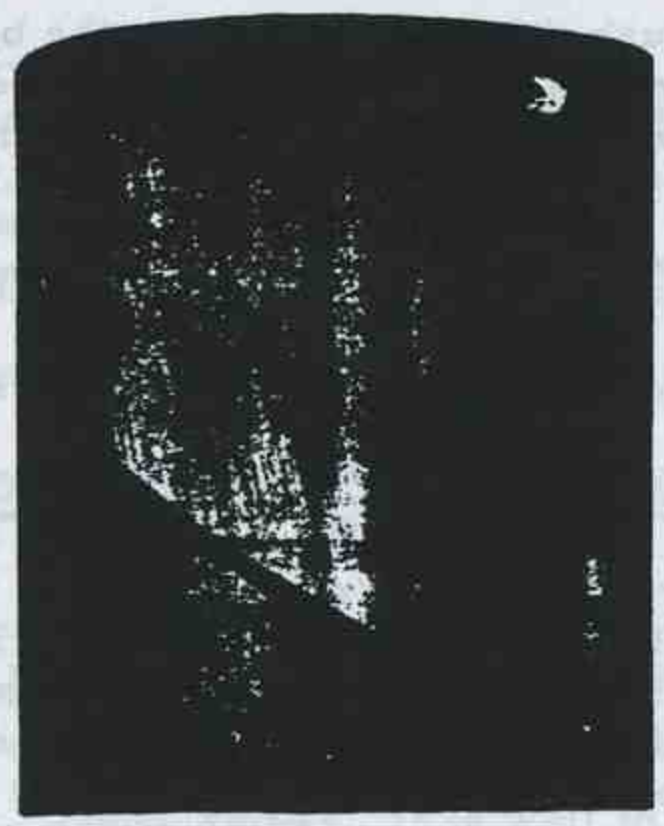


Figure B

Examine the barrel carefully, especially the lapped end. If this surface is rusted or pitted these marks may be removed with the aid of a surface plate and lapping compound. Otherwise the plunger and barrel must be replaced with a new one.

Occasionally, plungers are found to have dark discolorations and pit marks on the lapped surface, which indicates corrosion caused by fuel oil containing destructive acids or water. In such cases, the grade of fuel oil must be changed as soon as possible and the filtering system investigated. Plungers showing corrosion or pit marks or on which the edge of the helix is rough or worn must be replaced with new ones, because this condition prevents proper metering of fuel.

DELIVERY VALVE AND BODY: Preferably examine with the aid of a magnifying glass. The valve should not show scratches, scuff marks, or pits on its relief piston or on the conical seating surface. Likewise the valve body seat should not show scratches, scuff marks or pits. These indicate wear by erosion or attack by corrosion and when in this condition will affect engine performance. (Slight scuff marks can be removed from the seating surface of the valve by lapping the valve and seat together using fuel oil and talcum powder. Do not allow this lapping compound to reach the relief piston.)

If badly damaged, such assemblies should be replaced. Individual parts are not interchangeable. If the valve when lubricated with clean oil does not slide to its seat of its own weight, apply clean mutton tallow and work the valve into the body with a back

and forth rotary motion to remove gummy deposits. Under no circumstances use a grinding compound on the relief piston. Wash thoroughly and repeat this operation if necessary.

DELIVERY VALVE HOLDER AND SPRING: Examine the holder for damaged threads. The spring must be free from nicks or pitting. Either of these might cause breakage. If springs are flexed by bending, cracks will become apparent. Always replace questionable springs with new ones.

CONTROL RACK: Examine the teeth of the control rack for possible excessive wear. Slight wear is normal and replacement is rarely required.

CONTROL SLEEVE: Examine gear teeth for wear or damage. Slight wear is normal and will not appreciably affect performance. Replacement will be necessary if the wear is excessive or if the plunger guide slots are badly worn.

PLUNGER SPRING: The spring must be free from nicks or pitting. Either of these might cause breakage. If springs are flexed, cracks will become apparent. Always replace questionable springs.

SPRING SEATS: Replace with new ones if examination discloses them to be badly worn. This is rarely necessary.

PLUNGER GUIDE CUP: The plunger guide cup may show wear at the outside bottom center which contacts engine tappet mechanism. If wear is so pronounced that only little material remains or if any cracks are visable, a new guide cup must be installed.

BARREL POSITIONING SCREW: Examine for mutilated head or damaged threads. Replace it with a new one if the spill deflecting end shows signs of erosion.

GASKETS: Replace all gaskets with new ones.

7. REASSEMBLY OF THE PUMP

Take every precaution possible to assure cleanliness during all operations of reassembly. Be sure that all parts have been thoroughly cleaned in accordance with the previous section.

a. Clamp the pump housing upright in a vise.

b. Separate the plunger and barrel. Rinse the barrel in clean fuel oil. Note: That one port hole is slotted and one is round. Slide the barrel into the housing and rotate it if necessary until the slotted port is in line with the barrel positioning screw hole. Insert the barrel positioning screw with its gasket and tighten cautiously. The end of the screw must enter the slotted port freely. With the barrel properly located and the screw in place, the barrel is free to move vertically. Be absolutely sure the barrel positioning screw engages the slot before final tightening. Restake the lead plug that locks the barrel positioning screw.

c. Rinse the delivery valve and valve body in clean fuel oil. The valve must move freely in the valve body and slide to its seat by its own weight. If the valve appears sticky, refer to the previous section on cleaning. Be sure that the lapped surface at the top of the barrel and at the bottom of the valve body are free from dirt or dust. Place a new gasket over the valve body and insert the body in the housing.

d. Place the spring over the top of the valve and screw in the delivery valve holder.

Work the holder into the gasket by carefully tightening and loosening it several times. Finally, pull it down firmly. Never tighten it with a hammer or sledge. Overtightening will distort the barrel.

e. Invert the pump in the vise.

f. Rinse the plunger in clean fuel oil and carefully lower it into the barrel. A slow rotating motion will help to start the plunger into the barrel. Never use force. The plunger must be free of any stickiness over the entire length of its travel in every radial position. Sticking of a clean plunger indicates an overtightened delivery valve holder in which case loosen and retighten holder. If the plunger still sticks, remove the delivery valve assembly and the barrel from the pump housing and check both the barrel and the housing seating surfaces for dirt. It may also be necessary to use a different delivery valve gasket. After determining that the plunger is free, withdraw it and continue with the assembly.

g. Slide the control rack into position with its teeth toward the center of the pump, its slot in line with the stop screw hole and its graduations under the pointer.

h. Screw in the control rack stop screw. The locating end must engage the control rack slot and permit free rack movement. Tighten it securely.

i. Place the control rack in its center position. Observe the teeth visible within the housing and note the locating mark in line with the center tooth. Also observe the gear segment of the control sleeve and note the locating mark in line with one tooth.

Lower the sleeve into the housing over the barrel and engage the marked tooth with the marked tooth of the rack (Figure N-3). These must coincide to assure proper pump operation. Check for smooth control rack movement, and if sticky, correct before proceeding.

j. Drop the upper spring seat over the control sleeve with its shoulder toward the base of the pump. The flat surface must be against the control sleeve shoulder.

k. If a flat spring ring is used, insert it into the bore of the housing. Use the plunger guide cup to press the ring into position against the shoulder of the upper spring seat. Remove the guide cup with the service pin.

l. Rinse the plunger in clean fuel oil. After rinsing do not touch its lapped surfaces with the hands. Note the locating mark on one of plunger flanges. Also note the locating mark at one slot of the control sleeve. Carefully lower the plunger into the barrel and engage the marked plunger flange in the marked sleeve slot.

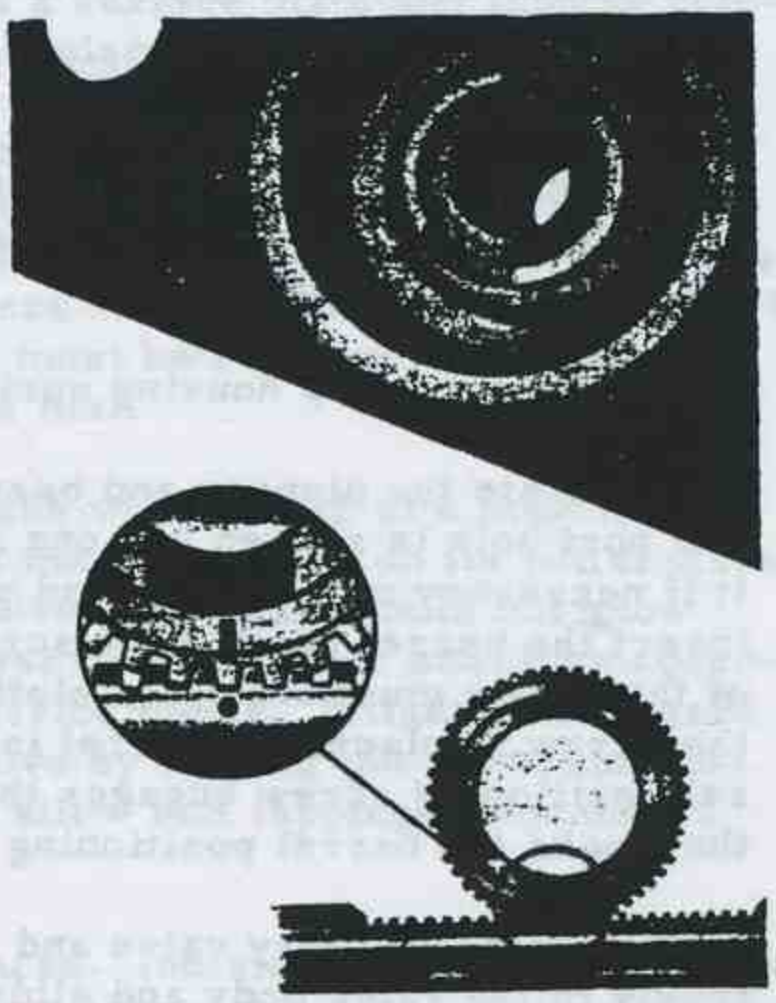


FIG. N-3

Important: The assembly mark on the plunger yoke is to be assembled on the same side as the control sleeve and control rack marks. Raise and lower the plunger and check for free movement in slots.

m. Lower the plunger spring into position.

n. Lift the plunger just high enough to slide the lower spring seat into position under the head of the plunger. When correctly assembled the end of the knob will be flush with the seat. Do not rotate the plunger. Keep the plunger flange in line with the sleeve slots.

o. Rinse the plunger guide cup in clean fuel oil and insert it in the housing. Depress the guide cup and secure it with the service pin through the hole in the housing shoulder or inside the housing. Do not force the guide cup down. If it is apparent that the plunger flange is not in line with the sleeve slots, release the cup, move the control rack slightly and depress the cup again. If repeated efforts are necessary remove the guide cup with service pin and recheck the alignment and locating marks.

p. Press the round spring ring into the annular groove in the housing. Locate the ends of the spring ring in line with the vertical slot.

q. Depress the guide cup and remove the service pin.

r. Remove the pump from the vise.

s. Assemble all remaining miscellaneous small parts.

t. Immediately close all pump openings with protective caps, paper or clean cloth.

8. PUMP TIMING

Pumps are adjusted at the factory so that the cam follower and consequently the pump plunger has lifted .210" at the time of port closing which is stamped on the engine nameplate. It is stated in crankshaft degrees before top dead center. The fuel cams are then doweled and clamped to the cam shaft and should not be disturbed.

Due to manufacturing tolerances port closing on different pumps may however not occur at exactly the same point of plunger rise. Consequently if a pump is exchanged the port closing should be checked. If it should occur too early add a shim under the pump mounting flange; if it occurs too late remove a shim and try to have the port closing occur as close to the point stated on the nameplate as possible. In each case check that the mark on the plunger guide stays within the timing window as described in paragraph 4.

9. BALANCING OF FIRING PRESSURES

If new pumps have been substituted or if the engine consistently fires heavily on one or more cylinders, the firing pressures should be checked and if found to vary more than 75 pounds per square inch the cause should be determined and the pumps should be readjusted if necessary by means of the shims under the pump mounting flange. Before doing this, however, ascertain that the difference in firing pressure is actually due to the pump and is not due to uneven load balance or to faulty functioning of other parts such as valves, rings, or the spray nozzle. It is particularly important that the spray nozzle and cylinder load balance and cylinder compression be checked before

the pump shimming is disturbed. The compression can be checked by opening the bleeder valve on the nozzle holder and should be equal within 50 pounds per square inch on the various cylinders. Should the compression vary more than this the cause should be determined first and corrected. Low compression as a rule means high firing pressure and vice versa.

If it is found however that a high firing pressure is due to the pump, this can be corrected by adding a shim under the pump mounting flange. If the firing pressure is low a shim should be removed. Use the thinnest available shim (.003") and repeat if necessary. In each case be sure that the conditions regarding the timing mark stated in paragraph 4 are fulfilled.

10. BALANCING OF CYLINDER LOADS

On engines equipped with exhaust pyrometers the various pumps should be adjusted to as nearly equal exhaust temperatures as possible. The variation in exhaust temperature on naturally aspirated engines should not vary more than 40°. Supercharged engines will as a rule vary more for equal amounts of fuel injected and in this case the exhaust temperatures should be held within 60°. If exhaust pyrometers are not available the fuel pump racks should be set for equal reading on all pumps.

In order to adjust the fuel pumps it is first necessary to remove the cylinder block front covers. The pump racks are then adjusted by means of the small set screw on the control shaft lever. Be sure to lock the set screw by tightening up the lock nut after the adjustment is done.

11. NOZZLE HOLDER AND SPRAY TIP (See Fig. N-4)

Whenever the engine is taken down for inspection and servicing, or if fuel injection trouble is suspected, the nozzle assemblies may be checked as follows: As soon as a nozzle holder has been removed from the engine, wipe off with a clean cloth wet with fuel oil, kerosene or other cleaning fluid to remove all traces of dirt or grit. If not disassembled immediately wrap or cover with clean cloths to protect from possible dirt. To disassemble, place in a vise having soft jaws, nozzle end up, holding by flats of holder body. Loosen assembly nut (B) with a hex box wrench of proper size. Remove from vise and unscrew assembly nut from body, holding so that the internal parts do not fall out. Remove all parts from body and clean by soaking in a pan of clean fuel oil, kerosene or other cleaner.

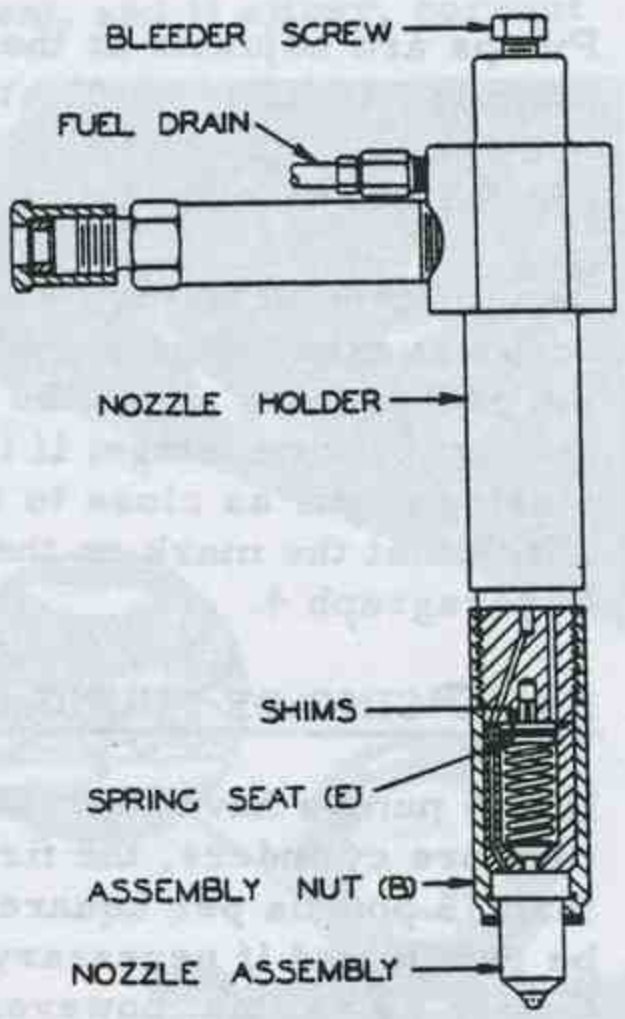


FIG. N-4

SPRAY NOZZLE: If spray nozzle sticks in nut (B) due to hard carbon deposit, place nut on bench and drive tip out with a piece of brass tubing which will clear the spray orifices. Use light hammer blows. This tubular tool should bear only on the shoulder of the spray tip. Avoid striking the nose of the tip as this will deform and render it inoperative. Soak spray tip in fuel oil or preferably in carbon tetrachloride. Remove all deposit with a

fine brass wire brush. The cleaning of the spray orifices is a delicate operation requiring good light and preferably a magnifying glass. Cleaning needles must be inserted into the spray orifices very gently and should be rotated while being inserted. No attempt should be made to push needles through the spray orifices if they are filled with hard carbon or other dirt.

If spray tip cannot be properly cleaned, it should be discarded. After cleaning, wipe the lapped end face of the tip with clean tissue paper and soak in light oil.

The nozzle valve is lapped into and seats in the nozzle body. Soak the parts in clean fuel oil or carbon tetrachloride and blow dry with compressed air. Dip parts in spindle oil. Insert needle into nozzle body and rotate slightly on the needle seat in the body. While rotating slightly, move needle up and down. If the needle moves freely and the needle seat shows no slight nicks or scratches, the nozzle is in good condition. If the needle is sticky, the parts may have to be washed several times. A needle is considered to be free when it will descend into the valve body by its own weight -- the parts being lubricated with light spindle oil.

The assembly nut (B) should be thoroughly cleaned inside and out with a soft brush, using liberal quantities of fuel oil or kerosene. If the hole for the spray nozzle contains carbon, it should be cleaned, preferably by using a standard hand reamer. After all carbon is removed, rinse in fuel oil, blow dry and lubricate with spindle oil.

Before reassembling, clean holder body and assembly nut with a soft brush and fuel oil, kerosene or carbon tetrachloride. Rinse thoroughly and blow out with clean compressed air. Make sure no dirt is lodged in the threads or undercuts. Assemble parts in the order indicated by the parts illustration sheet, liberally oiling each part with spindle oil.

Place in a suitable "pop" tester. When pumping at the rate of 30 strokes per minute the nozzle should open with a sharp "pop". The spray pattern should conform to the number of holes in the tip, evenly spaced with all jets uniform in density. The nozzle valve should close sharply when pumping ceases, with no after-dripping. The nozzle valve should open at 3400 to 3500 pounds per square inch. If the pressure setting is not high enough, insert more shims under the spring seat (E) to increase the tension on the pressure spring. To reduce the opening pressure and consequently the tension on the pressure spring, remove shims from under the spring seat.

CONTROL SYSTEM

1. The control unit is mounted at the forward end of the engine and on it is mounted most of the various Westinghouse Air Brake Company elements that are used for controlling the starting, maneuvering and engine speed. In the control unit is also incorporated the air cylinders which shift the camshaft as well as the levers and shafting used to transmit the motion of the air cylinder piston to the camshaft.

2. For the functioning and construction of the Westinghouse Air Brake Company equipment the operator is referred to the Westinghouse Section under "Auxiliary Equipment". Particular reference is made to the chapter entitled "Description and Operation" and to the schematic piping diagrams in this section. Description of the individual units is also contained in the Westinghouse Section as well as the care, operation and maintenance of the units. The operator should thoroughly familiarize himself with all of this material before attempting to operate the engine. It is best to remove all the cover plates found on the control unit so that the operator can see the location of all the individual Westinghouse units, as well as the camshaft shifting mechanism.

3. WESTINGHOUSE EQUIPMENT MOUNTED IN OR ON THE CONTROL UNIT (See Fig. R-1)

Referring to Fig. R-1 the various Westinghouse parts are given the same reference numbers (below number 30) as on the schematic piping diagrams and on specification I-302.8B found in the Westinghouse Section under "Auxiliary Equipment". No further description of these units and their connections will be given here.

Note: A tabulation of all Westinghouse Controls including Reference Number, Description and Location will be found on Pages 6 and 7.

4. CAMSHAFT SHIFTING MECHANISM IN CONTROL UNIT (See Fig. R-1)

The camshaft (31) is shifted from AHEAD to ASTERN position or vice versa by means of an air cylinder piston connected by means of shifting levers and links shown on Fig. R-1. When shifting air under pressure is directed by Controlair unit (2A) through Relayair valves (25) to one side of air shifting piston (37) while the other side of this piston is connected to atmosphere causing the piston to move in the proper direction for shifting until it comes up against one of the two cylinder heads (38). Thus the shifting piston always traverses its entire stroke. (In standard port engines with rotation for right hand propellers, the piston movement is to the right when shifting from ASTERN to AHEAD. See arrows marked AHEAD and ASTERN on Fig. R-1.)

The piston is connected to shifting lever shaft (34) by means of lever (35) which is clamped and keyed to this shaft. Lever (35) engages pin (36) in the piston. At the lower end the shifting lever (33) also keyed and clamped to the shaft engages a bronze collar (32) which positions and holds the camshaft in the proper location for AHEAD or ASTERN running as the case may be.

The stroke of the shifting cylinder piston is set at the factory and if end cylinder head covers (38) are removed for any reason always use the same thickness of shims and gaskets when reassembling.

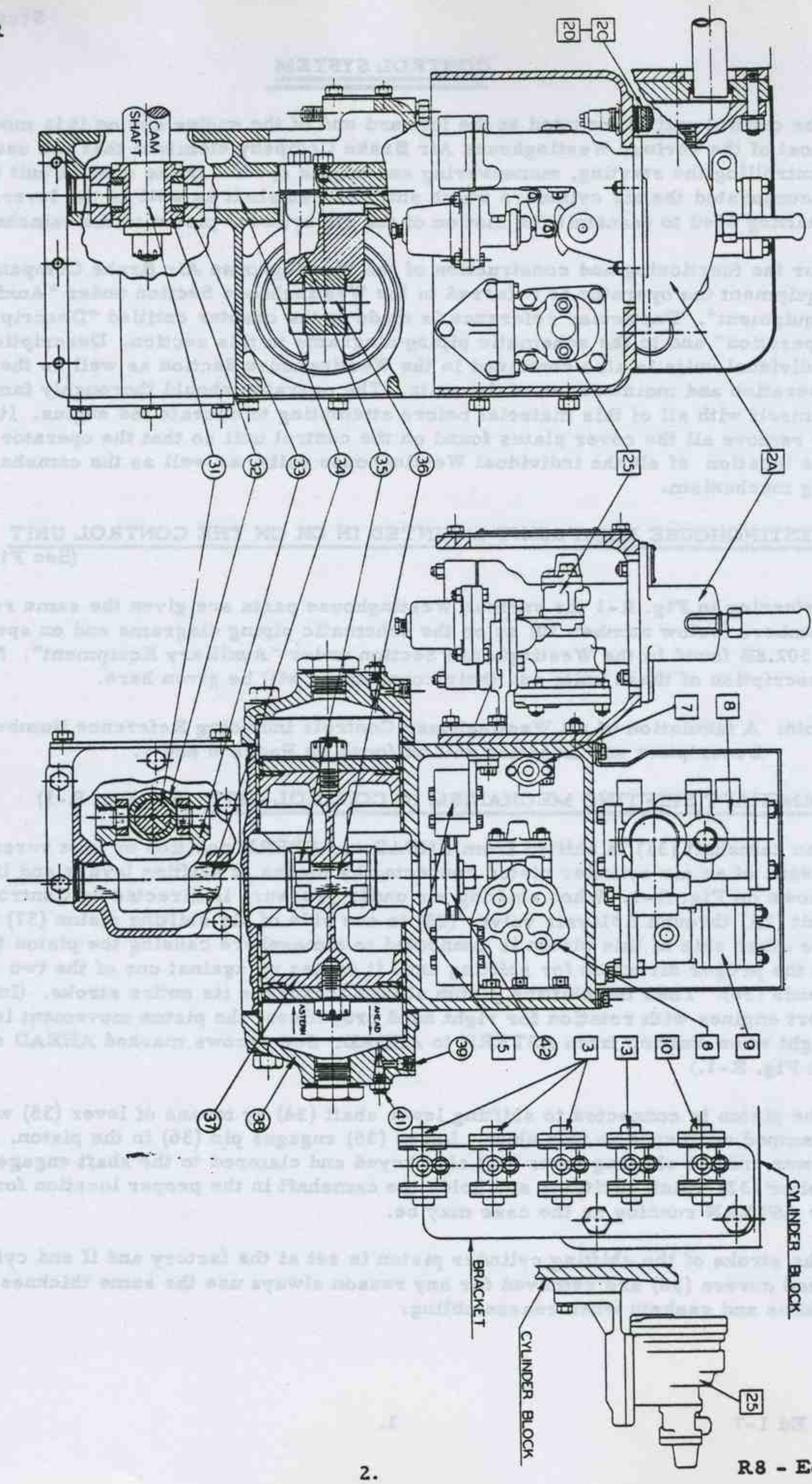

CAM SHAFT
20
20
31
32
33
34
35
36
25
24
7
8
ASTERN
AHEAD
39
5
42
3
13
10
6
9
37
38
41
CYLINDER BLOCK
BRACKET
CYLINDER BLOCK
25

FIG. R-1

The speed of shifting is controlled by needle valves (41) which rarely, if ever, need adjusting. However, the shifting speed can be controlled by screwing these valves in or out as needed, and the valves should then be securely locked. Under no circumstances should these valves be completely closed.

5. SHIFTING INTERLOCK

On top of the shifting lever shaft (34) there is mounted a quadrant (42) keyed and clamped to the shaft. This quadrant is provided with a notch which will allow the rollers and levers of pilot air valves (5) to move to a position which will allow starting air to the engine through Relayair valve (8) (main starting valve) providing the control lever is in the START position. The position at which the relay air rollers move into the slot on the quadrant correspond to the position at which the camshaft is fully shifted to AHEAD or ASTERN as the case may be. Thus Pilot air valves (5) and quadrant (42) prevent starting air from entering the engine air start header until the camshaft shifting is completed even if the control lever should be in start position.

6. FUEL CUT-OFF CYLINDER (See Fig. R-3)

Fuel cut-off cylinder (12) is mounted on the cylinder block in the push rod and fuel pump compartment. It is accessible by removing the third cover from the forward end.

The piston rod of the fuel cut-off cylinder engages a lever on the fuel pump control shaft. An adjusting screw on this lever allows the control shaft to be positioned for no fuel when air is admitted to the cut-off cylinder.

Air is admitted to the cut-off cylinder by the control lever on Controlair (2A) and admittance of air is also controlled by the Directional interlock (11) as explained in the Westinghouse Section. Thus air is admitted to the cut-off cylinder and fuel cut-off when the control lever is moved to the STOP position and the air remains on and fuel off until the engine is turning in the right direction of rotation.

7. DIRECTIONAL INTERLOCK VALVE

The directional interlock valve is mounted under the control unit. The shoe on this unit engages an extension on the forward end of the crankshaft. By removing the sheet steel cover the unit is made accessible. For construction and functioning the operator is referred to the Westinghouse Section under "Special Equipment".

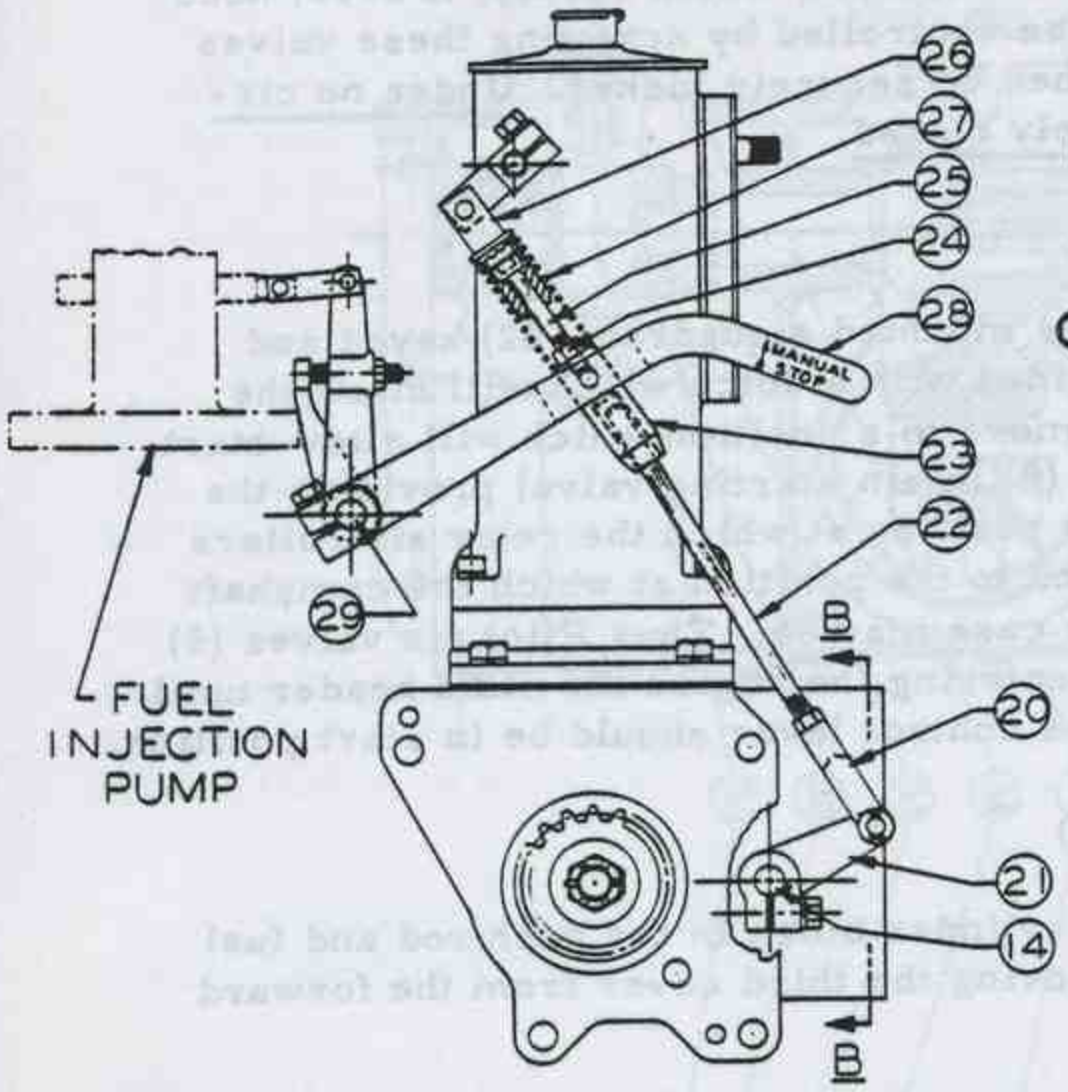
8. FUEL LIMITING CYLINDER (See Fig. R-4)

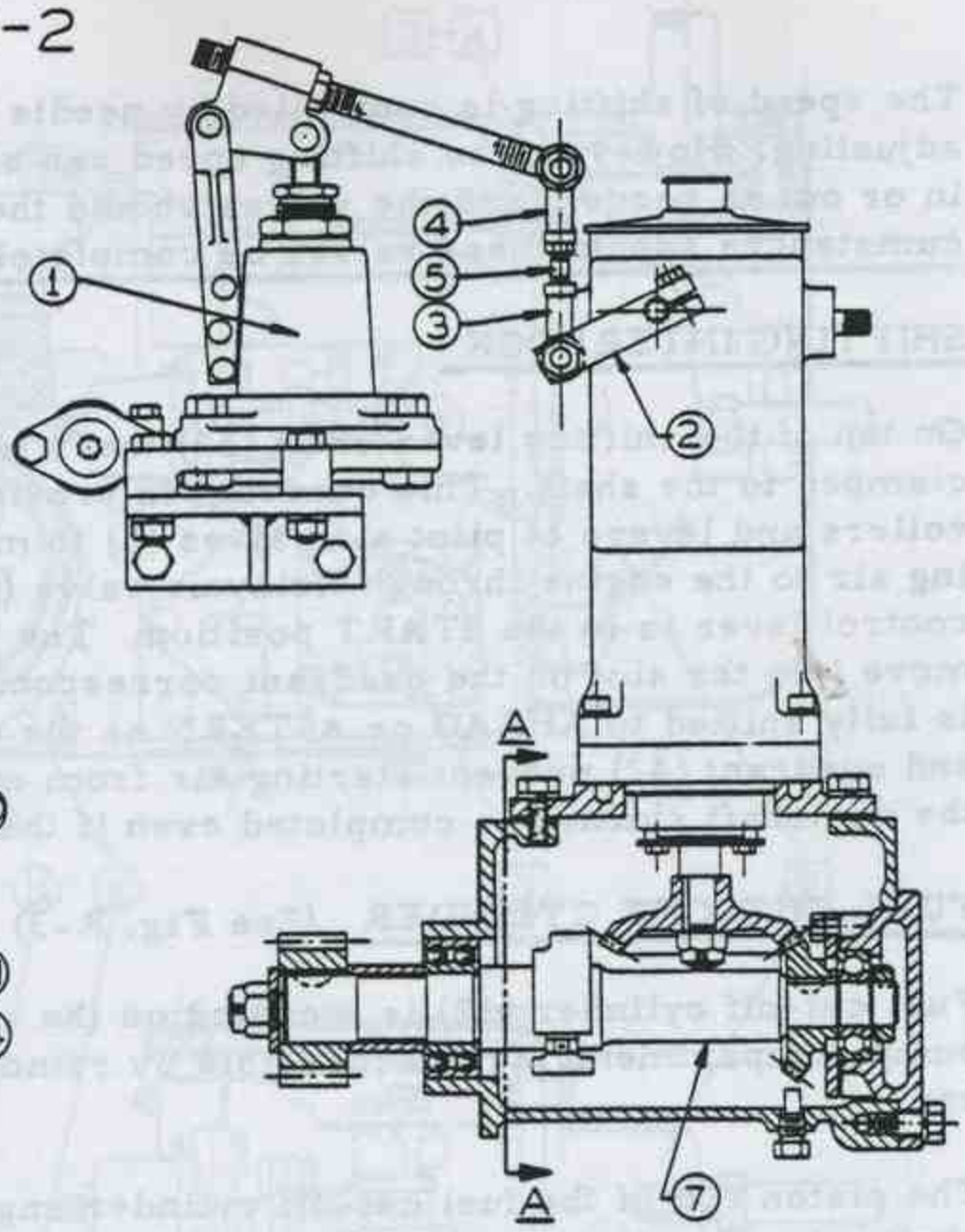
During starting the amount of fuel injected is limited to a small amount by the fuel limiting cylinder. (About 10 m/m on fuel pump rack.) Construction and functioning of this item will be found in the Westinghouse Section. The fuel limit cylinder is mounted on the cylinder block in the push rod and fuel pump compartment and is accessible by removing the second cover from the forward end.

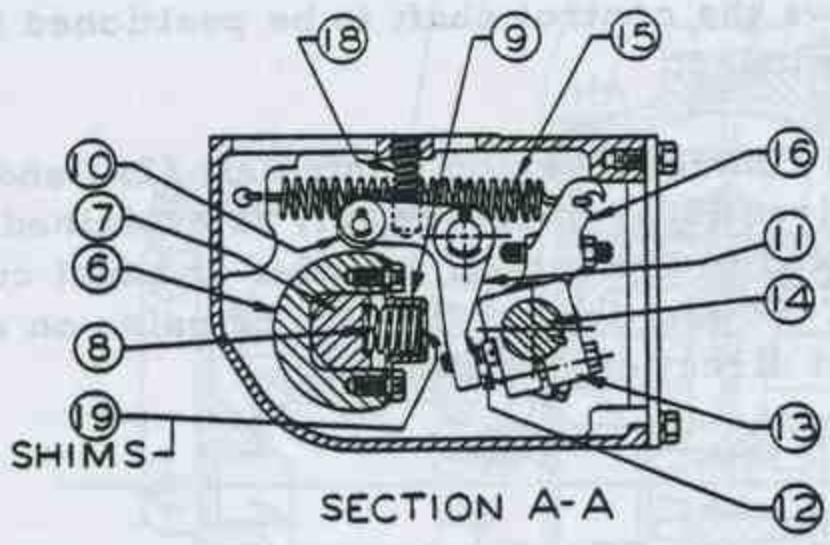
9. GOVERNOR (See Fig. R-2)

The Woodward Governor is fully described in Woodward Governor Bulletin under "Auxiliary Equipment". The governor, driven by bevel gears, is mounted on an adaptor plate bolted to the governor drive housing. The adaptor plate is doweled to the housing after governor is properly adjusted to give correct meshing of gear teeth by

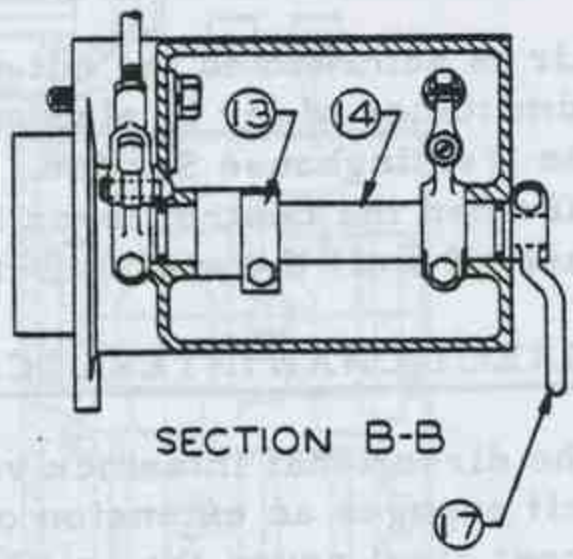
FIG. R-2







SECTION A-A



SECTION B-B

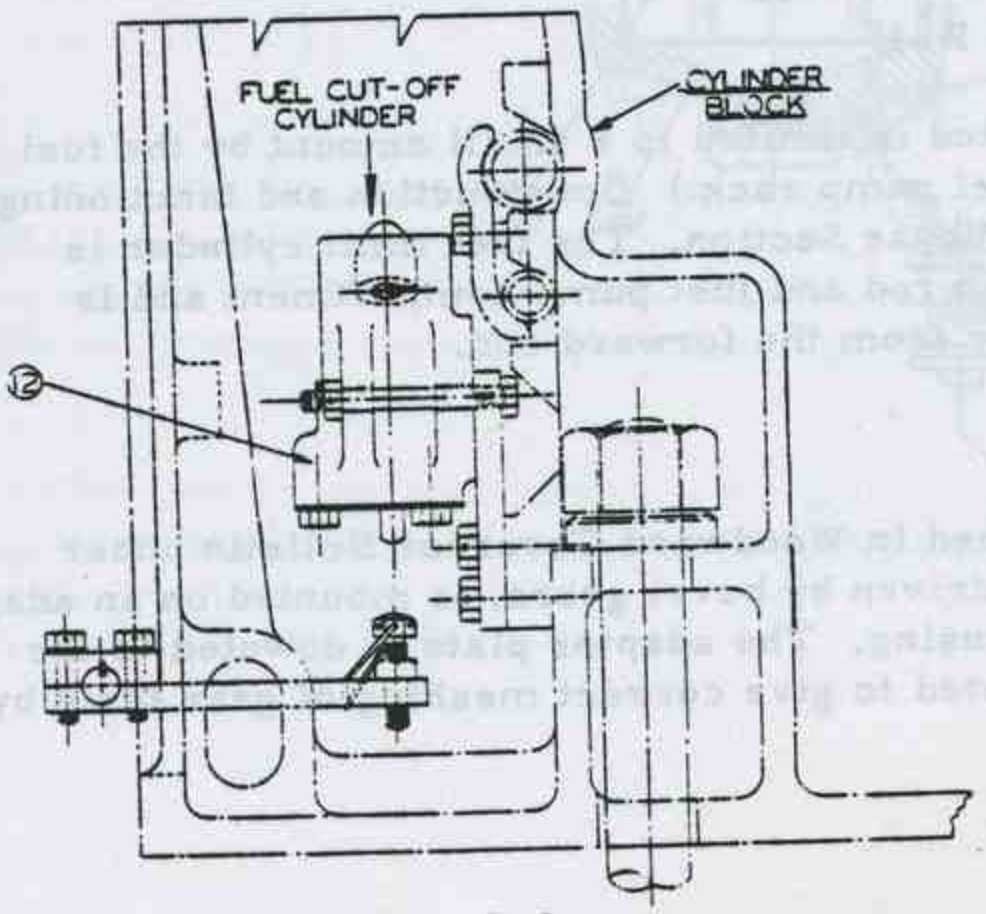


FIG R-3

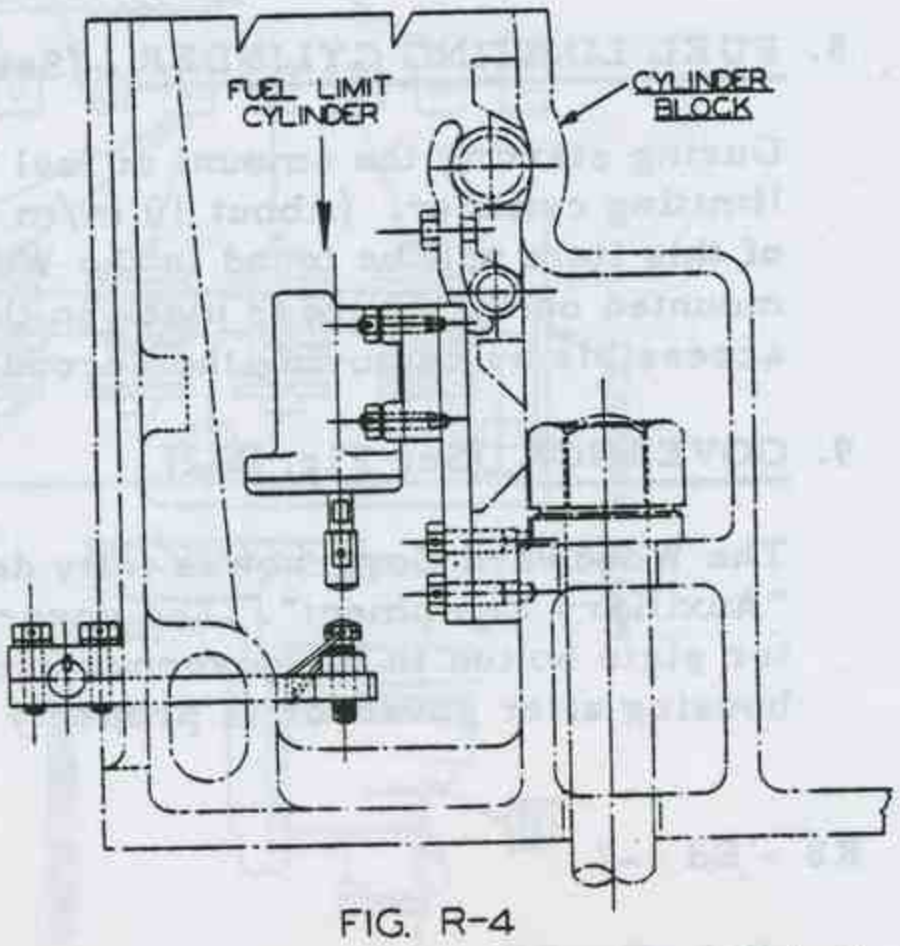


FIG. R-4

means of shims between housing and adaptor. Should it become necessary to remove the governor for any reason be sure all shims are replaced and dowel pins are inserted to insure same setting as originally installed at the factory.

10. ACTUATOR

The Actuator (1) bolted to a bracket mounted on the gear housing is connected to the speed control lever (2) on the governor by two spherical rod end fittings (3) and (4) and connecting rod (5) with left and right hand thread for adjustment. If lever (2) is removed from the serrated governor speed control shaft it must be replaced in the same position; therefore, shaft and lever should be marked before disassembly.

11. OVERSPEED GOVERNOR (See Fig. R-2)

The overspeed governor or trip is arranged in the governor drive housing. The flyweight (6) is mounted on the drive shaft (7) and is held to the shaft by spring (8) acting on yoke (9) which is bolted to the flyweight. Normally the flyweight is thus held against the shaft.

If the engine overspeeds the centrifugal force on weight (6) will overcome the tension of spring (8) and it will fly out suddenly and as it rotates will hit roller (10) on lever (11) turning this lever against tension of spring (18). Screw (12) will then disengage lever (13) allowing fuel cut-off shaft (14) to be turned by comparatively strong spring (15) and lever (16) affecting the fuel shut-off.

After the overspeed governor has tripped it must be reset by hand. This is done by pushing lever (17) inwardly toward the engine turning the fuel cut-off shaft and lever (13). Spring (18) will hold lever (11) and screw (12) against lever (13) so that as soon as its notch is in position the whole mechanism will be reset.

Do not restart the engine until the cause of the overspeeding has been determined and corrected.

The overspeed governor is set at the factory to throw-out at approximately 800 to 825 R.P.M. and should not need adjustment. However, should it become necessary to increase speed, additional shims (19) can be added or if slower speed is desired shims should be removed to attain desired results. Under no circumstances should speed be increased beyond maximum operating speed recommended.

12. OVERSPEED GOVERNOR LINKAGE (See Fig. R-2)

The overspeed governor is connected to the fuel pump control shaft by means of levers and links as follows. Fork (20) is pinned to overspeed throw-out lever (21) which is keyed and clamped to fuel cut-off shaft (14). The rod (22) works in and out of a sleeve (23) when the engine operates under governor control. When the overspeed governor is tripped, the lever (21) is snapped up, and the top of the locknut (24) on screw (25) comes up against the end of sleeve (26). This action collapses the buffer spring (27) and lever (28) pinned and clamped to pump control shaft (29) is moved upward turning the control shaft to the NO FUEL position.

LOCATION OF WESTINGHOUSE EQUIPMENT
See Spec. I-302.8B - Pages 1 and 2 Under
Westinghouse Controls in "Auxiliary Equipment"

WESTINGHOUSE REFERENCE NO.	DESCRIPTION	LOCATION
1	CB-1A Control Stand	Pilot House
2a	2A-2B Controlair	Control Unit
2c	Red Alarm Light	Control Unit
2d	Green Alarm Light	Control Unit
2e	A5A Rotair Valve	On Gage Board
3	#18A Double Check Valves	On Bracket at Forward End of Cylinder Block
4	#22A Double Check Valve	On Bracket Supporting Actuator Next to Governor
5	C-1-B Pilotair Valves	In Control Unit
6	H-5 Relayair Valve	In Control Unit
7	#18A Double Check Valve	In Control Unit
8	D-1-A Relayair Valve	On Top Control Unit Connects to Air Start. Man.
9	H-5 Relayair Valve	On Top Control Unit
10	#18A Double Check Valve	On Bracket at Forward End of Cylinder Block
11	Directional Interlock Valve	Above Crankshaft at Forward End
12	Fuel Cut-Off Cylinder	In Push Rod & Fuel Pump Comp. of Cylinder Block
13	#18A Double Check Valve	On Bracket at Forward End of Cylinder Block
14	AA-1 Actuator	On Bracket Next to Governor
24	Fuel Limiting Cylinder	In Push Rod & Fuel Pump Comp. of Cylinder Block
25	H-5 Relayair Valve	On Cylinder Block-Exhaust Side - Forward End. Also in Control Unit
26	H-5 Relayair Valve	On Cylinder Block - Exhaust Side - Aft End

WESTINGHOUSE REFERENCE NO.	DESCRIPTION	LOCATION
18	Low Pressure Alarm Switch	In Junction Box at Aft End of Cylinder Block
19	3 1/2" Air Gage	Air Supply System in Engine Room
20	3/8" Vented Cock	
21	1/4" Unvented Cock	
22	1/4" Vented Cock	
23	D-1 Reducing Valves	

REDUCTION GEAR

INSTALLATION AND SERVICE INSTRUCTIONS "CAPITOL" MODEL EC-9500 PLANETARY IN-LINE REDUCTION GEAR, MANUFACTURED BY THE AUTO ENGINE WORKS, INC., 349 NORTH HAMLINE AVENUE, ST. PAUL 4, MINNESOTA.

1. DESCRIPTION

"THE CAPITOL" Model EC-9500 REDUCTION GEAR is of planetary type with helical gears. Power input is through the Sun Gear driving three idlers mounted in a stationary spider and transmitting power to a ring gear directly connected to the propeller shaft. The gear is designed for 618 H.P. at 750 R.P.M. input. The reduction ratio is $2\frac{1}{2}$:1 and output speed is 300 R.P.M.

2. ALIGNMENT

Due to the overall length and the small space occupied by this type of reduction gear, it is necessary that the output shaft (reduction gear to tail shaft) alignment be made very carefully.

NOTE: THIS ALIGNMENT SHOULD BE CHECKED AND RE-ALIGNED, IF NECESSARY, WITH BOAT FULLY LOADED TO NORMAL RUNNING DRAFT.

It is also suggested that the output coupling be broken and alignment checked under the before noted loaded condition, after the first long trip, and again after one year's operation.

3. LUBRICATION (See Fig. S-1)

"THE CAPITOL" Model EC-9500 REDUCTION GEAR is lubricated by the engine lubrication system. The pipe from the oil pressure system of the engine is connected to the oil inlet of the gear (Ref. No. 70) and supplies approximately two (2) gallons per minute to the system within the gear.

A scavenge pump is built into the gear at the forward end of the upper idler shaft (Ref. No. 1). The function of this pump is to remove oil from the gear and return it to the engine lubrication system. The pump is readily accessible through the hand hole in the top of housing (Ref. No. 57) by removing the hand hole cover capscrews (Ref. No. 14) and cover (Ref. No. 4). All connections are 1/2" National pipe thread.

When making initial installation, or after a long period of disuse, it is advisable that rear hand hole cover (Ref. No. 15) be removed and about two (2) gallons of the same oil as is used in the lubrication system of the engine be poured into the gear before the engine is started.

4. OIL SEALS

The oil seals of this unit should be replaced each time the gear and engine are overhauled. The output shaft oil seal (Ref. No. 26) is a Garlock Split Klozure type and is $8\frac{1}{2} \times 9\frac{1}{2} \times \frac{1}{2}$. Two (2) of these seals are used in the one recess. The lip of the first facing inward to keep the oil in; the lip of the second faces outward to exclude moisture or foreign matter of any kind. These seals may be removed and replaced without disturbing the gear or propeller shaft couplings or their alignment, as follows: Remove the capscrews (Ref. No. 14) from the seal retainer (Ref. No. 23) slip the retainer aft to the shoulder of the driven shaft coupling (Ref. No. 30). The seals

may then be withdrawn with the aid of a screw driver or a wire hook.

In replacing these seals they should be installed according to Cross Section Assembly drawing EC-9500, and sparingly lubricated, using graphite grease upon installation. The joints in these seals should be at 30° on top center. Care should be taken not to scratch the sealing surface with any type of sharp instrument.

5. DISASSEMBLY

Major disassembly of "THE CAPITOL" Model EC-9500 REDUCTION GEAR is accomplished by removing the 16 capscrews (Ref. No. 24) which hold the rear housing (Ref. Nos. 45 and 43) to the forward housing (Ref. No. 57), and after which the entire rear half of the gear, containing the driven shaft ring gear, thrust bearing and propeller shaft coupling, may be drawn back until it swings clear of the forward bushing of the gear, which contains the Sun gear, input shaft and idlers, together with their attendant shafts, bearings, and so forth.

There are no adjustable components in the gear unit whatsoever, even when replacing worn out or damaged parts. The only measurement which must be checked is the end-play of the Timken thrust bearings (Ref. No. 34) which must be .008 to .010 when assembled. Due to the variation in "standout" of individual pairs of Timken bearings, it is necessary that cone spacer (Ref. No. 32) and cup spacer (Ref. No. 33) be ground to provide the correct clearance. Nominal "standout" of the Timken cones is .250 each, making the total difference in width between cup spacer (Ref. No. 33) and cone spacer (Ref. No. 32), Auto Engine Works part Nos. EC-8732 and EC-8731, respectively, .500 plus .008 to .010 clearance for standard bearings, plus or minus total variation from standard of the Timken bearings. We strongly advise purchase of a matched set of bearings, together with spacers, at the time of thrust bearing replacement.

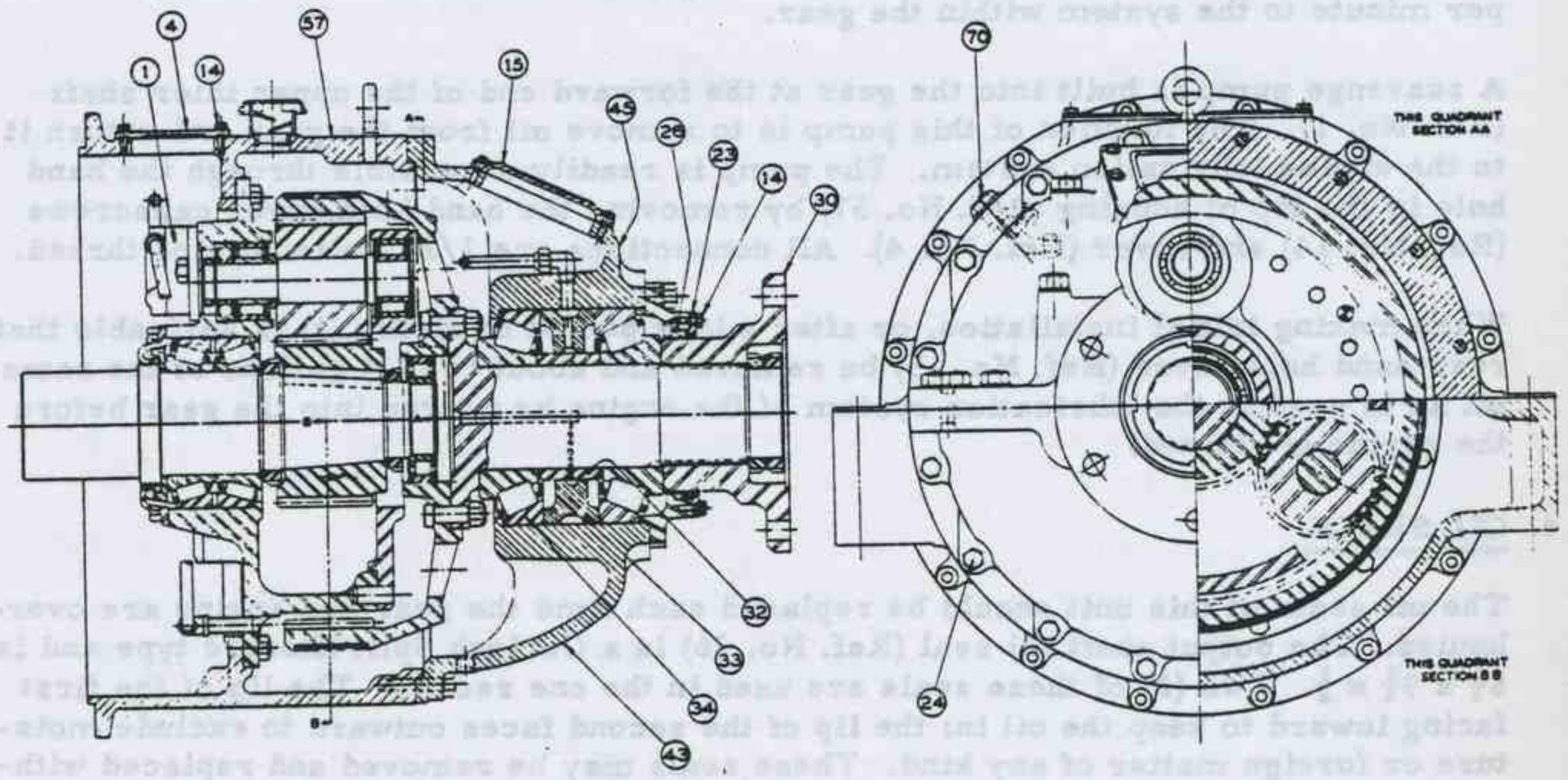


FIG. S-1

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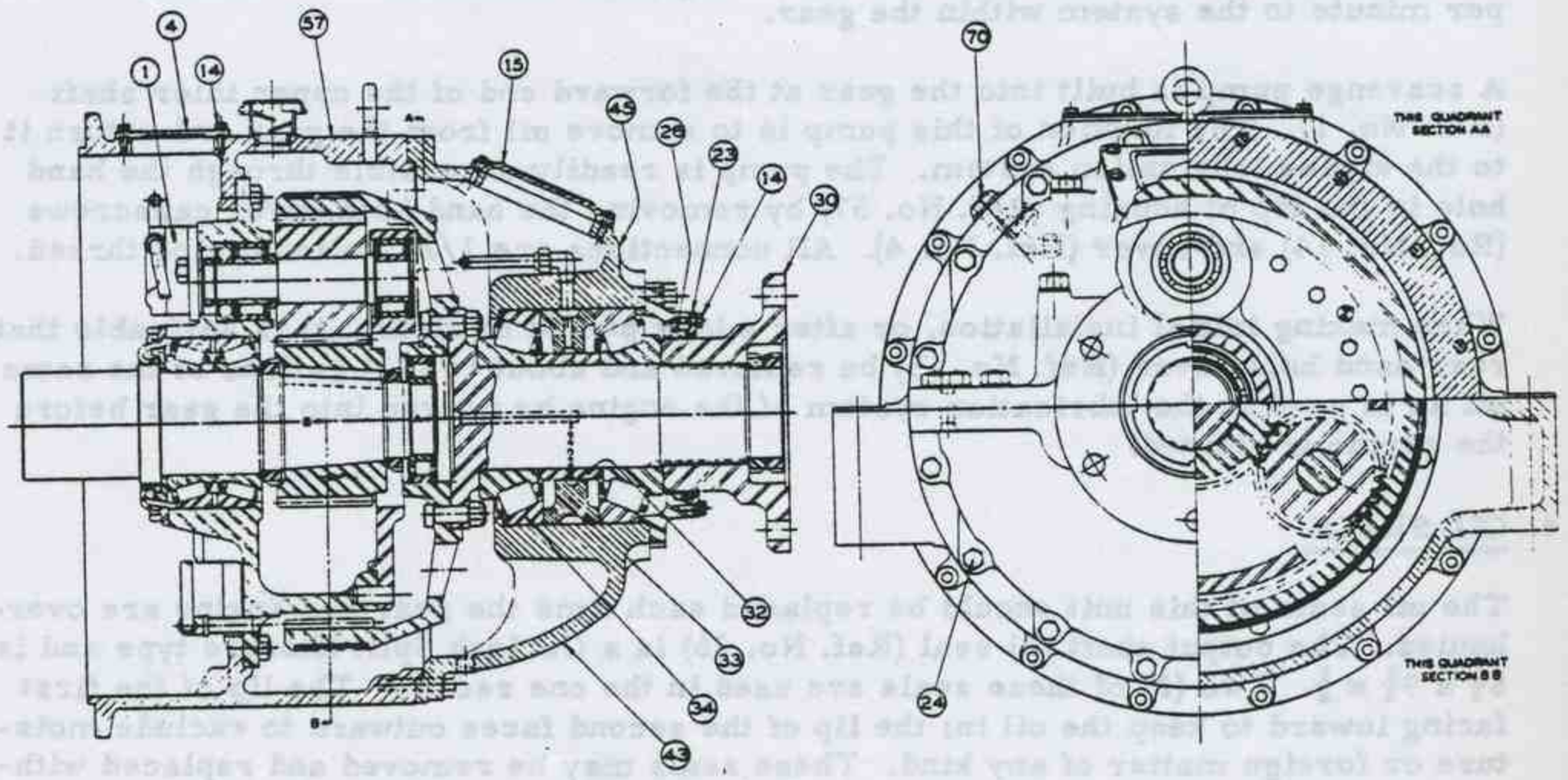


FIG. S-1

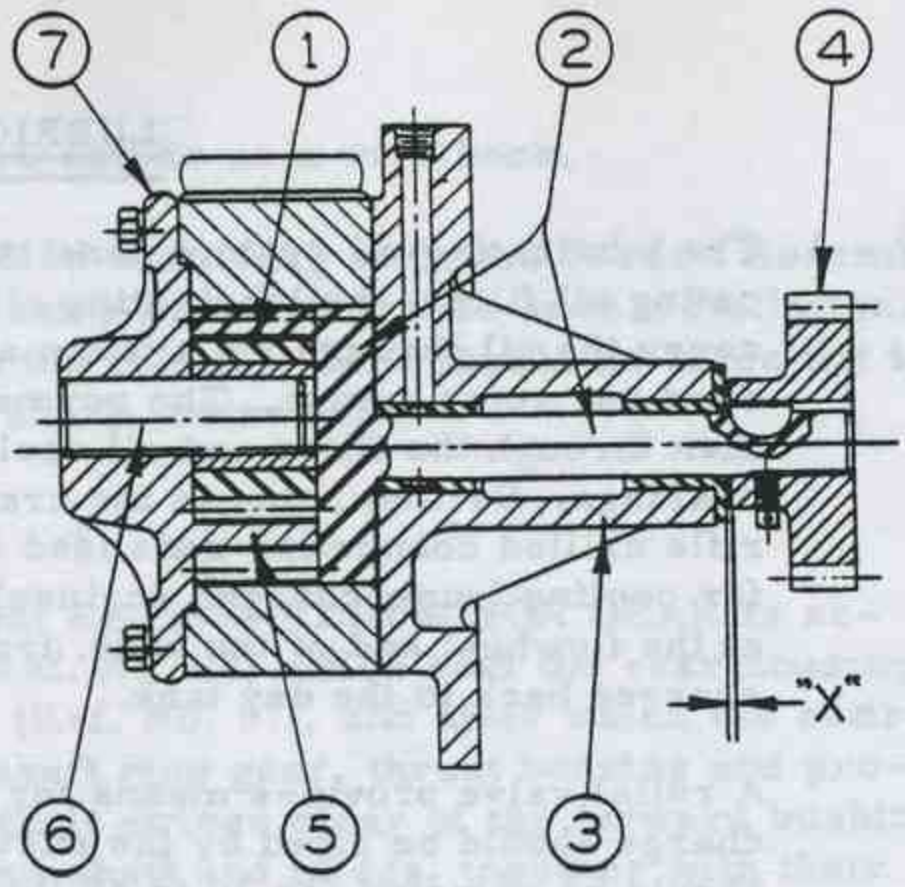
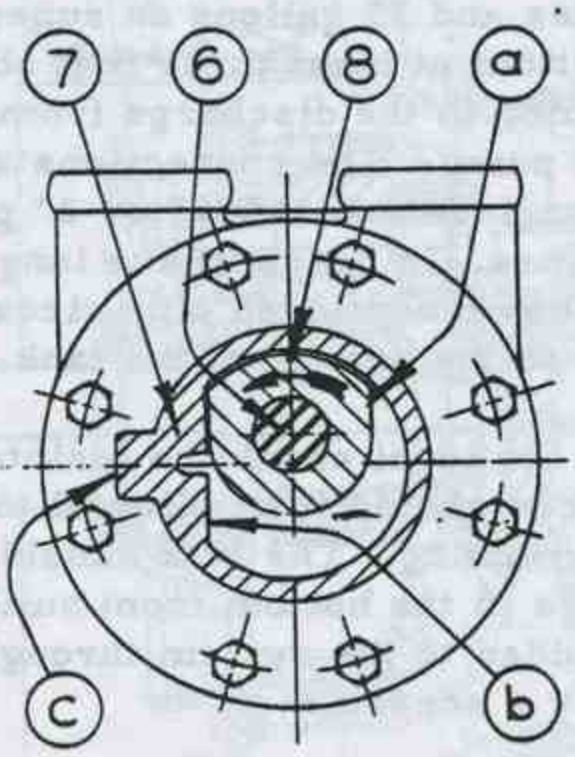


FIG. T-1

of a small idler pinion meshing with internal teeth on a larger driving gear. Fig. T-1 shows the pump used on stationary and reverse gear marine engines. Driving gear (2) with its shaft extention is driven by gear (4) and is bearinged in housing (3). Idler gear (1) is bearinged on a pin (6) which in turn is pressed into cover (7). The external driving gear and the pinion mesh at the top on Fig. T-1, and since the idler pinion is mounted eccentrically relative to the driving gear there will be a space at the bottom between the two gears. This space is filled up by a crescent shaped baffle (5) which is part of cover (7). As the driving gear turns oil is then forced from one side of the pump to the other by the action of the two gears meshing and the crescent shaped baffle. Also by these means the suction and discharge connections can easily be exchanged for a given direction of rotation by turning cover (7) 180°. Alternatively the suction and discharge connections can be kept the same for different directions of rotation by turning the cover 180°.

The lubricating oil pumps on direct reversible marine engines are shown on Fig. T-2 in which similar parts have the same reference number as on Fig. T-1. In this case, however, pin (6) on which pinion (1) turns is mounted in a carrier (8) which in turn is held by, and can turn in, cover (7). Crescent (5) in this case is a part of the carrier. The carrier assembly is pressed against the driving gear by spring (9) and ball (10) and will consequently tend to follow the rotation of the gear. Assuming, for example, that the driving gear (2) rotates in the direction of rotation shown by the arrow in Section A-A of Fig. T-2, then the whole carrier assembly, including the pinion, will



SECTION A-A

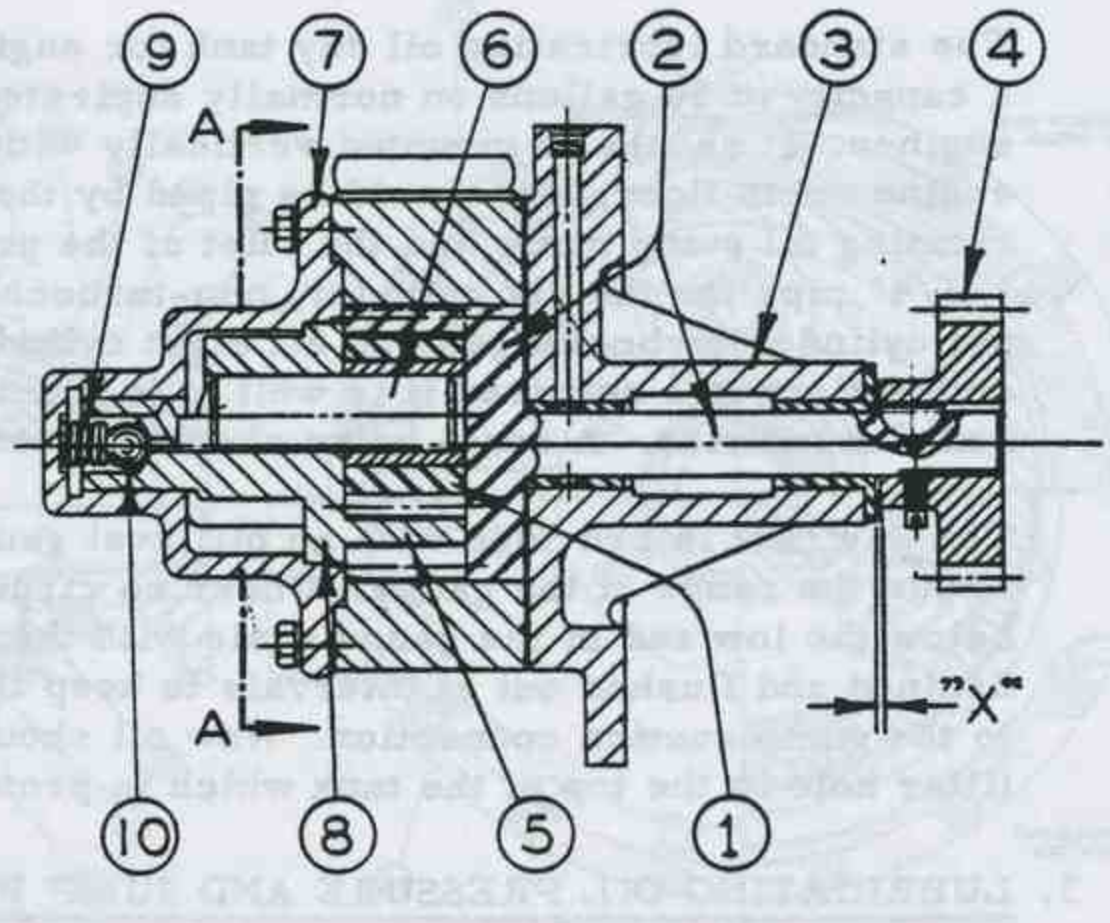


FIG. T-2

rotate in this direction until the carrier is up against the face on cover (7) as shown. This corresponds to the suction connection being on the left hand side and the discharge connection on the right hand side (see Section A-A).

If the direction of rotation of the engine, and consequently of the pump, should now change to the direction opposite that shown by the arrow, then the carrier assembly will rotate in the new direction of rotation until face (a) on the carrier is up against face (b) on the cover. The effect of this will be that the suction connection will still be on the left side and the discharge connection on the right side. The suction and discharge connections can easily be determined without taking the pump apart by noting on which side projection (c) on the cover is located. This projection is always on the suction side.

The total end play of the pump drive gear should be very small, only about .002" to .003". However, some end play must be allowed. This is particularly important on marine engines. When the engine is reversed the crescent can then move in the new direction of rotation until it is up against the stop. The end play "X" (refer to Fig. T-1 and T-2) between the drive gear (4) and housing (3) should be .003" to .005" with the drive gear against the housing face.

4. LUBRICATING OIL FILTER

The full flow lubricating oil filters are of the replaceable cartridge type and are mounted on the engine. The filter elements should be changed when oil conditions warrant and it is suggested that a change period of 500 to 600 hours be adopted at first. Experience will indicate if longer element life is possible, and in this connection it should be noted that it is more economical to maintain the filters in good condition. Do not expect the filters to clarify the oil. If a detergent type of oil is used it can be dark, even black, and still be entirely satisfactory.

The necessity of changing filter elements is best indicated by the pressure drop through the filters. The by-pass valves which are built into the filters, open when a pressure drop of approximately 17 to 18 pounds per square inch has been reached and when this happens the engine receives unfiltered oil. This is a condition which should not be allowed to persist and elements should be changed when a drop of 10 to 12 pounds per square inch has been reached with warm oil (to allow for a higher drop when engine and oil are cold). The pressure regulating valve is mounted on the oil line ahead of the filters, whereas the oil gauge on the instrument panel is connected to the oil line after the filters. When filter cartridges are new we have a pressure drop of about 6 pounds per square inch through the filters and consequently when the oil pressure on instrument panel gauge shows a pressure drop of 5 to 6 pounds per square inch below normal the elements should be changed.

5. LUBRICATING OIL COOLER

The lubricating oil is cooled in a tube oil cooler by water circulating through the tubes. The tube bundle should be cleaned at annual overhauls, or when lack of cooling ability indicates the necessity. The zinc plugs in the cooler head should be renewed when about 50% to 75% gone.

WATER COOLING SYSTEM

1. Only fresh water cooling systems should be used on this model. A fresh water or closed cooling system recirculates fresh water from a storage or surge tank and requires dual water pumps, one for the fresh water and the other for the raw water which is pumped thru a heat exchanger to cool the fresh water.

2. The water circuits thru the engine are as follows:

(a) FRESH WATER

The water is sucked by the fresh water pump from the heat exchanger and is then discharged to the oil cooler and water inlet manifold which distributes the water to the lower portion of the cylinder block. The water rises to the top of the cylinder block and then thru brass nipples (screwed into the cylinder block) up into the cylinder heads. Each nipple is sealed between the cylinder block and head by means of a rubber grommet. The water circulated thru the cylinder heads is then collected in the water cooled exhaust manifold from which it is discharged to the heat exchanger.

A piping diagram is furnished for each installation and it is important that this diagram be followed and that all fresh water connections, including the connections to the surge tank, be made in accordance with this diagram. The pipe sizes called for, for the various connections, should be adhered to. This is to avoid vacuum being developed at the fresh water pump suction which would result in air being drawn into the fresh water system through the pump gland, resulting in heating of this gland and erosion of oil cooler and heat exchanger tubes. Vacuum any place in the fresh water system should be avoided.

(b) SEA WATER

The raw water pump sucks sea water through the cooling ducts of the reduction or reverse gear and discharges to the heat exchanger and then overboard.

The raw water pump should if possible be located below the water line for light draft. Where it is located close to this line a check valve should be incorporated in the pump suction line. It is not advisable to have the sea water pump located appreciably above the light draft water line. In these cases it may be advisable to use a separate motor or belt driven pump located below the water line.

3. DRAINING THE WATER

If the engine is to be allowed to stand idle in freezing weather it will be necessary to drain all water. Drain plugs or cocks will be found on the cylinder block, water pumps, exhaust manifold and reduction or reverse gear.

4. CENTRIFUGAL WATER PUMPS AND DRIVE

The pumps are mounted on the gear housing at the aft end of the engine and are driven from opposite ends of a common drive shaft, rotating on ball bearings. As shown in Fig. W-1 the drive gear floats on the drive shaft and drives it and the pumps through a rubber bushed pin type coupling. Either pump may be removed by unbolting the pump mounting bracket from the drive housing and breaking the pump coupling.

Both pumps are identical and are interchangeable. When replacing a pump, the half coupling on the drive shaft should be removed and replaced by the one supplied with the new pump. The construction of the pumps and drive is shown on Fig. W-1. The pump packing gland should be kept only sufficiently tight to prevent excessive leakage, and should not be tightened unnecessarily.

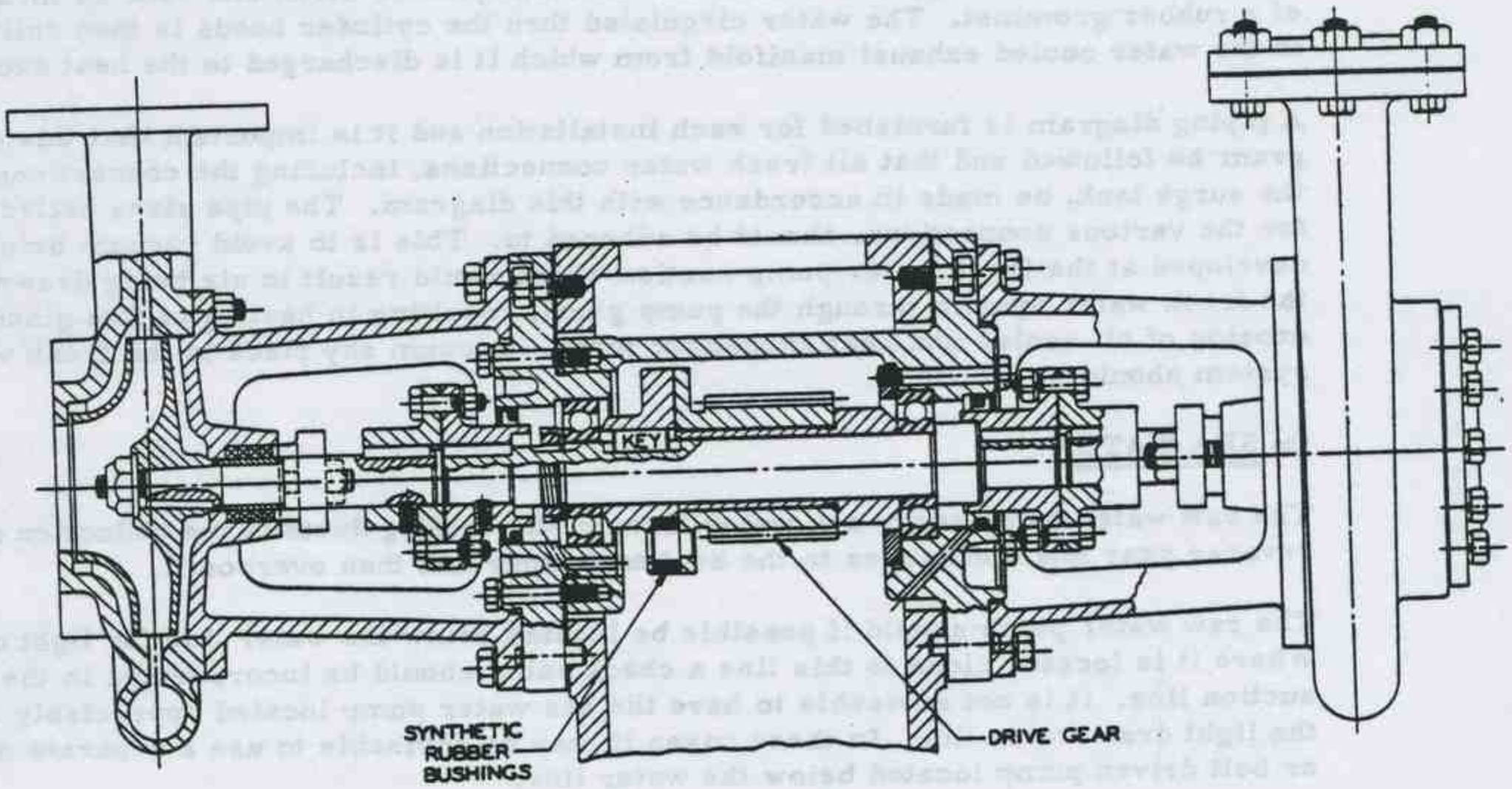


FIG.-W1

MAINTENANCE & INSPECTION

1. GENERAL RULES

Observing the following general rules will go a long way toward insuring satisfactory and trouble-free operation. Refer to preceding sections for detail instructions.

KEEP YOUR ENGINE CLEAN

Inspect the engine regularly and keep it wiped clean. If oil is left standing it quickly hardens and must be washed or scraped off. It is much easier to keep the engine clean than to get it clean, and there is always less trouble with a clean engine than with one that is covered with oil and dirt.

LEAVE WELL ENOUGH ALONE

When the engine is running satisfactorily and smoothly, do not continually try to better the operation with minor adjustments.

NEVER ALLOW YOUR ENGINE TO SMOKE

When the exhaust from an engine is smoky it clearly indicates that combustion is not perfect and that residue, in the shape of smoke is clinging to the oily surfaces of the cylinders, pistons, piston rings, valves, etc. When this happens you are creating trouble for yourself and doing an injustice to the engine. Therefore, the first thing in consideration of the operation of a Diesel engine is: DO NOT ALLOW YOUR ENGINE TO SMOKE.

KEEP A COMPLETE LOG OF ENGINE OPERATION

A complete log should always be kept of the engine operation, and back sheets should be consulted frequently and compared with present conditions. In this way gradual changes can be detected and investigated and insignificant troubles corrected before becoming real ones. Any unusual noises or other irregularities should be logged so that they will be investigated at the regular routine inspections.

INSPECTING REPAIRS

At completion of any adjustment or repair job, always make a thorough inspection to see that all parts have been correctly replaced, that bolts and nuts are tight, and that all cotter pins and locking wires are in place. If work involved rotating parts, bar engine around at least two full revolutions (so that camshaft is turned one revolution) to be sure that all parts are clear. Be sure that no tools or rags are left inside the engine.

2. SMOKY EXHAUST

Smoky exhaust indicates defective combustion which is usually due to one of the following causes:

(a) Excessive carbon on spray valve tips.

(b) Leaking spray valve.

(c) Uneven cylinder load balance

(d) Leaky exhaust, inlet, or air starting valves.

(e) Leaky or stuck piston rings.

(f) Fuel cam or roller may be worn.

(g) Engine overloaded.

If the exhaust smoke is not even but occurs in the form of puffs it is likely that the combustion is defective in one or two cylinders only. Where the trouble lies can usually be determined by cutting out spray valves one at a time by means of the bleeder valve on the spray nozzle holder in the cylinder head. When this is done, however, the engine should not carry more than about 3/4 load or the remaining cylinders will be overloaded.

3. INSPECTION AND MAINTENANCE ROUTINE

The following routine for regular inspection and maintenance work is suggested as a guide for the operator, but experience with the engine over a period of time may indicate changes that should be made in the schedule.

It will be noted in the following schedules that spray tip cleaning has not been included. It is believed the spray tips should be cleaned only when necessary, rather than at definite intervals. The necessity for cleaning will be indicated by increased exhaust temperatures or smoky exhaust and at either of these indications the spray tips and valves should be inspected and cleaned, or replaced if necessary.

In the following, work to be done under each routine should include work listed under preceding routines. For example, work under "Annual Routine" includes everything listed under all other routines.

DAILY ROUTINE

(a) Check oil level in day tank and add oil if necessary.
(b) Check fresh water level in surge tank. If frequent additions of water are required, check entire system for leaks.
(c) Check fuel level in day tank and storage tanks.
(d) Check lubricating oil filter. It is a good idea to mount pressure gauges on both sides of the filter and note the pressure drop which should not exceed ten to twelve pounds per square inch.
(e) Check all gauges, temperatures, etc. on instrument panel for proper functioning of the engine.

250 to 300 HOUR ROUTINE

(a) Check intake and exhaust valve clearances.
(b) Check injection pump port closing. (After starting engine check cylinder load balance.)
(c) Clean out lubricating oil day tank if lubricating oil is dirty or dark in color.
(d) The cartridges in the lubricating oil and fuel filters may or may not need replacement. The time between replacements will vary with the type of lubricating oil and fuel used and with the operating conditions to which the engine is subjected. Drain off any accumulated water and sediment.
(e) Rinse breather caps in fuel oil and blow off excess with compressed air.
(f) Check cylinder peak compression and firing pressures. Compression pressures should not vary more than 50 p.s.i. and firing pressures not more than 75 p.s.i.

SEMI-ANNUAL ROUTINE

(a) Pull cylinder heads and piston, remove rings and clean pistons and grooves if necessary. Check rings for side and end clearance.
(b) Examine cylinder liner walls. Watch for shoulders due to ring travel.
(c) Check intake and exhaust valves. Grind in lightly or replace if necessary. Check valve springs for defects.
(d) Inspect entire spray valve assembly. Replace spray tip valve assembly if leaky. Clean spray tips.
(e) Inspect main and connecting rod bearings. Check clearances and inspect bearing surfaces.
(f) Inspect gear train carefully, observing backlash, indications of excessive wear on teeth.
(g) Inspect camshaft. Watch for worn or loose cams, loose or worn rollers or pins on the lifters. Be sure all keys and set screws are in place and tight.
(h) Inspect air reversing cylinder and cams in control unit (marine engines).
(i) Disassemble lubricating oil cooler and inspect for corrosion. Clean thoroughly before reassembling. Renew zincs if necessary.
(j) Check propeller shaft coupling bolts (marine engines).
(k) Check all hold-down bolts between engine and foundation. If they are loose check the engine alignment.
(l) See attached Elliott Company instruction book for supercharger maintenance if engine is turbo-charged.

ANNUAL ROUTINE

(a) Check crankshaft alignment. If necessary, replace bearing shells.
(b) Examine cylinder jackets. If scale is over 1/16" thick it should be removed by scale remover solution.
(c) Remove and inspect lubricating oil and fuel oil transfer pumps. Note condition of bearings, shafts and seals. Replace if necessary.
(d) Remove and inspect fuel injection pumps. Note condition of pump plungers and barrels. Replace if necessary.
(e) Disassemble governor and inspect carefully all moving parts for wear and signs of distress. Inspect entire linkage between governor and fuel control shaft for lost motion and wear. Links and pins should be inspected for wear and replaced if necessary.
(f) Clean out crankcase thoroughly. Be sure that all cleaning solvent is drained out and the crankcase blown or wiped dry after cleaning is completed.

FOREWORD

This Parts Catalog has been compiled to serve the dual purpose of providing a means for ordering parts and to furnish illustrations to aid in the dismantling and reassembling of the various units of the engine.

This Parts Catalog is made to conform to the original construction of the engine, and The National Supply Co. does not assume the responsibility or obligate itself to maintain this catalog to conform to any subsequent changes made on the engine after it leaves the factory. Complete records of all changes and service orders for each engine are maintained at the factory in an effort to always supply correct parts, but due to occasional substitution of parts in the field, of which we have no knowledge, and the fact that we have no assurance that parts furnished from the factory are installed, we cannot guarantee the furnishing of correct parts.

The right is reserved to change the construction or material of any part or parts without incurring the obligation of installing such changes on engines already delivered.

INSTRUCTIONS FOR ORDERING PARTS

Always furnish Engine Number when ordering parts or when communicating with factory or agency. This number will be found on name plate located on operating side of engine. It is VERY NECESSARY THAT THE ENGINE NUMBER BE GIVEN as it helps to insure the furnishing of correct parts and is also the means whereby the factory service records of each engine are maintained.

Always give PART NUMBER, PART NAME AND QUANTITY. If part has no Part Number then give a COMPLETE DESCRIPTION AND SIZE OF PART.

Be particular to state POST OFFICE ADDRESS, TOWN, COUNTY and STATE to which parts are to be shipped.

Specify how merchandise is to be shipped--whether by FREIGHT, EXPRESS or PARCEL POST.

Confirm all Telephone and Telegraph orders in writing.

Claims for shortages or errors must be made within five days from the receipt of goods or same will not be considered.

Broken or damaged goods should be refused, or a complete description made of damage by the carrier agent on the freight bill. If this is done, full damage can generally be collected from the transportation company.

No responsibility is assumed for delay or damage to merchandise while in transit. Our responsibility ceases upon delivery of shipment to the transportation company, from whom a receipt is received showing that shipment was in good condition when delivered to them; therefore, claims if any, should be made with the transportation company and not with The National Supply Co. - Engine Division-Springfield, Ohio

INSTRUCTIONS ON "HOW TO USE PARTS CATALOG"

In order TO LOCATE PART NUMBERS it is IMPERATIVE that the person concerned thoroughly understands the makeup of this book. He should CAREFULLY READ THE INSTRUCTIONS given on this and the following page, and thoroughly familiarize himself with the necessary steps involved. Particularly is this important when sub-assemblies are involved.

DO NOT ORDER PARTS BY REFERENCE NUMBERS as these numbers sometimes change and wrong parts might be supplied.

This catalog is made up of four basic sections, as follows:-

1. INDEX SHEET -- This sheet lists the various groups into which the engine is divided and must be used for obtaining the group sheet number. This sheet also lists any special parts used on engine.

2. GROUP LIST SHEET -- This sheet lists the parts which comprise the group, and are numbered with the prefix "L" or "2L" NOTE - Catalog may contain sheets which are not used - Use only those sheets listed on index.

3 PLATE (OR LINE DRAWING) -- Plates are arranged to face the group sheet to which they apply, and in most cases shows only the parts listed in the group. Occasionally a plate may include two or more groups making it necessary to always first obtain the group number from the index. If this is not done you may by chance turn to a plate showing the part wanted but will not find it listed on the group sheet facing this plate.

NOTE:----- If no plate is found facing the group sheet, then the part wanted can be identified by the description. This will apply mainly to piping, and in this connection the actual pipe and fittings on the engine should always be measured and then ordered accordingly, due to unavoidable variations between engines.

4. SUB-ASSEMBLIES -- The term "Sub-assembly" (or the Word "Assembly" appearing in the part name) is used to indicate parts which are made up of two or more parts (or pieces) and yet must be considered as a unit part. For example, parts that are welded together, parts that have bushings pressed in, or parts that have to be machined together.

A Sub-assembly list will be found immediately following the last group sheet, and itemizes the various parts used in each assembly. These assemblies are arranged in numerical sequence.

NOTE: ----- Certain parts of assemblies indicated by an "*" in place of a reference number are not sold individually, and if wanted, the complete assembly must be ordered.
Sub-assembly lists contains assemblies used on several different engines. Use only assemblies listed on group list sheet.

REFERENCE NUMBERS ON PLATES OR ASSEMBLY DRAWINGS

SINGLE NUMBERS or the TOP NUMBER (when more than one number appears in the circle) refers directly to a corresponding number on the group list sheet.

A circle with MORE THAN ONE NUMBER indicates part in question is a component part of a sub-assembly. The top number will refer to a corresponding number on the group list sheet, and the lower number will refer to a corresponding number in the sub-assembly.

TO FIND A PART WITH TWO REFERENCE NUMBERS IN THE CIRCLE PROCEED AS FOLLOWS: -
(NOTE:- Select a part on any plate and follow step by step as explained.)

1st -- Using the top number in the circle locate corresponding reference number on the group list sheet, which will be an assembly.

2nd -- Using the Part Number of the assembly locate same in the numerical assembly list at rear of book.

3rd -- Refer back to the plate and obtain the second or lower number in the reference circle, then locate this number in the reference number column of the sub-assembly, and this will be the part desired.

If there are MORE THAN TWO NUMBERS in the reference number circle, proceed exactly as outlined above, only this time the part in the first assembly located will be another sub-assembly, so therefore it will be necessary to find the second assembly, and then referring back to the plate take the third number in the reference circle and match it with the corresponding number in the second assembly.

The following page will show a typical example and illustrate the above explanation step by step.

The following illustrated example will show the procedure as explained on opposite Page, for finding parts involved in sub-assemblies.

For this illustration assume that the part number for the Cylinder Head Cleanout Cover is wanted:-

We know that this cover would be listed with the "Cylinder Head" so we turn to the Index Sheet and locate the "Cylinder & Head Group" which gives us the sheet number.

PARTS CATALOG ---- INDEX — ENGINE NO. 11830
6 Cyl. 13 x 16 Marine Engine

	No. Req'd.	Group No.
BASE SECTION		
Base -- (Studs - Covers - Bearing Caps Etc.)	1	2L27
Base Oil Piping-(Main Manifold - Crank Brg.Oil Lines)	1	2L629
Crankshaft & Flywheel -- (Thrust Shaft & Bearing)	1	2L30
CYLINDER & VALVE MECHANISM SECTION		
Cylinder & Head	6	L-9776
Valve Rockers & Push-Rods	6	L-9777
Valve Lifters & Guide	6	L-6919
Piston & Connecting Rod	6	2L351

We find the sheet number for this group to be L-9776, and now we turn to this sheet and opposite we find a Plate or group drawing.

ALWAYS GIVE PART NUMBER—PART NAME—ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE
* INDICATES PART NOT SERVICED INDIVIDUALLY

L-9776
PLATE NO. X-1890

REF. NO.	*	PART NO.	NO. REQD.	PART NAME	ADDEN. SERVC. NO.
1		X1283	1	CYLINDER ASSEMBLY	
2		753A-FB4	4	WASHER - Cyl. to Centerframe Stud	
3			4	NUT -- 1 3/4-5-NC-Hex. - - (Steel)	
4		X2810	1	HEAD ASSEMBLY - Cylinder	
5		C-3957	1	GASKET - Head to Cylinder	
6		610A-03	8	GROMMET - Cyl. to Head Water By-Pass Pipe	
7			8	NUT -- 1 1/2-6-NC-Hex. - - (Steel)	
8		785	1	FLANGE - Cyl. Head Water Outlet Hole (Blind)	

NAME CYLINDER & HEAD GROUP
ORIGINALLY ISSUED FOR 13-X 16 MAR. - STAT.
FOR TOTAL REQUIREMENTS PER ENGINE REFER TO THE NUMBER ABOVE OR TO THE NEXT GREATER GIVEN ON INDEX SHEET

PARTS LIST — THE NATIONAL SUPPLY CO. ENGINE DIVISION SPRINGFIELD, OHIO

L-9776

Looking at the Plate we locate the part we want and find the reference number to be 4-1-8. We now take the top number "4" and match this with the reference number "4" on the group list sheet. We find this to be X2810 Head Assembly, so that this assembly must next be found in the sub-assembly list at rear of book.

SUB-ASSEMBLY LIST

X2810	HEAD ASSEM. - CYLINDER — [illegible]	
[illegible]	1	HEAD ASSEM.
[illegible]	1	VALVE & CAGE ASSEM.
[illegible]	1	VALVE & CAGE ASSEM.
[illegible]	1	NUT - Plain

After finding assembly X2810 in sub-assembly list, we now take the second of the reference numbers in the oval which is "1" and match this with the corresponding number of the sub-assembly. We find this to be X2818 Head Assembly so we now have to proceed to this assembly.

SUB-ASSEMBLY LIST

X2818	HEAD ASSEM. - CYLINDER — [illegible]	
[illegible]	1	HEAD CYLINDER
[illegible]	6	PIPE PLUG - 1 1/4-stub
1	S-5620LS	4	STUD - In. & Exh. Cage
2	S-3060	2	STUD - Air Valve Cage
7	C-447	2	NOZZLE - Cooling
8	C-8214	2	COVER - Cleanout (Blind)

After this assembly X2818 is found we now take the bottom reference number in the oval which is "8" and match this with the corresponding reference number in X2818. We now have the unit part which we want.

The National Supply Co.
Atlas Imperial Engine

PARTS CATALOG INDEX

CATALOG APPLIES ONLY TO ENGINES INDICATED →

Eng. #50090-50092 Incl.
Eng. #50116-50119 Incl.
Eng. #50123-50176 Incl.

ENG. SIZE 9 x 10 1/2 NO. CYL. 8 TYPE Marine - R.H. (TURBO)

Mod. 45-M5X-8

SPEC. NO. 1652-1
ES NO. 365
DATE TYPED 3-23-53
ISSUE NO. 2
INSTR. 32 (M)

GROUP NAME	NO. USED	GROUP SHEET NUMBER
BASE SECTION	---	-----
Base - Bearing Caps - Covers - Studs - Lube Strainer	1	2L2530
Crankshaft - (Bearing Shells)	1	2L2531
Flywheel & Housing	1	2L2532
Reduction Gear	1	2L2533
Coupling - Flywheel to Reduction Gear	1	2L2535
CENTERFRAME SECTION	---	-----
Centerframe - Gear Housing - Covers (Oil Guards)	1	2L2534
Intermediate Gear	1	2L2479
Camshaft - Cams - Bearings - Shifter Collar	1	2L2536
INSTRUMENT PANEL (Gages, Tach. & Pyrometer)	1	2L2576
CYLINDER BLOCK & HEAD SECTION	---	-----
Cylinder Block - Covers - Studs - Liners	1	2L2537
Cylinder Head - Covers - Valve Mech. (Rockers to Lifters)	8	2L2773
Piston & Connecting Rod	8	2L2304
MANIFOLDS	---	-----
Inlet & Exhaust - Turbocharger - Water Elbows for Manifold	1	2L2539
Air Starting - Air Valves & Push Rods	1	2L2520
GOVERNOR & CONTROL	1	2L2540
Gov. Linkage - Woodward & O.S. to Control Shaft	1	2L2521
Westinghouse Gov. Air Actuator	1	2L2522
Eng. Control Housing & Covers	1	2L2541
Westinghouse Equipment in and on Control Housing	1	2L2555
Reversing Air Cyl. & Camshaft Shifter	1	2L2543
FUEL SYSTEM	---	-----
Fuel Pumps - Injection Valve - Internal Fuel Piping	1	2L2545
Fuel Pump Control Shaft & Connecting Linkage	1	2L2546
Fuel Piping (External) & Filter	1	2L2298
Fuel Transfer Pump	1	2L2255
LUBE OIL SYSTEM	---	-----
Lube Pumps - Sump & Pressure	1	2L2547
Manifolds - (Main & Secondary) & Internal Piping	1	2L2548
Lube Oil Piping (External)	1	2L2549
Cooler - Lube Oil	1	2L2550
Filter - Lube Oil	1	2L2551
WATER COOLING SYSTEM	---	-----
Twin Water Pumps & Drive	1	2L2552
Water Inlet Manifold & Piping	1	2L2666
Water Piping to Turbocharger	1	2L2554
WESTINGHOUSE CONTROLS	---	-----
Westinghouse Control & Air Cylinder Relays	1	2L2556
Westinghouse Directional Interlock	1	2L2557
Westinghouse Fuel Limiting Device	1	2L2558
Westinghouse Fuel Cut-off	1	2L2559
Westinghouse Control Piping	1	2L2774
Piping - Air Starting Check Valve Actuator & Air Lock Relief	1	2L2775
	---	-----
	---	-----
NOTE: Substitute Air Filter Silencer BM-6583 on All Engines	---	-----
Except 50090 to 50092 Inclusive and 50116 to 50118 Inclusive	---	-----
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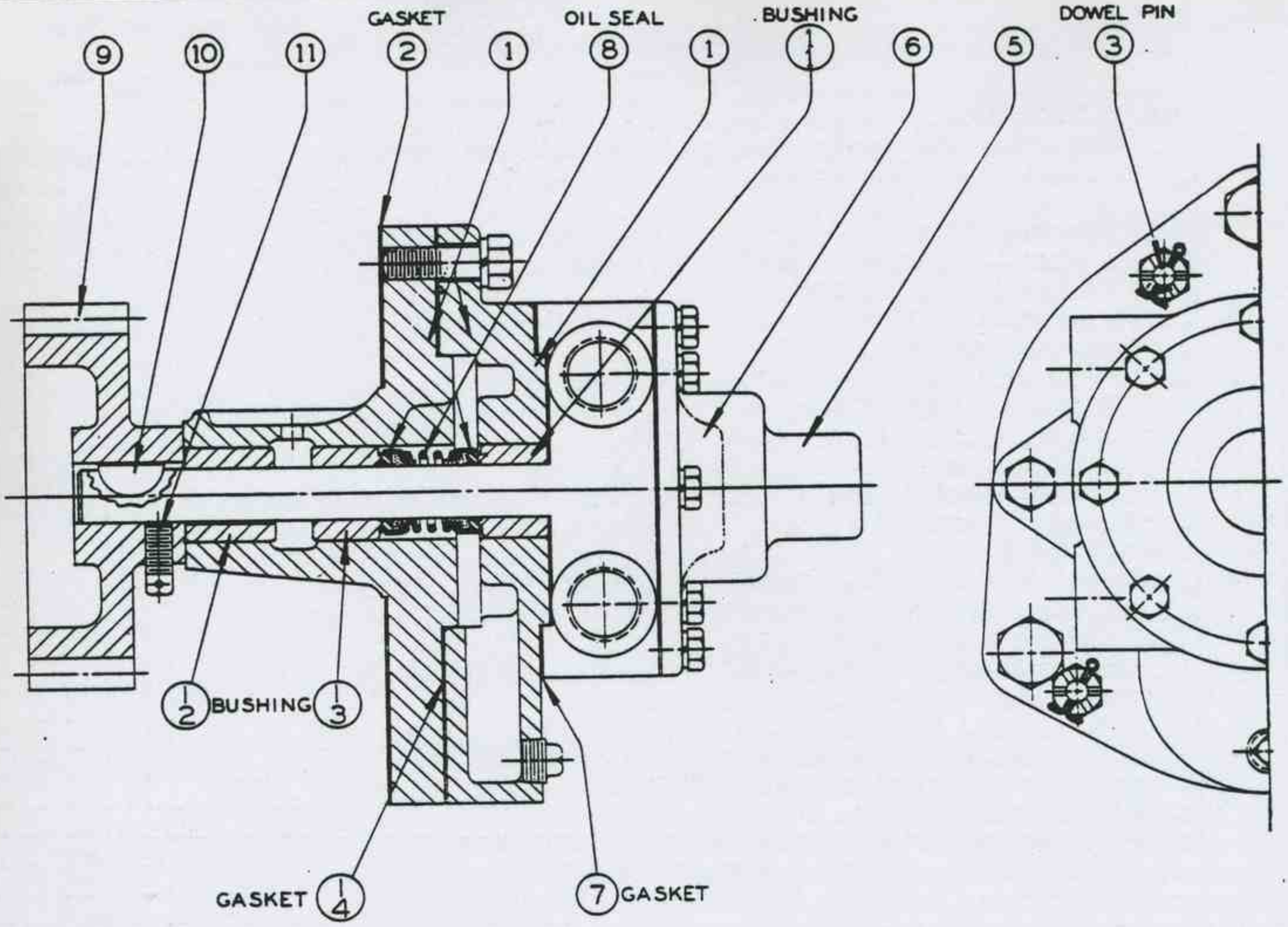
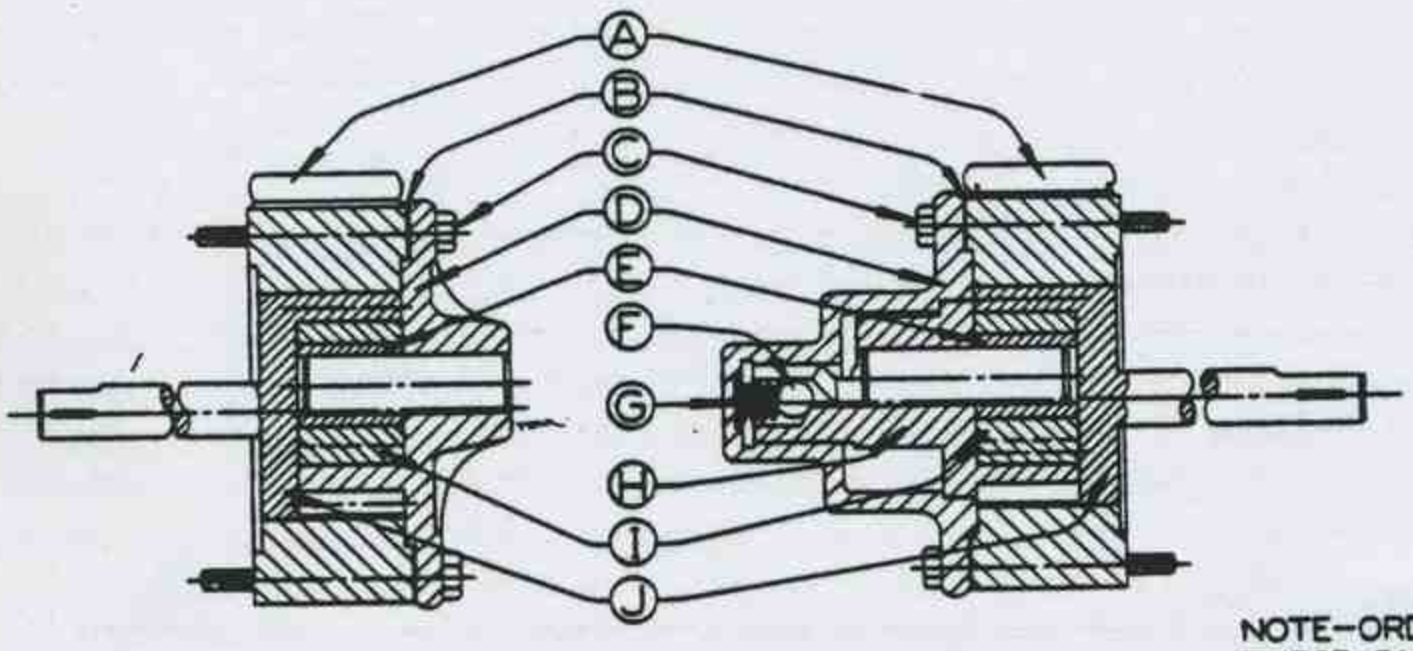
NOTE: SPARE PARTS LIST IN BACK OF BOOK	---	-----
	---	-----



DETAIL OF PUMPS



NON-REVERSING TYPE

REVERSIBLE TYPE

SEE GROUP LIST FOR PART NO. OF COMPLETE PUMP

REF NO.	PART NAME	COMPLETE PUMP NO. C9290P	COMPLETE PUMP NO. C9289P
A	HOUSING	C-9290-P1	C-9289-P1
B	GASKET	C-8193	C-8193
C	CAPSCREW	1/4-20x2	1/4-20x2
D	COVER	C-9290-P2	C-9289-P2
E	BUSHING	C-9290-P3	C-9290-P3
F	STEEL BALL	9/16 DIA.	
G	SPRING	C-9290-P4	
H	CARRIER & PIN	C-9290-P5	
I	IDLER & BUSHING	C-9290-P6	C-9290-P6
J	ROTOR & SHAFT	C-9290-P7	C-9290-P7

NOTE-ORDER PUMP PARTS AS PER ABOVE PART NUMBERS.
THESE PARTS ARE NOT LISTED ON GROUP SHEET.
PARTS NOT LISTED ARE NOT SOLD INDIVIDUALLY.

PLATE NO.
3A3015

DO NOT ORDER PARTS BY REFER. NUMBERS

Retyped from copy dated 9/28/51.
#3 - Line 14 was 3A2097. 9/11/52.

CHANGES

CHANGES

2L2255

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A3015

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1	3A2195	1	3A2195-X	1	ADAPTOR ASSEMBLY - Fuel Transfer Pump	
2		2	3A2197	1	GASKET - Adaptor to Housing	
3				3	CAPSCREW - 1/2-13-NC x 1-1/2 Lg. - St.	
4				3	LOCKWASHER - 1/2 SAE Reg. - St.	
5	C-9992	3	C9992L1 1/4	2	PIN - Adaptor to Housing Dowel	
6				2	NUT - 1/4-28-NF-Hex. - St.	
7				2	COTTER PIN - 1/16 x 1/2 Lg. - St.	
8						
9	C-9290	5	C9290-P	1	PUMP - Fuel Transfer	
10		7	C-8193	3	GASKET - Pump to Adaptor	
11				8	CAPSCREW - 1/4-20-NC x 2-1/4 Lg. - St.	
12				8	LOCKWASHER - 1/4 SAE Reg. - St.	
13	2C2478	8	2C2478-P	1	OIL SEAL	
14		9	4B1236	1	GEAR - Fuel Transfer Pump Drive	
15		10		1	WOODRUFF KEY - 1/8 x 3/4 Std. - St.	
16		11	C-8217	1	SETSCREW - Gear to Shaft	
17				1	WIRE - #16 Ga. x 8 Lg. - St.	
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2L2255

FOR OPP. HAND SEE

FOR OPP. ROT. SEE

NAME FUEL TRANSFER PUMP GROUP

ORIGINALLY ISSUED FOR 9 x 10-1/2 MARINE - R.H.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

Retyped & Revised from copy dated 9/28/51.

CHANGES #2

CHANGES

2L2298

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO For Filter Only

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG. NO See "Aux. Equip."
1						
2						
3			---- Fuel Transfer Pump Discharge & By-Pass---			
4				1	CLOSE NIPPLE - 1/2 Std. - W.I.)	
5				1	TEE - 1/2 x 3/8 x 1/2 Std. Red. - M.I.	
6			2C5460	1	RELIEF VALVE (20 Lb)	
7						
8						
9			---- Fuel Transfer Pump Discharge to Fuel Filter---			
10			C-9804P-1/2	1	ELBOW - Tube	
11				1	TUBE - 1/2 OD. x .049 x 52" Lg. (Cop.)	
12			C9804P-1/2	1	ELBOW - Tube	
13				1	REDUCING BUSHING - 3/4 x 3/8 Std. (C.I.)	
14						
15						
16			3A2536	1	FILTER - Fuel	
17				2	CAPSCREW -3/8-16-NC x 1-1/4 Lg. (St.)	
18				2	NUT - 3/8-16-NC-Hex. (St.)	
19				2	LOCKWASHER - 3/8 SAE Reg. (St.)	
20						
21						
22			---- Filter Outlet to Fuel Manifold--			
23				1	REDUCING BUSHING - 3/4 x 3/8 Std. (C.I.)	
24			C9804P-1/2	1	ELBOW - Tube	
25				1	TUBE - 1/2 O.D. x .049 x 11-1/2 Lg. (Cop.	
26			C9801P-1/2	1	CONNECTOR - Tube	
27				1	TEE - 3/8 Std. - M.I.	
28			C-9801P-1/2	1	CONNECTOR - Tube	
29				1	TUBE - 1/2 O.D. x .049 x 14" Lg. (Cop.)	
30			C9801P-1/2	1	CONNECTOR - Tube	
31				1	ELBOW - 1-1/4"	
32				1	REDUCER BUSHING - 1-1/4" x 3/8"	
33						
34						
35			----Tee in Filter Outlet Line to Pressure Gage---			
36				1	CLOSE NIPPLE - 1/8 Std. (W.I.)	
37			C9846P-1/8	1	NEEDLE VALVE	
38				1	REDUCING BUSHING - 3/8 x 1/8 Std. (C.I.)	
39			C9801P-1/4	1	CONNECTOR - Tube	
40				1	TUBE - 1/4 OD x .030 x 75" Lg. (S.D. Cop.	
41			C9804P-1/4	1	ELBOW - Tube	
42						
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FOR OPP. HAND SEE

FOR OPP. ROT. SEE

NAME FUEL PIPING (EXTERNAL & FILTER GROUP

ORIGINALLY ISSUED FOR 6 CYL, 9 x 10-1/2 MARINE

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2298

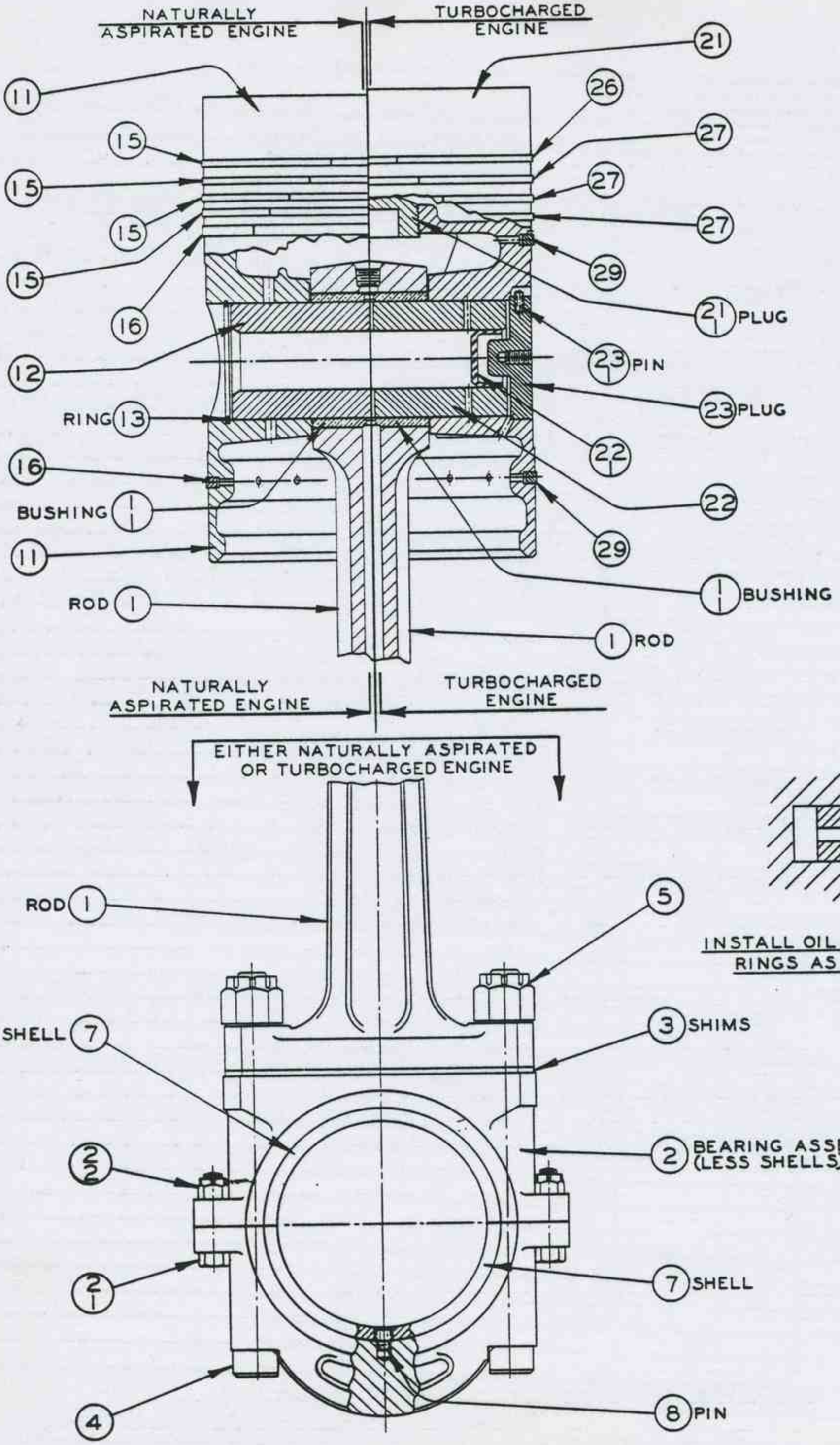

PLATE No.
3A2915

DO NOT ORDER PARTS BY REFER. NUMBERS

CHANGES

Retyped from Sheet Dated 9-28-51 - No Changes
#5-10/16/52-Added Line #6 - C7562-D

CHANGED

2L2304

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A2915

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1	3A2192	1	3A2192-X	1	ROD ASSEMBLY - Connecting	
2	3A2067	2	3A2067-X	1	BEARING ASSEMBLY - Connecting Rod	
3		3	C-7562-A	1	SHIM - Connect. Rod to Bearing (1/16)	
4		3	C-7562-B	1	SHIM - Connect. Rod to Bearing (1/32)	
5		3	C-7562-C	2	SHIM - Connect. Rod to Bearing (1/64)	
6		3	C-7562-D	2	SHIM - Connect. Rod to Bearing (.010)	
7		4	3A2089	4	BOLT - Connect. Rod to Bearing	
8		5	3A2458	4	NUT - Connect. Rod to Bearing Bolt	
9				4	COTTER PIN - 1/8" x 1-3/4" Lg. - St.	
10		7	3A2055	2	SHELL - Connecting Rod Bearing	
11		8	3A2076	1	PIN - Bearing Shell Dowel	
12						
13	4B1103	21	3A2832-X	1	PISTON ASSEMBLY	
14		22	3A2578-X	1	PIN ASSEMBLY - Piston	
15		23	3A2757-X	2	PLUG ASSEMBLY - Piston Pin	
16						
17						
18		26	3A2700	1	RING - Piston (Compression) (Top Groove)	
19		27	3A2169	3	RING - Piston (Compression) (2-3-4 Groove) (From Top)	
20						
21		29	3A2166	2	RING - Piston (Oil Control) (5-6 Groove from Top)	
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2L2304

OR OPP. HAND SEE

OR OPP. SOT. SEE

NAME PISTON AND CONNECTING ROD GROUP (OIL COOLED PISTON)

ORIGINALLY ISSUED FOR 9 x 10-1/2 TURBO

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

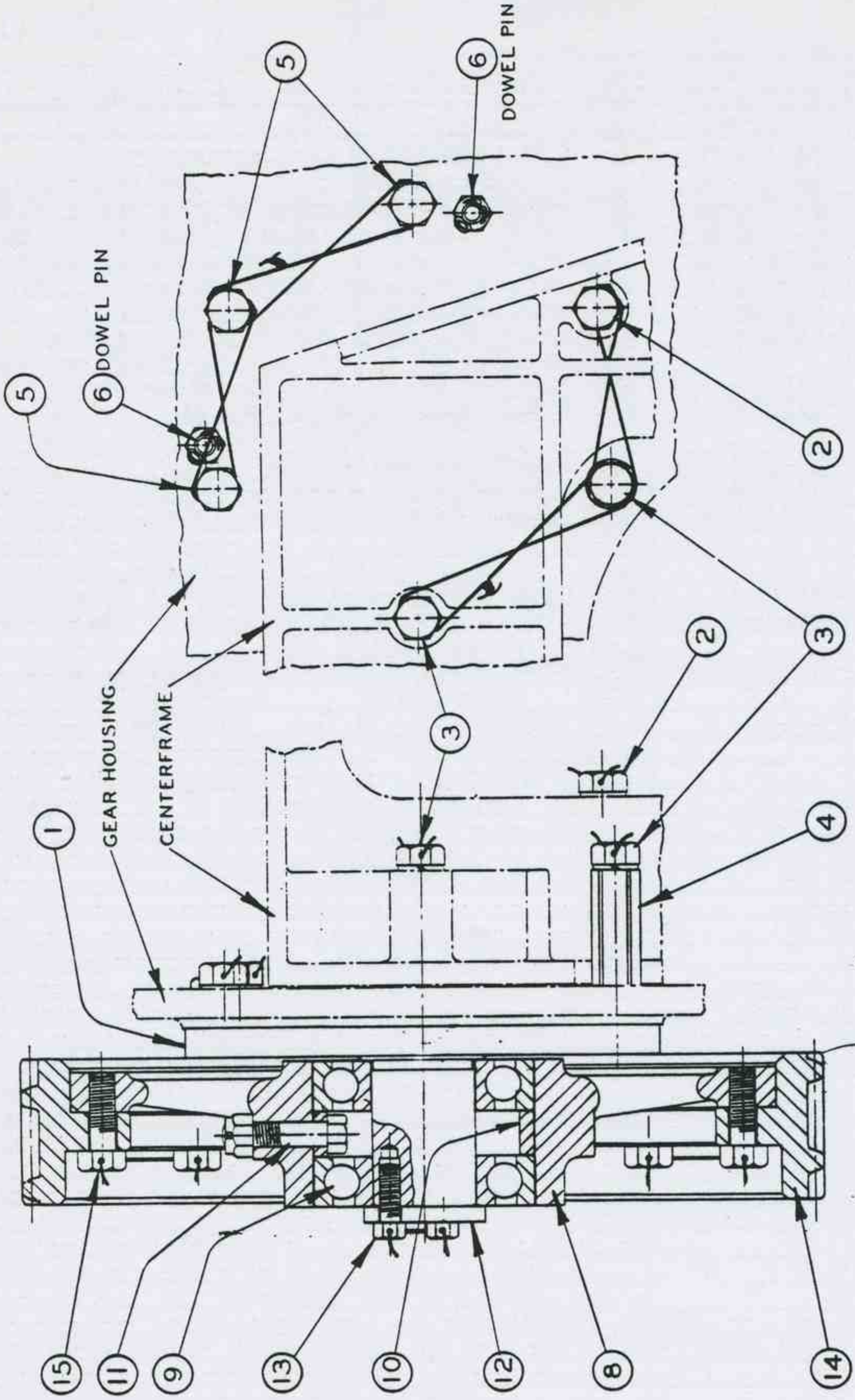

PLATE No.
3A2813 ED.2 DO NOT ORDER PARTS BY REFER NUMBERS

CHANGES

Supersedes Sheet Dated 9-28-51- No Changes
#1

CHANGES

2L2479

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A2813 (ED. 2)

LINE NO	DRWG. NO.	REF. NO	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		1	3A2118	1	PLATE - Intermediate Gear Mounting	
2		2	C2410L6-3/4	1	CAPSCREW - Mounting Plate to Centerframe	
3		3	C2410L-5	2	CAPSCREW - Mounting Plate to Centerframe	
4		4	3A2147	1	SPACER - Mounting Plate Capscrew	
5				3	LOCKWASHER - 5/8 SAE Reg. - St.	
6				1	WIRE - #16 Ga. x 24 Lg. - St.	
7		5	C2410L-2	3	CAPSCREW - Mounting Plate to Gear Housing	
8				3	LOCKWASHER - 5/8 SAE Reg. - St.	
9				1	WIRE - #16 Ga. x 30 Lg. - St.	
10			C6392L1-1/2	2	PIN - Mounting Plate to Gear Housing Dowel	
11				2	HALF NUT - 1/2-13-NC-Hex. - St.	
12				2	COTTER PIN - 3/32 x 3/4 Lg. - St.	
13						
14		8	3A3306	1	HUB - Intermediate Gear	
15		9	3A2125	2	HALL BEARING	
16		10	3A3246	1	SPACER - Ball Bearing	
17		11	3A3308	1	CAPSCREW - Bearing Spacer Retainer	
18				1	NUT - 5/8-18 Light Thick Slotted	
19				1	COTTER PIN - 1/8 x 1-1/2	
20		12	3A2123	1	WASHER - Gear Hub Retainer	
21		13	3A2114	3	CAPSCREW - Washer to Mounting Plate	
22				1	WIRE - #16 Ga. x 8 Lg. - St.	
23		14	3A2092	1	GEAR - Intermediate	
24		15	C2410L-2	8	CAPSCREW - Gear to Hub	
25				4	WIRE - #16 Ga. x 17 Lg. - St.	
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2L2479

FOR OPP. HAND SEE

FOR OPP. ROT. SEE

NAME INTERMEDIATE GEAR GROUP

ORIGINALLY ISSUED FOR 9 x 10-1/2

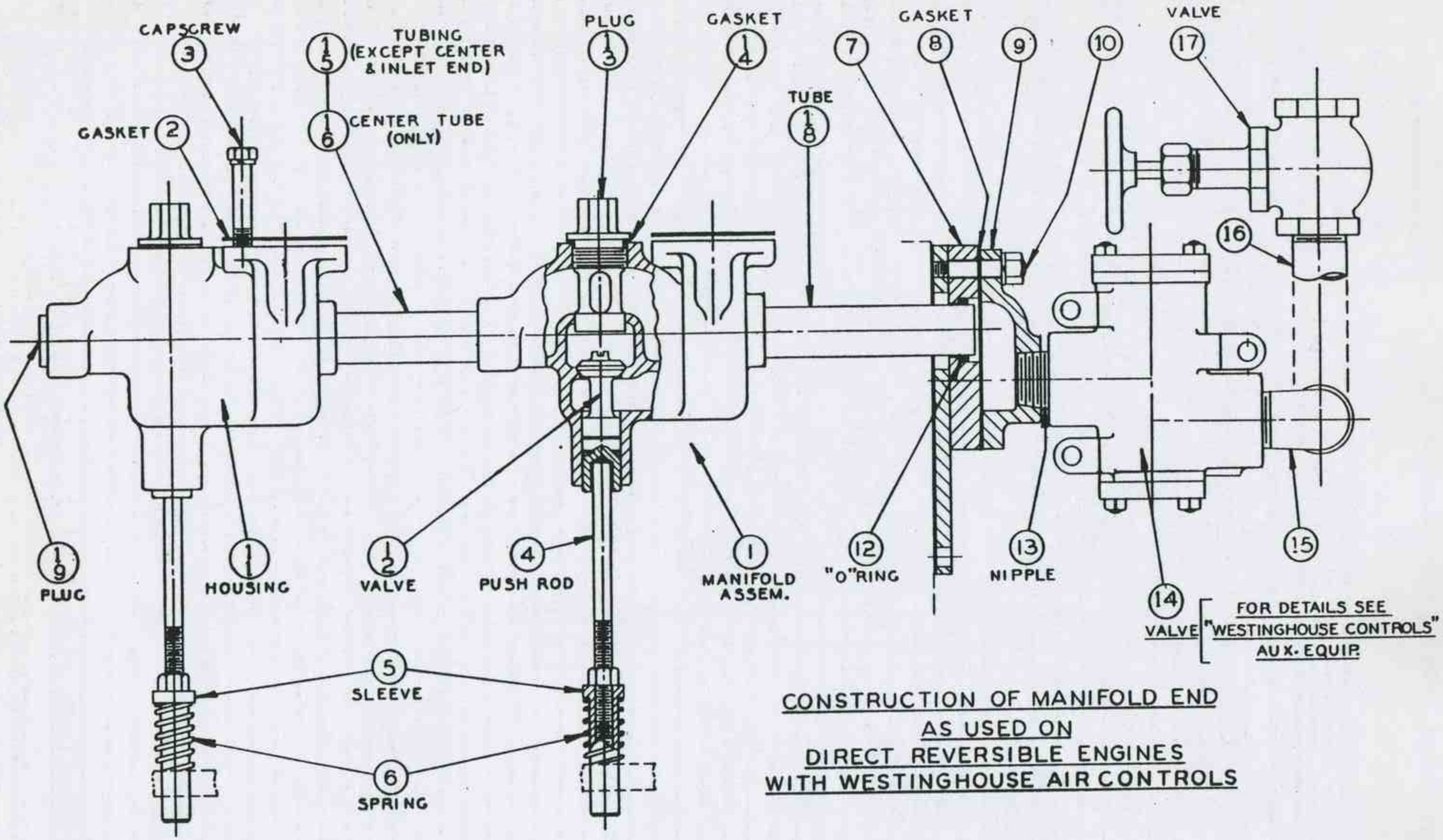
FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

PLATE No. 3A4025

DO NOT ORDER PARTS BY REFER. NUMBERS.



CONSTRUCTION OF MANIFOLD END
AS USED ON
DIRECT REVERSIBLE ENGINES
WITH WESTINGHOUSE AIR CONTROLS

CHANGES

Revised & Retyped from Sheet Dated 10-19-51

CHANGES

2L2520

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A4025

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1	4B1112	1	4Y1066	1	MANIFOLD ASSEMBLY - Air Starting	
2		2	3A2223	8	GASKET - Manifold to Head	
3		3		24	CAPSCREW - 1/2"-13-NC x 4-1/2" Lg. - St.	
4				24	LOCKWASHER - 1/2" SAE Reg. - St.	
5		4	3A2130	8	PUSH ROD - Air Starting Pilot Valve	
6				8	NUT - 1/2"-20-NF-Hex. - St.	
7		5	3A2133	8	SLEEVE - Pilot Valve Push-Rod Adjusting	
8		6	3A2270	8	SPRING - Pilot Valve Push-Rod	
9						
10						
11						
12						
13		12	4A1231	1	"O" RING - Air Manifold Air Seal	
14						
15		7	4A1187	1	GLAND - Air Starting Manifold "O" Ring	
16		8	4A1188	1	GASKET - Air Starting Mani. Companion Flang	
17		9	4B1098	1	FLANGE - Air Starting Mani. Companion	
18		10	4A1217	5	STUD - Air Starting Mani. Companion Flange	
19				5	LOCKWASHER - 1/2"	
20				5	NUT - 1/2"-13 Hex Full	
21		13		1	NIPPLE - 1-1/4" Short - Brass	
22		14		1	"DIA." - Relay-Air Valve - "Engine Start" -	
23					West. Part #526408 (Item 8 on our BM6383	
24		15		1	ELBOW - 1-1/4" Street	
25		16		1	NIPPLE - 1-1/4" x 8" Long	
26		17	BM-2046-A	1	GLOBE VALVE - 1-1/4"	
27						
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2L2520

P. HAND SEE

P. ROT. SEE

NAME AIR START. MANIFOLD & PILOT VALVE PUSH-ROD GROUP

ORIGINALLY ISSUED FOR 8 CYL, 9 x 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

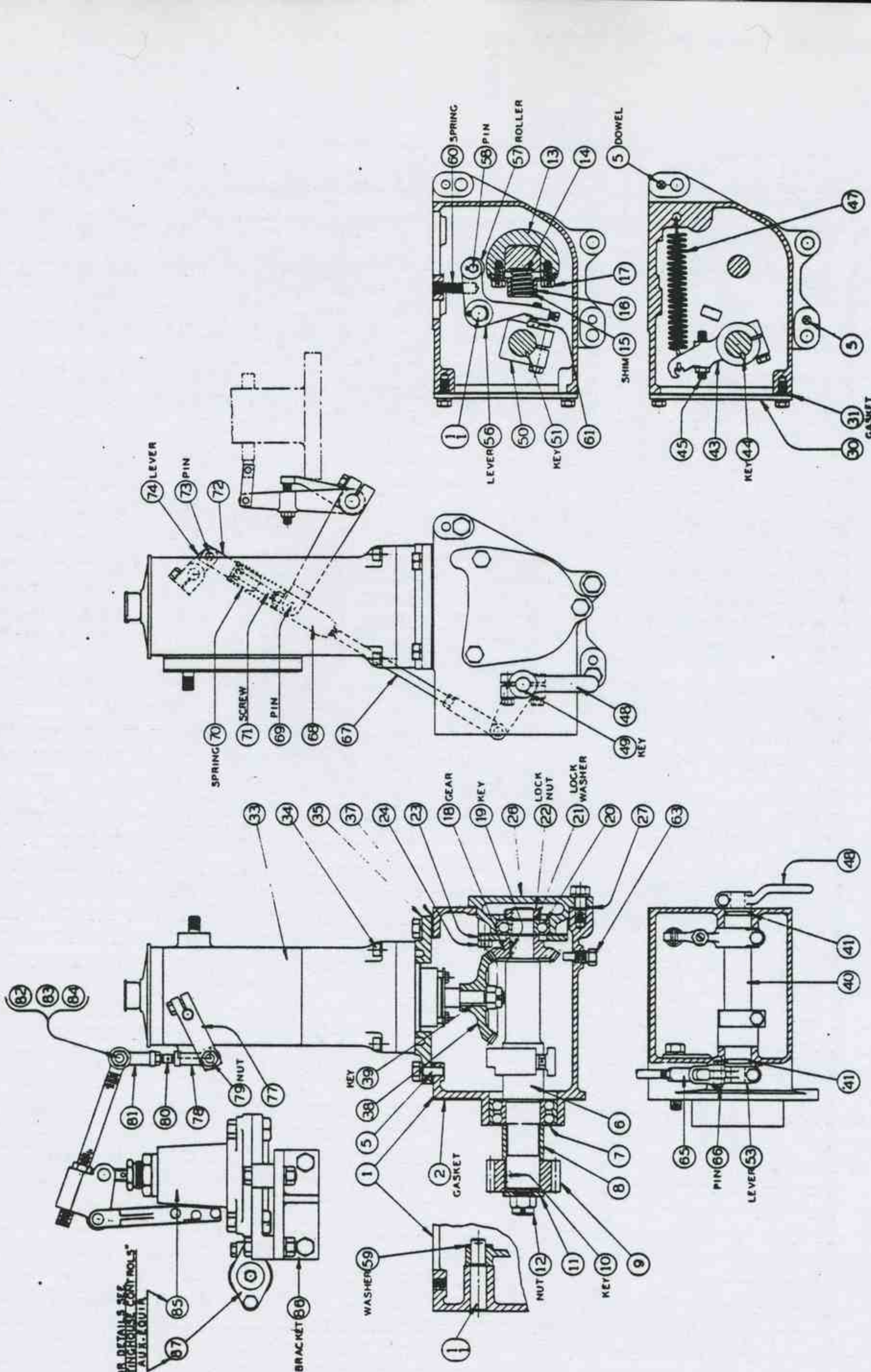

PLATE No.
3A4026

DO NOT ORDER PARTS BY REFER NUMBERS

CHANGES

#1-3-27-Line #10-Added Part No.
#2-4-15-52-Line #13-Part # was 4A-1164
#3- Line 6 - was Hex Head.

CHANGES

2L2521

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A4026

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		66	2C175P-3/8	1	PIN - Rod End	
2		65	2C174P-3/8	1	YOKE - Adjustable	
3				1	COTTER PIN - 3/32" x 5/8"	
4		67	3A3017	1	ROD - O.S. Throwout	
5		68	4A1166	1	PIVOT - Gov. Collapsible Link	
6				2	NUT - 3/8"-24 Jam - Hex	
7		69	H-8277	1	PIN - Rod to Pivot	
8				2	COTTER PIN - 1/16" x 3/4" Lg.	
9		70	3A3023	1	SPRING	
10		71	4A1266	1	CAPSCREW - 3/8"-24 x 2-1/2" Allen Head	
11		72	4A1165	1	SLEEVE - Gov. Collapsible Link	
12		73	S-1319	1	PIN - Sleeve to Gov. Lever	
13		74	4A1270	1	LEVER - Woodward Gov. Shaft	
14				1	COTTER PIN - 3/32" x 1"	
15				1	CAPSCREW - 5/8"-18 x 1" H.H.	
16				1	LOCKWASHER - 5/8"	
17						
18						
19						
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2L2521

OR OPP. HAND SEE

OR OPP. ROT. SEE

NAME GOVERNOR LINKAGE-WOODWARD & OVERSPEEDTO CONTROL SHAFT

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

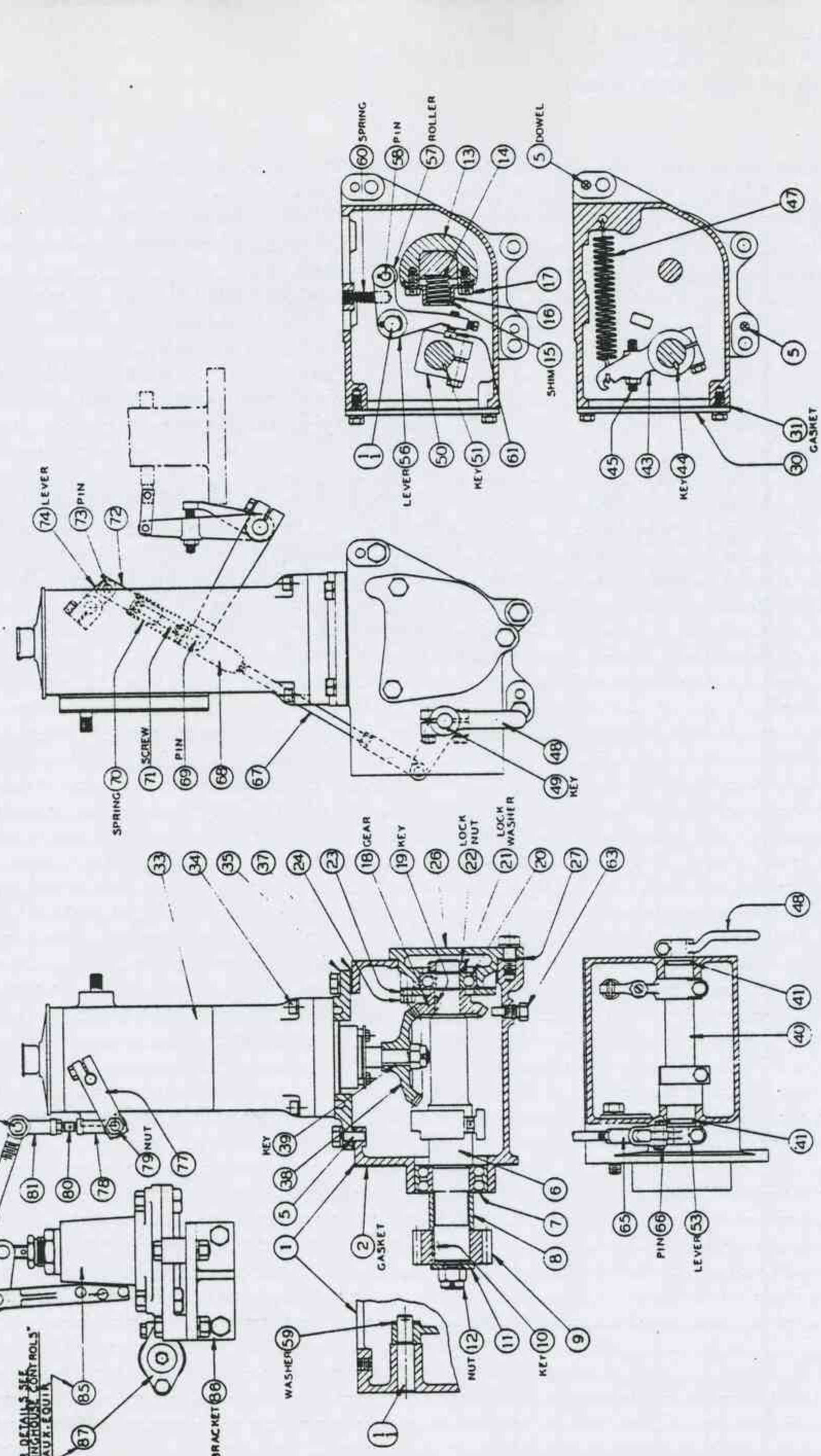

PLATE No.
3A4026

DO NOT ORDER PARTS BY REFER NUMBERS

CHANGES

CHANGES

Supersedes Sheet Dated 10-19-51

2L2522

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4026

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO. REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		77	4A1168	1	LEVER - Gov. Speed Control Shaft	
2				1	CAPSCREW - 3/8"-16 x 1"	
3		78	BM-5909-A	1	HEIM FITTING	
4				1	CAPSCREW - 3/8"-24 x 1-1/2" Hex Head	
5		79		1	ELASTIC STOP NUT - 29E064 - 3/8"-24	
6		80	4A1171	1	CONNECTING ROD - Gov. Speed Control Lever	
7				1	NUT - 3/8"-24 Hex	
8		81	BM-5909	1	HEIM FITTING	
9		82	4A1191	1	SHAFT - Gov. Actuator	
10		83		1	ELASTIC STOP NUT - 29E080 - 1/2"-20	
11		84		1	ELASTIC STOP NUT - 29E064 - 3/8"-24	
12		85		1	WESTINGHOUSE AIR ACTUATOR - Part #850650	
13					Dwg. #C69872-55-Item 14 of our BM-6383	
14		86	4B1089	1	BRACKET - Westinghouse Air Actuator	
15		87		1	WESTINGHOUSE DOUBLE CHECK Part #540107 -	
16					Dwg. #E73850-52 - Item 4 of our BM-6383	
17				1	CAPSCREW - 3/8"-16 x 2-3/4" Hex Head	
18				1	LOCKWASHER - 3/8"	
19				1	NUT - 3/8"-16 Hex	
20				3	CAPSCREW - 1/2"-13 x 2" Lg. - Hex Head	
21				3	NUT - 1/2"-13 Hex	
22				3	LOCKWASHER - 1/2"	
23				2	CAPSCREW - 1/2"-13 x 1-1/4" Hex Head	
24				2	LOCKWASHER - 1/2"	
25			Parker#6CBTX	2	ELBOW FITTINGS	
26				1	PARKER TUBING - 3/8" OD x .035 Wall x 12" Lg	
27						
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PP. HAND SEE

PP. ROT. SEE

NAME WESTINGHOUSE GOVERNOR - AIR ACTUATOR

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2522

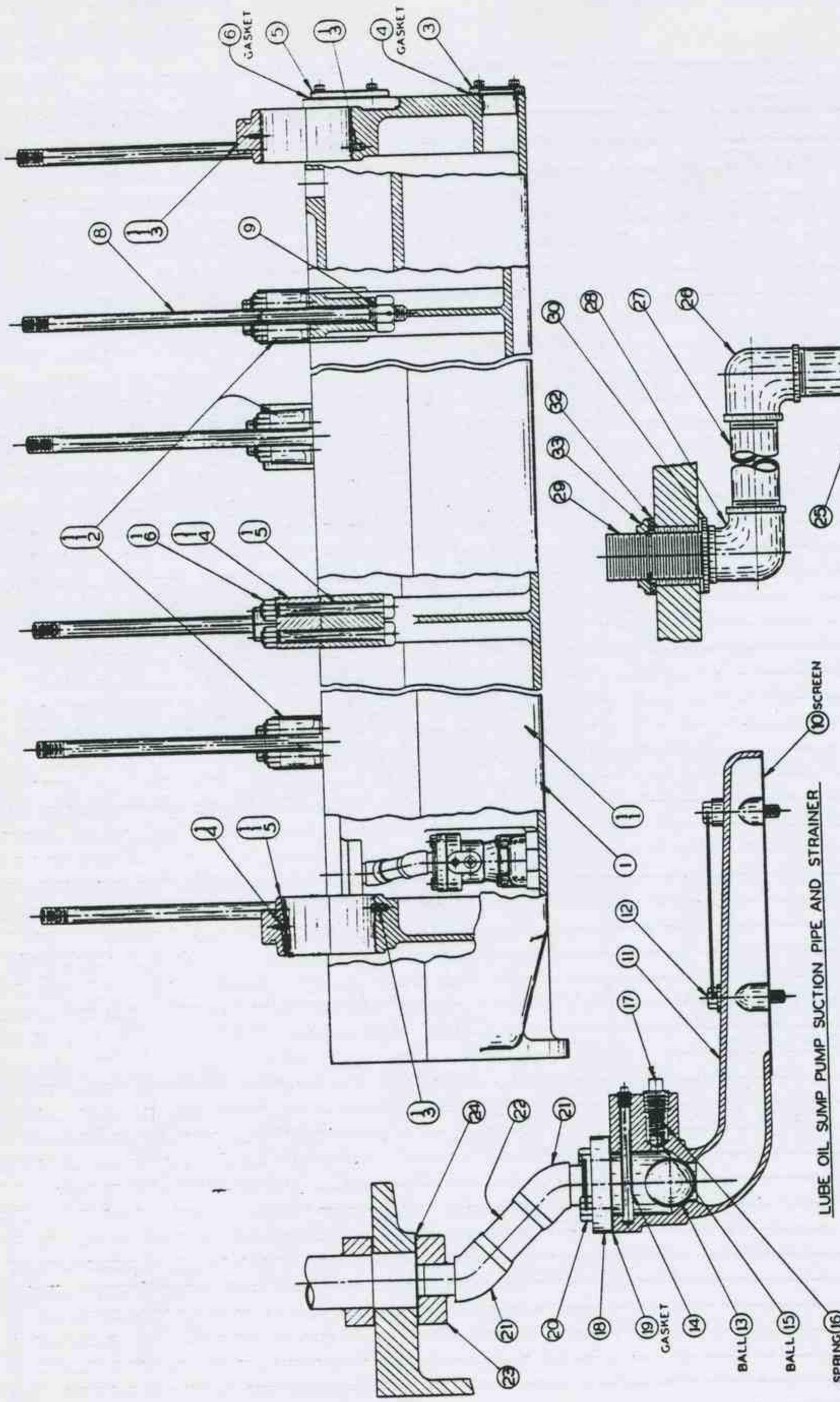

PLATE NO.
3A4027

DO NOT ORDER PARTS BY REFER. NUMBERS

CHANGES

Supersedes Sheet Dated 9-28-51

CHANGES

2L2530

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4027

LINE NO	DRWG. NO.	REF NO	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG NO.
1	4D1044	1	4Y1053	1	BASE ASSEMBLY	
2						
3						
4		3	3A2056	1	COVER - Base End - (Fwd. End)	
5		4	3A2229	1	GASKET - Cover to Base	
6				4	CAPSCREW - 1/2"-13-NC x 1-1/4 Lg. - St.	
7				4	LOCKWASHER - 1/2 SAE Reg. - St.	
8		5	3A2061	2	COVER - Lube Manifold Hole	
9		6	3A2230	2	GASKET - Cover to Base	
10				8	CAPSCREW - 1/2-13-NC x 1-1/4 Lg. - St.	
11				8	LOCKWASHER - 1/2 SAE Reg. - St.	
12						
13		8	3A2073	18	THRU BOLT - Base Center Frame & Cyl. Block	
14		9	3A2074	18	NUT - Base to Cyl. Block Bolt - Lower	
15				18	COTTER PIN - 5/16" Dia. x 3-1/2" Lg. - St.	
16						
17						
18		11	3A2065	1	BODY	
19		10	3A2070	1	SCREEN - Lube Oil Strainer	
20		12	C2408L1-1/2	4	CAPSCREW - Strainer to Base	
21				1	WIRE - #16 Ga. x 35 Lg. - St.	
22		13	3A2453	1	BALL - Suction Line Check Valve	
23		14	3A2455	1	PIN - Ball Retainer	
24				1	PIPE PLUG - 1/4 Std. - C.I.	
25		15	3A2452	1	BALL - Suction Line Relief Valve	
26		16	3A2462	1	SPRING - Relief Valve	
27		17	3A3124	1	PLUG - Refief Valve Spring Retainer	
28		18	4A1173	1	FLANGE - Strainer Suction Pipe	
29		19	3A2461	1	GASKET - Flange to Strainer	
30		20	C2410L1-1/2	2	CAPSCREW - Flange to Strainer	
31				1	WIRE - #16 Ga. x 10 Lg. - St.	
32						
33						
34			----Strainer to Base Suction Piping----			
35		21		2	MUELLER #A-2674 - 45° Street Elbow	
36		22		1	Pc. COPPER TUBING 1-5/8 OD x .065 Wall -	
37					x 4-1/4" Long	
38	4A1174	23	4A1174	1	FLANGE - Upper	
39	4A1175	24	4A1201	1	GASKET - Flange to Base	
40			C2408L-2	2	CAPSCREW - Flange to Base	
41				2	Pc. WIRE - 16 Gage - 12" Long	
42						
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OPP. HAND SEE

OPP. HOT. SEE

NAME BASE GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 MARINE

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2530

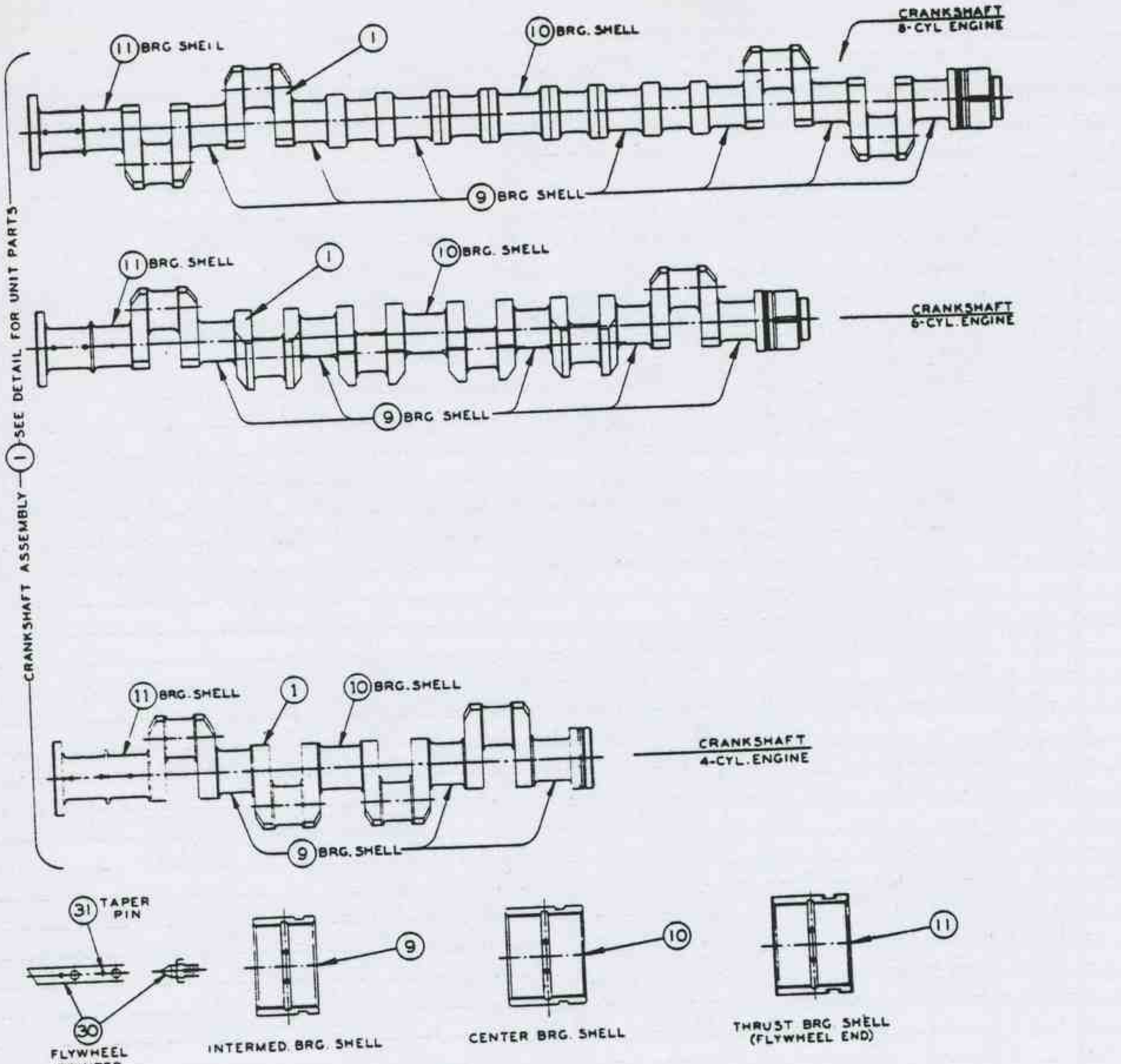

PLATE No. 3A2810 ED. 2 DO NOT ORDER PARTS BY REFER NUMBERS

CHANGES

Supersedes Sheet Dated 9-28-51

CHANGES

2L2531

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A2810 Ed. 2

LINE NO	DRWG NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG NO.
1	4B1091	1	4Y1056	1	CRANKSHAFT ASSEMBLY	
2	3A2051	2	3A2051-X	1	GEAR ASSEMBLY - Crankshaft	
3	3A2045	3	3A2045-X	2	CLAMP ASSEMBLY - Crankshaft Gear	
4						
5						
6						
7						
8		9	3A2028	14	SHELL - Crankshaft Bearing	
9		10	3A2026	2	SHELL - Crankshaft Bearing - (Center)	
10		11	3A3012	2	SHELL - Crankshaft Bearing - (Thrust)	
11						
12						
13						
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FOR OPP. HAND SEE

FOR OPP. ROT. SEE

NAME CRANKSHAFT & BEARING SHELL GROUP

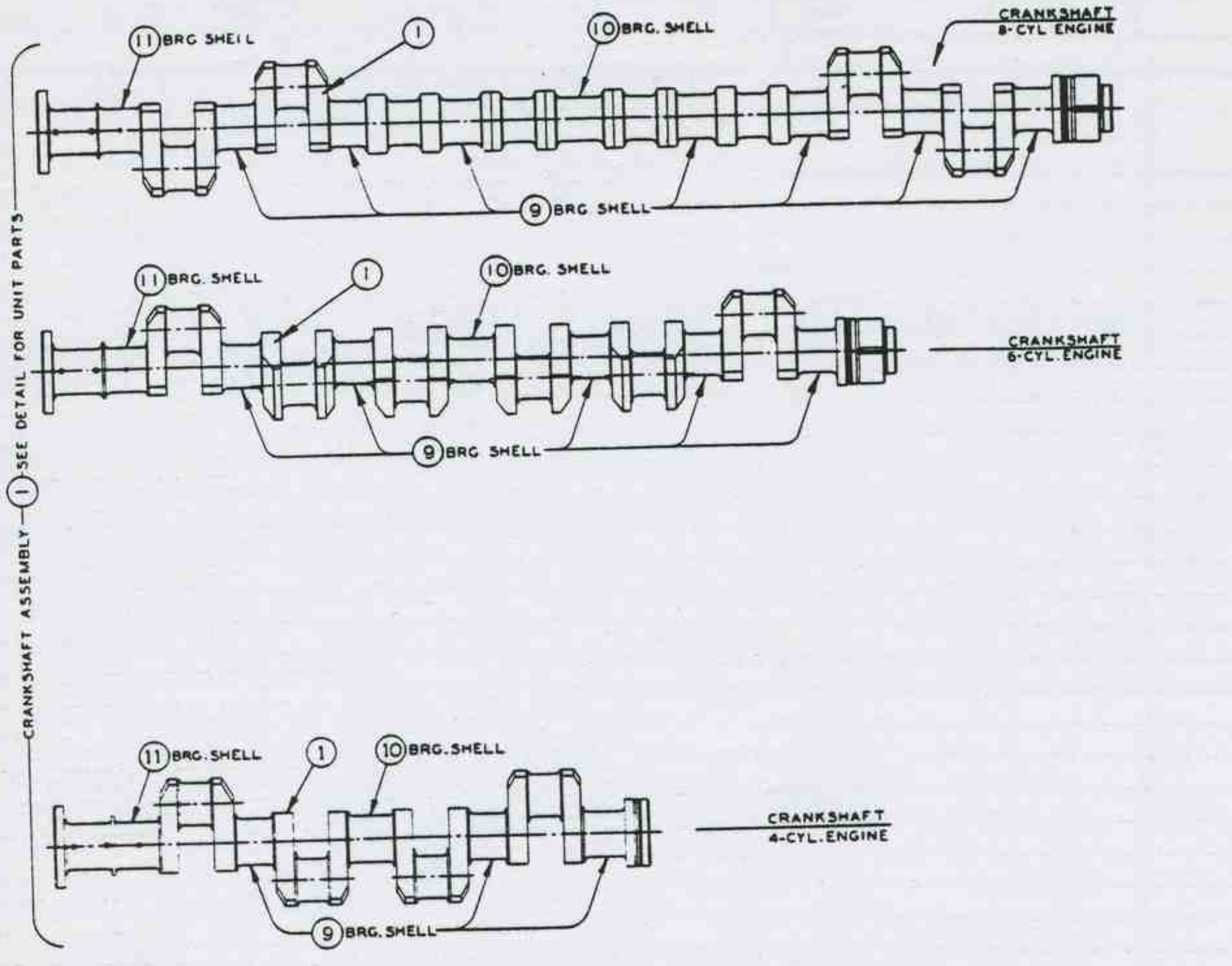
ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2

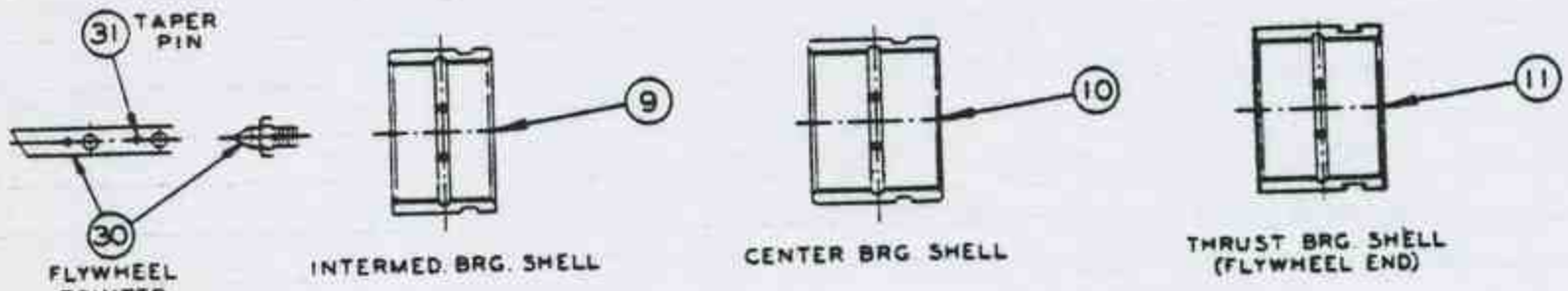
FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

INDEX





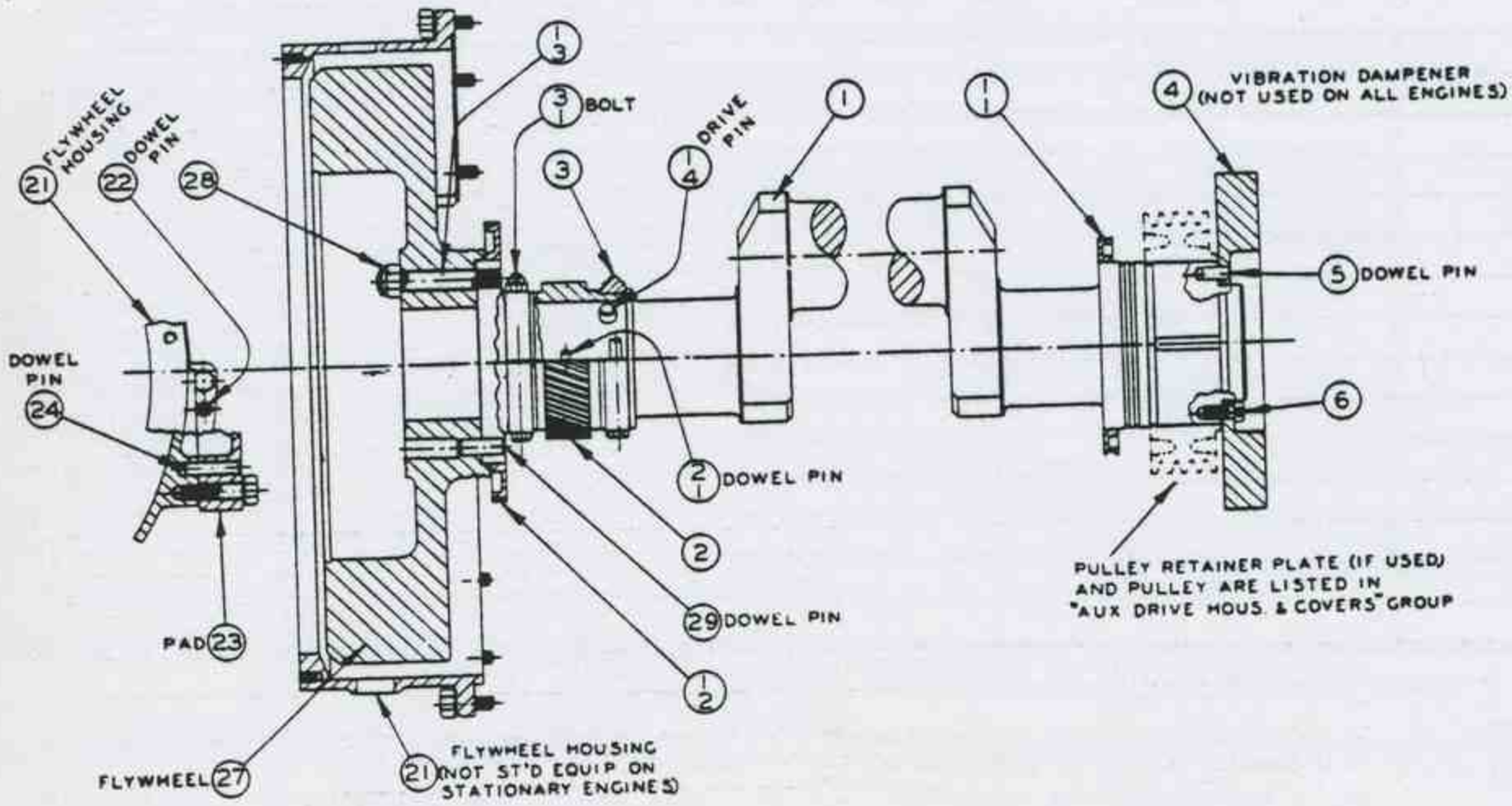


PLATE No. 3A2810 ED. 2 DO NOT ORDER PARTS BY REFER NUMBERS

CHANGES

Supersedes Sheet Dated 10-22-51

CHANGES

2L2532

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A2810

LINE NO	DRWG. NO.	REF. NO	PART NO.	NO REQ'D	PART NAME	ASSEM DRWG NO
1		21	4D1035	1	HOUSING - Flywheel	
2				12	CAPSCREW - 5/8"-11 x 2" Lg. - St.	
3				4	CAPSCREW - 5/8"-11 x 1-3/4" Lg. - St.	
4				16	LOCKWASHER - 5/8 SAE Reg. - St.	
5		22	2C2394L-2	2	PIN - Housing to Base Dowel	
6				1	PIPE PLUG - 1/4" Solid - C.I. - Fly. Housi	
7						
8						
9						
10						
11						
12		27	4D1036	1	FLYWHEEL	
13		28		6	LIGHT THICK SLOTTED NUT - 1-14-Hex - St.	
14				6	COTTER PIN - 1/8 x 1-3/4 Lg. - St.	
15		29	C6271L2-1/2	2	PIN - Flywheel to Crankshaft Dowel	
16		30	3A3123	1	POINTER - Flywheel	
17				1	JAM NUT - 1/2"-13	
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OPP. HAND SEE

OPP. ROT. SEE

NAME FLYWHEEL AND HOUSING GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 MARINE

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2532

CHANGES

Supersedes Sheet Dated 10-19-51

CHANGES

2L2533

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO SEE NOTE

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG NO.
1			BM-6387	1	REDUCTION GEAR	
2						
3						
4						
5						
6						
7						
8						
9						
10			NOTE: Parts List and Cross Section of Gear will be found			
11			in Parts Catalog under "Auxiliary Equipment".			
12						
13						
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2L2533

OR OPP. HAND SEE

OR OPP. ROT. SEE

NAME REDUCTION GEAR

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 MARINE

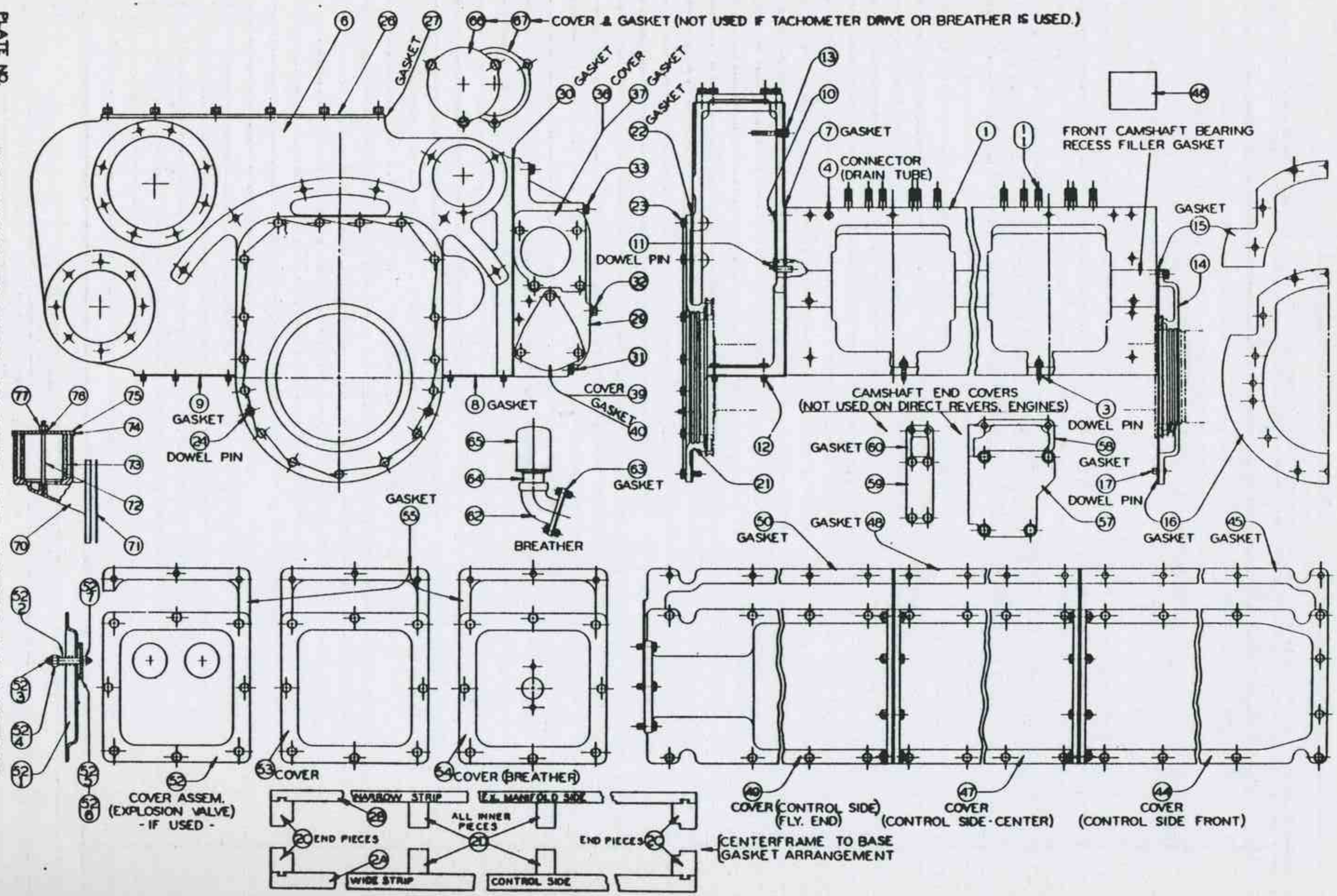
FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

PLATE NO. 3A4028 ED. 2

DO NOT ORDER PARTS BY REFER. NUMBERS



letyped & Revised from copy dated 12/29/51/
#1

CHANGES

2L2534 SHEET 1 OF 3

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4028 Ed. 2

NO.	DRWG. NO.	REF NO	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG NO
1	3A2597	1	3A2597-X	1	CENTERFRAME ASSEMBLY	
2				1	PIPE PLUG - 1/4 Std. C't's'k. Hd. -C.I.	
3		2A	3A3069	1	GASKET - Cent. to Base - Lg. Strip -	
4					Wide - Cont. Side	
5		2B	3A3071	1	GASKET - Cent. to Base - Lg. Strip -Narrow	
6					Mani. Side	
7		2C	3A3073	4	GASKET - Cent. to Base - End Pieces	
8		2D	3A3072	14	GASKET - Cent. to Base - Inner Pieces	
9		3	C7950-L2	2	PIN - Centerframe to Base Dowel	
10				2	HALF NUT - 3/8-24-NF-Hex. - St.	
11				2	COTTER PIN - 1/8 x 1 Lg. - St.	
12		4	#8-FBTX	1	CONNECTOR - Tube (For Drain Tube-Not Connected	
13		6	4E1013	1	HOUSING - Timing Gear	
14		7	3A2212	1	GASKET - Gear Housing to Centerframe	
15		8	3A2282	1	GASKET - Gear Housing to Base (Cont. Side)	
16		9	3A2273	1	GASKET - Gear Housing to Base (Exh. Side)	
17		10	C2408L1 1/4	11	CAPSCREW - Gear Housing to Centerframe	
18				3	CAPSCREW - 1/2" -13-NC x 1-1/4 Lg. (St.).	
19				14	LOCKWASHER - 1/2 SAE Reg. - St.	
20		11	C6392L1 3/4	1	PIN - Gear Housing to Centerframe Dowel	
21						
				1	WIRE - #16 Ga. x 60 Lg. - St.	
		12	C2408L1 1/4	7	CAPSCREW - Gear Housing to Base	
24				7	LOCKWASHER - 1/2 SAE Reg. - St.	
25				2	WIRE - #16 Ga. x 16 Lg. - St.	
26		13	3A2469	1	NOZZLE - Timing Gear Lube Oil (Point Oil	
27					Hole Down)	
28		14	3A2032	1	COVER - Centerframe (& Base) Fwd. End	
29					(Oil Guard)	
30		15	3A2511	2	GASKET (Top Half) Cover to Centerframe	
31		16	3A2213	1	GASKET - Cover to Centerframe & Base	
32				14	CAPSCREW - 1/2-13-NC x 1-1/4 Lg. - St.	
33				14	LOCKWASHER - 1/2 SAE Reg. - St.	
34		17	C6392L1 1/4	2	PIN - Cover to Base Dowel	
35		21	3A2012	1	COVER - Gear Hsg. Aft. End (Oil Guard)	
36		22	3A2214	1	GASKET - Cover to Gear Hsg. & Base	
37		23	C2408L1 1/4	17	CAPSCREW - Cover to Gear Hsg. & Base	
38				17	LOCKWASHER - 1/2 SAE Reg. - St.	
39		24	C7950L1 3/4	2	PIN - Cover to Gear Housing Dowel	
40				2	HALF NUT - 3/8-24-NF-Hex. - St.	
41				1	WIRE - #16 Ga. x 60 Lg. - St.	
42	4B1077	26	4B1077	1	COVER - Gear Housing Top	
43		27	4B1078	1	GASKET - Cover to Housing	
44				12	CAPSCREW - 1/2-13-NC x 1" Lg. - St.	
45				12	LOCKWASHER - 1/2 SAE Reg. - St.	
46		29	3A2011	1	HOUSING - Gov. & Fuel Trans. Pump Dr.	
47		30	3A2219	1	GASKET - Housing to Gear Housing	
		31	3A2496	3	CAPSCREW - Housing to Gear Housing	
50					---CONTINUED ON SHEET NO. 2---	

P. HAND SEE

ROT SEE

NAME CENTERFRAME, GEAR HOUSING & COVERSGROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 MARINE- R.H.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2534 SHEET 1 OF 3

CHANGES

Retyped & revised from copy dated 4/30/52.
#1

CHANGES

PLATE NO 3A4028 Ed. 2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG. NO.
1					---CONTINUED FROM SHEET NO. 1---	
2						
3		32	3A2498	2	CAPSCREW - Housing to Gear Housing	
4		33	3A2497	2	CAPSCREW - Housing to Gear Housing	
5				3	CAPSCREW - 1/2" -13-NC x 2-1/4" Lg. - St.	
6				10	LOCKWASHER - 1/2" SAE Reg. - St.	
7		36	3A2465	1	COVER - Governor Gear Inspection	
8		37	3A2466	1	GASKET - Cover to Governor Drive Housing	
9				4	CAPSCREW - 1/2" -13-NC x 1" Lg. - St.	
10				4	LOCKWASHER - 1/2" SAE Reg. - St.	
11						
12		39	3A2015	1	COVER - Fuel Trans.Pump Gear Inspection	
13		40	3A2217	1	GASKET - Cover to Gov. Drive Housing	
14				3	CAPSCREW - 1/2" -13-NC x 1" Lg.	
15				3	LOCKWASHER - 1/2" SAE Reg. - St.	
16		70	C2330A	1	BODY - Crankcase Breather	
17		71	3A2228	1	GASKET - Tach. Dr. Opening	
18				3	CAPSCREW - 1/2" -13 x 1-1/4" Long	
19				3	LOCKWASHER - 1/2" Reg.	
20						
21		75	C2331	1	CAP - Body	
22		72	C2332	1	STUD - Cap to Body	
23		74	C2333	1	GASKET - Cap to Body	
24		76	H-9842	1	WASHER - Stud	
25		73	BM-6311	1	AIR MAZE FILTER ELEMENT	
26		77		1	NUT - 3/8" -24 Elastic - Stop Cap to Body	
27						
28		44	3A2177	1	COVER - Centerframe Side (Cont.Side- Fwd.)	
29		45	3A2220	1	GASKET - Cover to Centerframe	
30		46	3A2274	1	GASKET - Front Cam. Brg. Recess Filler	
31		47	3A2178	2	COVER - Centerframe Side (Cont.Side-Center	
32		48	3A2222	2	GASKET - Cover to Centerframe	
33		49	3A2176	1	COVER - Centerframe Side (Cont.Side-Aft.)	
34		50	3A2221	1	GASKET - Cover to Centerframe	
35				38	CAPSCREW (To Center) 1/2" -13-NC x 1-1/4"	
36					Lg. - St.	
37				3	CAPSCREW - (Gear & Gov. Hsg.)	
38					1/2" -13-NC x 1-1/2" Lg. - St.	
39						
40				12	CAPSCREW (Cover to Cover)	
41					1/2" -13-NC x 1-3/4 Lg. - St.	
42				12	NUT - 1/2" -13-NC-Hex. - St.	
43						
44						
45		52	4Y1055	6	COVER - With Exp.Valve- Centerframe	
46					Side - Exhaust Side	
47		54	F-2768	2	DOOR - Centerframe Side (Breather)	
48					(Exhaust Side)	
49						
50					---CONTINUED ON SHEET NO. 3---	

FOR OPP. HAND SEE

OR OPP. ROT. SEE

NAME CENTERFRAME, GEAR HOUSING & COVERS GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 MARINE- R.H.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2534 SHEET 2 OF 3

CHANGES

CHANGES

2L2534 SHEET 3 OF

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER.
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4028 Ed. 2

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1					---CONTINUED FROM SHEET NO. 2---	
2		55	F-1099	8	GASKET - Door to Centerframe	
3				64	CAPSCREW - 1/2" -13-NC x 7/8" Lg. - St.	
4				64	LOCKWASHER - 1/2" SAE Reg. - St.	
5						
6			T-1269	1	WARNING PLATE	
7			BM-3508	4	DRIVE SCREW	
8						
9					---BREATHER LINE FROM CRANKCASE BREATHER	
10					TO TURBOCHARGER---	
11						
12			#16CBTX	1	MALE ELBOW	
13				1	COPPER TUBING 1" OD x .049 Wall x 60"	
14			#16FBTX	1	MALE CONNECTOR	
15						
16						
17						
18						
19						
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R OPP. HAND SEE

FOR OPP. ROT. SEE

NAME CENTERFRAME, GEAR HOUSING & COVERS GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 MAR-R.H.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2534 SHEET 3 OF 3

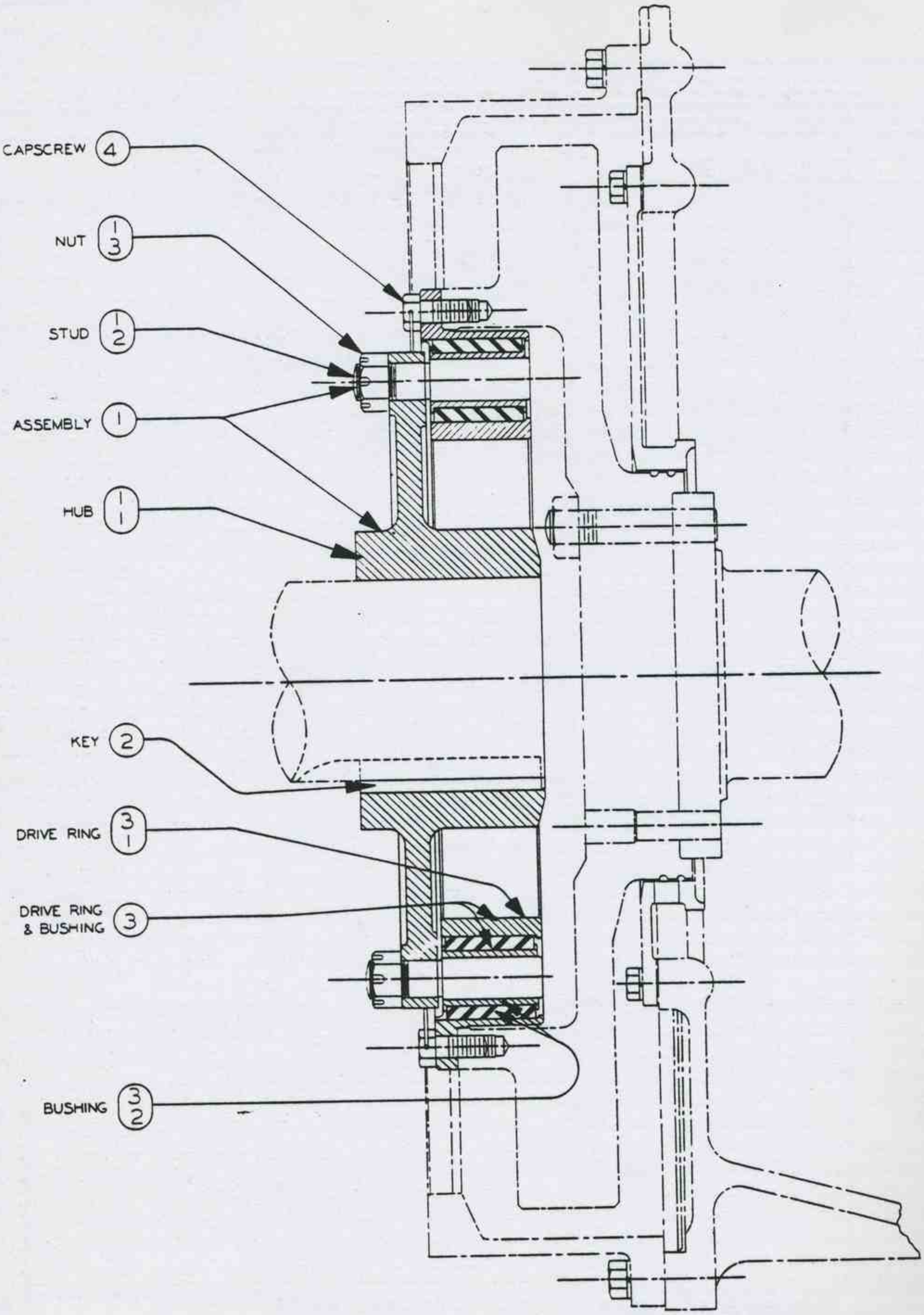

PLATE No.
3A4038

DO NOT ORDER PARTS BY REFER. NUMBERS

CHANGES

Supersedes Sheet Dated 10-19-51

CHANGES

2L2535

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4038

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		1	4Y1058	1	HUB & STUD - Reduction Gear Assembly	
2		2	4A1172	1	KEY - Hub Assem. to Reduction Gear	
3		3	4Y1054	1	BUSHING & RING ASSEMBLY	
4		4	T-1060-A	12	CAPSCREW - Coupling to Flywheel	
5				6	Pc WIRE 16 Gauge - 10" Long	
6				16	CAPSCREW - 1/2"-13 x 1-1/4" Hex Head	
7				16	LOCKWASHER - 1/2"	
8						
9						
10						
11						
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13						
14						
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OPP. HAND SEE

OPP. ROT. SEE

NAME REDUCTION GEAR COUPLING

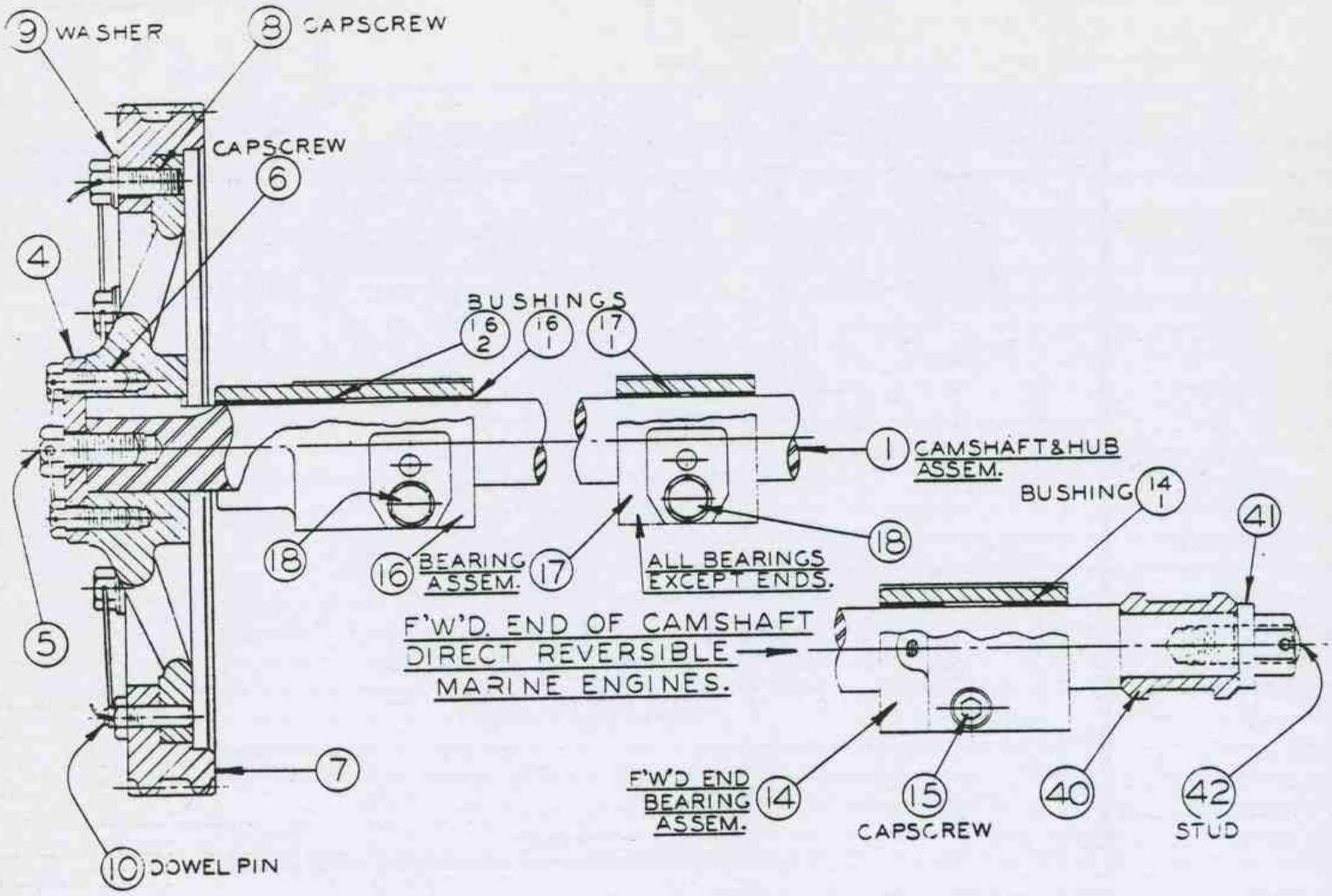
ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 MARINE-TURBO.

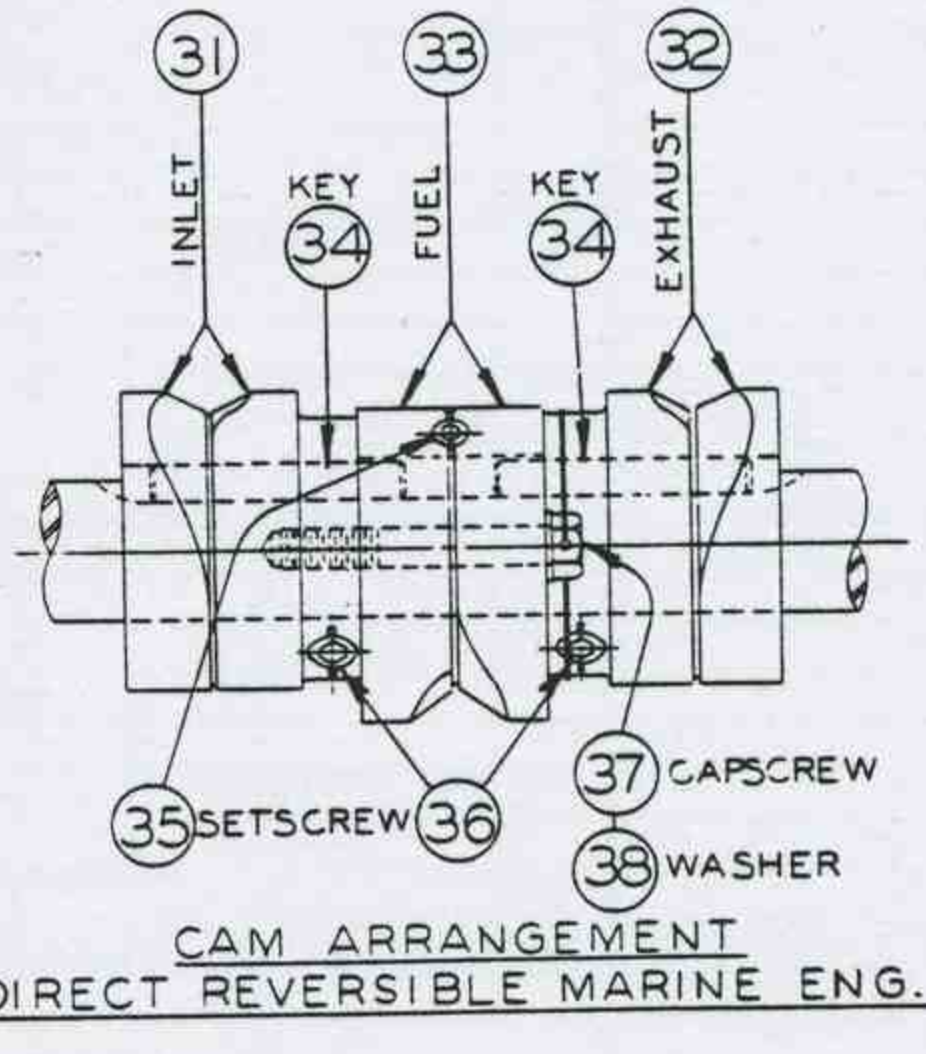
FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2535





CAM ARRANGEMENT
DIRECT REVERSIBLE MARINE ENG.

FOR CORRECT POSITIONING AND RELATION
OF CAM LOBES SEE INSTRUCTION BOOK

PLATE No.
3A4029

DO NOT ORDER PARTS BY REFER. NUMBERS

CHANGES

#1 -3-25-Changed Line #24 from 3A-2060 to 4D-1071
#2-3-26-52 Line 28-Changed C2408L3-1/2 to 4A1264
Supersedes Sheet Dated 10-19-51
#3-3-26-52-Changed Line #30 from 881AE to 4A1265

CHANGES

2L2536 C

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4029

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO. REQ'D.	PART NAME	ASSEM. DRWG. NO.
1	4B1094	1	4Y1046	1	CAMSHAFT & HUB ASSEMBLY	
2		4	3A2113	1	WASHER - Camshaft Gear Hub Retainer	
3		5	3A2116	1	CAPSCREW - Washer to Camshaft	
4		6	3A2114	2	CAPSCREW - Washer to Gear Hub	
5				1	WIRE - #16 Ga. x 7" Lg. - St.	
6		7	3A2090	1	GEAR - Camshaft	
7		8	3A2115	6	CAPSCREW - Gear to Hub	
8		9	3A2117	6	WASHER - Gear to Hub Capscrew	
9		10	C6633L2	2	PIN - Gear to Hub Dowel	
10				2	HALF NUT - 1/2"-13-NC-Hex. - St.	
11				1	WIRE - #16 Ga. x 40 Lg. - St.	
12						
13						
14	3A3227	14	3A3227-X	1	BEARING ASSEMBLY - Camshaft (Fwd.)	
15		15		1	CAPSCREW - (Fwd.Brg.)-5/8-11-NC x 4-1/2 Lg Allen Socket Head - St.	
16						
17	3A3228	16	3A3228-X	1	BEARING ASSEMBLY - Camshaft (Aft.End)	
18	3A3229	17	3A3229-X	7	BEARING ASSEMBLY - Camshaft	
19		18	4A1177	8	CAPSCREW - Bearing to Centerframe	
20				8	WASHER - 5/8 - Shakeproof Lock - Type12	
21						
22		31	3A2444	8	CAM - Inlet	
23		32	3A2445	8	CAM - Exhaust	
24		33	4D1071	8	CAM - Fuel	
25		34	3A2132	16	KEY - Cam Group to Camshaft	
26		35	3A2531	8	SETSCREW - Fuel Cam Retainer	
27		36	3A2473	16	SETSCREW - Cam Retainer	
28		37	4A1264	16	CAPSCREW - Fuel Cam to Inlet Cam	
29				8	WIRE - #16 Ga. x 10 Lg. - St.	
30	S-2233	38	4A1265	16	WASHER - Fuel Cam Capscrew	
31						
32		40	3A3212	1	COLLAR - Camshaft Shifter	
33		41	3A3213	1	WASHER - Collar Retainer	
34		42	4A1137	1	STUD	
35				1	NUT - 7/8-14-NF Light Thick Slotted	
36				1	COTTER PIN - 1/8 x 1 Lg.	
37						
38						
39						
40						
41						
42						
43						
44					----Outboard or Inboard Rotation----	
45						
46						
47						
48						
49						
50						

OR OPP. HAND SEE

R OPP. ROT. SEE

NAME CAMSHAFT GROUP (TURBO.)

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 Mar. R.H.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2536

NO.	WAS	DATE	BY

DRWN GGS
TRCD
CHKD
APPR
SCALE FULL
DATE 5-6-54

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

BRACKET FOR TUBE CLIP

ORIGINALLY RELEASED FOR MODEL 45-M5X-8

FRACTIONAL FINISH DIMENSIONS MAY VARY ± .015 UNLESS OTHERWISE SPECIFIED

MATERIAL SPEC. SEE BELOW
APPR
PATT. OR DIE NO.
PART NUMBER 4A1875

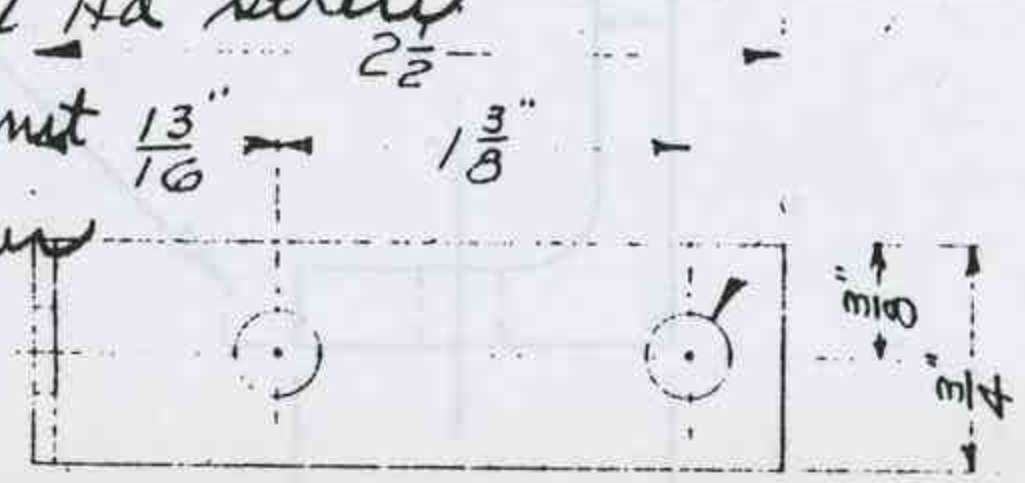
DRAWING NUMBER 4A1875
SUPERSEDES
SUPERSEDED BY

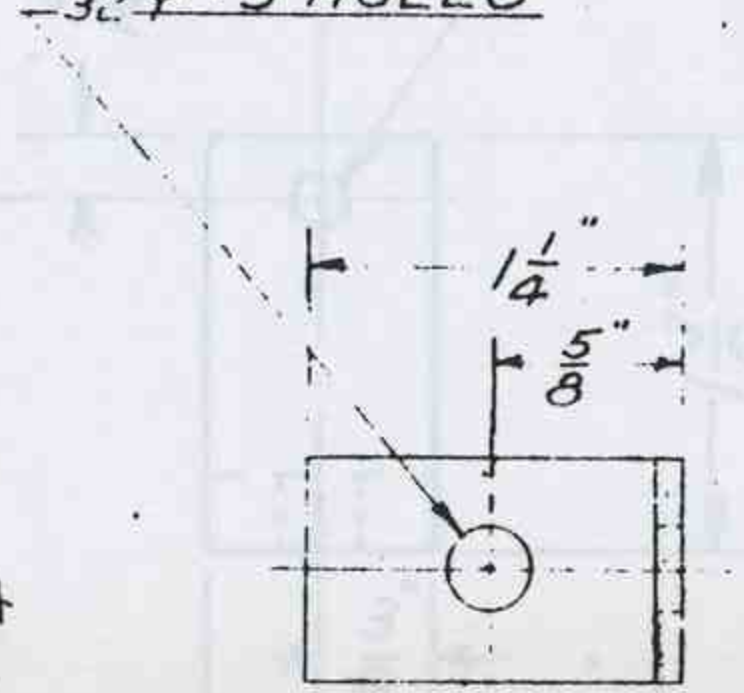
13 GA. (.089") SHEET STEEL

PURCHASE FROM
PATTON MFG. CO.
SPRINGFIELD, O.

Fig to 4Y-1106 Hog-2L-2538
1 Sold 3A2526-X Tube rigid

1 - 4A-1875 Bracket - Tube clip
1 - 4A-1876 Clip - Fuel Line
2 - 1/4-20 x 1/2" Hex Hd. screws
1 - 1/4-20 x 3/4" Hex Hd screw
1 - 1/4-20 Hex full nut
1 - 1/4" Lock Washer





Dwg. No. 4A1875

CHG'D	WAS	DATE	BY	NO.

DRWN W.H.S.
TRCD
CHKD W.H.S.
APPR
SCALE Full
DATE 12-22-59

THE NATIONAL-SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

BRACKET FOR TUBE CLIP

ORIGINALLY RELEASED FOR MODEL # 45

FRACTIONAL FINISH DIMENSIONS MAY VARY ± .015 UNLESS OTHERWISE SPECIFIED

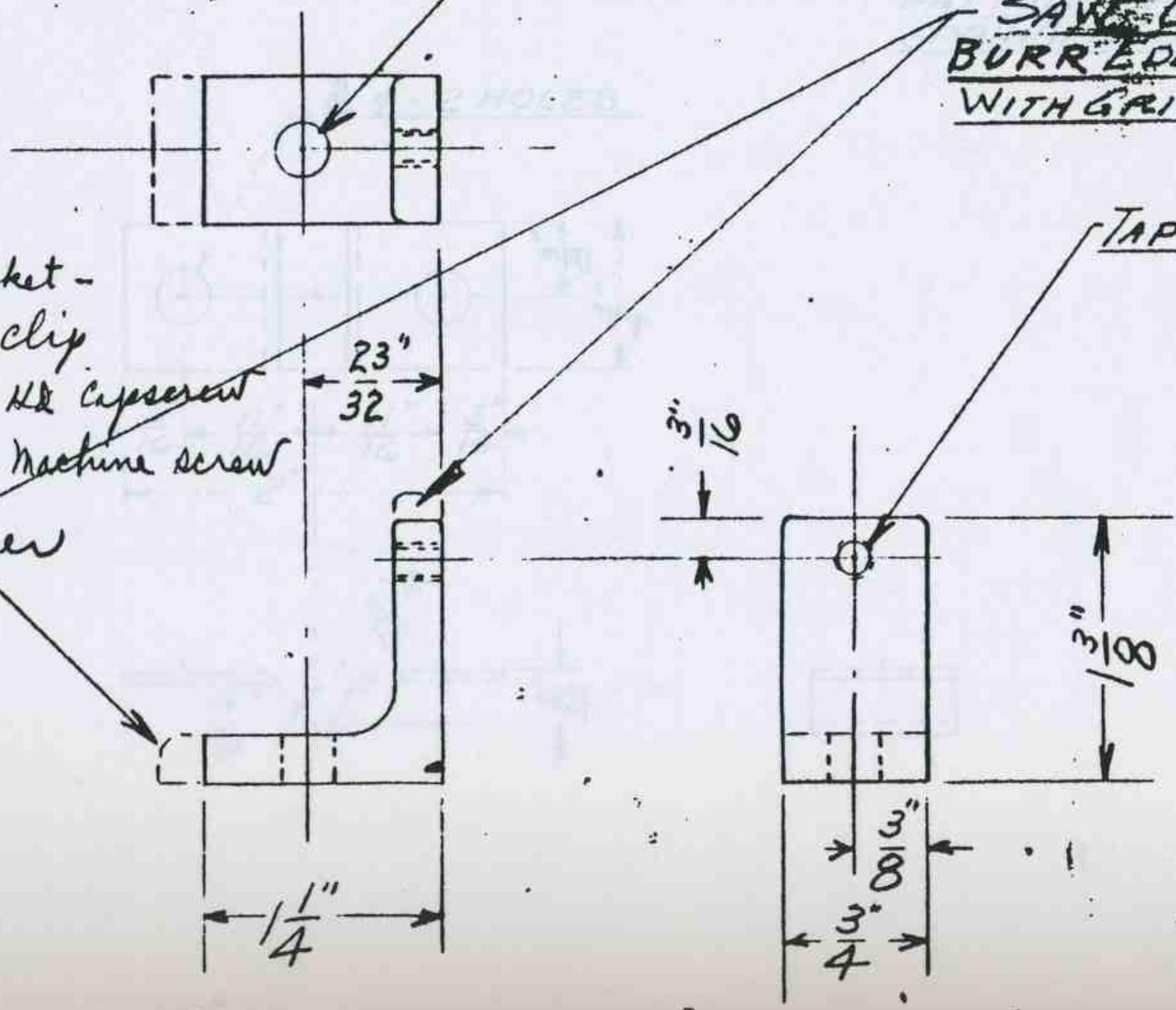
MATERIAL SPEC. [redacted]
APPR [redacted]
PATT. OR [redacted]
PART NUMBER 4A1875A

DRAWING NUMBER 4A1875A
SUPERSEDED
SUPERSEDED BY

R.O. # 50686

MAKE FROM $1\frac{1}{2} \times 1\frac{1}{2}$" ANGLE $\frac{1}{4}$" THICK

1 - 4A-1875-A Bracket -
1 - TA-713 S5 Tube clip
2 - 1/4-20 x 1" lg. Hex Hd Capscrew
1 - #10-24 x 3/8" Rd. Hd. Machine screw
1 - 3/16" Lock washer



Dwg. No. 4A1875A

CH'G	WAS	DATE	BY	NO.

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

TUBE CLIP

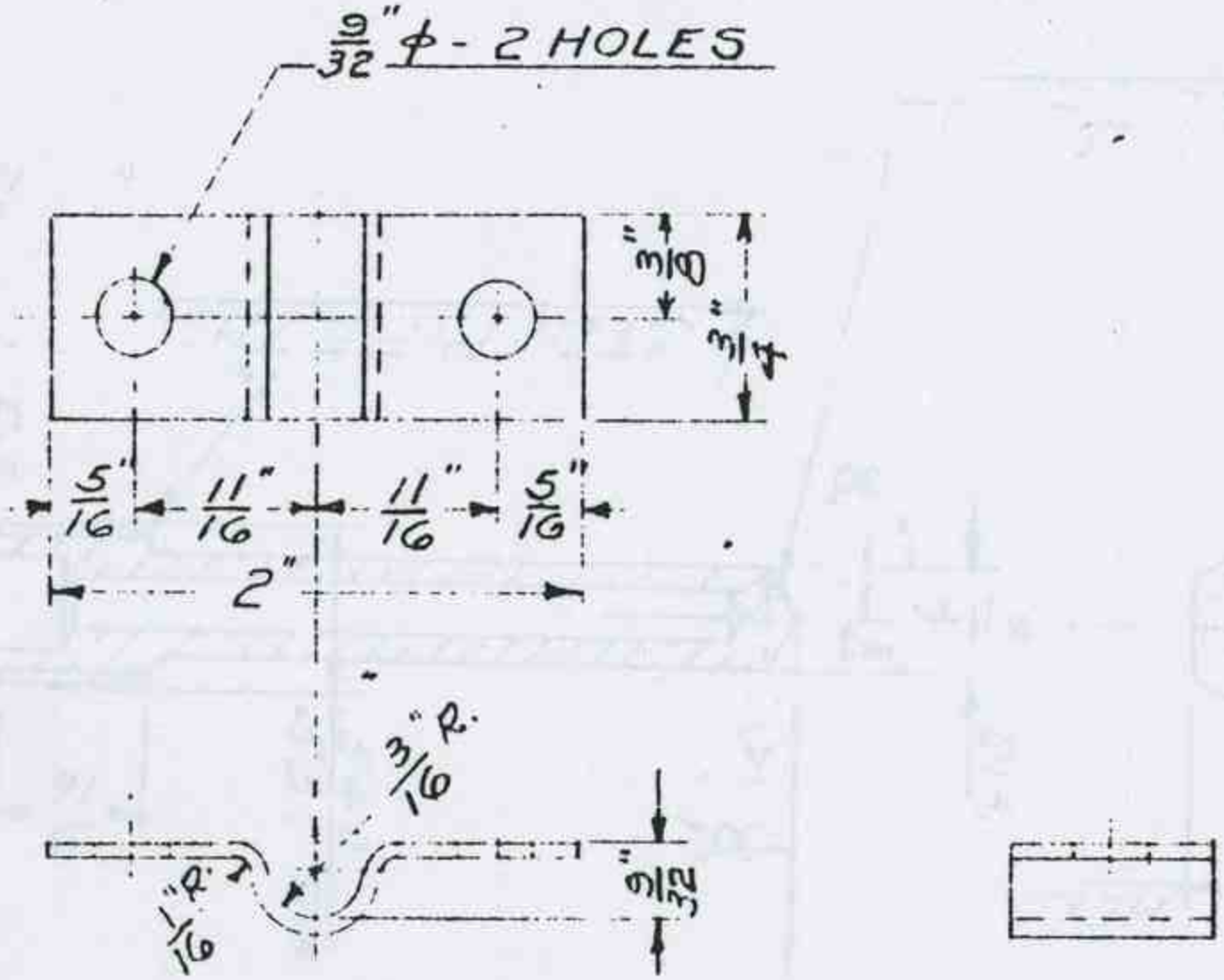
ORIGINALLY RELEASED FOR MODEL 45-MJX-8

FRACTIONAL FINISH DIMENSIONS MAY VARY ± .015 UNLESS OTHERWISE SPECIFIED

APPR	SEE BELOW
PATT. OR DIE NO.	4A1876
PART NUMBER	SUPERSEDED
	4A1876
	SUPERSEDED BY

16 GA. (.0598") SHEET STEEL

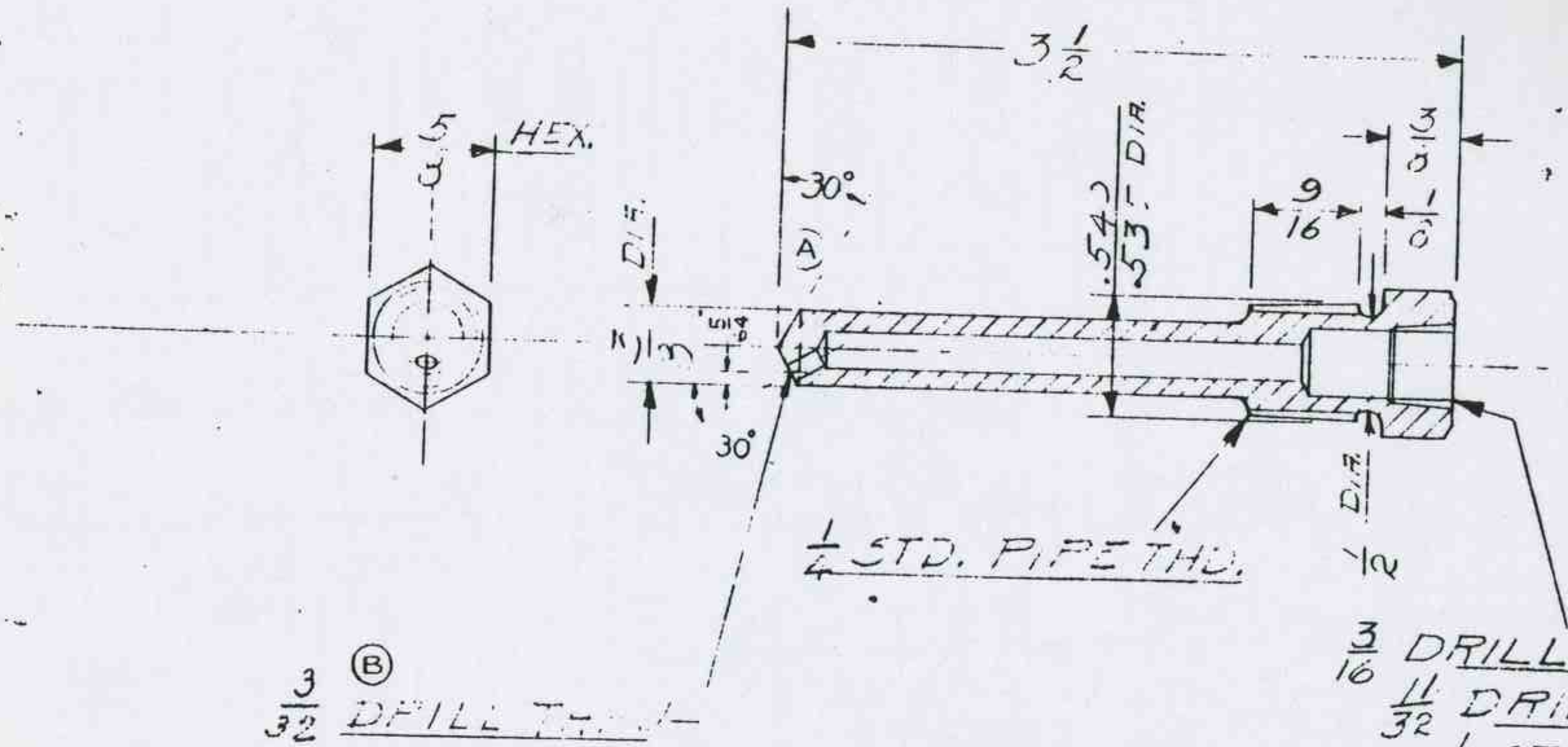
PURCHASE FROM
PATTON MFG. CO.
SPRINGFIELD, O.



Dwg. No. 4A1876

Dwg. No. 3A2469

M



NO.	WAS	DATE	BY
B	WAS DRILLED IN SIDE OF TUBE	3-25-53	A10311
A	CONICAL POINT ADDED	3-25-53	"

DRWN JMS
TRCD
CHKD
APPR J.S.
SCALE FULL
DATE 11-24-48

ATLAS IMPERIAL DIESEL ENGINE CO.
OAKLAND, CALIFORNIA MATTOON, ILLINOIS

TUBE-GEAR OILING

ORIGINALLY RELEASED FOR 9 X 10 1/2 MARINE

FRACTIONAL FINISH DIMENSIONS MAY VARY ±.010 UNLESS OTHER

MAT'L STEEL C.R. HEX. BAR
SAE 1112 or
SAE 1020 or
N.S. CO. SPEC.

PATT. OR DIE NO.

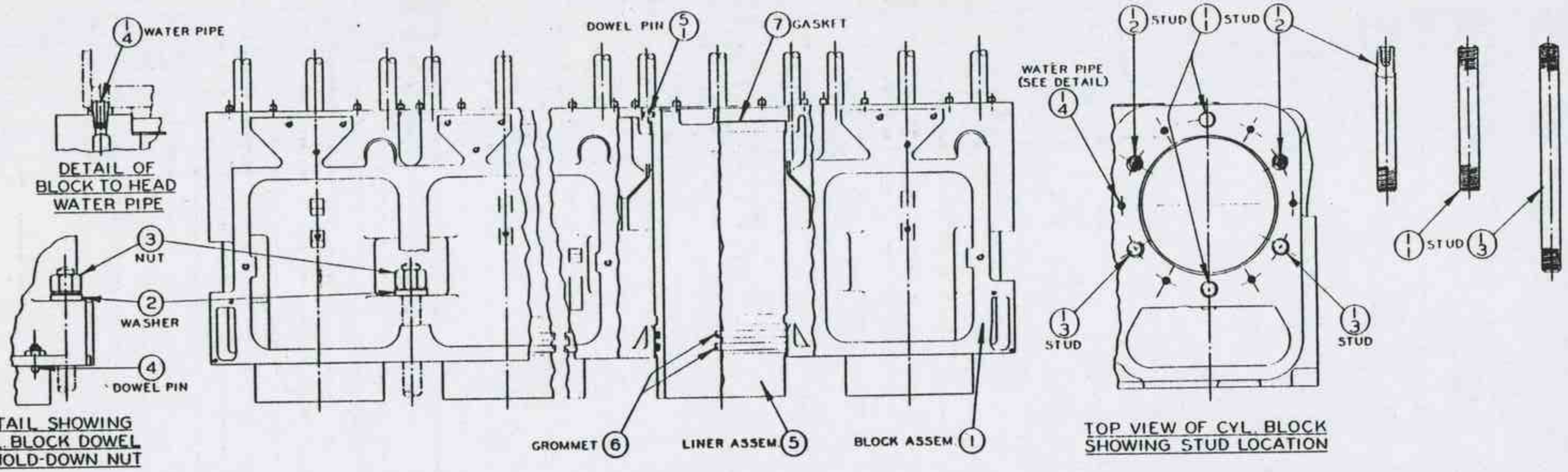
PART NUMBER 3P2467

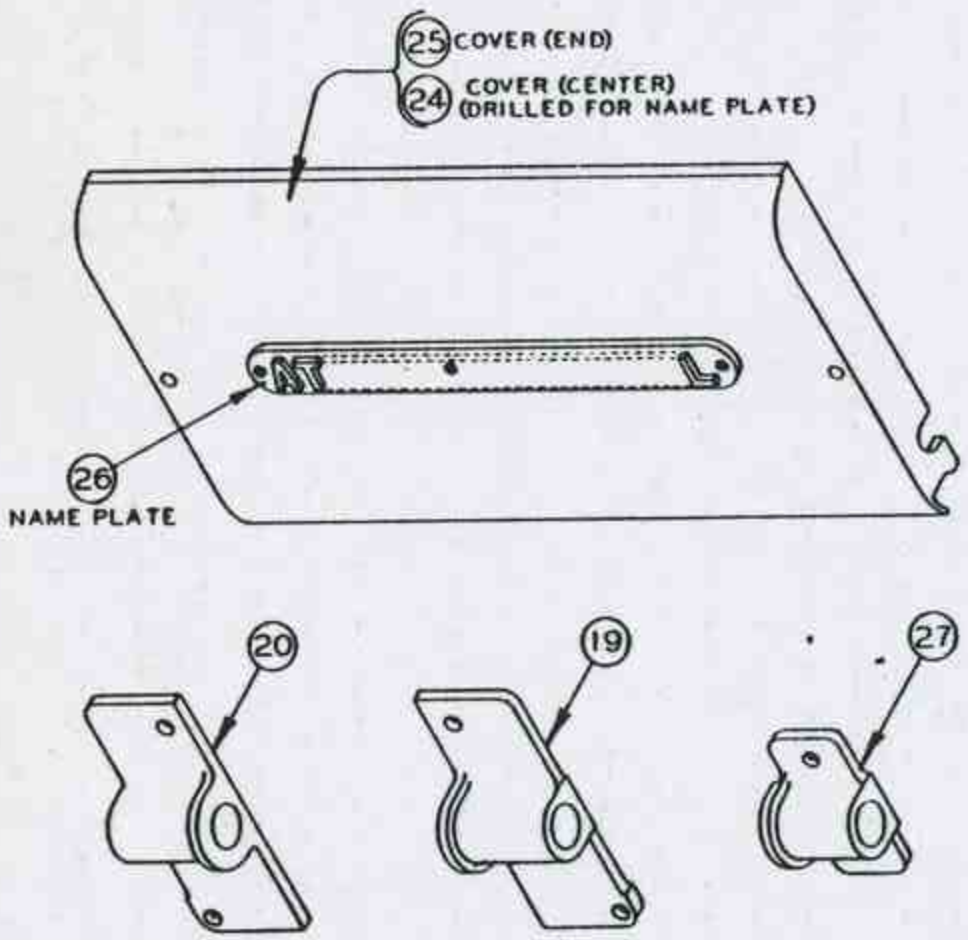
DRAWING NUMBER 3AP2469

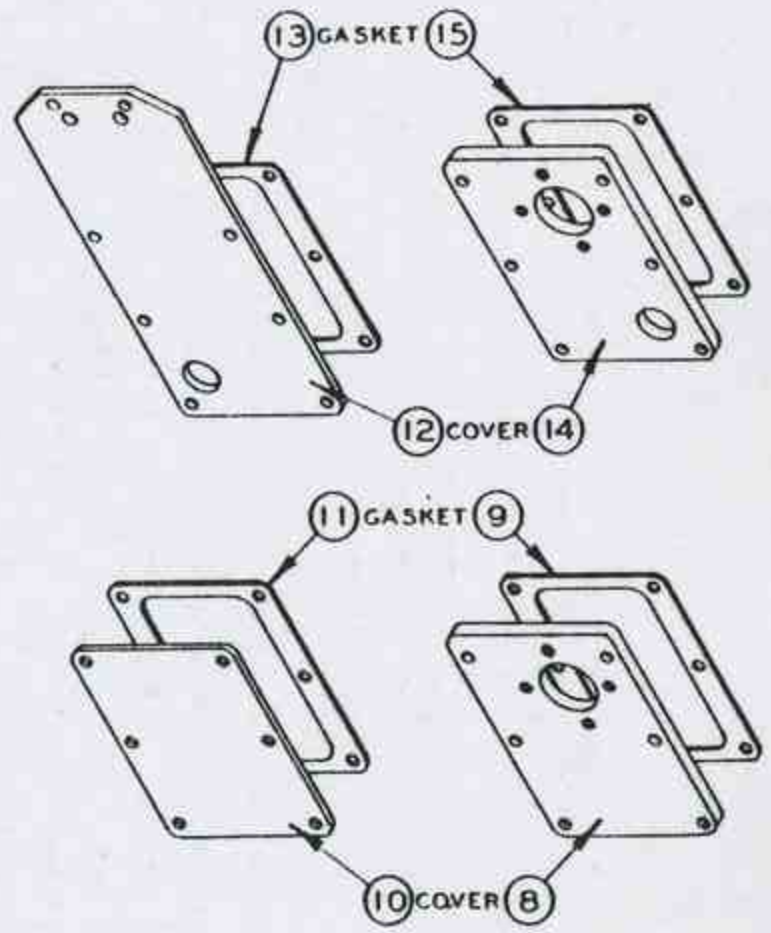
FORM NO. 9-22-1800 PRINTED IN U.S.A. ON IRISH ARTPROOF

PLATE No. 3A2828

DO NOT ORDER PARTS BY REFER. NUMBERS







Supersedes Sheet Dated 9-28-51
1-15-52-Line 3-Changed 3A2668 to
4A1448

CHANGES

2L2537

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A2828

NO	DRWG. NO	REF NO	PART NO	NO REQ'D	PART NAME	ASSEM DRWG NO
1	3A2598	1	3A2598-X	1	BLOCK ASSEMBLY - Cylinder	
2	S-976	2	727A-KXH	18	WASHER - Base to Cyl. Block Thru-Bolt	
3		3	4A1448	18	NUT - Cylinder Block	
4		4	C-3610	2	PIN - Cyl. Block to Centerframe Dowel	
5				2	HALF NUT - 1/2-20-NF-Hex. - St.	
6				2	COTTER PIN - 1/8 x 3/4 Lg. - St.	
7	3A2210	5	3A2210-X	8	LINER ASSEMBLY - Cylinder	
8	F-560	6	604-KXH	16	GROMMET - Cylinder Liner	
9		7	S-800	8	GASKET - Liner to Cyl. Block	
10	4B1099	8	4B1099	1	COVER - Cyl. Block End - (Air Start. Pipe Hole)	
11						
12		9	3A2208	1	GASKET - Cover to Cyl. Block	
13			M-1773	6	STUD - Cyl. Block End (Air Start. Pipe Hole)	
14				6	LOCKWASHER - 3/8 SAE Reg. - St.	
15		12	4C1104	1	COVER - Cyl. Block Gov.End (& Filter Bracket)	
16				6	NUT - 3/8"-16 Hex Full-Stud-Cyl. Block End	
17				6	CAPSCREW - 3/8"-16-NC x 7/8" Lg. - St.	
18				6	LOCKWASHER - 3/8" SAE Reg. - St.	
19						
20						
21						
22		24	4A1161	2	COVER - Cyl. Block Side (Large for Name Plate	
		25	3A2179	2	COVER - Cyl. Block Side (Large)	
24				8	CAPSCREW - 1/2"-13-NC x 3" Lg. - St.	
25				8	LOCKWASHER - 1/2 SAE Reg. - St.	
26	4A1162	26	4A1162	1	PLATE - Cyl. Block Side Cover Name - "Atlas"	
27	4A1163	26	4A1163	1	PLATE - Cyl. Block Side Cover Name- "Imperia"	
28				4	MACHINE SCREW-1/4"-20 x 5/8" Lg.-Flat Hd.-St.	
29		27	3A2573	2	HOUSING - Fuel Pump Rack Shaft End (& Side) (Cover Closure)	
30						
31				4	CAPSCREW - 1/4-20-NC x 5/8 Lg. - St.	
32				4	LOCKWASHER - 1/4 SAE Reg. - St.	
33				1	PIPE PLUG - Water Drain - 1/2 Std. - Brass	
34				1	NIPPLE - 1/2" x 1-1/2" Lg. - Brass	
35			C9053P-1/2	1	COCK - Drain	
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
50						

HAND SEE

OPP. ROT. SEE

NAME CYLINDER BLOCK & COVERS GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9" x 10-1/2"

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2537

INLET AND EXHAUST MANIFOLDS

TURBOCHARGED ENGINES

NOTE:- SHAPE OF MANIFOLDS WILL VARY WITH THE NUMBER OF CYLINDERS.

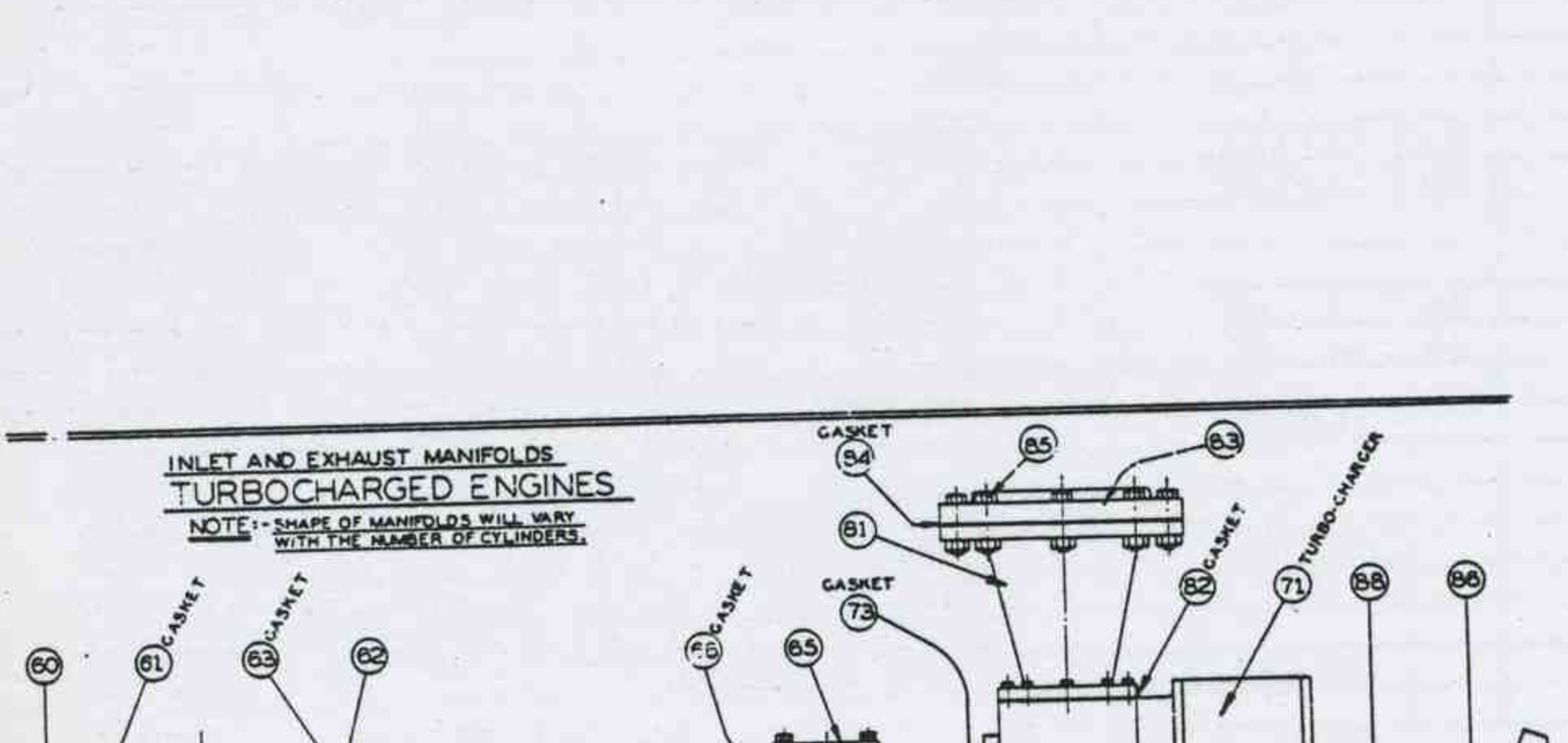


PLATE NO. 3A 4031

DO NOT ORDER PARTS BY REFER. NUMBERS

#1 -4-14-52 - Line 41 was BM-1701

CHANGES

CHANGES

2L2539 SHEET 1 OF 2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A4031

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG NO.
1	3A2589	56	3A2589X	1	MANIFOLD ASSEMBLY - Air Inlet	
2		57	3A2441	8	GASKET - Manifold to Head	
3				16	CAPSCREW - 5/8-11-NC x 1-1/2 Lg. - (St.)	
4		54	2C4628	1	GAGE - Inlet Manifold Pressure	
5				1	PIPE PLUG - 1/4"	
6	4E1015	51	4E1015	1	MANIFOLD ASSEMBLY - Exhaust	
7						
8				16	CAPSCREW - 5/8-11-NC x 1-1/2 Lg. - (St.)	
9		52	3A2440	8	GASKET - Manifold to Cylinder Head	
10						
11				16	PLAIN WASHER - 5/8 SAE Std. - (St.)	
12						
13						
14		60	3A2431	8	ELBOW - Cyl. Head to Exhaust Man. Water	
15		61	S-2334	16	GASKET - Elbow to Manifold & Head	
16				32	CAPSCREW - 1/2-13-NC x 1-1/2 Lg. - (St.)	
17				32	LOCKWASHER - 1/2 SAE Reg. - (St.)	
18				32	PLAIN WASHER - 1/2 SAE Std. - (St.)	
19		62	4A1159	1	FLANGE - Exhaust Manifold Water Outlet	
20				1	NIPPLE 2-1/2" Close	
21				1	TEE 2-1/2" X 2-1/2" X 3/4"	
22		63	4A1160	1	GASKET - Flange to Manifold	
23				4	CAPSCREW - 1/2-13-NC x 1-1/2 Lg. - (St.)	
24						
25				4	LOCKWASHER - 1/2 SAE Reg. - (St.)	
26		65	2C5044	1	FLANGE - Turbo. Water Discharge Pipe	
27		66	2C3047	1	GASKET - Flange to Manifold	
28				4	CAPSCREW - 1/2-13-NC x 1-1/2 Lg. - (St.)	
29				4	LOCKWASHER - 1/2 SAE Reg. - (St.)	
30						
31						
32	4D1047	69	4D1047	1	BRACKET - Turbocharger Support	
33				4	CAPSCREW - 3/4-10-NC x 2 Lg. - (St.)	
34				4	LOCKWASHER - 3/4 SAE Reg. - (St.)	
35				4	PLAIN WASHER - 3/4 SAE Std. - (St.)	
36						
37		71	BM-6336	1	TURBOCHARGER	
38				4	CAPSCREW - 5/8-11-NC x 1-3/4 Lg. - (St.)	
39				4	LOCKWASHER - 5/8 SAE Reg. - (St.)	
40				4	PLAIN WASHER - 5/8 SAE Std. - (St.)	
41			BM-1707	1	DRAIN COCK - Turbo (Blower Casing)	
42		73	3A2572	1	GASKET - Turbo. to Exhaust Manifold	
43		74	3A2591	12	CAPSCREW - Turbo. to Exhaust Manifold	
44				12	PLAIN WASHER - 1/2 SAE Std. - (St.)	
45						
46						
47					----CONTINUED ON SHEET NO. 2----	
48						
49						
50						

2L2539 SHEET 1 OF 2

OR OPP. HAND SEE

FOR OPP. ROT. SEE

NAME INLET, EXHAUST MANIFOLD & TURBOCHARGER GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 TURBO R.H.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

CHANGES

CHANGES

2L2539 SHEET 2 OF 2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4031

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO
1					----CONTINUED FROM SHEET NO. 1----	
2						
3		76	4C1060-A	1	ELBOW - Turbo. to Inlet Manifold	
4				2	PIPE PLUG - 1/2 STD. - (C.I.)	
5				1	PIPE PLUG - 1-1/2 Std. - (C.I.)	
6		77	3A2435	1	GASKET - Elbow to Turbocharger	
7		78	3A2436	1	GASKET - Elbow to Inlet Manifold	
8				8	CAPSCREW - 1/2"-13 x 1-1/2" Hex Head	
9				24	PLAIN WASHER - 1/2" Std.	
10				16	LOCKWASHER - 1/2" Std.	
11				8	CAPSCREW - 1/2"-13 x 2-1/4" Lg.	
12				8	NUT - 1/2"-13 Hex Full	
13						
14		81	3A2609	1	ADAPTOR - Turbocharger Exhaust Outlet	
15			2C4470-D	1	THERMOCOUPLES	
16				1	PIPE PLUG - 1/2 Std. - (C.I.)	
17		82	2C4260	1	GASKET - Adaptor to Turbocharger	
18				16	CAPSCREW - 3/8-16-NC x 1-1/4 Lg. - (St.)	
19						
20						
21		86	BM-6402	1	FILTER SILENCER	
22		87	4A1190	1	GASKET - Silencer to Elbow	
23				8	CAPSCREW - 1/2-13 x 1-1/2 Lg.	
24				8	LOCKWASHER - 1/2"	
25				8	NUT - 1/2"-13 Hex Head	
26		88	4C1082	1	ELBOW - Silencer to Turbo	
27		87	4A1190	1	GASKET - Elbow to Silencer	
28				8	CAPSCREW - 1/2"-13 x 1-1/4" Lg.-Hex Head	
29				8	LOCKWASHER - 1/2"	
30						
31						
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FOR OPP. HAND SEE

FOR OPP. ROT. SEE

NAME INLET, EXHAUST MANIFOLD & TURBOCHARGER GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 TURBO R.H.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2539 SHEET 2 OF 2

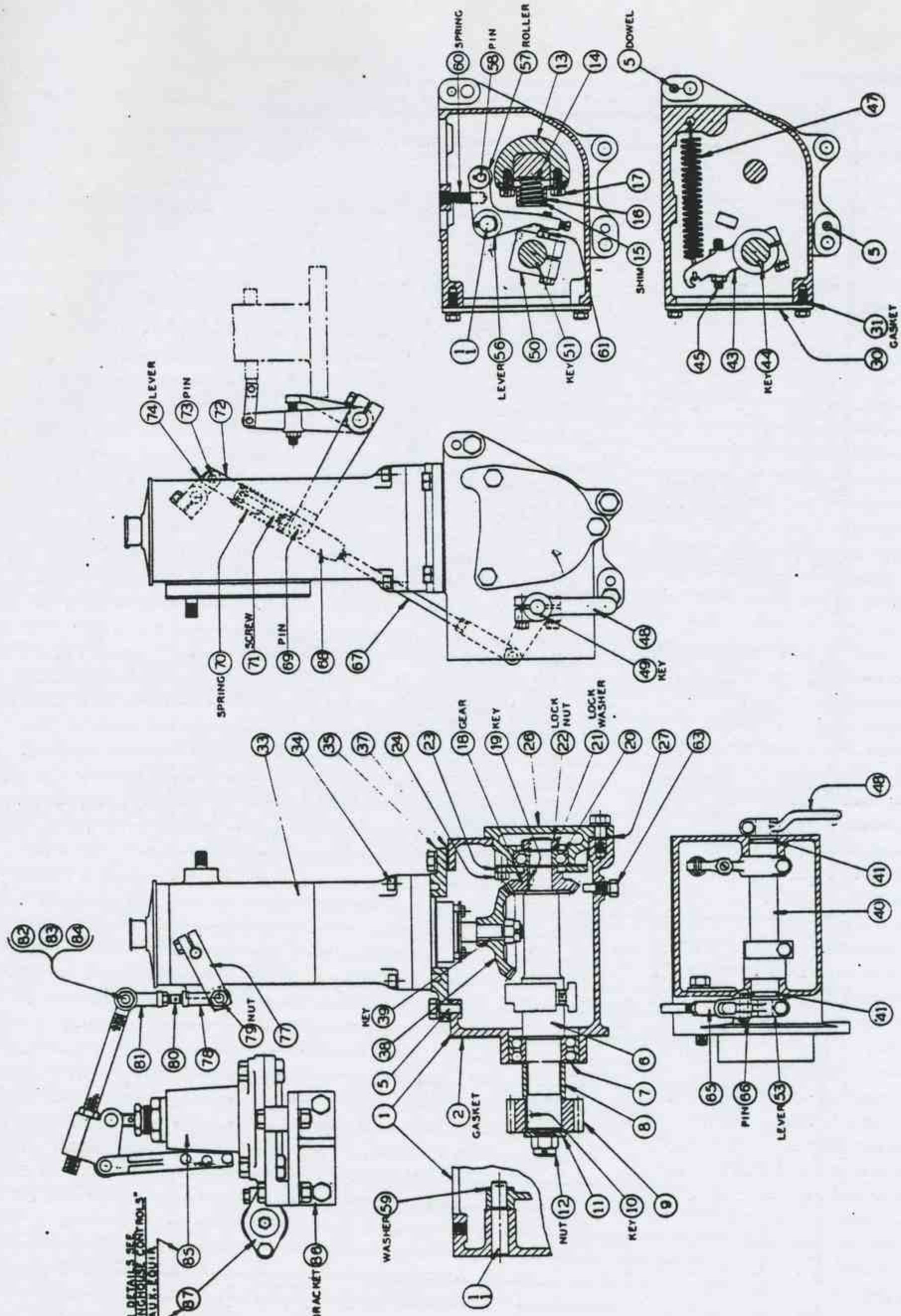

PLATE No.
3A4026

DO NOT ORDER PARTS BY REFER NUMBERS

CHANGES

Supersedes Sheet Dated 10-19-51
#1 -2-15-52 - Added Lines 47 to 49

CHANGES

2L2540 SHEET 1 OF 2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4026

LINE NO.	DRWG. NO.	REF NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		1	3A3036-X	1	HOUSING ASSEMBLY VERTICAL & OVERSPEED GOV	
2					DRIVE	
3		2	4B1090	1	GASKET - Assembly Vertical & Overspeed	
4					Governor Drive Housing	
5				3	CAPSCREW - 1/2"-13-NC x 1-1/4" Lg. - St.	
6				1	CAPSCREW - 1/2"-13 x 2-3/4" Lg. - St.	
7				4	LOCKWASHER - 1/2" SAE Reg. - St.	
8		5	T-270	4	PIN DOWEL	
9		6	4B1084	1	SHAFT - Overspeed Governor Drive	
10		7	BM-6378	1	MRC-5208K - Ball Bearing	
11		8	4A1146	1	SPACER - Governor Drive Shaft	
12		9	4B1080	1	GEAR - Governor Drive	
13		10		1	KEY - Woodruff #5	
14		11	3A2964	1	WASHER	
15		12		1	NUT - 3/4"-16 Light Thick Slotted	
16				1	COTTER PIN - 1/8" x 1-1/4" Long	
17		13	4A1144	1	WEIGHT - O.S. Gov. Control	
18		14	3A2996	1	SPRING - O.S. Gov. Control	
19		15	3A3010	3	SHIMS - O.S. Gov. Spring	
20		16	4A1145	1	SPRING RETAINER - O.S. Gov.	
21		17	H-14259	2	CAPSCREW	
22				2Pc.	16 GAUGE - 4" Long - Wire	
23		18	4B1082	1	BEVEL PINION GEAR - Gov. Drive	
24		19		1	KEY - Woodruff #5	
25	C-9859	20	5709	1	BALL BEARING	
26	C-9845	21	C-9845	1	LOCKWASHER - Ball Bearing	
27	C-9844	22	C-9844	1	LOCKNUT - Ball Bearing	
28		23	3A2958	1	RETAINER - Gov. Dr. Ball Bearing	
29	C-2406	24	C2406L-3/4	3	CAPSCREW	
30				1	LOCKWIRE - 16 Ga. x 12" Long	
31		26	3A2898	1	CAGE - Ball Bearing	
32		27	3A3007	1	GASKET - Ball Bearing Cage	
33				3	CAPSCREW - 1/2"-13 x 1" Lg. - St.	
34				3	LOCKWASHER - 1/2" SAE Reg. - St.	
35						
36		30	3A2965	1	COVER - Gov. Housing	
37		31	3A2972	1	GASKET - Gov. Housing Cover	
38				5	CAPSCREW - 3/8"-16 x 3/4" Long	
39						
40		33	4C1055	1	GOVERNOR WOODWARD UG-8	
41		35	3A2899	1	ADAPTOR - Governor to Housing	
42				4	CAPSCREW - 1/2"-13 x 1-1/4" Hex Head	
43				4	LOCKWASHER - 1/2"	
44		37	3A2998	3	SHIMS - Gov. Adapter to Housing (1/32	
45		37	3A2999	5	SHIMS - Gov. Adapter to Housing (.010	
46		37	3A3000	2	SHIMS - Gov. Adapter to Housing (.003	
47		34		4	CAPSCREW-3/8"-16 X2" Allen Socket Head	
48					Gov. to Adaptor	
49				4	LOCKWASHER - 3/8" - Gov. to Adaptor	
50					----CONTINUED ON SHEET NO. 2----	

FOR OPP. HAND SEE

FOR OPP. ROT. SEE

NAME WOODWARD & OVERSPEED GOVERNOR

ORIGINALLY ISSUED FOR 8 CYL. 9" X 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2540 SHEET 1 OF 2

CHANGES

Supersedes Sheet Dated 10-19-51
#1 -10/16/52-Part # on Line 27 was
R-3477

CHANGES

2L2540 SHEET 2 OF 2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4026

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO. REQ'D.	PART NAME	ASSEM. DRWG. NO.
1					----CONTINUED FROM SHEET NO. 1----	
2						
3						
4		38	4B1081	1	GEAR - Governor Spindle	
5		39	H-7663	1	KEY - Governor to Gear	
6						
7		40	4B1088	1	SHAFT - Overspeed Gov. Throw-Out	
8		41		2	"O" RING - (Parker #5427-19)	
9		43	4B1083	1	ARM - O. S. Throw-Out - Spring	
10		44		1	KEY - #5 Woodruff	
11				1	CAPSCREW - 3/8"-16 x 1-1/2" Hex Head	
12				1	WASHER - 3/8" Lock	
13		45		1	SETSCREW - Allen - 3/8"-16 x 2-1/4" Oval Pt	
14				1	HALF NUT - 3/8"-16	
15		47	3A2992	1	SPRING	
16		48	4A1158	1	LEVER - Overspeed - Governor Reset	
17		49		1	KEY - #5 Woodruff	
18				1	SCREW - 5/16"-18 x 1" Hex Head Cap	
19		50	3A2937	1	LATCH - O. S. Gov. Trip	
20		51		1	KEY - #5 Woodruff - Latch to Shaft	
21				1	CAPSCREW - 3/8"-16 x 1-1/2" Hex Head	
22		53	4A1157	1	LEVER - Overspeed Throw-Out	
23				1	KEY - #5 Woodruff	
24				1	CAPSCREW - 3/8"-16 x 1" Lg. - Hex Head	
25		56	3A2947	1	PIVOT ARM - O. S. Gov. Trip	
26		57	3A2983	1	ROLLER - O. S. Gov. Trip Arm	
27		58	T-1384	1	PIN - O. S. Gov. Trip Roller	
28				2	COTTER PIN - 1/8" x 3/4"	
29		59	3A2985	1	WASHER	
30				1	COTTER PIN - 1/8" x 1-1/4"	
31		60	3A2995	1	SPRING - O. S. Gov. Trip Lever	
32		61	3A2984	1	SCREW - O. S. Gov. Trip Lever	
33				1	SETSCREW - 5/16"-18 x 3/4" Sq. Hd. -Cup Pt.	
34		63	4A1176	1	TUBE - Gear - Gov. Drive	
35						
36						
37						
38						
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40		—				
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47						
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2L2540 SHEET 2 OF 2

OPP. HAND SEE

OPP. HOT. SEE

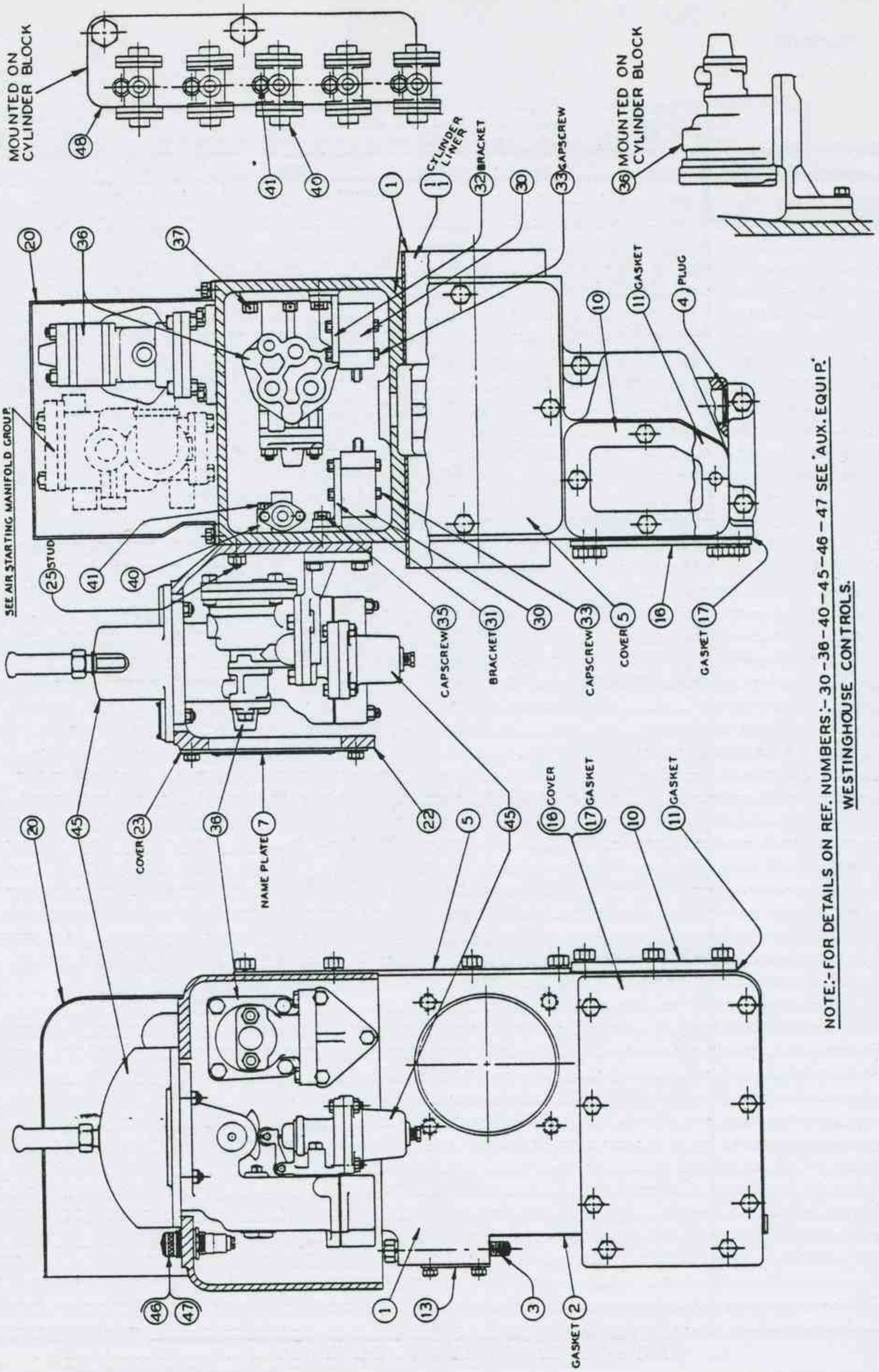
NAME WOODWARD & OVERSPEED GOVERNOR

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO



NOTE:- FOR DETAILS ON REF. NUMBERS:- 30-38-40-45-46-47 SEE 'AUX. EQUIP.' WESTINGHOUSE CONTROLS.

DO NOT ORDER PARTS BY REFER. NUMBERS.

Retyped from copy dated 10/26/51.
#1- Added Line 8. 2/6/52.

CHANGES

CHANGES

2L2541

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4032

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM DRWG. NO.
1	4B1108	1	4Y1031	1	HOUSING ASSEMBLY- Engine Control	
2		2	3A2340	1	GASKET- Housing to Centerframe	
3				3	CAPSCREW- 1/2" -13-NC x 1-1/2" Lg.- St.	
4				1	CAPSCREW- 1/2" -13-NC x 1-1/4" Lg.- St.	
5				4	LOCKWASHER- 1/2" SAE Reg. - St.	
6		3		4	CAPSCREW- 5/8" -11-NC x 5" Lg.- St.	
7				4	LOCKWASHER- 5/8 SAE Reg.- St.	
8		4		1	PLUG- Welsh Expansion 1-3/4" Dia. Engine Control Housing	
9						
10						
11		5	3A2315	1	COVER- Control Housing End (Large)	
12						
13				6	CAPSCREW- 1/2"-13-NC x 1" Lg.- St.	
14				6	LOCKWASHER- 1/2 SAE Reg.- St.	
15		7	T-1247-E	1	PLATE- Name	
16			BM-3508	4	DRIVE SCREW	
17						
18		10	3A2324	1	COVER- Control Housing End- Small	
19		11	3A2387	1	GASKET- Cover to Housing	
20				4	CAPSCREW- 1/2" -13-NC x 1-1/4" Lg.- St.	
21				4	LOCKWASHER- 1/2 SAE Reg. - St.	
22						
23		13	3A2364	1	COVER- Control Housing (Aft. End)	
24				4	CAPSCREW- 3/8" -16-NC x 5/8" Lg.- St.	
25						
26						
27						
28						
29		16	3A3045	1	COVER- Control Housing Side (Lower)	
30		17	3A2398	1	GASKET- Cover to Housing	
31				8	CAPSCREW- 1/2" -13-NC x 7/8" Lg.- St.	
32				8	LOCKWASHER- 1/2 SAE Reg.- St.	
33						
34		20	4D1050	1	COVER- Air Reverse Housing	
35				8	CAPSCREW- 3/8" -16 x 3/4" Lg.	
36				3	CAPSCREW- 3/8" -16 x 1" Lg.	
37				3	LOCKWASHER- 3/8"	
38						
39		22	4C1068	1	STAND- Engine Control	
40		23	4A1169	1	COVER- Engine Control Stand	
41				4	CAPSCREW- 5/16" -18 x 3/4" Hex Head	
42				4	CAPSCREW- 5/16" -18 x 1" Hex Head	
43		25	H-9203	4	STUD- Stand Engine Control-Air Rev.Hsg	
44				4	LOCKWASHER- 3/8"	
45			BM-4850-V	2	NAME PLATE- Blank- Ahead & Astern	
46				4	ESCUTCHEON PIN #16 -3/8"- Name Plate to Engine Control Stand	
47						
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OR OPP. HAND SEE

FOR OPP. ROT. SEE

NAME ENGINE CONTROL HOUSING & COVERS GROUP

ORIGINALLY ISSUED FOR 9 x 10-1/2 MARINE- R.H.

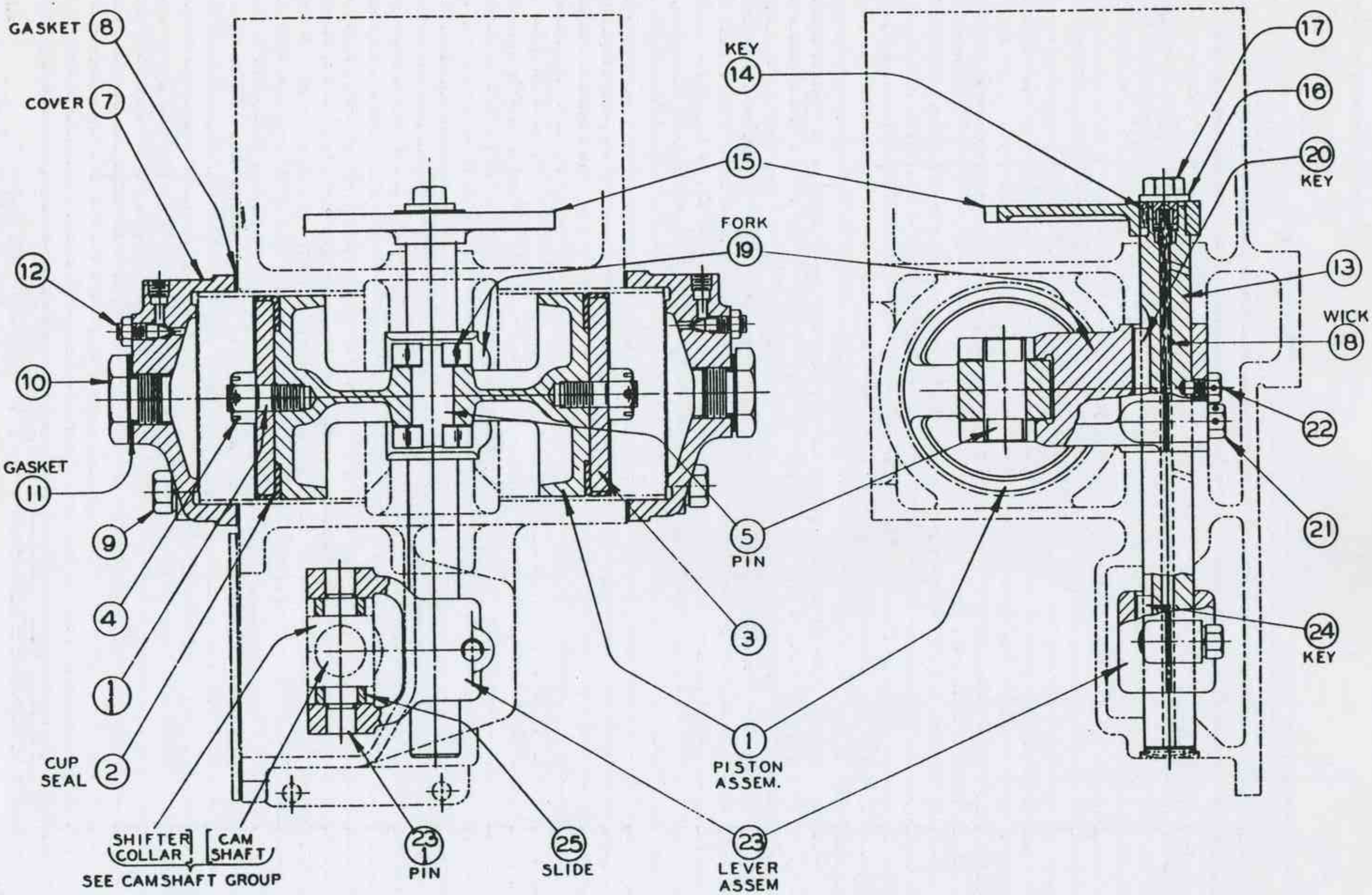
FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2541

PLATE No.
3A4033 DO NOT ORDER PARTS BY REFER. NUMBERS



typed & Revised from Sheet dated 1/2/52.

CHANGES #1

CHANGES

2L2543

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4033

LINE NO.	DRWG. NO.	REF NO	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG NO
1	3A2348	1	3A2348-X	1	PISTON ASSEMBLY- Air Cylinder	
2		2	F-6944	2	CUP SEAL- Air Cylinder Pistnn	
3		3	3A2349	2	FOLLOWER- Cup Seal	
4			4A1347	4	SHIM- Follower- Piston Cup	
5		4		2	SLOTTED NUT- 3/4" -10-NC-Hex. - St.	
6				2	COTTER PIN- 3/16" x 1-1/2" Lg.- St.	
7		5	3A2483	1	PIN- Air Cylinder Piston	
8						
9		7	4C1069	2	COVER- Air Cylinder End	
10		8	4A1199	2	GASKET- Cover to Control Housing	
11		9		8	CAPSCREW- 3/4" -10-NC x 3" Lg.- St.	
12				8	LOCKWASHER- 3/4" SAE Reg.- St.	
13		10	3A2291	2	PLUG- Air Cyl. End Cover	
14		11	3A2351	2	GASKET- Plug to End Cover	
15		12	2C1504	2	VALVE NEEDLE	
16				2	HALVE NUTS- 1/2" -13-Hex- St.	
17						
18		13	4B1101	1	SHAFT- Camshaft Shifter	
19		14	H-7954	1	KEY- Quadrant Pilot Air Valves	
20		15	4B1092	1	QUADRANT- For Pilot Air Valves	
21		16	H-222	1	WASHER	
22		17	4A1192	1	CAPSCHEW- Quadrant Pilot Air Valve	
23				1	WIRE- 16 Gauge- x 6" Long	
24		18	4A1178	1	WICK - Shaft Camshaft Shifter	
25		19	3A2301	1	FORK- Shifter Shaft Control	
26		20	C7108L3 1/2	1	KEY- Fork to Shifter Shaft	
27		21	C2410L2 1/4	2	CAPSCREW- Fork Clamp	
28		22	3A2369	1	SETSCREW- Shifter Fork	
29				1	COTTER PIN- 1/16" x 5/8" Lg.	
30	3A2353	23	3A2353-X	1	LEVER ASSEMBLY- Camshaft Shifter	
31		24	C7108L2 3/4	1	KEY- Lever to Shifter Shaft	
32				1	CAPSCREW- 5/8" -11-NC x 2" Lg.- St.	
33				1	LOCKWASHER- 5/8 SAE Reg.- St.	
34		25	3A2485	2	SLIDE- Camshaft Shifter	
35						
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R OPP. HAND SEE

R OPP. ROT. SEE

NAME REVERSING AIR CYLINDER & CAMSHAFT SHIFTER GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 MARINE

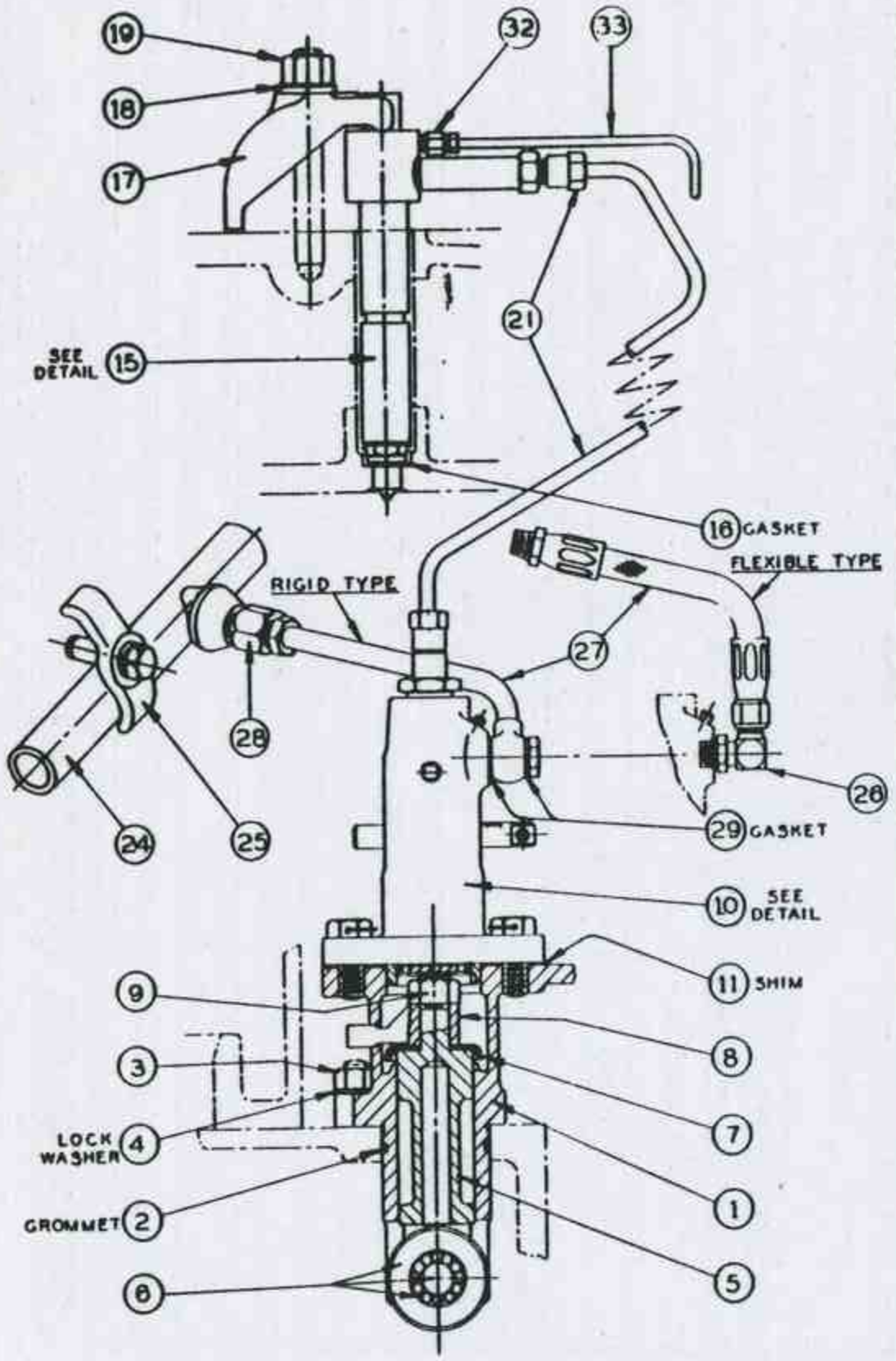
FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

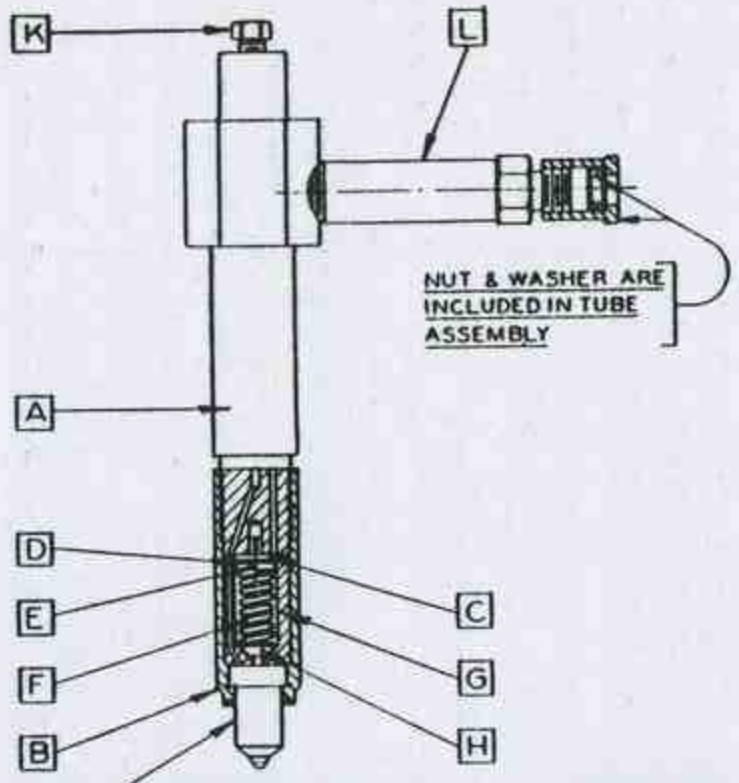
PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2543

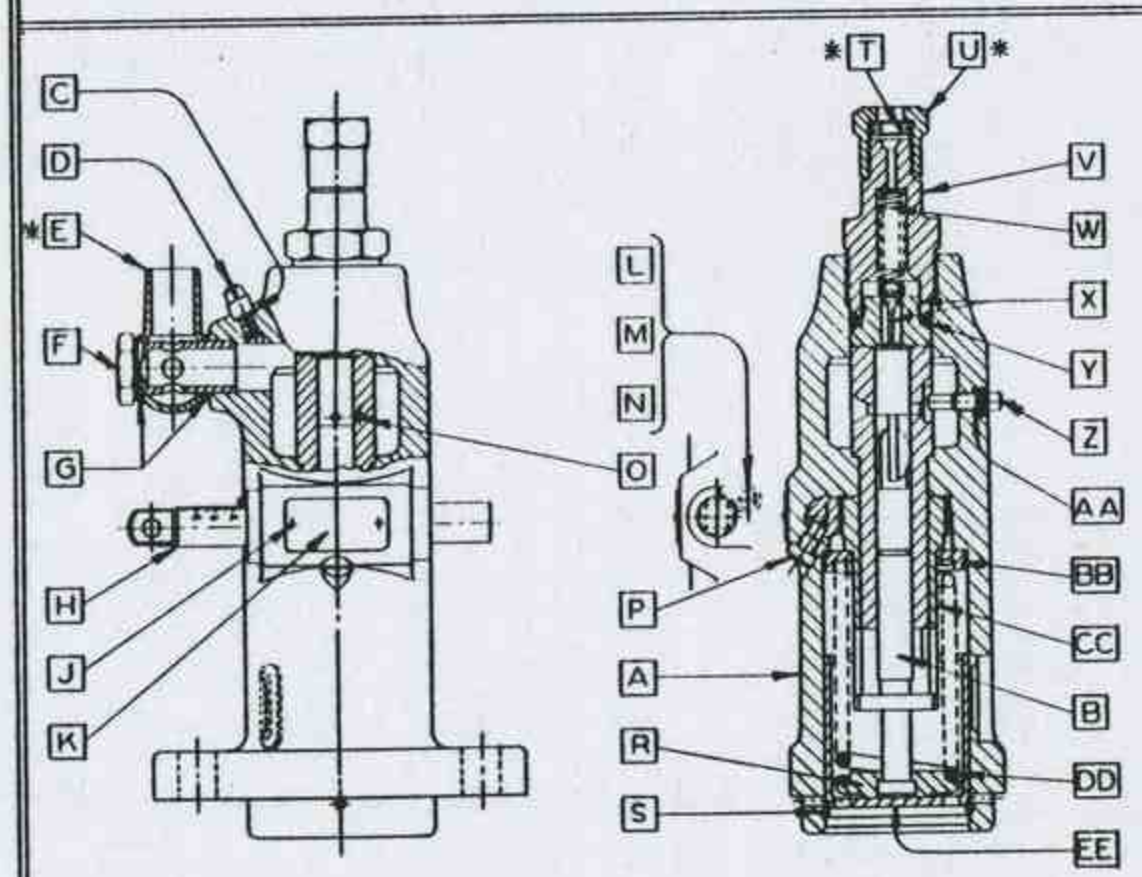
PLATE NO. 3A4034 ED.2 DO NOT ORDER PARTS BY REFER. NUMBERS.





REF. LET.	NAME	H.B. CO. PART NO.
A	BODY, NOZZLE HOLDER	B146372-1
B	NUT, NOZZLE CAP	B146373-1
C	SPACER	B146374-1
D	SHIM -- .001" THICK	B146375-1
D	SHIM -- .003" THICK	B146375-2
D	SHIM -- .005" THICK	B146375-3
D	SHIM -- .010" THICK	B146375-4
D	SHIM -- .015" THICK	B146375-5
E	SEAT, SPRING - UPPER	B146376-1
F	SPRING, PRESSURE ADJUSTING	B146377-1
G	SPACER, VALVE STOP	B146378-1
H	SEAT, SPRING - LOWER	B146379-1
I	SCREW, BLEEDER	B146380-1
L	STUD, FUEL INLET	B146382-10

NOTE:- THE NOZZLE ASSEMBLY IS NOT FURNISHED WITH NOZZLE HOLDER. WHEN REORDERING NOZZLE ASSEMBLY, REFER TO THE TYPE DESIGNATION STAMPED ON THE NOZZLE BODY.



REF. LET.	NAME	H.B. CO. PART NO.
A	HOUSING, PUMP — SEE LIST BELOW	
B	PLUNGER AND BARREL — SEE LIST BELOW	
C	GASKET, BLEEDER SCREW	B146371-3
D	SCREW, BLEEDER	B146371-4
F	SCREW, RETAINING	B146371-6
G	GASKET, FUEL INLET UNION	B146371-7
H	RACK, CONTROL	B146371-8
I	SCREW, NAMEPLATE	B146371-9
K	PLATE, NAME	B146371-10
L	SHIM, CONTROL RACK POINTER -- .008" THICK	B146371-11
L	SHIM, CONTROL RACK POINTER -- .011" THICK	B146371-12
L	SHIM, CONTROL RACK POINTER -- .020" THICK	B146371-13
L	SHIM, CONTROL RACK POINTER -- .040" THICK	B146371-14
L	SHIM, CONTROL RACK POINTER -- .055" THICK	B146371-15
M	POINTER, CONTROL RACK	B146371-16
N	SCREW, CONTROL RACK POINTER	B146371-17
O	PLUG, LEAD	B146371-18
P	SCREW, CONTROL RACK	B146371-19
S	SEAT, PLUNGER SPRING -- LOWER	B146371-20
R	RING, SPLIT	B146371-21
V	HOLDER, DELIVERY VALVE	B146371-29
W	SPRING, DELIVERY VALVE	B146371-30
X	VALVE ASSEMBLY, DELIVERY	B146371-31
Y	GASKET, DELIVERY VALVE HOLDER	B146371-32
Z	SCREW, BARREL LOCATING	B146371-33
AA	GASKET, BARREL LOCATING SCREW	B146371-34
BB	SEAT, PLUNGER SPRING -- UPPER	B146371-35
CC	SLEEVE, CONTROL	B146371-37
DD	SPRING, PLUNGER	B146371-38
EE	GUIDE, PLUNGER -- FLOATING	B146371-39

COMPLETE PUMP NO.	HOUSING	PLUNGER & BARREL
B146371	B146371-1	B146371-2

* PARTS INDICATED ARE LISTED ON EITHER GROUP LISTS OR IN TUBE ASSEMBLIES.

CHANGES

typed & revised from sheet dated 9/28/51.
#1 -Quan. was (4) on lines 32,33,34.
Added Line 35-BM-1701. 10/16/52.

CHANGES

2L2545

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4034

LINE NO	DRWG. NO.	REF NO	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG NO.
1		1	3A2025	8	GUIDE- Fuel Pump Lifter	
2		2	3A2146	8	GROMMET- Lifter Guide	
3		3		16	NUT- 5/8" -18 NF-Hex. -St.	
4		4		16	LOCKWASHER- 5/8" Shakeproof Type 14(Int.)(S	
5						
6		5	3A2148	8	LIFTER- Fuel Pump	
7		6	3A2053	8	ROLLER UNIT- Fuel Pump Lifter(Roller, Pin-	
8					Bearing)	
9		7	3A2149	8	GUARD- Pump Lifter Oil	
10		8	3A2155	8	ARM- Air Starting Valve Push Rod	
11		9	3A3084	8	NUT	
12		10	BM-6371	8	PUMP- Fuel Injection	
13		11	3A2253	32	SHIM- Pump to Lifter Guide (.003)	
14		11	3A2252	40	SHIM- Pump to Lifter Guide (.010)	
15		11	3A2251	16	SHIM- Pump to Lifter Guide (1/32)	
16				16	CAPSCREW- 5/8" -11-NC x 1-3/4" Lg.- St.	
17				16	LOCKWASHER- 5/8" SAE Reg.- St.	
18						
19						
20			BM-6361-A	8	SPRAY TIPS	
21		15	BM-6372	8	VALVE ASSEMBLY- Fuel Injection	
22		16	3A2259	8	GASKET- Injection Valve to Cyl. Head (1)	
23		17	3A2181	8	CLAMP- Injection Valve	
24		18	C-3238	8	WASHER- Injection Valve Clamp	
25		19		8	NUT- 3/4" -10-NC-Hex.- St.	
26						
27	3A2526	21	3A2526-X	8	TUBE ASSEMBLY- Pump to Injection Valve Fuel	
28						
29						
30	4C1108	24	4Y1109	1	MANIFOLD ASSEMBLY- Fuel	
31				1	PIPE CAP- 1-1/4" - C.I.	
32		25	3A2174	8	CLAMP- Fuel & Lube Oil Manifold to Block	
33				8	CAPSCREW- 3/8" -16-NC x 1-1/4" Lg.- St.	
34				8	LOCKWASHER- 3/8" SAE Reg. - St.	
35			BM-1707	1	DRAIN COCK- Fuel Manifold Assembly	
36		27	4A1236	8	TUBE ASSEMBLY- Mani. toPump Fuel	
37					(Pump Inlet)	
38		26	4A1237	8	PARKER CONNECTOR- Tube	
39		32	C9801P 1/4	8	CONNECTOR- Tube (Inj. Valve Drain)	
40		33		8	TUBE- 1/4" OD x .030 x 22-1/2" Lg.	
41					(S.D.Cop.)	
42						
43						
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OPP. HAND SEE

OPP HOT SEE

NAME FUEL INJECTION SYSTEM & INTERNAL FUEL PIPING GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 MAR.TURBO.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2545

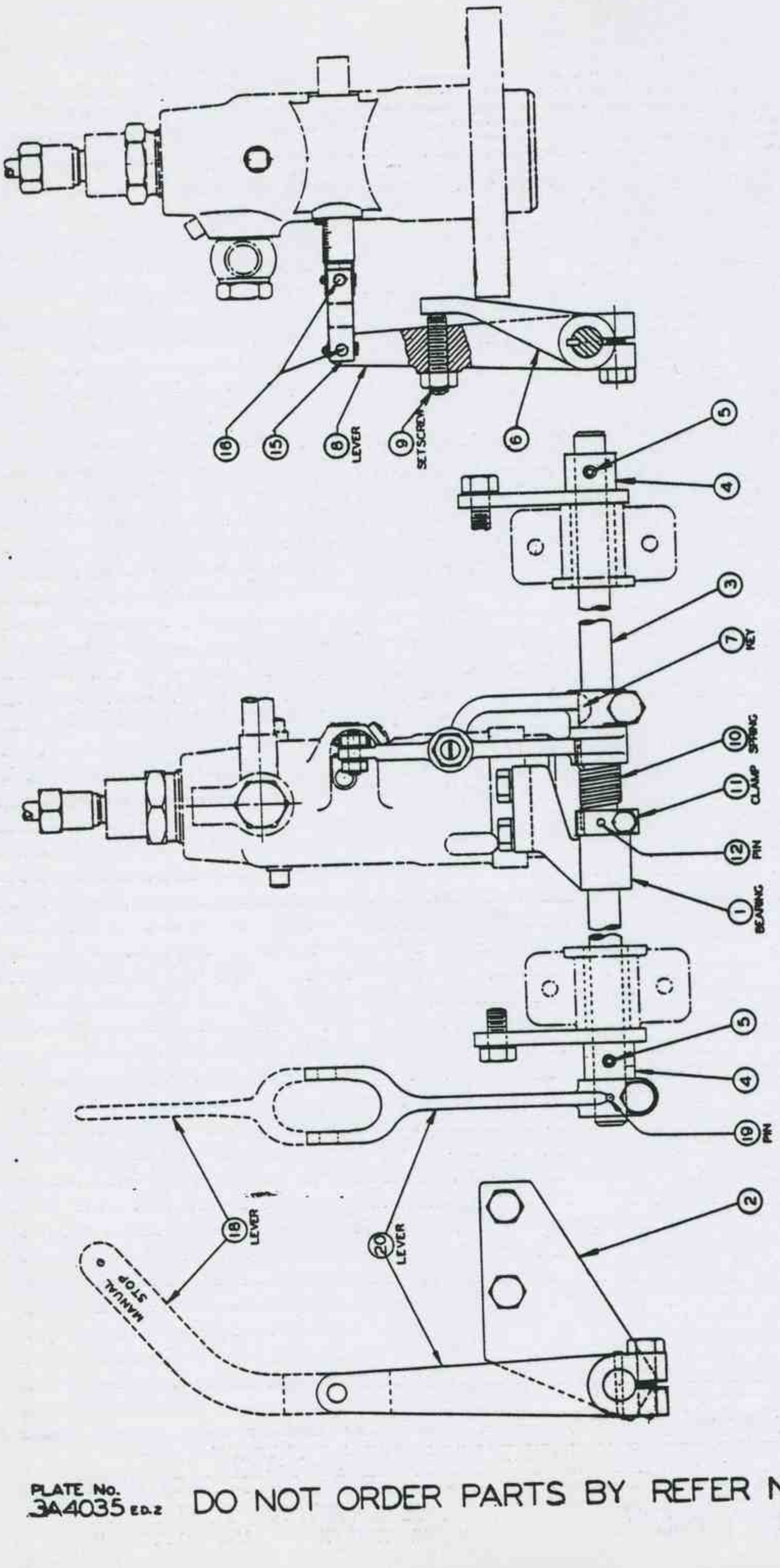

PLATE No. 3A4035 ED.2 DO NOT ORDER PARTS BY REFER NUMBERS

Retyped from sheet dated9/28/51.
CHANGES #1- Added lines #19, 20. 3/2/52.
#2- Line 15 was 3A2501. 4/15/52.

CHANGES

2L2546

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4035

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		1	3A2043	8	BEARING- Fuel Pump Control Shaft	
2				16	CAPSCREW- 3/8" -16-NC x 1" Lg.- St.	
3				16	LOCKWASHER- Type 11- Shakeproof- 3/8"- St.	
4		2	3A2330	2	BEARING- Control Shaft End	
5				4	CAPSCREW- 3/8"-16-NC x 3/4" Lg.- St.	
6				4	LOCKWASHER- 3/8 SAE Reg.- St.	
7		3	4B1106	1	SHAFT- Pump Control	
8		6	3A2049	8	LEVER- Fuel Pump Control- Drive	
9		7		11	WOODRUFF KEY- #5 - St.	
10				8	CAPSCREW- 3/8" -16-NC x 1 Lg.- St.	
11		8	3A2048	8	LEVER- Fuel Pump Control (Driven-Floating)	
12		9		8	SETSCREW- 3/8" -16-NC x 1-1/2" Lg.- Headless	
13					Cup Point- St.	
14				8	HALF NUT- 3/8" -16-NC-Hex.- St.	
15		10	4A1272	8	SPRING- Pump Control Lever	
16		11	2C1116	8	CLAMP- Spring Anchor	
17				8	CAPSCREW- 1/4" -20 -NC x 1 Lg.- St.	
18		12		8	TAPER PIN- #1 x 1-1/4" Lg.- St.	
19		4	S-862	2	COLLAR- Control Shaft	
20		5		2	SETSCREW- 1/4"-20 x 1/2" Lg.-Sq.Hd.- C.P.	
21		15	3A2046	8	LINK- Control Lever to Pump Rack	
22		16	3A2047	16	PIN- Link to Lever & Pump Rack	
23				16	COTTER PIN- 3/32" x 3/4" Lg.- St.	
24						
25					---Control Shaft Linkage- Governor to Shaft-	
26		18	4B1139	1	LEVER- Manual Stop- Fuel Rack Shaft	
27						
28				1	CAPSCREW- 3/8" -16 x 1-1/4" Lg.- St.	
29		19		1	TAPER PIN- #2 x 1-1/4"	
30						
31						
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OR OPP. HAND SEE

TOR OPP. ROT. SEE

NAME FUEL PUMP RACK CONTROL & FUEL CUT-OFF GROUP

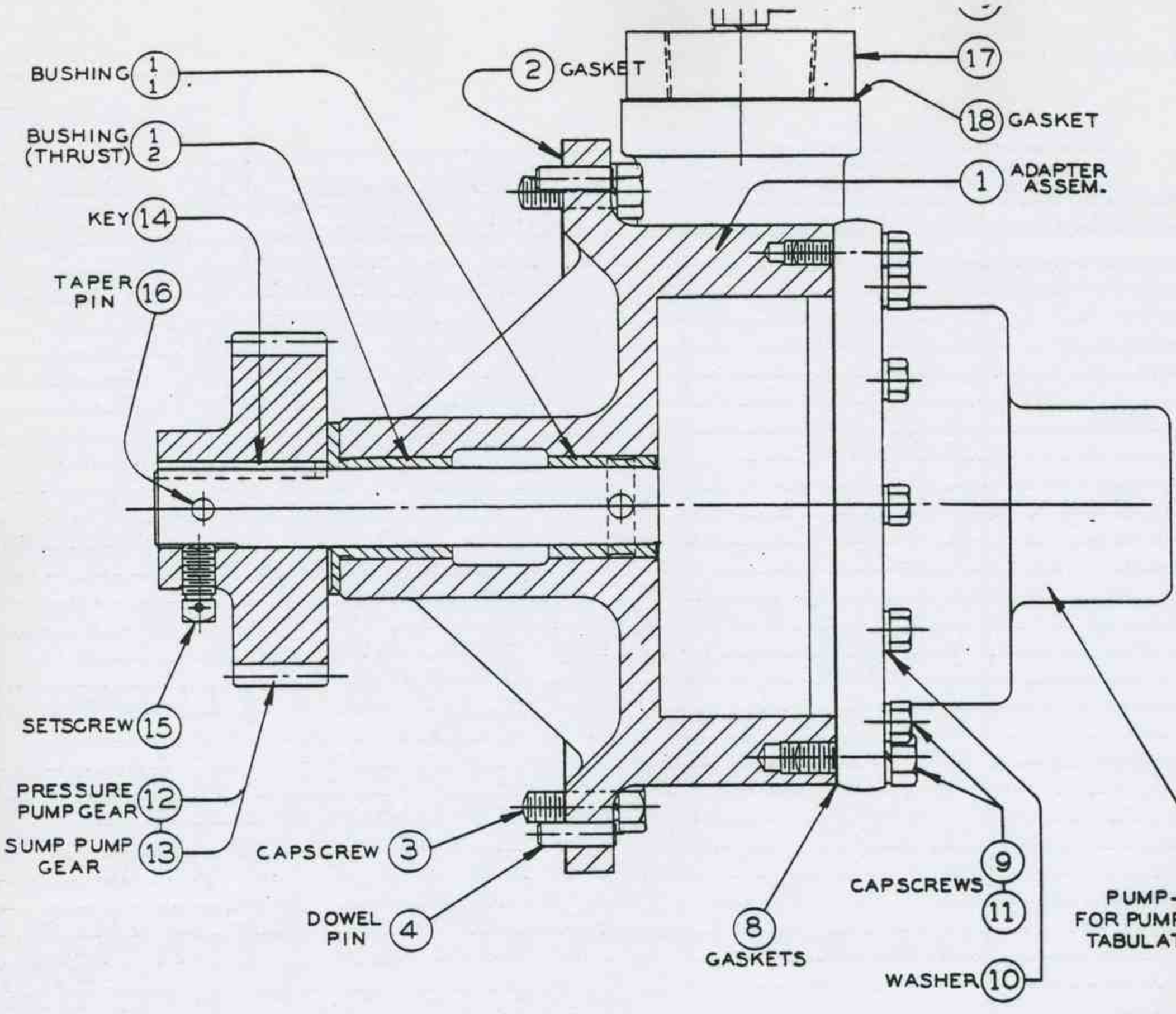
ORIGINALLY ISSUED FOR 8 CYL. 9X 10-1/2" MARINE

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

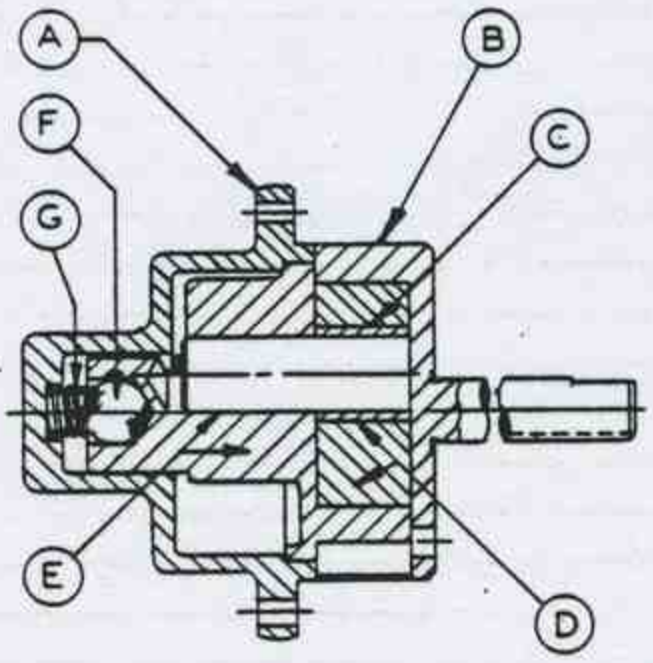
PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2546



DETAIL OF PUMPS



REVERSIBLE PUMP

REF. LET.	PART NAME	PUMP No. 4A1195
A	COVER	4A1195P1
B	ROTOR & SHAFT	4A1195P2
C	BUSHING	4A1195P3
D	IDLER & BUSHING	4A1195P4
E	CARRIER & PIN	4A1195P5
F	BALL	4A1195P6
G	SPRING	4A1195P7

NOTE-
ORDER PUMP PARTS AS PER ABOVE PART NUMBERS.
THESE PARTS ARE NOT LISTED ON GROUP SHEET.
PARTS NOT LISTED ARE NOT SOLD INDIVIDUALLY.

DO NOT ORDER PARTS BY REFER. NUMBERS

CHANGES

CHANGES

2L2547

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4036

LINE NO	DRWG. NO.	REF. NO	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG. NO.
1	4B1079	1	4Y1051	2	ADAPTOR ASSEMBLY- Lube Oil Pump	
2		2	4A1142	2	GASKET- Adaptor to Gear Housing	
3		3		16	CAPSCREW- 1/2" -13 x 1-1/2" Hex Head	
4				16	LOCKWASHER- 1/2"	
5		4	C8265L 3/4	4	PIN- Dowel Adaptor to Housing	
6						
7						
8						
9						
10		7	4A1195	2	PUMPS- L.O. (Sump & Pressure)	
11		8	4A1203	2	GASKET- (.003)	
12		8	4A1204	2	GASKET (.004)	
13		8	4A1205	2	GASKET (.005)	
14		8	4A1202	1	GASKET (.015)	
15		9		22	CAPSCREW- 3/8" -16 x 1-1/2" Hex Head	
16		10	H-9842	22	COPPER WASHER	
17		11		2	CAPSCREW- 1/2" -13 x 1-1/2" Hex Head	
18			A-573	2	WASHER	
19		12	4B1076	1	GEAR - L.O. Pressure Pump Drive	
20		13	4B1075	1	GEAR - L.O. Sump Pump Drive	
21		14	T-369	2	KEY- Gear to Pump Shaft	
22		15	4A1143	2	SETSCREW- Gear to Shaft	
23				2Pc	16 GAUGE WIRE - 8" Long (St.)	
24		16		2	TAPER PINS- #5 x 2-3/4" Lg. (St.)	
25						
26					LUBE OIL SUMP PUMP DISCHARGE	
27		17	4A1174-2	1	FLANGE- Lube Oil Sump Pump Discharge	
28		18	4A1201	1	GASKET- L.O. Sump Pump Discharge- Flange	
29		19		2	CAPSCREW- 1/2" -13 x 2-1/4"	
30				2	LOCKWASHER- 1/2"	
31				1	NIPPLE- 2" Close	
32				1	TEE- 2"	
33				1	BUSHING- 2" x 1/2" - Reducer	
34						
35					LUBE OIL PRESSURE PUMP SUCTION	
36		17	4A1174-2	1	FLANGE- L.O. Pump- Press.- Suction	
37		18	4A1201	1	GASKET- Lube Oil Press. Pump Suction-Flange	
38		19		2	CAPSCREW- 1/2" -13 x 2-1/4"	
39				2	LOCKWASHER- 1/2" Lock	
40		—				
41						
42						
43						
44						
45						
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48						
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FOR OPP. HAND SEE

R OPP. ROT. SEE

NAME LUBE OIL PRESSURE & SUMP PUMP GROUP

ORIGINALLY ISSUED FOR 9 x 10-1/2 MARINE TURBO.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2547

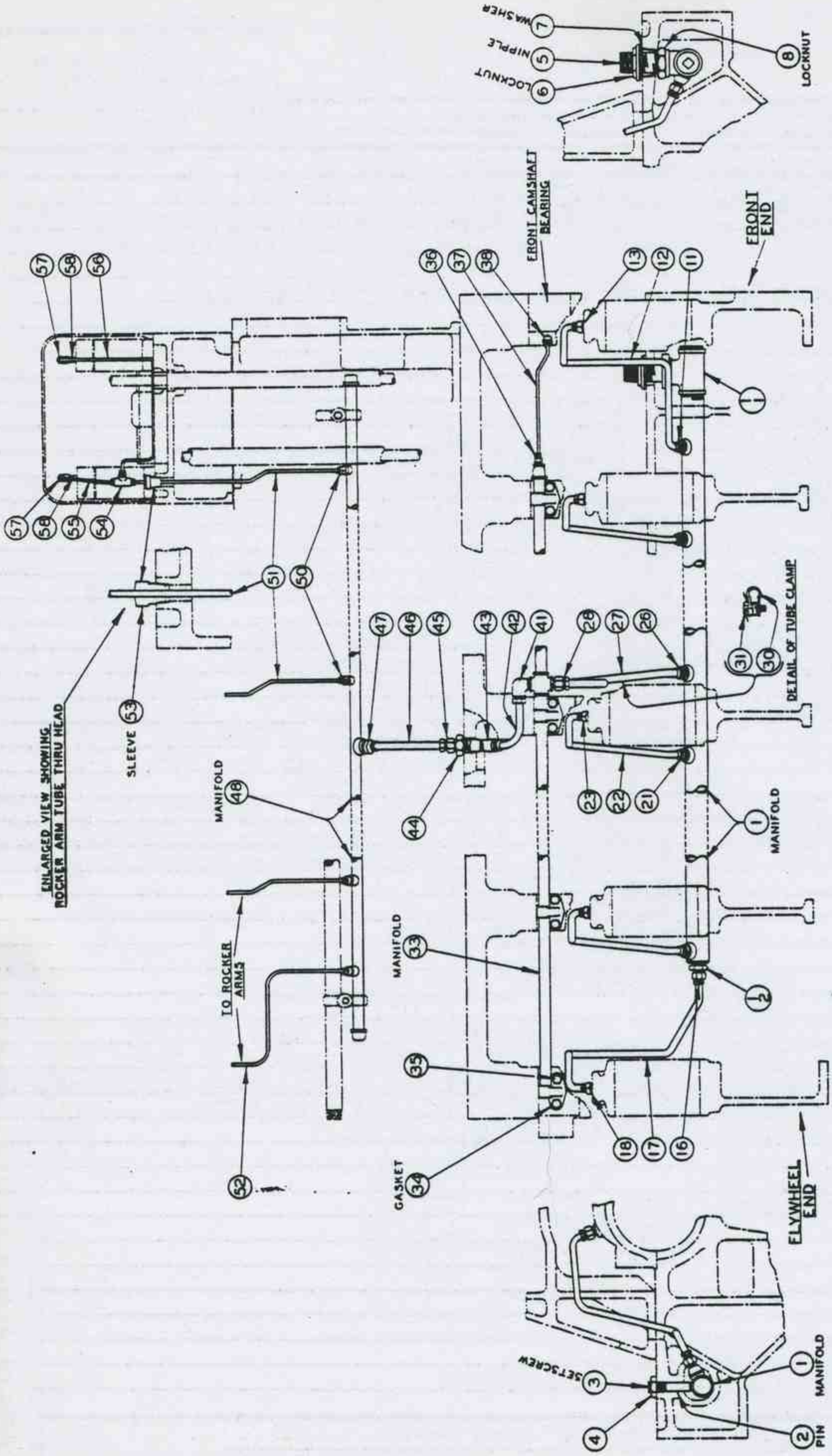

PLATE No.
3A2905

DO NOT ORDER PARTS BY REFER. NUMBERS

persedes Sheet dated 10/18/51.
#1- Changed Line 3- 2/19/52.

CHANGES

CHANGES

2L2548 SHEET 1 OF 2

PLATE NO. 3A2905

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG NO.
1		1	3A2543-X	1	MANIFOLD ASSEMBLY - Lube Oil	
2		2	3A2087	4	PIN- Manifold Retainer	
3		3	3A2088	4	SETSCREW- Mani. Pin Retainer & Hole Plug	
4		4		4	HALF NUT- 7/8" -9-NC-Hex.- St.	
5		5	3A2236	1	NIPPLE- Manifold Inlet (Thru Base)	
6		6	C-5124	1	LOCKNUT- Nipple	
7		7	3A2237	1	WASHER- Locknut Seal	
8						
9						
10						
11		---MANIFOLD OUTLET TO CRANK BEARING CAP - FRONT END---				
12		11	C9801P 1/2	1	CONNECTOR- Tube	
13		12	3A2759	1	TUBE- Manifold to Brg. Cap (Front End)	
14		13	C9801P 1/2	1	CONNECTOR- Tube	
15						
16						
17		---MANIFOLD OUTLET TO CRANK BEARING CAP- FLYWHEEL END---				
18		16	C9801P 1/2	1	CONNECTOR- Tube	
19		17	3A2764	1	TUBE- Mani. to Brg. Cap- Flywheel End	
20		18	C9801P 1/2	1	CONNECTOR- Tube	
21						
22						
23		---MANIFOLD OUTLET TO CRANK BEARING CAP---				
24		21	C9801P 1/2	7	CONNECTOR- Tube	
25		22	3A2755	7	TUBE- Manifold to Bearing Cap	
26		23	C9801P 1/2	7	CONNECTOR - Tube	
27						
28						
29		---MAIN LUBE MANIFOLD TO CAMSHAFT LUBE MANIFOLD---				
30		26	C9801P 5/8	1	CONNECTOR- Tube	
31		27	4C1045	1	TUBE- Mani. to Camshaft Lube Manifold	
32		28	#10-FBTX	1	PARKER ASSEMBLY	
33						
34		30	3A2516	1	CLAMP - Tube to Centerframe	
35		31	C2408L1 1/4	1	CAPSCREW- Clamp to Centerframe	
36				4	PLAIN WASHER- 1/2" SAE Std. - St.	
37				1	WIRE- #16 Ga. - x 8" Lg. - St.	
38	4C1044	33	4Y1030	1	MANIFOLD ASSEMBLY- Camshaft Lubricating	
39		36	#4-FBTX	1	PARKER ASSEMBLY	
40		37		1	TUBE- Front End Bearing 1/4" OD x .030 x 13" Lg.- S.D. Copper	
41						
42		38	#4-FBTX	1	PARKER ASSEMBLY	
43		34	4A1105	8	GASKET- Manifold to Camshaft Bearing	
44						
45						
46						
47					---CONTINUED ON SHEET NO. 2---	
48						
49						
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FOR OPP. HAND SEE

OR OPP. ROT. SEE

NAME MANIFOLDS- L.O.(Main & Secondary) & INTERNAL PIPING

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 MAR. TURBO.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2548 SHEET 1 OF 2

Retyped & revised from copy dated 1/2/52.

CHANGES #3

CHANGES

2L2548 SHEET 2 OF 2

PLATE NO 3A2905

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

LINE NO	DRWG. NO.	REF. NO	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG. NO
1					---CONTINUED FROM SHEET NO. 1---	
2		----	-CAM BEARING	MANIFOLD TO	VALVE ROCKERS----	
3				1	BUSHING- 1/2" x 3/8" Reducing	
4		41	#8-CBTX	1	PARKER ASSEMBLY	
5		42		1	TUBE (To connect on Centerframe)	
6					1/2" OD x .049 x 9-1/2" Lg.- Copper	
7		43	3A2777	1	ELBOW- Tube 45°	
8		44	3A3303	1	FITTING- Tube Conn. thru Centerframe	
9				1	BUSHING- Reducer 1/2" x 1/8"- Mall.	
10		45	#3-FBTX	1	MALE CONNECTOR- Tube	
11		46		1	TUBE (Centerframe Connect to Valve Rocker	
12					Manifold) 3/16" OD - .032 Wall x 34" Lg.	
13		47	#3-FBTX	1	MALE CONNECTOR - Tube	
14				1	BUSHING- Reducer- 3/8" x 1/8"- Mall.	
15		48	3A2563-X	1	MANIFOLD ASSEMBLY- Valve Rocker Lube	
16					(NOTE: For Clamp see Fuel Inj. Group)	
17						
18		50	C9801P 1/4	8	CONNECTOR- Tube	
19		51		7	TUBE (Mani. to Tee) 1/4" OD x .030	
20					x 19-1/4" Lg.- S.D.Copper	
21		52		1	TUBE (Mani. to Tee- Flywheel End) 1/4" OD x	
22					.030 x 25-1/2" Lg.- S.D.Copper	
23		53	3A2581	8	SLEEVE- Rocker Lube Oil Tube Seal (Rubber)	
24		54	C9809P 1/4	8	TEE - Tube	
25		55		8	TUBE- 1/4" OD x .030 x 8-3/4" Lg.-S.D.Cop.	
26		56		8	TUBE- 1/4" OD x .030 x 24-1/4" Lg.-S.D.Cop.	
27				8	TUBE CLIPS- TA-604-4	
28		57	C-9805P 1/4	16	ELBOW- Tube (Female)	
29		58		16	NIPPLE- In Rocker Bearing-	
30					1/8" x 2" Long- W.I.	
31						
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OPP. HAND SEE

OPP ROT SEE

NAME MANIFOLDS -L.O. (Main & Secondary) & INTERNAL PIPING

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 MAR. TURBO.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2548 SHEET 2 OF 2

evised & retyped from copy dated 12/29/51.

CHANGES #1

CHANGES

2L2549 SHEET 1 OF 3

PLATE NO

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG. NO.
1					---LUBE OIL LINES- SUMP TO PUMP---	
2			4A1174-1	1	FLANGE- Lube Oil Line	
3			4A1201	1	GASKET	
4				2	CAPSCREW- 1/2" -13 x 2" Lg.	
5				2	LOCKWASHER- 1/2"	
6			4C1080	1	TUBE- Lube Oil Suction Line	
7			4B1100	1	CONNECTION- Lube Oil Sump Pump Suction	
8			4A1201	1	GASKET- Lube Oil Sump Pump SuctionConn.	
9				2	CAPSCREW- 1/2" -13 x 2"	
10				2	LOCKWASHER- 1/2"	
11				1	PIPE PLUG- 1" - C.I.	
12						
13					---LUBE OIL LINE- PUMP TO FILTER BRACKET---	
14			4C1073	1	CONNECTION- Lube Oil Pressure Discharge	
15			4A1201	1	GASKET- Lube Oil Pressure Discharge Conn.	
16				2	CAPSCREW- 1/2" -13 x 2"	
17				2	LOCKWASHER- 1/2"	
18			BM-3421-A	1	LUBE OIL PRESSURE REGULATING VALVE	
19			4C1077	1	TUBE- Lube Oil Pump to Filter Bracket	
20			4A1174-1	1	FLANGE- Lube Oil Line	
21			4A1201	1	GASKET- Lube Oil Line	
22				2	CAPSCREW- 1/2" -13 x 1-1/2"	
23				2	LOCKWASHER- 1/2"	
24						
25			4C1075	1	CONNECTION- Filter Bracket to Cooler	
26			4A1201	2	GASKET	
27				4	CAPSCREW- 1/2" -13 x 1-3/4"	
28				4	LOCKWASHER- 1/2"	
29				1	PIPE PLUG- 3/8" Std.- C.I.	
30						
31					---LUBE OIL LINE- COOLER TO ENGINE---	
32			4B1102	1	CONN.- L.O. Cooler Outlet	
33			4A1267	1	COLLAR- Conn. L.O. Cooler Outlet	
34			4A1201	1	GASKET	
35				1	CAPSCREW- 1/2" -13 x 1-1/2"	
36				1	CAPSCREW- 1/2" -13 x 4" Lg.	
37				2	LOCKWASHER- 1/2"	
38			4C1079	1	TUBE- Lube Oil Line Cooler to Engine	
39			4A1058	1	CLAMP- Lube Oil Line	
40		—	A-11457	1	MUELLER UNION ELBOW	
41				1	PIPE PLUG- 1/4" Std.- C.I.	
42				1	TUBING- 2-1/8" OD x .065 Wall x 34" Lg. (Co	
43			A-6113	1	MUELLER ELBOW	
44				1	REDUCER BUSHING- 2" x 1-1/2"	
45						
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FOR OPP. HAND SEE

OR OPP. ROT. SEE

NAME EXTERNAL LUBE OIL PIPING

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2549 SHEET 3 OF 3

Retyped & revised from copy dated 12/29/51.

CHANGES #1

CHANGES

2L2549 SHEET 2 OF 3

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG NO
1					---LUBE OIL PIPING BRACKET TO FILTER---	
2			#16-CBTX	8	PARKER ELBOW	
3				4	TUBING- 1" OD x .065 Wall x 24" Long	
4						
5					---PIPING FILTER TO BRACKET	
6			#16-CBTX	8	PARKER ELBOW	
7				4	TUBING- 1" OD x .065" Wall x 12" Long	
8						
9					---MASTER L.O.PIPE FROM L.O.COOLER TO	
10					AUX. LINES---	
11			#12-CBTX	2	PARKER MALE ELBOW	
12				1	COPPER 3/4" OD x .049 Wall x 6' Lg.	
13				1	TEE- 3/4" x 3/4" x 3/4"- Mall.	
14						
15					---FROM TEE (L.O.Cooler) TO TIMING GEAR"	
16				1	BUSHING- 3/4" x 1/8"- Mall.	
17				1	NIPPLE- 1/8" Close	
18				1	TEE- 1/8" x 1/8" x 1/8"	
19			#4-FBTX	1	PARKER MALE CONNECTOR	
20				1	COPPER TUBING- 1/4" OD x .049 Wall x 9" Lg.	
21			#4-CBTX	1	PARKER MALE ELBOW	
22						
23					---FROM TEE (TIMING GEAR) TO GOVERNOR---	
24			#4-CBTX	1	PARKER MALE ELBOW	
25				1	COPPER TUBING- 1/4" OD x .049" Wall -65" Lg	
26				2	TUBE CLIPS- TA-713S-4	
27			#4-CBTX	1	PARKER MALE ELBOW	
28						
29					---FROM TEE (L.O.COOLER) TO L.O.SUMP PUMP--	
30				1	TEE -3/4" x 1/2" x 1/2" - Mall.	
31				1	BUSHING- 3/4" x 1/8"- Mall.	
32			#4-CBTX	1	PARKER MALE ELBOW	
33				1	COPPER TUBING- 1/4" OD x .049 Wall- 9" Lg.	
34			#4-CBTX	1	PARKER MALE ELBOW	
35						
36					---FROM TEE (L.O.SUMP PUMP) TO L.O.	
37					PRESSURE PUMP---	
38				1	NIPPLE - 1/2" Close	
39				1	ELBOW- 1/2" x 45°- Mall.	
40				1	NIPPLE- 1/2" x 6-1/2" lg.- Black Pipe	
41			4A1206	1	CLAMP	
42				1	TEE- 1/2" x 1/2" x 1/2"- Mall.	
43				1	BUSHING- 1/2" x 1/8"- Mall.	
44			#4-FBTX	1	PARKER MALE CONNECTOR	
45				1	COPPER TUBING- 1/4" OD x .049" x 16"	
46					Lg.	
47			#4-CBTX	1	PARKER MALE ELBOW	
48						
49						
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UH OPP. HAND SEE

1 OPP. ROT. SEE

NAME EXTERNAL LUBE OIL PIPING

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2549 SHEET 2 OF 3

yped & revised from copy dated 12/29/51.
#1

CHANGES

2L2549 SHEET 3 OF 3

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG NO.
1					--FROM TEE (L.O.PRESSURE PUMP) TO	
2					REDUCTION GEAR---	
3				1	BUSHING- 1/2" x 1/4" - Mall.	
4			#6-CBTX	1	PARKER MALE ELBOW	
5				1	COPPER TUBING- 3/8" OD x .049 Wall- 5' Long	
6				2	CLIP- TA-7135-6	
7			#6-CBTX	1	PARKER MALE ELBOW	
8				1	BUSHING- 1/2" x 1/4" -Mall.	
9						
10					---TURBO L.O. DRAIN TO BASE---	
11				1	NIPPLE- 1" x 3-1/2" Lg.- Black Pipe	
12				1	BUSHING- 1" x 1-1/4"	
13				1	ELBOW- 1-1/4" x 45°	
14				1	COPPER TUBING- 1-1/4" OD x .083" Wallx 60"	
15					Long	
16			#20-FBTX	2	PARKER MALE CONNECTOR	
17						
18					---FROM REDUCTION GEAR TO BASE-	
19					DRAIN LINE ---	
20				1	NIPPLE- 1/2" x 1-1/2" Lg.- Black Pipe	
21				1	ELBOW- 1/2" -90°- Mall.	
?				1	NIPPLE- 1/2" x 3-1/2" Lg.- Black Pipe	
3			#10-DBTX	1	FEMALE CONNECTOR	
4				1	COPPER TUBING-1/2" OD x .049 x 25" Long	
5			#10-CBTX	1	PARKER MALE ELBOW	
6				1	CLOSE NIPPLE- 1/2" - Black Pipe	
7						
8					---LUBE OIL LINE- "TO TURBO"---	
9				2	BUSHING 3/8" x 1/4" - Reducer	
0				1	COPPER TUBING- 3/8" OD x .049 Wall x 60"	
1			#6-FBTX	2	PARKER MALE CONNECTOR	
2			TA-713S-6	6	TUBE CLIPS	
3						

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NAME EXTERNAL LUBE OIL PIPING

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2549 SHEET 3 OF 3

Retyped from copy dated 9/28/51.

CHANGES #1

CHANGES

2L2550

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO.

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1			4B1072	1	OIL COOLER	
2				4	CAPSCREW- 5/8-11-NC x 1-3/4 Lg. (St.)	
3				4	LOCKWASHER- 5/8 SAE Reg.- (St.)	
4				4	PLAIN WASHER- 5/8" SAE Std.- (St.)	
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NAME LUBE OIL COOLER GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 MAR. TURBO.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2550

Retyped & revised from copy dated 12/29/51.

CHANGES #1

CHANGES

2L2551

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO See "AUX.EQUIP."

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1			4D1006-A	4	FILTER- Lube Oil	
2			4E1014-B	1	BRACKET & MANIFOLD- L.O. Filter	
3			4	6	CAPSCREW- 1/2" -13 x 1-1/2"	
4						
5				6	LOCKWASHER- 1/2"	
6			4B1204	1	BRACE- Lube Oil Filter Bracket	
7				1	CAPSCREW- 5/8" -11 x 2-1/2" Lg.	
8				1	PLAIN WASHER 5/8"	
9				1	LOCKWASHER 5/8"	
10				1	NUT- 5/8" -11 - Hex	
11				2	CAPSCREW- 5/8" -11 x 1-3/4" Lg.	
12				2	LOCKWASHER- 5/8"	
13			S-1005	2	GASKET- Bracket to Block	
14			4A1210	1	SHIM- Bracket to Block	
15				32	CAPSCREW- 5/16" -18 x 3/4" Lg.	
16				32	LOCKWASHER- 5/16" Std.-Filter to Bracket	
17				2	PIPE PLUG- 1-1/4" Std. (C.I.)	
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NAME LUBE OIL FILTER

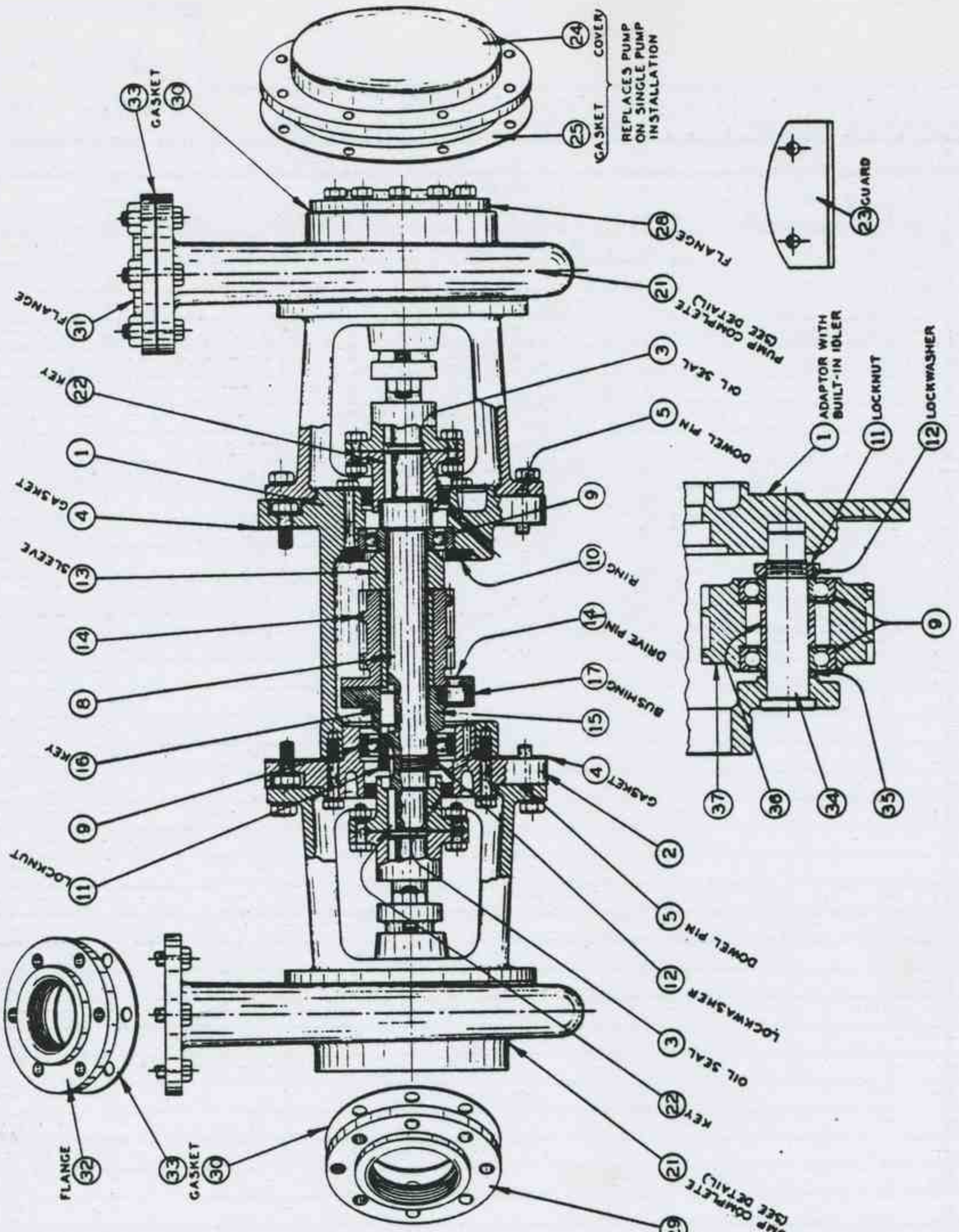
ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

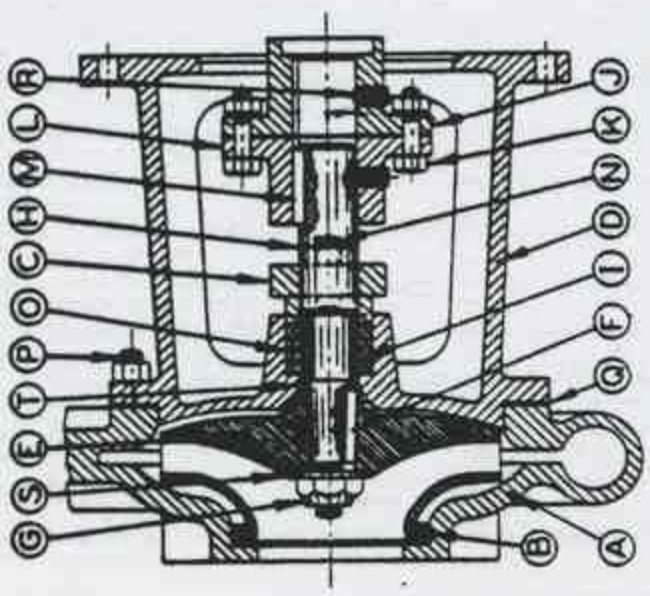
PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2551



ORDER PUMP PARTS AS PER PART NUMBERS LISTED IN TABULATION SHOWN BELOW.



FRESH WATER PUMP

RAW WATER PUMP

REF. LET.	PART NAME	PUMP No. W-2310-P	PUMP No. 3A1874
A	CASING	W-2310-P1	3A1874 P1
B	RING	W-2310-P2	W-2310-P2
C	GLAND	W-2310-P3	W-2310-P3
D	FRAME	W-2310-P4	3A1874 P4
E	IMPELLER	W-2310-P5	W-2310-P5
F	KEY	W-2310-P6	W-2310-P6
G	NUT	W-2310-P7	W-2310-P7
H	SHAFT	W-2310-P8	3A1874 P8
I	SLEEVE	W-2310-P9	W-2310-P9
J	COUPLING	W-2310-P10	W-2310-P10
K	BOLT		
L	COUPLING	W-2310-P14	W-2310-P14
M	KEY	W-2310-P15	W-2310-P15
N	STUD	W-2310-P17	W-2310-P17
O	PACKING	W-2310-P20	W-2310-P20
P	STUD	W-2310-P21	W-2310-P21
Q	GASKET	W-2310-P23	W-2310-P23
R	SET SCR.	W-2310-P16	W-2310-P16
S	IMP. WASH.	W-2310-P7A	W-2310-P7A
T	WASHER	W-2310-P25	W-2310-P25

--NOTE--
FRESH WATER PUMP - BRONZE FITTED
RAW (SALT) WATER PUMP - ALL BRONZE FITTED WITH MONEL SHAFT

PLATE No. 3A2935 (ED.3) DO NOT ORDER PARTS BY REFER. NUMBERS

typed & revised from sheet dated 1/7/52.
#1

CHANGES

CHANGES

2L2552

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A2935 (Ed.3)

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		1	4D1048	1	ADAPTOR- Water Pump- Lg.- Flywheel End	
2		2	4C1071	1	ADAPTOR- Water Pump- Short	
3		3		2	OIL SEAL- National Motor Brg. #50320	
4		4	4A1184	1	GASKET- Water Pump Adaptor- Lg.	
5		4	4A1185	1	GASKET- Water Pump Adaptor- Short	
6				14	CAPSCREW- 1/2" -13 x 1-1/4" Lg.-St.-Hex Hd.	
7				14	LOCKWASHER- 1/2"	
8			C2406L2 1/4	6	CAPSCREW	
9			4A1310	6	GASKET	
10		5	C6392L1 1/2	4	PIN- Adaptor to Gear Housing Dowel	
11						
12		8	3A2106	1	SHAFT- Water Pump Drive	
13		9	2C2585P	4	BALL BEARING- Drive Shaft	
14		10	3A2108	1	RETAINER RING- Ball Bearing	
15			C2506L3	4	CAPSCREW	
16				4	WASHER- 3/8" -Plain- Copper	
17		11	2C2619	2	LOCKNUT- Ball Bearing Washer	
18		12	2C2618	2	WASHER- Ball Bearing	
19		13	3A2110	1	SLEEVE- Drive Shaft- (& Gear Spacer)	
20	4A1186	14	4Y1057	1	GEAR ASSEMBLY- Water Pump Drive	
21		15	3A2107	1	COUPLING- Water Pump Drive Gear	
22		16	3A2203	1	KEY- Drive Coupling to Shaft	
23		17	2C5261	6	BUSHING- Coupling Drive Pin	
24						
25						
26		21	3A1874	1	PUMP - Centrifugal Water (Sea Water)	
27		21	W-2310	1	PUMP- Centrifugal Water (Fresh Water)	
28				16	CAPSCREW- 1/2" -13 x 1-1/2" - St.	
29				16	LOCKWASHER- 1/2" - St.	
30		22	C6804L1 7/8	2	KEY- Pump Coupling to Drive Shaft	
31		23	2C2918	2	GUARD- Water Pump Drive & Drive Coupling	
32						
33						
34		28	2C2764	1	FLANGE- Raw Water Pump Suction(3" Pipe Tap)	
35						
36		30	2C2765	1	GASKET- Flange to Pump	
37				8	CAPSCREW- 1/2" -13 x 1-1/2" Lg.- St.	
38		31	2C2762	1	FLANGE- Raw Water Pump Discharge	
39					(2-1/2" Pipe Tap)	
40		33	2C2763	1	GASKET- Flange to Pump	
41				6	CAPSCREW-(Flange) 1/2" -13 x 1-3/4" Lg.(St.)	
42				6	NUT-(Flange) -1/2" -13 Hex Head- Steel	
43						
44		34	4B1095	1	SHAFT- Water Pump Idler Gear	
45		35	4A1183	1	SPACER- Water Pump Idler Gear	
46		36	4A1182	1	SPACER- Water Pump Idler Gear Shaft	
47		37	4B1097	1	GEAR- Idler for Water Pump Gear	
48						
49					See 910LA-344	
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NAME CENTRIFUGAL WATER PUMP & DRIVE GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 MAR. TURBO.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2552

typed from copy dated 10/22/51.

CHANGES #1

CHANGES

2L2554

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO.

LINE NO.	DRWG. NO.	REF. NO	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1					---WATER LINE- INLET---	
2						
3			#16-FBTX	2	PARKER CONNECTION	
4				1	COPPER TUBING- 1" OD x .065" Wall x 26" Lg.	
5				1	NIPPLE- 3/4" x 2-1/2" Long	
6				1	COUPLING- 1" x 3/4" - Red.	
7						
8					---WATER LINE- OUTLET---	
9			#16-12-CBTX	1	PARKER ELBOW	
10				1	COPPER TUBING- 1" OD x .065" Wall x 22" Lg.	
11			#16-FBTX	1	PARKER CONNECTION	
12				1	TEE- 1" x 1/4" x 1" Mall.	
13				1	NIPPLE- 1" Close	
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NAME WATER PIPING- PUMP TO TURBO.

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 MAR. DR

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

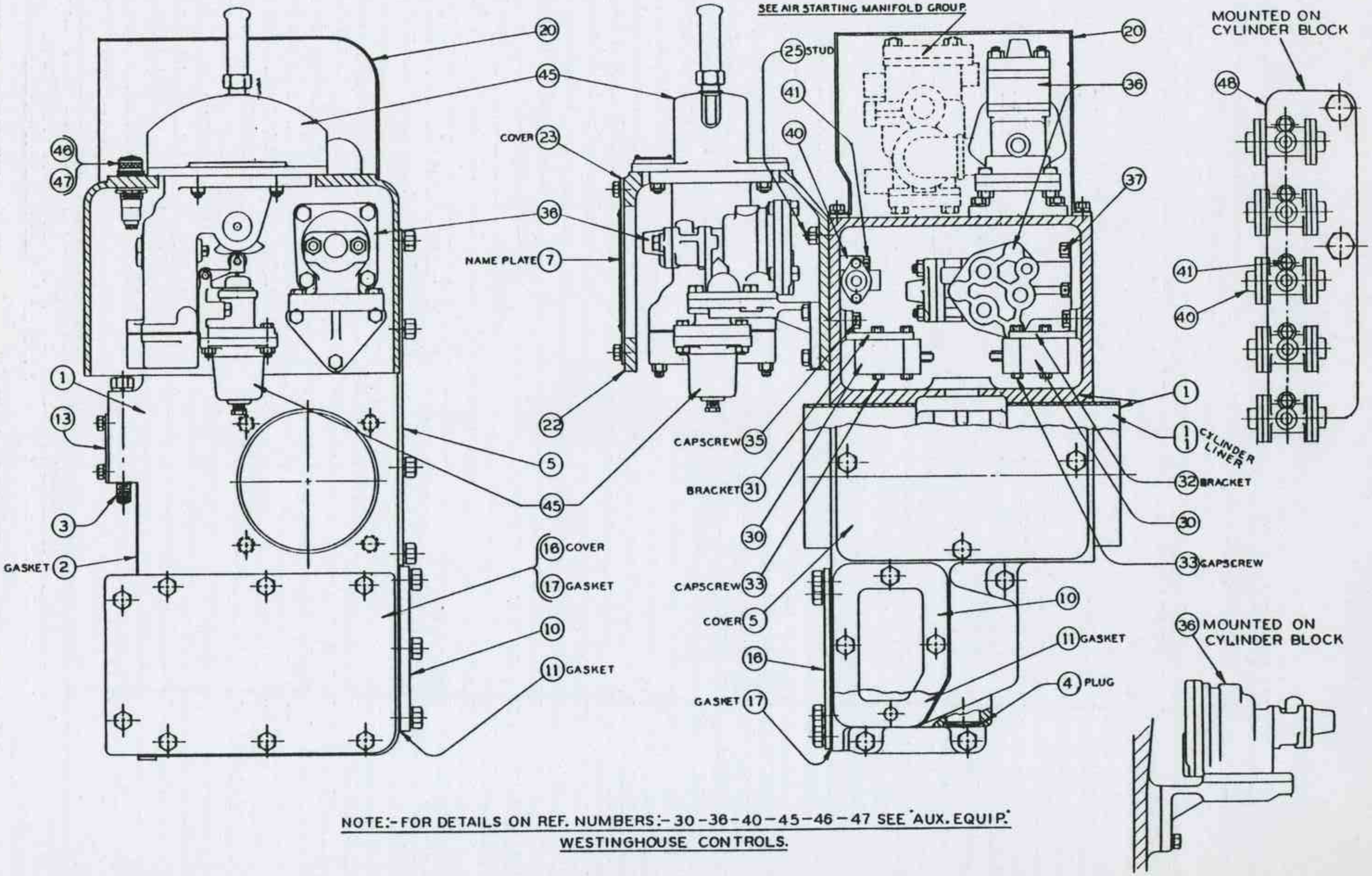
PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2554

PLATE No. 3A 4032

DO NOT ORDER PARTS BY REFER. NUMBERS.



NOTE:- FOR DETAILS ON REF. NUMBERS:- 30-36-40-45-46-47 SEE 'AUX. EQUIP.' WESTINGHOUSE CONTROLS.

Retyped & revised from copy dated 10/25/51.

CHANGES #1

CHANGES

2L2555 SHEET 1 OF

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4032

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG NO.
1		30		2	#C1B PILOTAIR VALVES "Shifting Control"	
2					Westinghouse Part #531315 (Item #5	
3					of our BM-6383)	
4		31	4A1197	1	BRACKET- Pilotair Valves	
5		32	4A1198	1	BRACKET- Pilotair Valves	
6			4A1304	6	SHIM- Pilotair Valves- Bracket	
7		33	R-7539	4	CAPSCREW	
8				4	NUT- 1/4" -24 Light Thick Slotted	
9				4	COTTER PIN- 1/16" x 5/8" Lg.	
10			R-6199	2	DOWEL PIN	
11		35	H-4828	4	CAPSCREW	
12				4	16 Ga. WIRE - 8" Long	
13		36		1	H-5 RELAYAIR VALVE-"Starting Line Inter-	
14					ceptor"- Westinghouse Part #530530	
15					(Item #6 of our BM-6383)	
16		37	H-4828	3	CAPSCREW	
17				3	LOCKWASHER- 3/8"	
18				3	16 GA. WIRE - 12" Long	
19		40		1	#18A DOUBLE CHECK VALVE "Starting Inter-	
20					ceptor Supply"- Westinghouse Part	
21					#521774 (Item #7 of our BM-6383)	
22		41	H-6624-A	1	CAPSCREW- 5/16" -18 x 1-1/2" -Double Check	
23					Valve to Air Reverse Housing	
24				1	16 GAUGE WIRE- 6" Long	
25		40		1	#18A DOUBLE CHECK VALVE- "Stop Relay Suppl	
26					Westinghouse Part #521774	
27					(Item #10 of our BM-6383)	
28		41	H-6624-A	1	CAPSCREW- 5/16" -18 x 1-1/2" Double Check	
29					Valve to Air Reverse Housing	
30				1	#16 GAUGE WIRE - 6" Long	
31		40		1	#18A DOUBLE CHECK VALVE "Stop Cylinder Che	
32					Westinghouse Part #521774	
33					(Item #13 of our BM-6383)	
34		41	H-6624-A	1	CAPSCREW- 5/16" -18 x 1-1/2"-Double Check	
35					Valve to Air Reverse Housing	
36				1	#16 GAUGE WIRE- 6" Long	
37		40		3	#18A DOUBLE CHECK VALVE- Pilot House or	
38					Engine Control- Westinghouse Part #5217	
39					(Item #3 of our BM-6383)	
40		41	H-6624-A	3	CAPSCREW- 5/16" -18 x 1-1/2" -Double Check	
41					Valve to Air Reverse Housing	
42				3	16 GAUGE WIRE- 6" Long	
43		36		1	H-5 RELAYAIR VALVES "To Engine Stop	
44					Cylinder"- Westinghouse Part	
45					#530530 (Item #9 of our BM-6383)	
46				3	CAPSCREW- 3/8" -16 x 1-1/4"	
47				3	LOCKWASHER- 3/8"	
48						
49						
50					---CONTINUED ON SHEET NO. 2---	

2L2555 SHEET 1 OF 2

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NAME WESTINGHOUSE EQUIPMENT IN & ON CONTROL HOUSING

ORIGINALLY ISSUED FOR

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

Typed & revised from copy dated 10/25/51.
#1

CHANGES

CHANGES

2L2555 SHEET 2 OF 2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A4032

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		48	4A1263-A	1	PLATE- for 18A - Double Check Valve	
2				2	CAPSCREW - 3/8" x 1" Hex Head	
3				5	CAPSCREW- 5/16" -18 x 1-1/2" Lg.- Hex Head	
4				5	LOCKWASHER- 5/16"	
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NAME WESTINGHOUSE EQUIPMENT IN & ON CONTROL HOUSING

ORIGINALLY ISSUED FOR

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

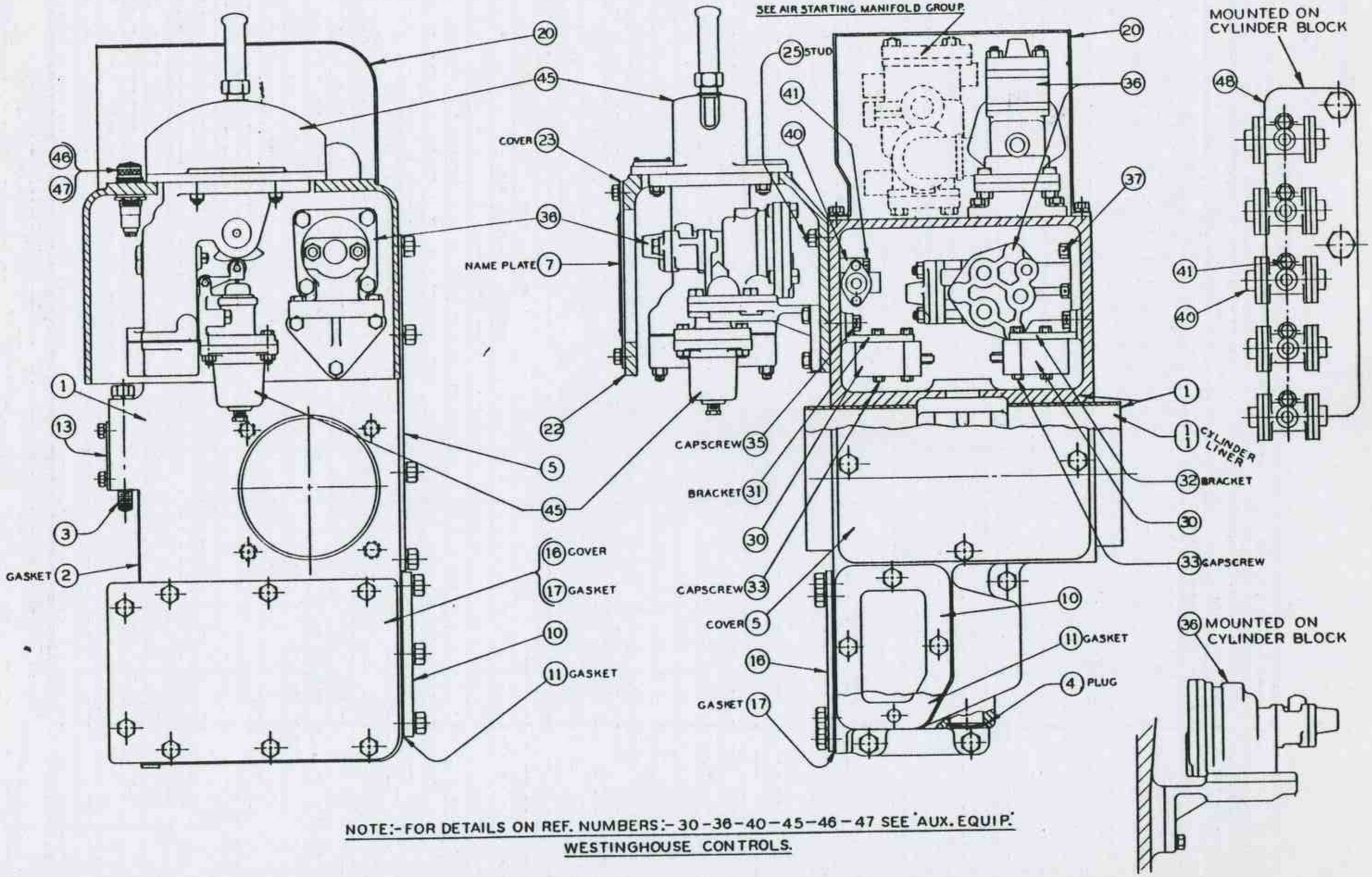
PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2555 SHEET 2 OF 2

PLATE No. 3A4032

DO NOT ORDER PARTS BY REFER. NUMBERS.



NOTE:- FOR DETAILS ON REF. NUMBERS:- 30-36-40-45-46-47 SEE 'AUX. EQUIP.' WESTINGHOUSE CONTROLS.

etyped from copy dated 10/25/51.

CHANGES #1

CHANGES

2L2556

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4032

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG NO.
1		45		1	#2A-2B - CONTROLAIR - Westinghouse Part	
2					#850652 (Item 2A or our BM-6383)	
3		46		1	#2C - RED ALARM LIGHT- Westinghouse Part	
4					#529990 (Item 2C of our BM-6383)	
5		47		1	#2D - GREEN ALARM LIGHT- Westinghouse Part	
6					#529989 (Item 2D of our BM-6383)	
7		36		1	#H5 - RELAYAIR VALVE - to Air Cylinder	
8					Operating Side- Westinghouse Part	
9					#530530 (Item #25 of our BM-6383)	
10				3	CAPSCREW- 3/8" -16 x 1" Hex Head	
11			H-15402	3	SPACER	
12				3	LOCKWASHER- 3/8"	
13		36		1	#H5 - RELAY AIR VALVE- to Air Cyl. Exh. Sid	
14					Westinghouse Part #530530	
15					(Item #25 of our BM-6383)	
16				3	CAPSCREW- 3/8" -16 x 1" Hex Head	
17				3	LOCKWASHER- 3/8"	
18						
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OPP. HAND SEE

OPP. ROT. SEE

NAME WESTINGHOUSE CONTROL AND AIR CYLINDER RELAYS

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 TURBO MAR.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2556

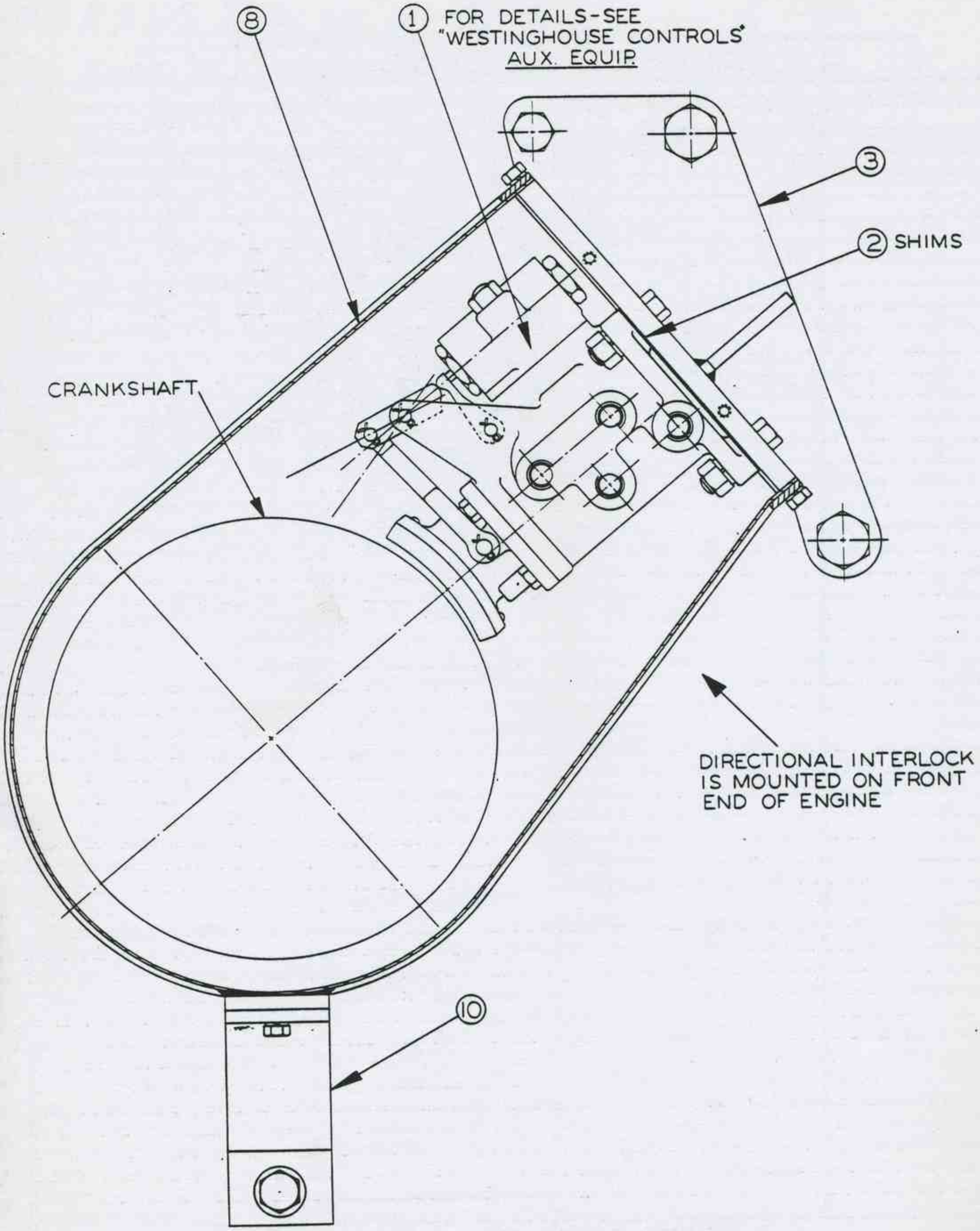

PLATE NO. 3A4041

DO NOT ORDER PARTS BY REFER. NUMBERS

Retyped & revised from sheet dated 1/2/52.

CHANGES #1

CHANGES

2L2557

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A4041

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO. REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		1		1	DIRECTIONAL INTERLOCK- Westinghouse Part	
2					#533195 (Item #11 of our BM-6383)	
3		2	R-6181	2	SHIMS- Interlock to Bracket	
4			4A1305	2	SHIMS- Westinghouse Interlock	
5		3	4D1049	1	BRACKET - Mtg. Directional Interlock	
6				2	CAPSCREW- 5/8" -11 x 1-1/4" Long	
7				2	LOCKWASHER- 5/8"	
8				1	CAPSCREW- 1/2" -13 x 1-1/4" Long	
9				1	LOCKWASHER- 1/2"	
10				3	CAPSCREW- 3/8" -16 x 1-1/2" Long	
11				3	LOCKWASHER- 3/8"	
12				3	NUT- 3/8" -16 Hex Head	
13		8	4C1078	1	GUARD- for Crankshaft	
14				6	CAPSCREW- 1/4" -20 x 3/4"	
15				6	LOCKWASHER- 1/4"	
16		10	4A1175	1	BRACKET- For Mtg. Crankshaft Guard	
17						
18				2	CAPSCREW- 1/4" -20 x 1" Long	
19				2	CAPSCREW- 1/2" -13 x 4-1/4" Long	
20				2	LOCKWASHER- 1/2"	
21						
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OPP. HAND SEE

OPP. ROT. SEE

NAME WESTINGHOUSE DIRECTIONAL INTERLOCK

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

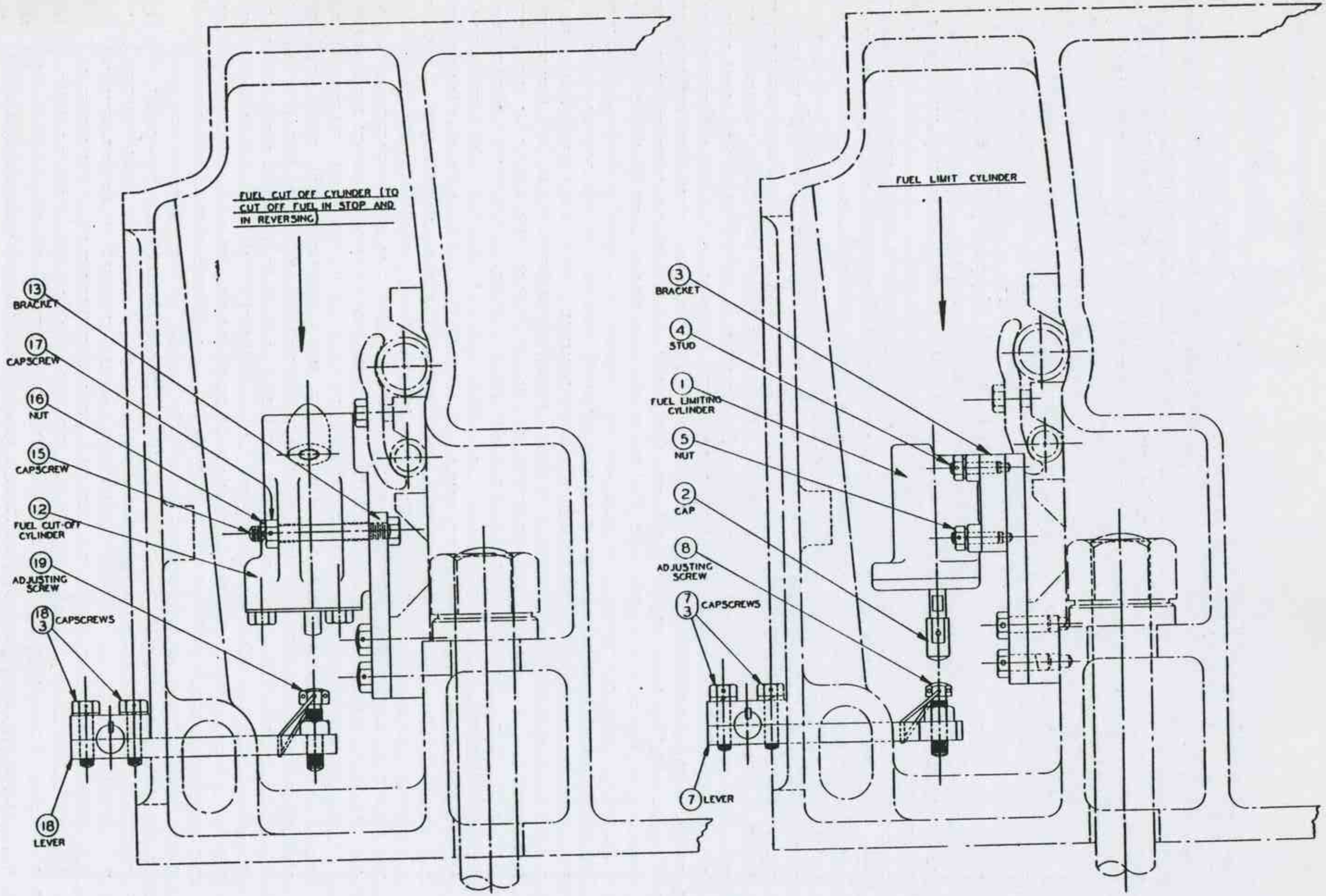
PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2557

PLATE No. 3A4042

DO NOT ORDER PARTS BY REFER NUMBERS



NOTE - FOR DETAILS ON REF. NUMBERS:- 1 & 12 SEE 'AUX EQUIP.' WESTINGHOUSE CONTROLS

typed from copy dated 10/25/51.
#1- Line 16 was 4A1216. 3/31/52.

CHANGES

CHANGES

2L2558

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A4042

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		1		1	FUEL LIMITING CYLINDER- Westinghouse Part	
2					#523159 (Item 24 of our BM-6383)	
3		2	R-6205	1	CAP- Fuel Limiting Cylinder	
4				1	COTTER PIN- 1/16" x 5/8" Lg.	
5		3	4B1107	1	BRACKET- Fuel Limiting Cylinder	
6		4	4A1219	4	STUD- Bracket- Fuel Limiting Cylinder	
7		5		4	NUT- 1/4" -28 Light Thick Slotted	
8				4	COTTER PIN- 1/16" x 5/8" Lg.	
9		6	H-4828	2	CAPSCREW- Fuel Limiting Bracket to Cyl.Blk.	
10				1	WIRE- #16 Gauge- 4" Long	
11		7	4Y1063	1	FUEL LIMITING LEVER- Limiting Cylinder	
12						
13						
14						
15						
16		8	4A1216-A	1	ADJ. SCREW- Fuel Limiting Cylinder	
17				1	NUT- 3/8" -16 Hex Head Full	
18				1	WIRE- 16 Gauge- 4" Long	
19						
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1 OPP. HAND SEE

R OPP. ROT. SEE

NAME WESTINGHOUSE FUEL LIMITING DEVICE

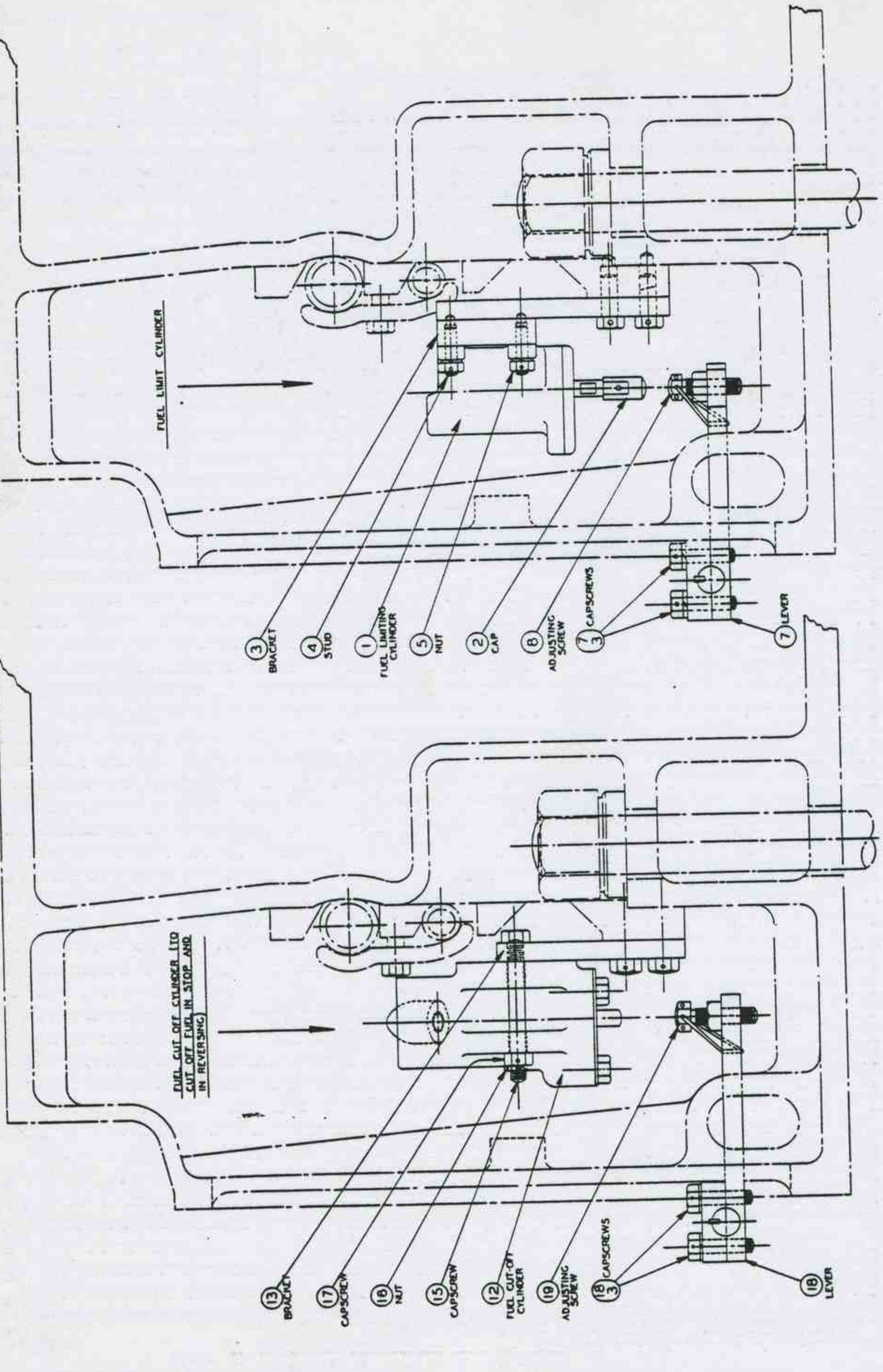
ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2558



NOTE - FOR DETAILS ON REF. NUMBERS:- 1 & 12 SEE 'AUX EQUIP.' WESTINGHOUSE CONTROLS

PLATE No. 3A4042

DO NOT ORDER PARTS BY REFER NUMBERS

CHANGES

#1-Changed Line 14 from 4A1216 to A-3-31-52

Supersedes Sheet Dated 10-25-51

CHANGES

2L2559

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4042

LINE NO	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO.
1		12		1	FUEL CUT-OFF CYLINDER - Westinghouse Part No	
2					528187 (Item 12 of our BM-6383)	
3		13	4A1215	1	MOUNTING BRACKET - Fuel Cutoff Cylinder	
4		14	H-4828	2	CAPSCREW - Mtg. Bracket-To Cyl. Block	
5		15	C-2392	1	CAPSCREW - Mtg. Bracket to Fuel Cutoff Cyl.	
6		16		1	NUT - 3/82-24 - Light Thick Slotted	
7				2	16 GAUGE WIRE - 8" Long	
8		17	H-2171	1	CAPSCREW - Fuel Limiting Cyl. to Mtg. Bracke	
9		18	4Y1062	1	FUEL CUT-OFF LEVER ASSEMBLY	
10						
11						
12						
13						
14		19	4A1216-A	1	ADJUSTING SCREW - Fuel Cut-Off Cylinder	
15				1	NUT - 3/8"-16 Hex Head Full	
16				1	WIRE - 16 Gauge - 4" Long	
17						
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R OPP. HAND SEE

OPP. ROT. SEE

NAME WESTINGHOUSE FUEL CUT-OFF

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

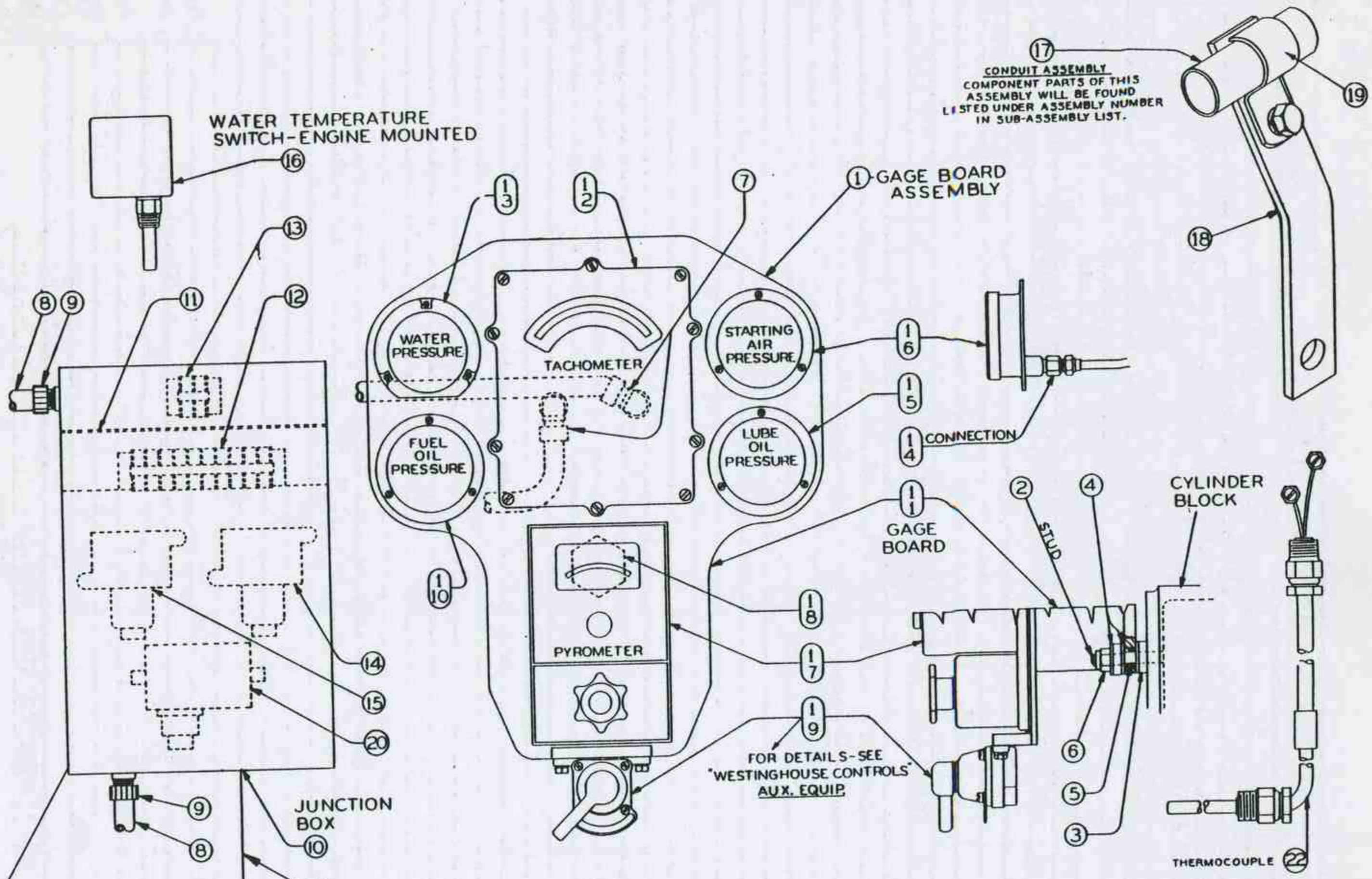
PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2559

PLATE NO. 3A4040

DO NOT ORDER PARTS BY REFER. NUMBERS



Retyped from copy dated 4/7/52. No changes.

CHANGES #1

CHANGES

2L2576 SHEET 1 OF 2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4040

ASSEM. DRWG NO See Layout 910LA-358

LINE NO	DRWG. NO.	REF. NO	PART NO.	NO REQ'D.	PART NAME
1		1	4Y1064	1	GAGE BOARD ASSEMBLY
2					
3		2	3A3074	3	STUD- Gauge Board to Cyl. Block
4					
5		3	3A1718	6	GROMMET - Gauge Board to Cyl. Block
6					
7		4	C-7567	9	WASHER- Gauge Board to Cyl. Block
8					
9		5	3A1717	3	GROMMET - Gauge Board to Cyl. Block
10					
11		6		3	ELASTIC STOP NUT- 1/2"-N.C. Cat. #29V083
12					
13		7		2	ELBOW CONNECTOR- 1/2" "Simplet Vapoil"
14					Fitting #5314
15					
16			BM-523-A	25'	WIRE
17		8		REc.	RIGID - Conduit- 1/2" -40' Long
18			4A1269	2	BRACKET- For Conduit
19				6	CAPSCREW- 1/4" x 1/2" Rd. - Head
20				16	PIPE STRAPS- 1/2" - Adapti #830
21				7	APPLETON 73N90 SHORT ELBOW THREADLESS
22					CONNECTOR FOR 1/2" CONDUIT
23				6	APPLETON 82N70 THREADLESS ELBOWS FOR
24					1/2" CONDUIT
25				2	T & B - #9105 TEE
26				2	T & B - #6000 TEE COVERS
27					
28		9		2	STRAIGHT CONNECTORS- 1/2" "Simplet Vapoil"
29					Fitting #5214
30		10	BM-5368-B	1	JUNCTION BOX
31				3	CAPSCREW- 1/2" -13 x 3/4" Hex Head
32		21	4B1153	1	BRACKET- Junction Box
33				4	MACHINE SCREW - 1/4" -20 x 5/8" Lg. Rd. Hd.
34				4	LOCKWASHER- 1/4"
35		11	R-7724	1	BAFFLE PLATE- Junction Box
36		12	BM-494-J	1	TERMINAL BLOCK
37		13	BM-494-P	1	TERMINAL BLOCK
38				4	SCREW- #8-32 x 1/2" Rd. Hd. Machine
39				4	NUTS- #8-32 Hex Full
40				4	LOCKWASHER - #8
41				4	SCREW- #8-32 x 1-3/4" Rd. Hd. Machine
42				12	NUT- #8 -32 Hex Full
43				4	LOCKWASHER- #8
44					
45		17	4Y1067	1	PYROMETER CONDUIT ASSEMBLY
46			BM-3702-A	200'	#16 FLAMENOL WIRE
47			BM-4745	20	T & B STAKONS
48				2	WATLOW #169B - Insulating Bushing
49					
50					--CONTINUED ON SHEET NO. 2---

OPP. HAND SEE

OPP. ROT. SEE

NAME INSTRUMENT PANEL (GAUGES- TACH.- PYROMETER)

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2576 SHEET 1 OF 2

Retyped & Revised from copy Dated 1/14/52
#1

CHANGES

CHANGES

2L2576 SHEET 2 OF 2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A4040

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO REQ'D.	PART NAME	ASSEM. DRWG. NO See Layout 910LA-358
1					--CONTINUED FROM SHEET NO. 1--	
2						
3		14	BM-483-D	1	LUBE OIL PRESSURE SWITCH	
4			T-1396-1	1	MOUNTING BRACKET for L.O. Pressure Switch	
5				2	SCREWS - #10-24 x 1/2" Lg. - Rd. Hd. Machine	
6				2	NUTS #10-24	
7				2	WASHER #10-24 - Lock	
8		15	BM-483-B	1	THROTTLE SWITCH	
9		16	BM-608-A	1	WATER TEMPERATURE SWITCH	
10		22	2C4470-~~6~~	8	THERMOCOUPLES	
11		18	3A2533	3	BRACKET - Pyrometer Conduit Assembly	
12				3	CAPSCREW - 5/8" -11 x 1-3/4" Hex Head	
13				3	LOCKWASHER - 5/8"	
14		19	BM-3357	3	CLAMP - Pyrometer Bracket	
15				3	CAPSCREW - 3/8" -16 x 3/4" Hex Head	
16				3	LOCKWASHER - 3/8"	
17				3	NUT - 3/8" -16 Hex Full	
18			BM-5965	96'	PYROMETER LEAD WIRE	
19		20		1	LOW PRESSURE ALARM SWITCH	
20					Westinghouse Part No. 530038	
21					(Item #18 of our BM-6383)	
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P. HAND SEE

P. ROT. SEE

NAME INSTRUMENT PANEL (GAGES - TACH.-PYROMETER)

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2576 SHEET 2 OF 2

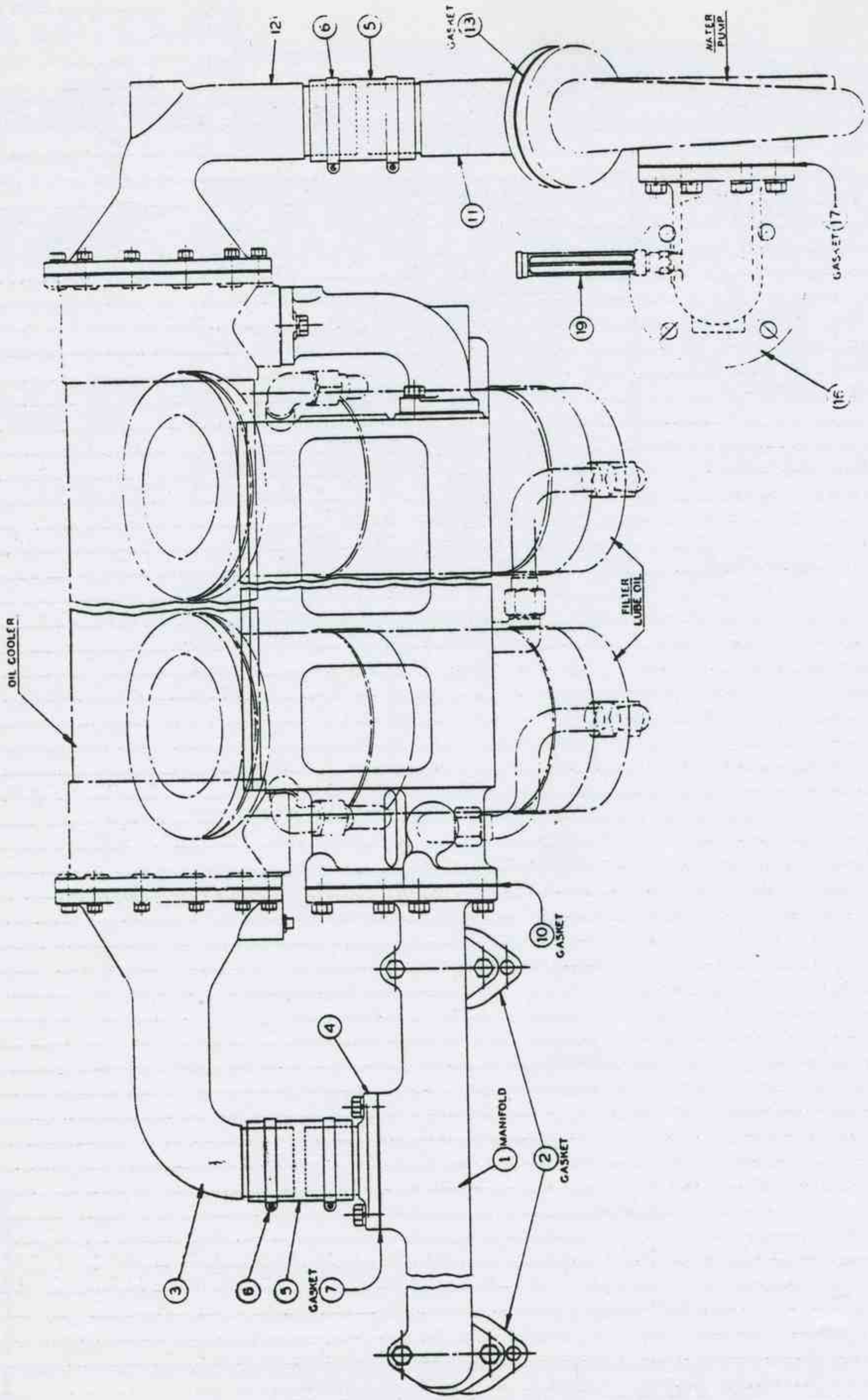

PLATE No.
3A4037 DO NOT ORDER PARTS BY REFER. NUMBERS.

CHANGES

CHANGES

2L2666

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4037

LINE NO	DRWG. NO.	REF. NO	PART NO.	NO REQ'D.	PART NAME	ASSEM DRWG. NO
1		1	4D1046-A	1	MANIFOLD- Water Inlet	
2		2	S-1005	2	GASKET- Manifold to Block	
3				2	CAPSCREW- 1/2" -13 x 1-1/2" Lg.- St.	
4				4	LOCKWASHER- 1/2" SAE Reg.- St.	
5				2	CAPSCREW- 1/2" -13 x 5" Long- St.	
6		3	4C1106	1	CONN.- L.O. Cooler to Water Manifold	
7		4	4A1299	1	CONN.- Water Manifold to Oil Cooler	
8		5	BM-158-A	1	HOSE- Water Conn.	
9		6	BM-154	4	HOSE CLAMP- Water Hose	
10		7	4A1189	1	GASKET	
11				2	CAPSCREW- 1/2" -13 x 1-1/2" Lg.- St.	
12				2	LOCKWASHER- 1/2 SAE Reg.	
13				1	PIPE PLUG- 3/8" - C.I.	
14				12	CAPSCREW- 3/8" -16 x 1-1/4" Lg.	
15				12	LOCKWASHER- 3/8"	
16		*		1	GASKET- Water Mani. to Lube Oil Cooler	
17				4	CAPSCREW- 1/2" -13 x 1-1/2" Lg.	
18				4	LOCKWASHER- 1/2"	
19		10	4A1207-A	1	GASKET- Manifold to Filter Bracket	
20						
21		11	4B1206	1	CONNECTION- Water Pump to Oil Cooler	
22		12	4B1207	1	CONNECTION- Oil Cooler to Water Pump	
23		5	BM-158-A	1	HOSE- Water Conn.	
24		6	BM-154	4	HOSE CLAMP- Water Hose	
25				1	PIPE PLUG- 3/8" Std.- C.I.	
26		*		1	GASKET- Water Pump to Oil Cooler Conn.	
27		13	2C2763	1	GASKET- Pipe to Water Pump	
28				12	CAPSCREW- 3/8" -16 x 1-1/4" Lg.	
29				12	LOCKWASHER- 3/8"	
30				6	CAPSCREW- 1/2" -13 x 2" Long- St.	
31				6	NUT- 1/2" -13 Hex Head- St.	
32				6	LOCKWASHER- 1/2" - St.	
33		16	4C1072	1	ELBOW- Water Inlet	
34		17	2C2765	1	GASKET- Pipe to Water Pump	
35				8	CAPSCREW- 1/2" -13 x 1-1/2" Lg.- St.	
36				8	LOCKWASHER- 1/2" SAE Reg.- St.	
37						
38						
39						
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41						
42						
43						
44						
45		NOTE: This Group used on Engine equipped with Fabricated				
46		Steel. "Bracket and Manifold- For Lube Oil Filter"				
47		(For Cast Iron see 2L2553)				
48						
49					---FURNISHED WITH ROSS COOLER--	
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OPP. HAND SEE

OPP. ROT. SEE

NAME WATER INLET MANIFOLD & WATER PIPING GROUP

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 MAR. SUPERCH.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2666

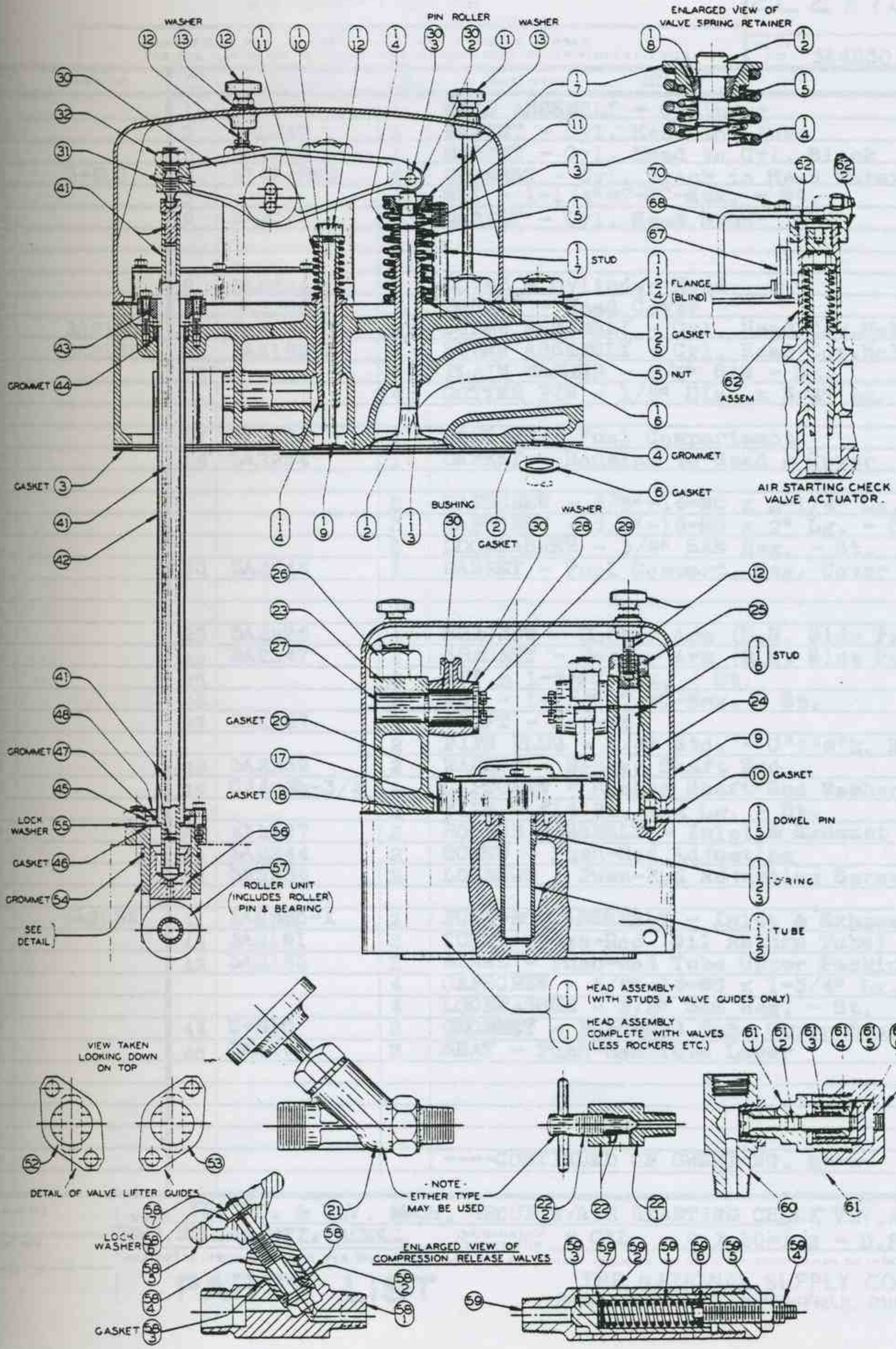

PLATE NO.
3A4030 ED.3

DO NOT ORDER PARTS BY REFER. NUMBERS

4E-1005 CS16
4D1017
4Y-2163 - W/plugs

4Y-2164 - W-6105
4Y-2165 - HK - W/6W DSD Vlv

2L 2773 SH-1 OF-2

PLATE NO 3A4030 Ed. 3

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

LINE NO	DRWG. NO.	REF NO	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG NO
1		1	4Y1048	1	HEAD ASSEMBLY - Cylinder	
2		2	3A2245	1	GASKET - Cyl. Head to Liner	
3		3	3A2246	1	GASKET - Cyl. Head to Cyl. Block	
4	S-803	4	610A-RB3	6	GROMMET - Cyl. Block to Head Water Pipe	
5		5		4	NUT - 1-1/4"-7-NC-Hex. - St.	
6		6	3A2717	5	GASKET - Cyl. Head Stud	
7						
8						
9		9	3A2224	1	COVER - Cylinder Head	
10		10	3A2258	1	GASKET - Head Cover	
11	3A2186	11	3A2186-X	2	SCREW ASSEMBLY - Cyl. Head Cov. Hold Down-Lg.	
12	3A2188	12	3A2188-X	2	SCREW ASSEMBLY - Cyl. Head Cov. Hold Down-Short	
13		13		4	PLAIN WASHER - 1/2" SAE - St.	
14				4	COTTER PIN - 1/8" Dia. x 3/4" Lg. - St.	
15						
16		17	4Y1184	1	HOUSING - Fuel Compartment	
17		18	3A2254	1	GASKET - Housing to Head & Cover	
18						
19				2	CAPSCREW - 3/8"-16-NC x 2-1/4" Lg. -St.	
20				3	CAPSCREW - 3/8"-16-NC x 2" Lg. - St.	
21				5	LOCKWASHER - 3/8" SAE Reg. - St.	
22		20	3A2746	1	GASKET - Fuel Compart. Hsg. Cover to Housing	
23						
24						
25		23	3A2226	1	BRACKET - Rocker Arm (L.H. Side Facing Eng.)	
26		24	3A2247	1	BRACKET - Rocker Arm (R.H. Side Facing Eng.)	
27		25		2	NUT - 1-8-NC-Hex. - St.	
28		26		2	NUT - 1-1/4"-7-NC-Hex. - St.	
29		27	3A2227	2	SHAFT - Rocket	
30				2	PIPE PLUG - 1/4" Std. - C't's'k. Hd. - C.I.	
31		28	3A2239	2	WASHER - Rocker Shaft End	
32		29	C2406-3/4	4	CAPSCREW - Rocker Shaft End Washer	
33				2	WIRE - #16 Ga. x 4 Lg. - St.	
34		30	4Y1107	2	ROCKER ASSEMBLY - Inlet & Exhaust	
35		31	3A2244	2	SCREW - Push-Rod Adjusting	
36		32	3A2584	2	LOCKNUT - Push-Rod Adjusting Screw	
37						
38	3A2085	41	3A2085-X	2	PUSH-ROD ASSEMBLY - Inlet & Exhaust Valve	
39		42	3A2161	2	TUBE - Push-Rod (Oil Return Tube)	
40		43	3A2165	2	GLAND - Push-Rod Tube Upper Packing	
41				4	CAPSCREW - 3/8"-16-NC x 1-3/4" Lg. - St.	
42				4	LOCKWASHER - 3/8" SAE Reg. - St.	
43		44	S-810	2	GROMMET - Push-Rod Tube Upper Seal	
44		45	3A2160	2	SEAT - Push-Rod Tube Lower	
45						
46						
47						
48						
49					----CONTINUED ON SHEET NO. 2----	
50						

2L 2773 SH 2 OF 2

* HAND SEE

APP ROT. SEE

NAME CYL. HD. & VLV. MECH. GROUP W/AIR STARTING CHECK VLV. ACT. & COMP. REL. SAFETY VALVE

ORIGINALLY ISSUED FOR 8 CYL. - 9 X 10-1/2 - D.R.M.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4030 Ed. 3

LINE NO	DRWG. NO.	REF NO	PART NO.	NO REQ'D.	PART NAME	ASSEM DRWG NO
1					----CONTINUED FROM SHEET NO. 1----	
2						
3		46	3A2240	2	GASKET - Seat to Lifter Guide	
4		47	S-810	2	GROMMET - Push-Rod Tube Lower Seal	
5		48	3A2159	2	COVER - Push-Rod Tube Lower Seal	
6				4	CAPSCREW - 3/8"-16-NC x 1-1/4" Lg. - St.	
7				4	LOCKWASHER - 3/8" SAE Reg. - St.	
8						
9						
10		52	3A2024	1	GUIDE - Valve Lifter	
11		53	3A2448	1	GUIDE - Valve Lifter	
12		54	3A2146	2	GROMMET - Lifter Guide	
13				4	NUT - 5/8"-18-NF-Hex. - St.	
14		55		4	LOCKWASHER - 5/8" Shakeproof Type 14 (Int.) - St.	
15						
16		56	3A2069	2	LIFTER - Inlet & Exhaust Valve	
17		57	3A2053	2	ROLLER UNIT - Valve Lifter (Roller, Pin & Bear.)	
18						
19						
20		58	YT-105-C	1	VALVE ASSEMBLY - Indicator V-10	
21						
22		60	4Y1282	1	ADAPTRO ASSEM. - Relief Vlv. Body to Cyl. Hd.	
23	4A-1535	61	4Y-1183	1	ASSEMBLY - Compression Relief Valve	
24		59	YLD-22-A	1	VALVE ASSEMBLY - Compression Relief Safety Valve	
25						
26						
27	4A-1368	62	4Y-1298	1	AIR STARTING CHECK VALVE BODY & PISTON	
28						
29						
30						
31						
32				1	LOCKWASHER - 3/8"	
33		67	4A-1537-A	1	STUD - Air Starting Check Vlv. Actuator	
34		68	4A-1536-A	1	CLAMP - Air Starting Check Vlv. Actuator	
35				1	PLAIN WASHER 3/8" Std.	
36		70		1	NUT - 3/8" - 16 - Regular Slotted	
37				1	COTTER PIN - 3/32" x 1" Lg.	
38						
39						
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41						
42						
43						
44					SEE-910LA-402	
45					SEE-910LA-403	
46						
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OPP. HAND SEE

OPP. ROT. SEE

NAME CYL. HD. & VLV. MECH. GROUP W/AIR STARTING CHECK VLV+ACT. & COMP. RELIEF SAFETY VLV. ORIGINALLY ISSUED FOR 8 CYL. 9" x 10-1/2 - D.R.M.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2773 SH-2 OF-2

CHANGES

CHANGES

2L2774 SH-1 OF-2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO

LINE NO	DRWG. NO.	REF. NO	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG NO.
1					---STARTING LINE---	
2			#6-FBTX	3	MALE CONNECTOR	
3			#6-CBTX	5	MALE ELBOW	
4			#6-JBTX	2	UNION TEE	
5				1	PIPE PLUG - 1/4" - C.I.	
6				5'	TUBING - 3/8" OD x .049" Wall	
7			4A1346	1	BULKHEAD FITTING	
8			#6-CBTX	1	ELBOW	
9			#6-BTX	2	NUTS	
10			#6-TX	2	SLEEVE	
11			#1205B-FX	1	LOCKNUT	
12						
13					----AHEAD LINE---	
14			#6-FBTX	1	MALE CONNECTOR	
15			#6-CBTX	9	MALE ELBOW	
16			#6-JBTX	1	UNION TEE	
17			#6-DBTX	1	FEMALE ELBOW	
18				1	BUSHING - 3/8" x 1/4" Brass-Outside - Hex.	
19				1	PIPE PLUG - 1/4" - C.I.	
20				5'	TUBING - 3/8" OD x .049" Wall	
21			#6-SBTX	1	PARKER MALE OUTLET TEE	
22			4A1346	2	BULKHEAD FITTING	
23			#6-CBTX	2	ELBOW	
24			#6-BTX	4	NUTS	
25			#6-TX	4	SLEEVE	
26			#1205-B-FX	2	LOCKNUT	
27				1	NIPPLE - 1/4" x 1-1/8" Blk.	
28						
29					---ASTERN LINE---	
30			#6-FBTX	4	MALE CONNECTOR	
31			#6-CBTX	7	MALE ELBOW	
32			#6-SBTX	1	MALE OUTLET TEE	
33			#6-DBTX	1	FEMALE ELBOW	
34			#6-MBTX	1	FEMALE TEE	
35				1	PIPE PLUG - 1/4" - C.I.	
36				5'	TUBING - 3/8" OD x .049" Wall	
37				1	BUSHING - 3/8" x 1/4" - Brass	
38				1	CLOSE NIPPLE - 1/4" Blk.	
39			4A1346	2	BULKHEAD FITTING	
40			#6-CBTX	2	ELBOW	
41			#6-BTX	4	NUTS	
42			#6-TX	4	SLEEVE	
43			#1205B-FX	2	LOCKNUT	
44						
45					---SPEED CONTROL LINE---	
46			#6-CBTX	3	MALE ELBOW	
47				5'	TUBING - 3/8" OD x .049" Wall	
48			4A1346	2	BULKHEAD ELBOW	
49						
50					--CONTINUED ON SHEET NO. 2--	

OR OPP. HAND SEE

OR OPP. ROT. SEE

NAME WESTINGHOUSE CONTROLS PIPING

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 DRM SUPERCH

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2774 SH-1 OF-2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO

LINE NO	DRWG. NO.	REF NO.	PART NO	NO REQ'D.	PART NAME	ASSEM DRWG NO
1					---SPEED CONTROL LINE (CONTINUED)---	
2			#6-CBTX	2	ELBOW	
3			#6-BTX	4	NUTS	
4			#6-TX	4	SLEEVE	
5			#1205B-FX	2	LOCKNUT	
6			#6-FBTX	1	MALE CONNECTOR	
7						
8			4A-1562	1	TUBE CLAMPS	
9			4A-1563	2	TUBE CLAMPS	
10				3	MACHINE SCREW 1/4"-20 x 1" Lg. Rd. Hd.	
11				3	NUTS 1/4" -20 Hex Full	
12				3	LOCK WASHER 1/4"	
13						
14					---100 PSI - AIR SUPPLY LINE---	
15			#6-FBTX	5	MALE CONNECTOR	
16			#6-CBTX	3	MALE ELBOW	
17			#6-JBTX	1	UNION TEES	
18				5	BUSHINGS - 3/8" x 1/4" Red. - Outside-	
19					Hex. - Brass	
20				5'	TUBING - 3/8" OD x .049" Wall	
21						
22					---250# SUPPLY LINE---	
23			#6-DBTX	3	FEMALE ELBOW	
24				1	NIPPLE - 1-1/4" - Close - Extra-Heavy-Pipe	
25				1	TEE - 1-1/4" x 1-1/4" x 1/2" Red.-Male 1500#	
26				1	TEE - 1/2" x 1/2" x 1/2" - 300#(M.1) 300#	
27				1	BUSHING - 1/2" x 1/4" - Reducing - 300#(M.1)	
28				2	CLOSE NIPPLE - 1/2" - Extra-Heavy-Pipe	
29				1	GLOBE VALVE - 1/2" Lunkenheimer #123	
30				2	REDUCING BUSHING - 1/2" x 1/4"	
31				5'	TUBING - 3/8" OD x .049" Wall	
32			#6-SBTX	1	MALE OUTLET TEE	
33			#6-HBTX	2	UNION	
34			4A1346	1	BULKHEAD FITTING	
35			#6-CBTX	1	ELBOW	
36			#6-BTX	2	NUTS	
37			#6-TX	2	SLEEVE	
38			#1205B-FX	1	LOCKNUT	
39				3	NIPPLE - 1/4" Close - Blk.	
40			#6-MBTX	2	FEMALE RUN TEE	
41			#6-GBTX	1	FEMALE CONN+	
42						
43						
44						
45						
46						
47						
48						
49						
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2L2774 SH-2 OF-2

PP. HAND SEE

PP. ROT. SEE

NAME WESTINGHOUSE CONTROLS PIPING

ORIGINALLY ISSUED FOR 8 CYL. 9 x 10-1/2 DRM SUPERCH

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

SHEET 1 OF 2

2L2775

PLATE NO

LINE NO	DRWG. NO.	REF NO	PART NO	NO REQ'D	PART NAME	ASSEM DRWG NO
1					"AIR STARTING CHECK VALVE ACTUATOR MOUNT-	
2					ING AND PIPING	
3			#6CBTX	8	ELBOW - Actuator Assembly	
4				8	TUBE - 3/8" OD x .049 Wall x 31" Lg. - Cop.	
5					Actuator To Manifold	
6			#6EBTX	1	ELBOW - Manifold End	
7			#6JBTX	7	TEE - Manifold Intermediate	
8				1	TUBE - 3/8" - O.D. x .049 Wall x 10" Lg.-	
9					Cop. For Front End	
10				6	TUBE - 3/8" OD x .049 Wall x 13" Lg.-Cop.	
11					For #1-2-3-5-6-7 Cylinder.	
12				1	TUBE - 3/8" OD x .049 Wall x 14" Lg.-Cop.	
13					For #4 Cylinder.	
14			4A-1564	4	TUBE CLIP	
15				4	SCREW - Button Head - Machine - 3/8"-16x 1"	
16					Long	
17				4	NUTS - 3/8" -16 Hex Full	
18				4	LOCKWASHER 3/8"	
19			4A-1346	1	BULKHEAD FITTING	
20			120EBFX	1	BULKHEAD NUT	
21			#6CBTX	1	ELBOW - Bulkhead Fitting	
22			#6BTX	1	NUT -	
23			#6FBTX	2	CONNECTOR - Relayair Valve	
24			#6RBTX	1	MALE RUN TEE	
25			BM-6746	1	WESTINGHOUSE RELAYAIR VALVE	
26			4A-1545	1	BRACKET	
27				3	CAPSCREW - 3/8"-16 x 1-1/2" Lg. - Hex Head	
28				3	CAPSCREW - 3/8" -16 x 1" - Lg.-Hex Head	
29				6	LOCKWASHER - 3/8" - Std.	
30				1	TUBE - 3/8" OD x .049 Wall x 10" Lg.-Cop.	
31			#6CBTX	1	CONNECTOR -	
32						
33					"AIR LOCK RELIEF VALVE PIPING"	
34			#6FBTX	8	CONNECTOR - Relief Valve Assembly	
35			#6JBTX	7	TUBE TEE - Manifold	
36				1	TUBE - 3/8" - O.D. x .049" Wall x 31" Lg.	
37					To Direction Interlock	
38			#6JBTX	1	TEE	
39				1	TUBE - 3/8" O.D. x .049 Wall x 20" Lg.	
40					To #1 Cylinder	
41				6	TUBE - 3/8" OD x .049 Wall x 10" Lg.	
42					To Intermediate Cyl., Relief Valve	
43				1	TUBE - 3/8" OD x .049 Wall x 28" Lg.	
44					To #8 Cyl.	
45				1	TUBE - 3/8" OD x .049 Wall x 39" Lg.	
46					#1 to #2 Manifold	
47				3	TUBE - 3/8" OD x .049 Wall 13-1/16" Lg	
48					Manifold #2 Cyl. - 3-6-7.	
49						
50					CONTINUED ON SHEET NO. 2	

2L2775 SHEET 1 OF 2

P. HAND SEE

PP. ROT. SEE

NAME PIPING - AIR STARTING CHECK VALVE ACTUATOR & AIR LOCK RELIEF VALVE

ORIGINALLY ISSUED FOR 8 CYL. - 9 X 10-1/2 D.R.M.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

SHEET 2 OF 2

2L2775

PLATE NO

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

LINE NO	DRWG. NO.	REF NO	PART NO.	NO REQ'D	PART NAME	ASSEM. DRWG. NO
1					CONTINUED FROM SHEET NO. 1	
2						
3				2	TUBE - 3/8" O.D. x .049 Wall x 13-9/16"	
4					Manifold #2 Cylinder - #4 & 5.	
5			P-211673	3	TUBE CLIPS	
6						
7						
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OPP. HAND SEE

R OPP. ROT. SEE

NAME PIPING - AIR STARTING CHECK VALVE ACTUATOR & AIR LOCK RELIEF VALVE

ORIGINALLY ISSUED FOR 8 C YL. - 9 X 10-1/2 D.R.M.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

PARTS LIST

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2775 SHEET 2 OF 2

ENGINE SIZE 9 X 10 1/2 ISSUE ASSEM. LIST NO. 3 AL201A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

WHEN ORDERING PARTS ALWAYS GIVE ENGINE NUMBER-PART NUMBER-NAME-OR COMPLETE DESCRIPTION AND SIZE
DO NOT ORDER PARTS BY REFERENCE NUMBERS
* INDICATES PARTS NOT SOLD INDIVIDUALLY

REF NO	PART NUMBER	NO USED	DESCRIPTION

YLD22 VALVE ASSEM.-CYLINDER PRESSURE RELIEF

Includes

1	H-15429	1	SPRING - Relief Valve
2	H-15397	1	BODY - Relief Valve
3	H-15398	1	RELIEF VALVE
4	H-15399	1	ADJUSTING SCREW - Relief Valve
5	H-15400	1	STOP NUT - Relief Valve Adj. Screw
6	H-15401	1	WASHER - Relief Valve Adj. Screw
7	H-15402	4	WASHER - Relief Valve
		1	NUT - 1/2" - 13 N.C. Hex Half

YLD22A VALVE ASSEM.-CYLINDER PRESSURE RELIEF

Includes

1	H-15429	1	SPRING - Relief Valve
2	H-15397	1	BODY - Relief Valve
3	H-15398	1	RELIEF VALVE
4	H-15399-A	1	ADJUSTING SCREW - Relief Valve
5	H-15400	1	STOP NUT - Relief Valve Adj. Screw
6	H-15401	1	WASHER - Relief Valve Adj. Screw
7	H-15402	4	WASHER - Relief Valve
		1	NUT - 1/2" - 13 N.C. Hex Half

YT105C INDICATOR VALVE ASSEM.

Includes

1	T105A-2	1	BODY - Indicator Valve
2	T106C	1	STEM - Indicator Valve
3	T1158	1	GASKET
4	T107C	1	PLUG - Indicator Valve
5	T1024	1	HAND WHEEL - Indicator Valve
6		1	LOCKWASHER - 5/16-SAE Reg.
7		1	NUT - 5/16 - 24 Hex.

X204 VALVE ASSEM.-COMPRESSION RELIEF SAFETY

Includes

1	F-2798	1	BODY
2	X541	1	STEM ASSEMBLY
3	S-3339	1	SPRING
4	S-3337	2	WASHER
5	S-3338	1	CAP - Valve Body
6		1	SETSCREW-#10-24 x 1 Lg.-Headless-Cup Pt.
7		1	NUT - #10-24-Hex.

X541 STEM ASSEM.-COMPRESSION RELIEF SAFETY VALVE

Includes

*		1	VALVE
*		1	STEM

4E-1005-C&G

4Y1028 CYLINDER HEAD & PLUG ASSEMBLY

Includes

*		1	HEAD - Cylinder 4E-1005
		7	PIPE PLUG - 1-1/2" Std.
		6	PIPE PLUG - 1" Std.
2	4A1093	1	TUBE - Fuel Injection Nozzle
3	4A1095	2	"O" RING - Tube for Fuel Oil Nozzle
4	785	1	FLANGE - Water Outlet Hole Blind
5	S-2334	1	GASKET - Flange
		2	CAPSCREW - 1/2" - 13 NC x 1 1/4" Lg.
		2	LOCKWASHER - 1/2" - SAE Reg.

4Y1030 MANIFOLD ASSEMBLY-CAMSHAFT LUBRICATING

Includes

*		1	BRACKET - Camshaft L. O. Manifold - Rear End
*		2	TUBE - Camshaft L.O. Manifold
*		6	BRACKET - Camshaft L.O. Manifold - Center
*		4	TUBE - Camshaft L.O. Manifold
*		1	TUBE - Short - Camshaft - L.O. Manifold
*		1	CROSS FITTING - Camshaft - L.O. Manifold
*		1	TUBE - Camshaft - L.O. Manifold
*		1	BRACKET - Camshaft - L.O. Manifold - Front End
		1	PIPE PLUG - 3/8" - Brass

4Y1031 CONTROL HOUSING

Includes

*		1	REVERSE HOUSING - R.H. Westinghouse
1	3A2338	2	LINER - Reverse Air Cylinder

4Y1046 CAMSHAFT & HUB ASSEMBLY

Includes

*		1	CAMSHAFT
*		1	HUB - Camshaft Gear
*		1	KEY - Gear Hub to Camshaft

4Y1047 CYLINDER HEAD & GUIDE ASSEMBLY

Includes

2	4Y1028	1	CYLINDER HEAD & PLUG ASSEMBLY
3	3A2187	2	GUIDE - Inlet & Exhaust Valve
4	3A2183	1	GUIDE - Air Starting Valve
5	C6392L-1	4	PIN - Rocker Brg. Dowel
6	3A2191	2	STUD - Rocker Bearing
7	C2012L5-3/4	1	STUD - Fuel Injection Valve Clamp

4Y-2165-

4Y1048 CYLINDER HEAD ASSEMBLY

Includes

1	4Y1047	1	CYLINDER HEAD & GUIDE ASSEMBLY
2	3A2054	2	VALVE - Inlet & Exhaust
3	3A2456	2	RING - Valve Safety Retainer
4	3A2538	2	SPRING - Inlet & Exhaust Valve Outer
5	3A2537	2	SPRING - Inlet & Exhaust Valve Inner
6	3A2243	2	WASHER - Valve Spring Lower Guide
7	C6462	2	RETAINER - Valve Spring
8	C6461	4	LOCK - Valve Spring Retainer
9	3A2182	1	VALVE - Air Starting Check
10	3A2184	1	STOP - Air Starting Check Valve
11	3A2257	1	SPRING - Air Starting Check Valve
12		1	CASTELLATED NUT - 5/8" - 18 NF Hex
		1	COTTER PIN - 1/8" x 1 1/4" Lg.

4Y1051 ADAPTOR ASSEMBLY - L.O. PUMP

Includes

*		1	ADAPTOR - L. O. Pump
1	4A1141	1	BUSHING - Oil Pump Adaptor
2	4A1140	1	THRUST BUSHING - L.O. Pump Adaptor

4Y1053 BASE ASSEMBLY

Includes

1	4Y1071	1	BASE & BEARING CAP ASSEMBLY
		1	PIPE PLUG (SUMP) -1-1/4" Std. -C't's'k. Hd.
3	3A2081	8	PIN - Crank. Brg. Shell Dowel (In Base)
4	3A2080	9	PIN - Crank. Brg. - Shell Dowel (In Caps)
5	3A3082	32	BOLT - Crank. Brg. Cap
6	3A3085	32	NUT - Crank. Brg. Cap Bolt

4Y1054 BUSHING & RING ASSEMBLY

Includes

1	4C1066	1	DRIVE RING - Flywheel
2	4A1180	18	BUSHING - Drive Ring

4Y1055 COVER - WITH EXPLOSION VALVES

Includes

1	4B1093	1	COVER - Centerframe - Exh. Side-Explosion
2	T1302-A	2	SPRING - Explosion Valves to Cover
3	T-1372	2	STUD - Explosion Valve
4		2	NUT - 1/4" - 20 Elastic Stop - Explosion Valve
5	BM-6235	2	"O" RING - Explosion Valve
6	T1263-B	2	COVER - Explosion Valve
7		2	NUT - 3/8" - 24 Elastic Stop. Exp. Valve

ENGINE SIZE 9 X 10½ ISSUE 3 ASSEM. LIST NO. AL202A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

WHEN ORDERING PARTS ALWAYS GIVE ENGINE NUMBER-PART NUMBER-NAME-OR COMPLETE DESCRIPTION AND SIZE
DO NOT ORDER PARTS BY REFERENCE NUMBERS
* INDICATES PARTS NOT SOLD INDIVIDUALLY

REF. NO.	PART NUMBER	NO. USED	DESCRIPTION
	4Y1056		**CRANKSHAFT ASSEMBLY** Includes
*		1	CRANKSHAFT
1	3A2019	1	THROWER - Crankshaft Oil (Fwd.End)
2	3A2018	1	THROWER - Crankshaft Oil (Aft.End)
3	4A1170	6	STUD - Flywheel to Crankshaft
4	3A2194	2	PIN - Crankshaft Gear Drive
	4Y1057		**GEAR ASSEMBLY - WATER PUMP DRIVE** Includes
*		1	GEAR-WATER PUMP DRIVEN
1	3A2111	6	PIN - Gear Coupling - Water Pump Drive
	4Y1058		**HUB & STUD ASSEMBLY - REDUCTION GEAR COUPLING** Includes
1	4C1059	1	HUB - Reduction Gear Coupling
2	4A1167	18	STUD - Bushing to Reduction Gear Hub
3	4A1246	18	NUTS - 1-1/8" -12 Light Thick Slotted
		18	COTTER PIN - 3/16" x 2 "
	4Y1062		**LEVER & CAP ASSEMBLY - FUEL CUT-OFF CYL** Includes
*		1	LEVER - Fuel Cut-Off Cylinder
*		1	CAP - Fuel Cut-Off Cylinder - Lever
3	H7449	2	CAPSCREW - Cap to Lever - Fuel Cut-Off Cyl.
	4Y1063		**LEVER & CAP ASSEMBLY - FUEL LIMITING CYL.** Includes
*		1	LEVER - Fuel Limiting Cylinder
*		1	CAP - Fuel Limiting Cyl. - Lever
3	H7449	2	CAPSCREW
	4Y1064		**GAGE BOARD ASSEMBLY** Includes
1	4D1051	1	GAGE BOARD
2		1	"ENGINE ROOM INDICATOR" (TYPE ICIF) Item #2 of BM-6400
		4	CAPSCREW - 3/8" - 16 x 1" FILISTER HEAD
3	BM5790A	1	JACKET WATER PRESSURE GAGE
		3	MACHINE SCREW - #6 - 32 x 3/4" Lg. Rd. Hd.
4	#6GBTX	4	FEMALE CONNECTION
5	2C1789	1	LUBE OIL PRESSURE GAGE
		3	MACHINE SCREW - #10 - 24 x ½" Lg. Rd. Hd.
4	#6GBTX	1	FEMALE CONNECTION
6	2C1791	1	STARTING AIR PRESSURE GAGE
		3	MACHINE SCREW - #10 - 24 x ½" Lg. Rd. Hd.
7	3A2600	1	PYROMETER
9		1	A-5A - ROTAIR VALVE - Westinghouse Part #529014 (Item 2E of BM6383)
		2	CAPSCREW - 5/16 - 18 x 1" Lg. - Hex Hd.
		2	LOCKWASHER - 5/16"
10	2C1790	1	FUEL OIL PRESSURE GAGE
		3	MACHINE SCREW #10-24 x ½" Lg. Rd. Hd.
		2	Reducing Bushing - 3/4" x 1/2"

REF. NO.	PART NUMBER	NO. USED	DESCRIPTION
	4Y1065		**CONDUIT ASSEM.-PYROM. CABLE (CENTER OUTLET)** Includes
	3A2627	2	TEE - Conduit
	3A2626	1	TEE - Conduit Outlet (Center)
	3A2683	2	ELL - Conduit (End)
	3A2630	4	BUSHING - Reducing
	3A2644	5	COVER - Conduit Tee, Ell, & Box
	3A1766	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1758	2	NIPPLE - Conduit - (Center Tee to Cyl. 2 & 3)
	3A1766	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A2632	1	CONNECTOR - Flex. Conduit
	3A1788	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flexible Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	4Y1066		**AIR STARTING MANIFOLD ASSEMBLY** Includes
1	4D1052	8	HOUSING - Air Starting Pilot Valve
2	3A2128	8	PILOT VALVE - Air Starting Pilot Valve
3	3A2030	8	PLUG - Air Starting Pilot Valve Housing
4	3A2225	8	GASKET - Air Starting Pilot Valve - Plug
5	4A1228	6	TUBING - Air Starting Manifold
6	4A1229	1	TUBING - Air Starting Manifold
8	4A1230	1	TUBING - Air Starting Manifold
9	4A1227	1	PLUG - Air Starting Pilot Valve
	4Y1067		**CONDUIT ASSEM.-PYROM. CABLE (END OUT)** Includes
	3A2627	8	TEE - Conduit
	3A2582	1	BOX - End Connection
	3A2644	9	COVER - Tee & Box
	3A2630	8	BUSHING - Reducing
	3A1764	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1768	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1769	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A1768	1	NIPPLE - Conduit - (Cyl. 6 to 7)
	3A1768	1	NIPPLE - Conduit - (Cyl. 7 to 8)
	3A1764	1	NIPPLE - Conduit - (Cyl. 8 to End Box)
		2	ELBOW CONNECTOR - 3/4" Short - Simplet Vapoil #5324
		3'	SEAL TIGHT CONDUIT - 3/4"
	3A2633	2	WASHER - Reducer
	4Y1071		**BASE & CAPS ASSEMBLY** Includes
*		1	BASE
2	3A2006R	6	CAP - Crank. Brg.
3	3A2007R	1	CAP - Crank. Brg. - Fwd. End
4	4B1119R	1	CAP - Crank. Brg. - Center
5	3A3047R	1	CAP - Crank. Brg. - Thrust
	4Y1072		**BASE ASSEMBLY** Includes
1	4Y1073	1	BASE & BEARING CAP ASSEMBLY
		1	PIPE PLUG (Sump) 1 1/2" Std. -C't'a'k. Hd.
3	3A2081	8	PIN - Crank. Brg. Shell Dowel - In Base
4	3A2080	9	PIN - Crank. Brg. Shell Dowel - In Caps
5	3A3082	32	BOLT - Crank. Brg. Cap
6	3A3085	32	NUT - Crank. Brg. Cap Bolt
	4Y1073		**BASE & CAPS ASSEMBLY** Includes
*		1	BASE
2	3A2006R	6	CAP - Crank. Brg.
3	3A2007R	1	CAP - Crank. Brg. - Fwd. End
4	4B1119R	1	CAP - Crank. Brg. - Center
5	3A3047R	1	CAP - Crank. Brg. - Thrust
	4Y1074		**MANIFOLD - AIR INLET** Includes
			(No Service Parts)
	4Y1076		**CAMSHAFT & HUB ASSEMBLY** Includes
*		1	CAMSHAFT
*		1	HUB - Camshaft Gear
*		1	KEY - Gear Hub to Camshaft

ENGINE SIZE 9 X 10½ ISSUE ASSEM.LIST NO. 4 AL203A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

WHEN ORDERING PARTS ALWAYS GIVE ENGINE NUMBER-PART NUMBER-NAME-OR COMPLETE DESCRIPTION AND SIZE
DO NOT ORDER PARTS BY REFERENCE NUMBERS
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REF NO	PART NUMBER	NO USED	DESCRIPTION
	4Y1077		AIR STARTING MANIFOLD ASSEMBLY — Includes
1	4D1052	4	HOUSING - Air Starting Pilot Valve
2	3A2128	4	PILOT VALVE - Air Starting
3	3A2030	4	PLUG - Air Starting Pilot Vlv. Hsg.
4	3A2225	4	GASKET - Air Starting Pilot Vlv. - Plug
5	4A1228	2	TUBING - Air Starting Manifold
6	4A1229	1	TUBING - Air Starting Manifold
9	4A1243	1	TUBING - Air Starting Manifold
	4A1227	1	PLUG - Air Starting Pilot Valve
	4Y1078		MANIFOLD ASSEMBLY - BASE LUBE OIL — Includes
*		1	PIPE
*		4	CONNECTION - Outlet Tube
*		1	CONNECTION - Outlet Tube (Cam Brg. Man.)
*		1	BUSHING - End
1		1	TEE - 1-1/2 x 1-1/2 x 1-1/2"
		1	PIPE PLUG - 1-1/2" - Co-sunk
2		1	REDUCER BUSHING 1" x 3/8" Std.
	4Y1079		MANIFOLD ASSEMBLY - VALVE ROCKER LUBE — Includes
			(No Service Parts)
	4Y1080		MANIFOLD ASSEMBLY - FUEL — Includes
			(No Service Parts)
	4Y1081		CRANKSHAFT ASSEMBLY — Includes
*		1	CRANKSHAFT
1	3A2019	1	THROWER - Oil (Fwd. End)
2	3A2018	1	THROWER - Oil (Aft. End)
3	3A2103	6	STUD - Flywheel to Crankshaft
4	3A2194	2	PIN - Gear Drive
	4Y1082		CYLINDER BLOCK ASSEMBLY — Includes
*		1	CYLINDER BLOCK
1	C-6466	8	STUD - Head
2	3A2189	8	STUD - Head (Tapped)
3	3A2241	8	STUD - Head (Long)
4	610RB-3	24	PIPE - Cyl. to Head - Water By-Pass
	4Y1083		BASE ASSEMBLY — Includes
1	4Y1084	1	BASE AND BEARING CAPS
		1	PIPE PLUG (SUMP) - 1-1/2" Std. - C't'sk. Hd.
3	3A2081	4	PIN - Crank. Brg. Shell Dowel (In Base)
4	3A2080	4	PIN - Crank. Brg. Shell Dowel (In Cap)
5	3A3082	16	BOLT - Crank. Brg. Cap
6	3A3085	16	NUT - Crank. Brg. Cap Bolt
	4Y1084		BASE AND CAPS ASSEMBLY — Includes
*		1	BASE
2	3A2006R	2	CAP - Crank. Brg.
3	3A2007R	1	CAP - Crank. Bearing - Fwd. End
4	4B1119R	1	CAP - Crank. Bearing - Center
5	3A3047R	1	CAP - Crank. Bearing - Thrust
	4Y1088		CENTERFRAME ASSEMBLY — Includes
*		1	CENTERFRAME
1	3A2449	24	STUD - Valve & Pump Lifter Guide
	4Y1089		MANIFOLD ASSEMBLY - CAMSHAFT LUBRICATING — Includes
*		1	BRACKET - Camshaft L.O. Manifold - Rear End
*		2	TUBE - Camshaft L.O. Manifold
*		2	BRACKET - Camshaft L.O. Manifold - Center
*		1	TUBE - Camshaft Lube - Short
*		1	CROSS FITTING - Camshaft - L.O. Manifold
*		1	TUBE - Camshaft - L.O. Manifold
*		1	BRACKET - Camshaft - L.O. Manifold - Front End
		1	PIPE PLUG - 3/8" - Brass
	4Y1090		CRANKSHAFT ASSEMBLY — Includes
*		1	CRANKSHAFT
1	3A2019	1	THROWER - Crankshaft Oil (Fwd. End)
2	3A2018	1	THROWER - Crankshaft Oil (Aft. End)
3	4A1248	6	STUD - Flywheel to Crankshaft
4	3A2194	2	PIN - Crankshaft Gear Drive

REF NO	PART NUMBER	NO USED	DESCRIPTION
	4Y1099		VALVE ASSEMBLY - FUEL INJECTION — Includes
*		1	HOLDER - Nozzle
1	BM-5421	1	VALVE - Nozzle
2	4A1259	1	TIP - Spray
	4Y1100		MANIFOLD ASSEMBLY - CAMSHAFT LUBRICATING — Includes
*		1	BRACKET - Camshaft L.O. Manifold - Rear End
*		2	TUBE - Camshaft L.O. Manifold
*		4	BRACKET - Camshaft L.O. Manifold - Center
*		2	TUBE - Camshaft L.O. Manifold
*		1	TUBE - Short - Camshaft L.O. Manifold
*		1	CROSS FITTING - Camshaft L.O. Manifold
*		1	TUBE - Camshaft - L.O. Manifold
*		1	BRACKET - Camshaft - L.O. Manifold - Front End
		1	PIPE PLUG - 3/8" - Brass
	4Y1101		AIR STARTING MANIFOLD ASSEMBLY — Includes
1	4D1052	6	HOUSING - Air Starting Pilot Valve
2	3A2128	6	PILOT VALVE - Air Starting
3	3A2030	6	PLUG - Air Starting Pilot Valve Housing
4	3A2225	6	GASKET - Air Starting Pilot Valve - Plug
5	4A1228	4	TUBING - Air Starting Manifold
6	4A1229	1	TUBING - Air Starting Manifold
8	4A1243	1	TUBING - Air Starting Manifold
	4A1227	1	PLUG - Air Starting Pilot Valve - End
	4Y1102		ADAPTOR ASSEMBLY - LUBE OIL PUMP — Includes
*		1	ADAPTOR
1	3A2124	1	BUSHING - (Pump End)
2	3A2463	1	BUSHING - (Thrust)
	4Y1103		CAMSHAFT AND HUB ASSEMBLY — Includes
*		1	CAMSHAFT
*		1	HUB - Camshaft Gear
*		1	KEY - Gear Hub to Camshaft
	4Y1106		HOUSING - FUEL COMPARTMENT ASSEMBLY — Includes
*		1	HOUSING Fuel Compartment
*		1	COVER - Fuel Compartment Housing
	4Y1107		ROCKER ASSEMBLY - INLET & EXHAUST — Includes
*		1	ROCKER ARM
1	3A2255	1	BUSHING
2	884E	1	ROLLER
3	3A2238	1	PIN - Roller
		1	MACHINE SCREW - 5/16" - 18 x 1/2" Rd. Head
	4Y1108		GOVERNOR DRIVE ADAPTOR & SHAFT ASSEMBLY — Includes
1	4D1082	1	HOUSING - Governor Adapter
2	BM-5346	2	WALDES TRUARC #5000 - 206 - Int. Snap Rind
3	BM-5	2	TIMKEN - Roller Bearing
4	4A1276	1	SPACER - Governor Adapter
5	4A1275	1	SHAFT - Governor Adapter
6	4B1157	1	GEAR - Governor Bevel Pinion
7		1	KEY - #5 Woodruff - Gov. Bevel Pin - Gear
8	BM-593	1	LOCKNUT - Ball Brg. SAE #N-05
9	BM-594	1	LOCKWASHER - Ball Bearing SAE #W-05
	4Y1109		MANIFOLD ASSEMBLY - FUEL — Includes
			(No Service Parts)

ENGINE SIZE 9 X 10 1/2 ISSUE 5 ASSEM. LIST NO. AL204A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

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REF. NO.	PART NUMBER	NO. USED	DESCRIPTION

REF. NO.	PART NUMBER	NO. USED	DESCRIPTION

4Y1116 COVER ASSEMBLY (FUEL FILTER BRACKET) AIR STARTING HOLE — Includes

*		1	COVER
*		3	STUD
*		1	SHAFT

4Y1117 AIR STARTING MANIFOLD — Includes

1	4D1052	6	HOUSING - Air Starting Pilot Valve
2	3A2128	6	PILOT VALVE - Air Starting Pilot Valve - Housing
3	3A2030	6	PLUG - Air Starting Pilot Valve - Housing
4	3A2225	6	GASKET - Air Starting Pilot Valve - Plug
5	4A1228	4	TUBING - Air Starting Manifold
6	4A1229	1	TUBING - Air Starting Manifold
8	4A1313	1	TUBING - Air Starting Manifold
	4A1227	1	PLUG - Air Starting Pilot Valve - End

4Y1118 AIR STARTING MANIFOLD ASSEMBLY — Includes

1	4D1052	8	HOUSING - Air Starting Pilot Valve
2	3A2128	8	PILOT VALVE - Air Starting Pilot Valve
3	3A2030	8	PLUG - Air Starting Pilot Valve Housing
4	3A2225	8	GASKET - Air Starting Pilot Valve - Plug
5	4A1228	6	TUBING - Air Starting Manifold
6	4A1229	1	TUBING - Air Starting Manifold
8	4A1316	1	TUBING - Air Starting Manifold
	4A1227	1	PLUG - Air Starting Pilot Valve

4Y1119 MANIFOLD ASSEMBLY - FUEL — Includes

(No Service Parts)

4Y1120 CRANKSHAFT ASSEMBLY — Includes

*		1	CRANKSHAFT
1	3A2019	1	THROWER - Oil (Fwd. End)
2	3A2018	1	THROWER - Oil (Aft. End)
3	4A1170	6	STUD - Flywheel to Crankshaft
4	3A2194	2	PIN - Gear Drive

ENGINE SIZE 9 X 10½ ISSUE 4 ASSEM. LIST NO. AL205A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

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REF NO	PART NUMBER	NO USED	DESCRIPTION

REF NO	PART NUMBER	NO USED	DESCRIPTION

4Y1137 MANIFOLD ASSEMBLY - FUEL — Includes

(No Service Parts)

4Y1138 MANIFOLD ASSEMBLY - FUEL — Includes

(No Service Parts)

4Y1148 HUB & STUD ASSEMBLY - REDUCTION GEAR COUPLING — Includes

1	4C1059-1	1	HUB - Reduction Gear Coupling
2	4A1167	18	STUD - Bushing to Reduction Gear Hub
3	3A1246	18	NUT - 1 1/8" - 12 Light Thick Slotted
		18	COTTER PIN - 3/16" x 2"

4Y1149 BUSHING & RING ASSEMBLY — Includes

1	4C1066-1	1	DRIVE RING - Flywheel
2	4A1180	18	BUSHING - Drive Ring

4Y1162 LEVER & CAP ASSEMBLY - FUEL SHUTDOWN — Includes

*		1	LEVER
*		1	CAP
*		2	CAPSCREW

4Y1163 COVER ASSEM.-AIR STARTING HOLE COVER AND FUEL OIL FILTER BRACKET — Includes

*		1	COVER
*		3	STUDS

4Y1178 BLOCK ASSEMBLY - CYLINDER — Includes

*		1	BLOCK - Cylinder
1	C-6466	12	STUD - Cylinder Head
2	3A2189	12	STUD - Cylinder Head (Tapped)
3	3A2241	12	STUD - Cylinder Head (Long)
4	610-RB3	36	PIPE - Cylinder to Head Water By-Pass

4Y1179 CRANKPIN BEARING & CONNECTING ROD ASSEMBLY — Includes

1	3A2192X	1	ROD ASSEMBLY - Connecting
2	3A2067X	1	BEARING ASSEMBLY - Connecting Rod
3	C7562D	4	SHIM - Connect. Rod to Bearing (.010)
3	4A1538	1	SHIM - Connect. Rod to Bearing (.5/32")
4	3A2055	2	SHELL - Connecting Rod Bearing
5	3A2089	4	BOLT - Connecting Rod to Bearing
6	3A2458	4	NUT - Connecting Rod to Brg. Bolt
7	3A2076	1	PIN - Bearing Shell Dowel

ENGINE SIZE 9 X 10½ ISSUE ASSEM.LIST NO. 5 AL206A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

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REF. NO.	PART NUMBER	NO. USED	DESCRIPTION
	4Y1181		**CONDUIT ASSEMBLY - PYROMETER CABLE (CENTER OUTLET)** Includes
	3A2627	4	TEE - Conduit
	3A2626	1	TEE - Conduit Outlet (Center)
	3A2683	2	ELL - Conduit (End)
	3A2644	7	COVER - Conduit Tee, Ell & Box
	3A2630	6	BUSHING - Reducing
	3A1766	1	NIPPLE - Conduit (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit (Cyl. 2 to 3)
	3A1758	2	NIPPLE - Conduit (Center Tee to Cyl. 3 & 4 Tee)
	3A1768	1	NIPPLE - Conduit (Cyl. 4 to 5)
	3A1766	1	NIPPLE - Conduit (Cyl. 5 to 6)
	3A2633	2	WASHER - Conduit Reducer
	4Y1183		**COMPRESSION RELIEF VALVE ASSEMBLY** Includes
1	4A1529	1	BODY - Compression Relief Valve
2	4A1531	1	VALVE - Compression Relief Valve
3	4A1555	1	SPRING - Compression Relief Valve
4	4A1554	1	RETAINER - Comp. Relief Valve Spring
5		1	WALDES TRAVARC EXTERNAL RING #5100-31
6	4A1530	1	PISTON - Compression Relief Valve
7	4A1532	1	CAP - Compression Relief Valve
	4Y1184		**HOUSING - FUEL COMPARTMENT ASSEMBLY** Includes
*		1	HOUSING - Fuel Compartment
*		1	COVER - Fuel Compartment Housing
	4Y1208		**CONDUIT ASSEMBLY - PYROMETER CABLE** Includes
	3A2627	8	TEE - Conduit
	3A2582	1	BOX - Conduit End Connection
	3A2644	9	COVER - Conduit Tee, Ell & Box
	3A2630	8	BUSHING - Reducing
	3A1764	1	NIPPLE - Conduit (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit (Cyl. 2 to 3)
	3A1768	1	NIPPLE - Conduit (Cyl. 3 to 4)
	3A1769	1	NIPPLE - Conduit (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit (Cyl. 5 to 6)
	3A1768	1	NIPPLE - Conduit (Cyl. 6 to 7)
	3A1768	1	NIPPLE - Conduit (Cyl. 7 to 8)
	3A1764	1	NIPPLE - Conduit (Cyl. 8 to End Box)
	4Y1211		**CONDUIT ASSEMBLY - PYROMETER CABLE** Includes
	3A2627	7	TEE - Conduit
	3A2683	1	ELL - Conduit
	3A2644	8	COVER - Conduit Tee & Ell
	3A2630	8	BUSHING - Reducing
	3A1766	1	NIPPLE - Conduit (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit (Cyl. 2 to 3)
	3A1768	1	NIPPLE - Conduit (Cyl. 3 to 4)
	3A1769	1	NIPPLE - Conduit (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit (Cyl. 5 to 6)
	3A1768	1	NIPPLE - Conduit (Cyl. 6 to 7)
	3A1768	1	NIPPLE - Conduit (Cyl. 7 to 8)
	4Y1212		**CONDUIT ASSEMBLY - PYROMETER CABLE** Includes
	3A2627	5	TEE - Conduit
	3A2683	1	ELL - Conduit
	3A2644	6	COVER - Conduit Tee & Ell
	3A2630	6	BUSHING - Reducing
	3A1766	1	NIPPLE - Conduit (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit (Cyl. 2 to 3)
	3A1769	1	NIPPLE - Conduit (Cyl. 3 to 4)
	3A1768	1	NIPPLE - Conduit (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit (Cyl. 5 to 6)

REF. NO.	PART NUMBER	NO. USED	DESCRIPTION
	4Y1235		**CONDUIT ASSEMBLY - PYROMETER CABLE** Includes
	3A2627	5	TEE - Conduit
	3A2683	1	ELL - Conduit (Front End)
	3A2793	1	BOX - Conduit - End Connection
	3A2644	7	COVER - Conduit Tee, Ell & Box
	3A2630	8	BUSHING - Reducing
	3A1766	1	NIPPLE - Conduit (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit (Cyl. 2 to 3)
	3A1769	1	NIPPLE - Conduit (Cyl. 3 to 4)
	3A1768	1	NIPPLE - Conduit (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit (Cyl. 5 to 6)
	3A1762	1	NIPPLE - Conduit (Cyl. 6 to End Box)
	4Y1238		**BASE ASSEMBLY** Includes
*		1	BASE
1	3A2081	6	PIN - Crank. Brg. Shell Dowel (In Base)
3	3A2006R	4	CAP - Crank. Bearing
4	3A2007R	1	CAP - Crank. Bearing (Fwd. End)
5	4B1119R	1	CAP - Crank. Bearing (Center)
6	3A3047R	1	CAP - Crank. Bearing (Thrust)
7	3A2080	7	PIN - Crank. Bearing Shell Dowel (In Caps)
		7	PIPE PLUG - 3/8 Std. C't's'k. Hd.
9	3A3082	24	BOLT - Crank. Bearing Cap
10	3A3085	24	NUT - Crank. Bearing Cap Bolt
	4Y1282		**ADAPTOR ASSEMBLY** Includes
1	4A1528	1	ADAPTOR - Relief Valve Body to Cyl. Head
2		1	BUSHING - 1/2" x 3/8" - Reducing - Brass. Faced
	4Y1284		**LEVER & CAP ASSEMBLY - FUEL LIMITING CYL.** Includes
*		1	LEVER - Fuel Limiting Cylinder
*		1	CAP - Fuel Limiting Cylinder - Lever
3	H-7449	2	CAPSCREW
	4Y1285		**LEVER & CAP ASSEMBLY - FUEL CUT-OFF CYLINDER** Includes
*		1	LEVER - Fuel Cut-off Cylinder
*		1	CAP - Fuel Cut-off Cylinder - Lever
3	H-7449	2	CAPSCREW - Cap to Lever - Fuel Cut-off Cylinder
	4Y1298		**AIR STARTING CHECK VALVE BODY & PISTON** Includes
*		1	BODY
*		1	PISTON
1	4A1544	1	GASKET
2	4A1543	1	CAP

ENGINE SIZE 9 X 10 1/2 ISSUE ASSEM.LIST NO. 4 AL207A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

WHEN ORDERING PARTS ALWAYS GIVE ENGINE NUMBER-PART NUMBER-NAME-OR COMPLETE DESCRIPTION AND SIZE
DO NOT ORDER PARTS BY REFERENCE NUMBERS
* INDICATES PARTS NOT SOLD INDIVIDUALLY

REF NO	PART NUMBER	NO USED	DESCRIPTION	
	X1583		NIPPLE ASSEM.-AIR STARTING VALVE TO GLOBE VALVE	Includes
			(No Service Parts)	
	X1752		MANIFOLD ASSEMBLY - EXHAUST	Includes
*		1	MANIFOLD	
1	C-2012L3	4	STUD - End Flange	
		1	PIPE PLUG - 1 1/4 Std.	
	X1753		MANIFOLD ASSEMBLY - EXHAUST	Includes
*		1	MANIFOLD	
1	C-2012L3	4	STUD - End Flange	
		2	PIPE PLUG - 1 1/4 Std.	
	3A2045X		CLAMP ASSEMBLY-CRANKSHAFT GEAR	Includes
*		2	CLAMP (Halves)	
1	3A2077	2	BOLT	
		2	CASTLE NUT - 5/8-16-Hex.	
		2	COTTER PIN - 1/8 x 1 1/8 Lg.	
	3A2051X		GEAR ASSEMBLY - CRANKSHAFT	Includes
*		1	GEAR (2 Halves)	
1	S-3302	2	PIN - Dowel	
	3A2067X		BEARING ASSEMBLY-CONNECTING ROD	Includes
*		1	BEARING - Crankpin (Upper Half)	
*		1	BEARING - Crankpin (Lower Half)	
1	C-2608L2 1/42		CAPSCREW - Upper Half to Lower Half	
2		2	CASTLE NUT - 1/2-13-Hex.	
		2	COTTER PIN - 1/8 x 1 Lg.	
	3A2085X		PUSH ROD ASSEM.-INLET OR EXHAUST VALVE	Includes
			(No Service Parts)	
	3A2095X		MANIFOLD ASSEMBLY - LUBE OIL	Includes
*		1	PIPE	
*		6	CONNECTION - Outlet Tube	
*		1	CONNECTION - Out. Tube (Cam. Brg. Man.)	
*		1	BUSHING - End	
1		1	TEE - 1 1/2 Std.	
		1	PIPE PLUG - 1 1/2 Std. C't's'k. Hd.	
2		1	REDUCING BUSHING - 1 x 3/8 Std.	
	3A2137X		BEARING ASSEMBLY - CAMSHAFT	Includes
*		1	BEARING	
1	3A2136	1	BUSHING	
	3A2139X		MANIFOLD ASSEMBLY - AIR STARTING	Includes
1	3A2029	6	HOUSING - Pilot Valve	
2	3A2128	6	VALVE - Pilot	
3	3A2030	6	PLUG - Pilot Housing (& Valve Stop)	
4	3A2225	6	GASKET - Plug to Housing	
5		4	NIPPLE - 1 1/4 x 7 7/8 Lg.	
6		1	NIPPLE (Center) - 1 1/4 x 8 7/8 Lg.	
	3A2144X		BEARING ASSEMBLY-CAMSHAFT (AFT. END)	Includes
*		1	BEARING	
1	3A2143	1	BUSHING - (Short)	
2	3A2471	1	BUSHING - (Long)	
	3A2150X		MANIFOLD ASSEMBLY-CAM. BEAR. LUBE OIL	Includes
*		1	PIPE	
*		6	BRACKET	
*		1	CROSS	
		1	REDUCER - 1/2 x 1/8 Std. Pipe	
	3A2164X		BEARING ASSEMBLY-CAMSHAFT (FWD.END)	Includes
*		1	BEARING	
1	3A2457	1	BUSHING	
	3A2171X		MANIFOLD ASSEMBLY - FUEL	Includes
			(No Service Parts)	
	3A2186X		SCREW ASSEMBLY-CYL. HEAD COVER (LONG)	Includes
			(No Service Parts)	

REF NO	PART NUMBER	NO USED	DESCRIPTION	
	3A2188X		SCREW ASSEM. - CYL. HEAD COVER (SHORT)	Includes
			(No Service Parts)	
	3A2192X		ROD ASSEM. - CONNECTING	Includes
*		1	ROD	
1	3A2078R	1	BUSHING - Piston Pin	
		1	PIPE PLUG -- 3/8 Std. C't's'k. Hd.	
	3A2193X		CRANKSHAFT ASSEMBLY	Includes
*		1	CRANKSHAFT	
1	3A2019	1	THROWER - Oil (Fwd. End)	
2	3A2018	1	THROWER - Oil (Aft. End)	
3	3A2103	6	STUD - Flywheel to Crankshaft	
4	3A2194	2	PIN - Gear Drive	
	3A2195X		ADAPTOR ASSEM. - FUEL TRANSFER PUMP	Includes
*		1	ADAPTOR	
1	2C2477	1	BUSHING - Adaptor	
*		1	BEARING	
2	C-9882	1	BUSHING - Pump Bearing (Gear End)	
3	2C2477	1	BUSHING - Pump Bearing (Seal End)	
4	3A2198	1	GASKET - Bearing to Adaptor	
		3	CAPSCREW -- 3/8-16 x 1 1/4 Lg.	
		3	LOCKWASHER -- 3/8 SAE Reg.	
	3A2196X		ADAPTOR ASSEM. - LUBE OIL PUMP	Includes
*		1	ADAPTOR	
1	3A2124	1	BUSHING - (Pump End)	
2	3A2463	1	BUSHING - (Thrust)	
	3A2202X		GEAR ASSEMBLY - WATER PUMP DRIVE	Includes
*		1	GEAR	
1	3A2111	6	PIN - Gear Coupling	
	3A2209X		BLOCK ASSEM. - CYLINDER	Includes
*		1	BLOCK	
1	C-6466	12	STUD - Head	
2	3A2189	12	STUD - Head (Tapped)	
3	3A2241	12	STUD - Head (Long)	
4	610-RB3	36	PIPE - Cyl. to Head Water By-Pass	
	3A2210X		LINER ASSEM. - CYLINDER	Includes
*		1	LINER	
1	S-988	1	PIN - Dowel	
	3A2211X		CENTER FRAME ASSEMBLY	Includes
*		1	CENTER FRAME	
1	3A2449	36	STUD - Valve & Pump Lifter Guide	
	3A2242X		ROCKER ASSEM. - INLET OR EXHAUST VALVE	Includes
*		1	ROCKER	
1	3A2255	1	BUSHING	
2	884-E	1	ROLLER	
3	3A2238	1	PIN - Roller	
		1	MACHINE SCREW -- 5/16-18 x 1/2 Lg.-Rnd.Hd.	
	3A2248X		HEAD ASSEMBLY - CYLINDER	Includes
1	3A2249X	1	HEAD ASSEM.	
2	3A2054	2	VALVE - Inlet & Exhaust	
3	3A2456	2	RING - Valve Safety Retainer	
4	3A2538	2	SPRING - Valve (Outer)	
5	3A2537	2	SPRING - Valve (Inner)	
6	3A2243	2	WASHER - Valve Spring Lower Guide	
7	C-6462	2	RETAINER - Valve Spring	
8	C-6461	4	LOCK - Retainer	
9	3A2182	1	VALVE - Air Starting Check	
10	3A2184	1	STOP - Check Valve	
11	3A2257	1	SPRING - Check Valve	
12		1	CASTLE NUT -- 5/8-18-Hex.	
		1	COTTER PIN -- 1/8 x 1 1/4 Lg.	
13	785	1	PLANGE - Water Outlet Hole Blind	
14	S-2334	1	GASKET - Flange	
		2	CAPSCREW -- 1/2-13 x 1 1/4 Lg.	
		2	LOCKWASHER -- 1/2 SAE Reg.	

ENGINE SIZE 9 X 10½ ISSUE 4 ASSEM.LIST NO. AL208A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

WHEN ORDERING PARTS ALWAYS GIVE ENGINE NUMBER-PART NUMBER-NAME-OR COMPLETE DESCRIPTION AND SIZE
DO NOT ORDER PARTS BY REFERENCE NUMBERS
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REF NO	PART NUMBER	NO USED	DESCRIPTION
	3A2249X		**HEAD ASSEM. - CYLINDER** Includes
*		1	HEAD
*		1	PIPE - Compression Release--Cast in Head
		5	PIPE PLUG -- 1 1/2 Std. - C't's'k. Hd.
		6	PIPE PLUG -- 1 Std. - C't's'k. Hd.
		1	PIPE PLUG -- 1/2 Std. - C't's'k. Hd.
2	3A2190	1	TUBE - Fuel Injection Valve
3	3A2187	2	GUIDE - Inlet & Exhaust Valve
4	3A2183	1	GUIDE - Air Start. Valve
5	C-6392L1	4	PIN - Rocker Bearing Dowel
6	3A2191	2	STUD - Rocker Bearing
7	C-2012L5 3/4	1	STUD - Fuel Injection Valve Clamp
	3A2277X		**GOVERNOR ASSEMBLY** Includes
1	3A2278X	1	BODY ASSEM.
2	3A2279X	2	WEIGHT ASSEM.
3	2C1820	2	PIN - Gov. Weight to Body
		4	CASTLE NUT -- 3/8-24-Hex.
		4	COTTER PIN -- 3/32 x 3/4 Lg.
4	3A2280X	1	QUILL ASSEM.
5	C-548	1	KEY - Thrust Quill
	3A2278X		**BODY ASSEM. - GOVERNOR** Includes
*		1	BODY
1	3A2094	1	GEAR - Drive
2		1	WOODRUFF KEY -- 1/8 x 5/8 Std.
	3A2279X		**WEIGHT ASSEM. - GOVERNOR** Includes
*		1	WEIGHT
1	3A2678	1	ROLLER
2	S-2899	1	PIN - Roller to Weight
	3A2280X		**QUILL ASSEM. - GOVERNOR THRUST** Includes
*		1	QUILL
1	3A2546	1	PLATE
	3A2287X		**MANIFOLD ASSEM. - ROCKER SHAFT LUBE OIL** Includes
			(No Service Parts)
	3A2316X		**CAM ASSEMBLY - AIR** Includes
*		1	CAM
1	C-3190	1	PIN
	3A2319X		**PLUNGER ASSEM. - GOVERNOR CONTROL** Includes
*		1	PLUNGER
1	3A2357	2	ROLLER
2	S-3041	2	PIN - Roller to Plunger
	3A2339X		**HOUSING ASSEM. - ENGINE CONTROL** Includes
*		1	HOUSING
1	3A2338	2	LINER - Air Compressor Cylinder
2		1	PLUG -- Welch Expansion - 1 3/4 Dia.
3	3A2866	1	SLEEVE - Control Unit Air Supply Valve
4	3A3061	1	BUSHING - Control Shaft
	3A2344X		**DISC ASSEM. - AIR CYL. CONTROL VALVE** Includes
*		1	DISC
1		1	PLUG -- Welch Expansion - 1 3/16 Dia.
	3A2346X		**LEVER ASSEM. - ENGINE CONTROL HAND** Includes
*		1	LEVER
1	C-5823	1	PIN - Remote Control Sprocket Dowel
2	3A2377X	1	LATCH ASSEM.
3	2C2258L1 5/8	1	PIN - Latch Fulcrum
4		1	COTTER PIN -- 1/8 x 2 Lg.
5	2C2224	1	SPRING - Latch
6	3A2380	1	PLUNGER - Latch Control
7	C-3952	1	PIN - Plunger Lock
	3A2348X		**PISTON ASSEM. - AIR CYLINDER** Includes
*		1	PISTON
1	3A2391	2	STUD
	3A2353X		**LEVER ASSEM. - CAMSHAFT SHIFTER** Includes
*		1	LEVER
1	3A2484	2	PIN

REF NO	PART NUMBER	NO USED	DESCRIPTION
	3A2356X		**VALVE ASSEM. - AIR STARTING** Include
1	3A2308	1	HOUSING
2	3A2310	1	VALVE
3	2C170P2 1/2	2	RING - Piston
4	3A2312	1	VALVE - Bleeder
5	3A2314	1	SPRING - Bleeder Valve
6	3A2311	1	WASHER - Bleeder Valve Spring Seat
7	3A2309	1	COVER - Housing
8	2C3563	1	GASKET - Cover to Housing
		4	CAPSCREW -- 1/2-13 x 1 1/4 Lg.
		4	LOCKWASHER -- 1/2 SAE Reg.
	3A2363X		**PLUNGER ASSEM. - INTERLOCK DRIVE** Include
1	3A2362	1	PLUNGER
2	3A2366	1	GEAR - Interlock Rack Drive
3		1	WOODRUFF KEY -- 3/32 x 5/8 Std.
4	3A2365	1	PISTON
5		1	TAPER PIN -- #3 x 1 Lg.
	3A2373X		**TUBE ASSEM. - GOV. SPRING** Include
			(No Service Parts)
	3A2377X		**LATCH ASSEM. - HAND CONTROL LEVER** Include
*		1	LATCH
1	3A2376	1	PIN
	3A2424X		**BASE ASSEMBLY** Include
*		1	BASE
		2	PIPE PLUG (Sump)--1 1/2 Std.-C't's'k. Hd.
1	3A2081	6	PIN - Crank. Brg. Shell Dowel (In Base)
2	3A2086	1	PIN - Crank. Brg. Shell Dowel (Thrust-In Base
3	3A2006	4	CAP - Crank. Bearing
4	3A2007	1	CAP - Crank. Brg. - (Fwd. End)
5	4B1119	1	CAP - Crank. Brg. - (Center)
6	3A2009	1	CAP - Crank. Brg. - (Thrust)
7	3A2080	7	PIN - Crank. Brg. Shell Dowel (In Caps)
		7	PIPE PLUG -- 3/8 Std. C't's'k. Hd.
9	3A2071	24	BOLT - Crank. Brg. Cap
10	3A2072	24	NUT - Crank. Brg. Cap Bolt
		24	COTTER PIN -- 1/8 x 1 3/4 Lg.
	3A2470X		**BODY ASSEM. - LUBE OIL STRAINER** Include
			(No Service Parts)
	3A2477X		**ROD ASSEM. - FUEL CUT-OFF** Include
			(No Service Parts)
	3A2479X		**VALVE ASSEM. - FUEL INJECTION** Include
*		1	HOLDER - Nozzle
1	BM-5421	1	VALVE - Nozzle
2	3A2261	1	TIP - Spray
	3A2489X		**HOUSING ASSEM. - ROTATION INTERLOCK** Include
*		1	HOUSING
1	3A2390	1	PIN - Rack Stop
	3A2492X		**MANIFOLD ASSEM. - AIR INLET** Include
			(No Service Parts)
	3A2502X		**BLOCK ASSEM. - GOVERNOR THRUST** Include
1	3A2679	1	BLOCK
2	C-543	1	PIN - Yoke
3	3A2400	1	QUILL - Thrust Block Guide
4	C-4351	1	PIN - Quill to Block
	3A2514X		**BRACKET ASSEM. - AIR COMP. IDLER PULLEY** Include
			(No Service Parts)
	3A2515X		**BRACKET ASSEM. - IDLER PULLEY** Include
*		1	BRACKET ASSEMBLY
1	3A2407	1	SHAFT

ENGINE SIZE 9 X 10½ ISSUE 2 ASSEM.LIST NO. AL209A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

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REF NO	PART NUMBER	NO USED	DESCRIPTION
	3A2524X		TUBE ASSEM. - FUEL INJECTION PUMP INLET — Includes
			(No Service Parts)
	3A2526X		TUBE ASSEM. - FUEL INJECTION — Includes
			(No Service Parts)
	3A2543X		MANIFOLD ASSEM. - LUBE OIL — Includes
*		1	PIPE
*		8	CONNECTION - Outlet Tube
*		1	CONNECTION - Out. Tube (Cam Brg. Man.)
1		1	BUSHING - End
		1	TEE -- 1 1/2 Std.
		1	PIPE PLUG -- 1 1/2 Std. C't's'k. Hd.
2		1	REDUCING BUSHING -- 1 x 3/8 Std.
	3A2545X		MANIFOLD ASSEM. - CAM. BRG. LUBE OIL — Includes
*		1	PIPE
*		8	BRACKET
*		1	CROSS
		1	REDUCER -- 1/2 x 1/8 Std. Pipe
	3A2552X		MANIFOLD ASSEM. - FUEL — Includes
			(No Service Parts)
	3A2553X		MANIFOLD ASSEM. - EXHAUST — Includes
			(No Service Parts)
	3A2563X		MANIFOLD ASSEM. - ROCKER SHAFT LUBE OIL — Includes
			(No Service Parts)
	3A2567X		MANIFOLD ASSEM - AIR STARTING — Includes
1	3A2029	8	HOUSING - Pilot Valve
2	3A2128	8	VALVE - Pilot
3	3A2030	8	PLUG - Pilot Housing (& Valve Stop)
4	3A2225	8	GASKET - Plug to Housing
5		6	NIPPLE -- 1 1/4 x 7 7/8 Lg.
6		1	NIPPLE (Center) -- 1 1/4 x 8 7/8 Lg.
	3A2575X		PISTON ASSEMBLY — Includes
*		1	PISTON
1	3A2560	1	PLUG - Piston Oil Chamber
		1	PIPE PLUG -- 1/4 Std. C't's'k. Hd.
	3A2576X		PISTON ASSEMBLY — Includes
*		1	PISTON
1	3A2566	1	PLUG - Piston Oil Chamber
		1	PIPE PLUG -- 1/4 Std. C't's'k. Hd.
	3A2577X		PIN ASSEM. - PISTON — Includes
*		1	PIN
1	3A2559	2	PLUG
	3A2578X		PIN ASSEMBLY - PISTON — Includes
*		1	PIN
1	3A2565	2	PLUG
	3A2585X		MANIFOLD ASSEM. - AIR INLET — Includes
			(No Service Parts)
	3A2589X		MANIFOLD ASSEM. - AIR INLET — Includes
			(No Service Parts)
	3A2593X		VALVE ASSEM. - FUEL INJECTION — Includes
*		1	HOLDER - Nozzle
1	BM-5421	1	VALVE - Nozzle
2	3A2594	1	TIP - Spray

REF NO	PART NUMBER	NO USED	DESCRIPTION
	3A2596X		BASE ASSEMBLY — Includes
*		1	BASE
		2	PIPE PLUG (Sump)-1 1/2 Std. C't's'k. Hd.
1	3A2081	8	PIN - Crank. Brg. Shell Dowel (In Base)
2	3A2086	1	PIN - Crank. Brg. Shell Dowel (Thrust-In Base)
3	3A2006	6	CAP - Crank. Bearing
4	3A2007	1	CAP - Crank. Brg. (Fwd. End)
5	4B1119	1	CAP - Crank. Brg. - (Center)
6	3A2009	1	CAP - Crank. Brg. - (Thrust)
7	3A2080	9	PIN - Crank. Brg. Shell Dowel (In Caps)
		9	PIPE PLUG - 3/8 Std. C't's'k. Hd.
9	3A2071	32	BOLT - Crank. Brg. Cap
10	3A2072	32	NUT - Crank. Brg. Cap Bolt
		32	COTTER PIN - 1/8 x 1 3/4 Lg.
	3A2597X		CENTERFRAME ASSEMBLY — Includes
*		1	CENTERFRAME
1	3A2449	48	STUD - Valve & Pump Lifter Guide
	3A2598X		BLOCK ASSEMBLY - CYLINDER — Includes
*		1	BLOCK
1	C-6466	16	STUD - Head
2	3A2189	16	STUD - Head (Tapped)
3	3A2241	16	STUD - Head (Long)
4	610-RB3	48	PIPE - Cyl. to Head Water By-Pass
	3A2599X		CRANKSHAFT ASSEMBLY — Includes
*		1	CRANKSHAFT
1	3A2019	1	THROWER - Oil (Fwd. End)
2	3A2018	1	THROWER - Oil (Aft. End)
3	3A2103	6	STUD - Flywheel to Crankshaft
4	3A2194	2	PIN - Gear Drive
	3A2663X		MANIFOLD ASSEMBLY - AIR INLET — Includes
			(No Service Parts)
	3A2666X		MANIFOLD ASSEMBLY - EXHAUST — Includes
			(No Service Parts)
	3A2734X		CONDUIT ASSEMBLY - PYROMETER CABLE — Includes
	3A2627	5	TEE
	3A2683	1	ELL
	3A2644	7	COVER - Tee & Ell
	3A2630	6	BUSHING - Reducing
	3A1764	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1769	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A1768	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1767	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A2631	1	ELBOW - Flex. Conduit
	3A1782	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	3A2757X		PLUG ASSEMBLY - PISTON PIN — Includes
*		1	PLUG
1	2C4519	1	PIN - Plug Locating
	3A2763X		HANDLE ASSEMBLY - GOVERNOR CONTROL — Includes
1	1117-E	1	HANDLE - (Upper Sect.)
2	3A2731	1	HANDLE - (Lower Sect.)
3	1249-E	1	SCREW - Handle to Handle
		1	HALF NUT - 1/4-20-Hex.
4	1118-E1	1	PAWL - Handle
5		1	TAPER PIN (Pawl Retain.) - #1 x 1 Lg.
6	1124-E	1	SPRING - Pawl
7	1125-E	1	PLUG - Spring Retainer

ENGINE SIZE 9 X 10½ ISSUE 1 ASSEM.LIST NO. AL210A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

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REF. NO.	PART NUMBER	NO. USED	DESCRIPTION
	3A2795X		COVER ASSEM.-CENTERFRAME SIDE (EXPLOSION VALVE) Includes
1	3A2750	1	COVER
2	3A2715	1	PLATE - Explosion Valve
3	3A2716	1	GASKET - Plate to Cover
4	3A2752	8	SPRING - Explosion Valve
5	3A2753	8	WASHER - Spring Retainer
6	3A2751	8	STOP - Explosion Valve
7	3A2811	8	BOLT - Plate
8	3A2812	8	GASKET - Valve Plate Bolt Seal
		8	SLOTTED NUT -- 1/2-13-Hex.
		8	COTTER PIN -- 1/8 x 1 Lg.
	3A2797X		PLUNGER ASSEM. - ROTAT. INTERLOCK DRIVE Includes
*		1	PLUNGER
1	3A2791	1	FACING
2		4	RIVET -- 1/8 x 9/32 Lg. - Tubular
	3A2798X		CONDUIT ASSEM - PYROMETER CABLE Includes
	3A2627	7	TEE
	3A2644	7	COVER - Tee
	3A2630	8	BUSHING - Reducing
	3A1764	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1769	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A1768	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A1764	1	NIPPLE - Conduit - (Cyl. 6 to End Tee)
	3A2631	1	ELBOW - Flex. Conduit
	3A1782	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	3A2799X		CONDUIT ASSEM. - PYROMETER CABLE Includes
	3A2627	5	TEE
	3A2683	1	ELL
	3A2644	6	COVER - Tee & Ell
	3A2630	6	BUSHING - Reducing
	3A1766	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1769	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A1768	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A2632	1	CONNECTOR - Flex. Conduit
	3A1787	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	3A2800X		CONDUIT ASSEM. - PYROMETER CABLE Includes
	3A2627	5	TEE
	3A2683	1	ELL - (Front End)
	3A2793	1	BOX - End Connection
	3A2644	7	COVER - Tee, Ell & Box
	3A2630	8	BUSHING - Reducing
	3A1766	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1769	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A1768	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A1762	1	NIPPLE - Conduit - (Cyl. 6 to End Box)
	3A2632	1	CONNECTOR - Flex. Conduit
	3A1783	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	3A2801X		CONDUIT ASSEM. - PYROMETER CABLE Includes
	3A2627	7	TEE
	3A2683	1	ELL
	3A2644	8	COVER - Tee & Ell
	3A2630	8	BUSHING - Reducing
	3A1764	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1768	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A1769	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A1768	1	NIPPLE - Conduit - (Cyl. 6 to 7)
	3A1767	1	NIPPLE - Conduit - (Cyl. 7 to 8)
	3A2631	1	ELBOW - Flex. Conduit
	3A1782	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer

REF. NO.	PART NUMBER	NO. USED	DESCRIPTION
	3A2802X		CONDUIT ASSEM. - PYROMETER CABLE Include
	3A2627	8	TEE
	3A2582	1	BOX - End Connection
	3A2644	9	COVER - Tee, Ell & Box
	3A2630	8	BUSHING - Reducing
	3A1764	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1768	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A1769	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A1768	1	NIPPLE - Conduit - (Cyl. 6 to 7)
	3A1768	1	NIPPLE - Conduit - (Cyl. 7 to 8)
	3A1764	1	NIPPLE - Conduit - (Cyl. 8 to End Box)
	3A2631	1	ELBOW - Flex. Conduit
	3A1782	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	3A2803X		CONDUIT ASSEM. - PYROMETER CABLE Include
	3A2627	7	TEE
	3A2683	1	ELL
	3A2644	8	COVER - Tee & Ell
	3A2630	8	BUSHING - Reducing
	3A1766	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1768	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A1769	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A1768	1	NIPPLE - Conduit - (Cyl. 6 to 7)
	3A1768	1	NIPPLE - Conduit - (Cyl. 7 to 8)
	3A2632	1	CONNECTOR - Flex. Conduit
	3A1787	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	3A2804X		CONDUIT ASSEM. - PYROMETER CABLE Include
	3A2627	7	TEE
	3A2683	1	ELL
	3A2794	1	BOX - End Connection
	3A2644	9	COVER - Tee & Ell
	3A2630	10	BUSHING - Reducing
	3A1766	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1768	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A1769	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A1768	1	NIPPLE - Conduit - (Cyl. 6 to 7)
	3A1768	1	NIPPLE - Conduit - (Cyl. 7 to 8)
	3A1762	1	NIPPLE - Conduit - (Cyl. 8 to End Box)
	3A2632	1	CONNECTOR - Flex. Conduit
	3A1783	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	3A2832X		PISTON ASSEMBLY Include
*		1	PISTON
1	3A2560	1	PLUG - Piston Oil Chamber
		1	PIPE PLUG -- 1/4 Std. C't's'k. Hd.
	X2847		MANIFOLD ASSEM. - EXHAUST Include
*		1	MANIFOLD
1	C-2012L3	8	STUD - End Flange
		10	PIPE PLUG -- 1 1/4 Std.
	3A3036X		HOUS. ASSEM.-VERT. AND OVERSPEED GOV. DR. Includes
*		1	HOUSING
1	3A2986	1	PIN
	X3056		MANIFOLD ASSEM. - EXHAUST Include
*		1	MANIFOLD
1	C-2012L3	4	STUD - End
		2	PIPE PLUG -- 1 1/4 Std.

ENGINE SIZE 9 X 10½ ISSUE 1 ASSEM. LIST NO. AL211A

THE NATIONAL SUPPLY COMPANY
ENGINE DIVISION

SUB-ASSEMBLY LIST

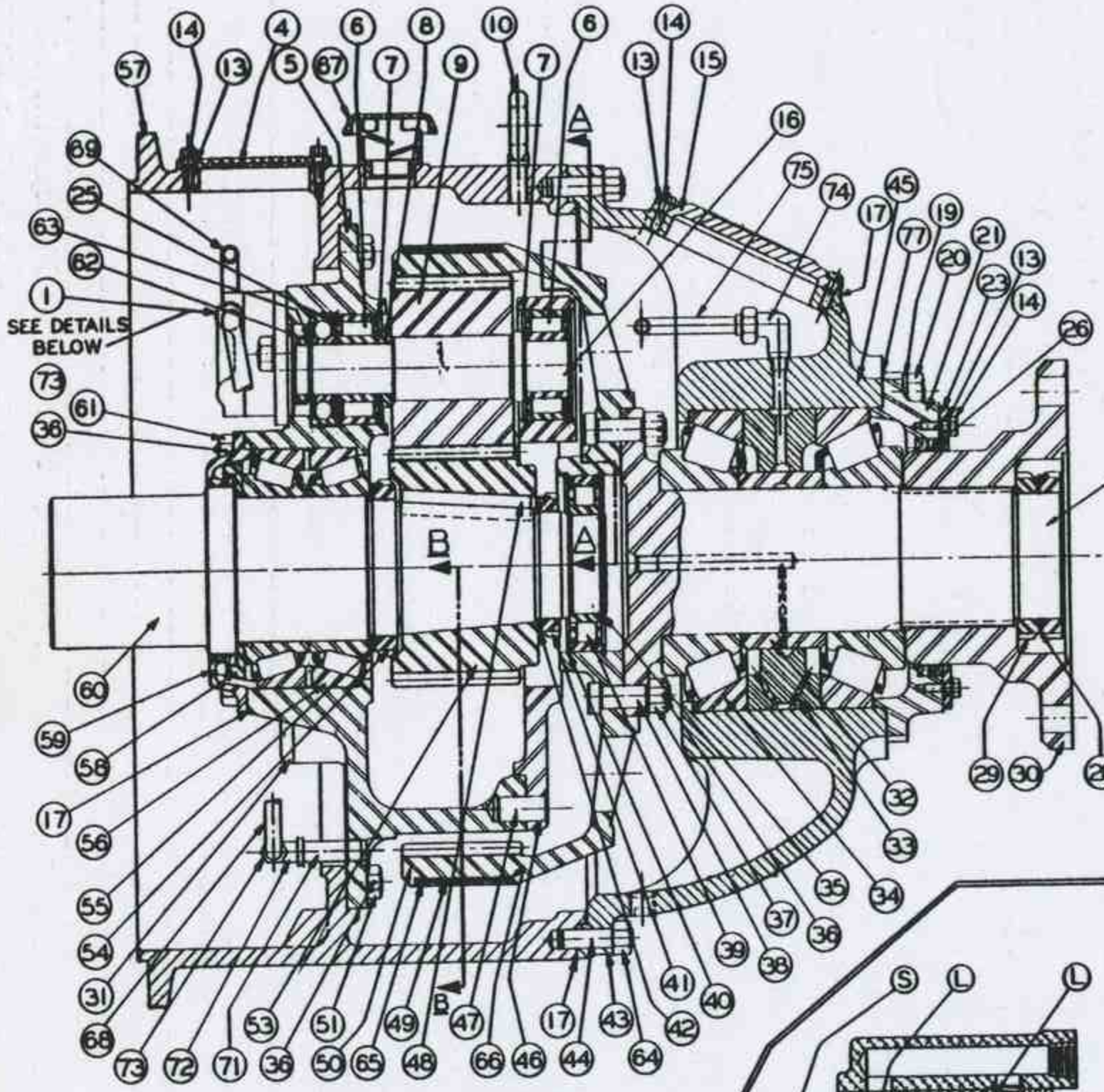
WHEN ORDERING PARTS ALWAYS GIVE ENGINE NUMBER-PART NUMBER-NAME-OR COMPLETE DESCRIPTION AND SIZE
DO NOT ORDER PARTS BY REFERENCE NUMBERS
* INDICATES PARTS NOT SOLD INDIVIDUALLY

REF NO	PART NUMBER	NO USED	DESCRIPTION
	3A3099X		BASE ASSEMBLY — Includes
*		1	BASE
		2	PIPE PLUG (SUMP) -- 1½ Std.-C't's'k. Hd.
1	3A2081	6	PIN - Crank. Brg. Shell Dowel (In Base)
3	3A2006	4	CAP - Crank. Bearing
4	3A2007	1	CAP - Crank. Brg. - (Fwd. End)
5	4B1119	1	CAP - Crank. Brg. - (Center)
6	3A3047	1	CAP - Crank. Brg. - (Thrust)
7	3A2080	7	PIN - Crank. Brg. Shell Dowel (In Caps)
		7	PIPE PLUG -- 3/8 Std. C't's'k. Hd.
9	3A3082	24	BOLT - Crank Brg. Cap
10	3A3085	24	NUT - Crank. Brg. Cap Bolt
	3A3100X		BASE ASSEMBLY — Includes
*		1	BASE
		2	PIPE PLUG (SUMP)-- 1 ½ Std. C't's'k. Hd.
1	3A2081	8	PIN- Crank. Brg. Shell Dowel (In Base)
3	3A2006	6	CAP - Crank. Bearing
4	3A2007	1	CAP - Crank. Brg. - (Fwd. End)
5	4B1119	1	CAP - Crank. Brg. - (Center)
6	3A3047	1	CAP - Crank. Brg. - (Thrust)
7	3A2080	9	PIN - Crank. Brg. - Shell Dowel (In Caps)
		9	PIPE PLUG -- 3/8 Std. C't's'k. Hd.
9	3A3082	32	BOLT -- Crank Brg. Cap
10	3A3085	32	NUT -- Crank. Brg. Cap Bolt
	3A3225X		CENTERFRAME ASSEMBLY — Includes
*		1	CENTERFRAME
1	3A2449	36	STUD - Valve & Pump Lifter Guide
	3A3226X		CENTERFRAME ASSEMBLY — Includes
*		1	CENTERFRAME
1	3A2449	48	STUD - Valve & Pump Lifter Guide
	3A3227X		BEARING ASSEM. - CAMSHAFT (FWD. END) — Includes
*		1	BEARING
1	3A3154	2	BUSHING - Camshaft Bearing
	3A3228X		BEARING ASSEM. - CAMSHAFT (FLY. END) — Includes
*		1	BEARING
1	3A3155	1	BUSHING - Camshaft Bearing (Long)
2	3A3154	1	BUSHING - Camshaft Bearing (Short)
	3A3229X		BEARING ASSEM. - CAMSHAFT — Includes
*		1	BEARING
1	3A3154	2	BUSHING- Camshaft Bearing
	3A3230X		MANIFOLD ASSEM. - CAM. BEARING LUBE OIL — Includes
*		1	PIPE - MANIFOLD
*		6	BRACKET - Lube Oil Manifold
*		1	CROSS - Lube Oil Manifold
		1	REDUCER -- ½ x 1/8 Std. Pipe
	3A3231X		MANIFOLD ASSEM. - CAM. BEAR.LUBE OIL — Includes
*		1	PIPE - Manifold
*		8	BRACKET - Lube Oil Manifold
*		1	CROSS - Lube Oil Manifold
		1	REDUCER -- ½ x 1/8 Std. Pipe
	3A3232X		MANIFOLD ASSEM. - EXHAUST — Includes
			(No Service Parts.)
	3A3233X		BRACKET ASSEM. - AIR COMP IDLER PULLEY — Includes
			(No Service Parts.)
	3A3297X		BRACKET ASSEMBLY - IDLER PULLEY — Includes
*		1	BRACKET ASSEMBLY
1	3A2407	1	SHAFT - Idler pulley
	3A3299X		BEARING ASSEMBLY - CAMSHAFT (FWD) — Includes
*		1	BEARING - Camshaft
1	3A2457	1	BUSHING - Camshaft Bearing
	3A3300X		BEARING ASSEMBLY - CAMSHAFT (AFT) — Includes
*		1	BEARING - Camshaft
1	3A2143	1	BUSHING - Camshaft Bearing (Short)
2	3A2471	1	BUSHING - Camshaft Bearing (Long)

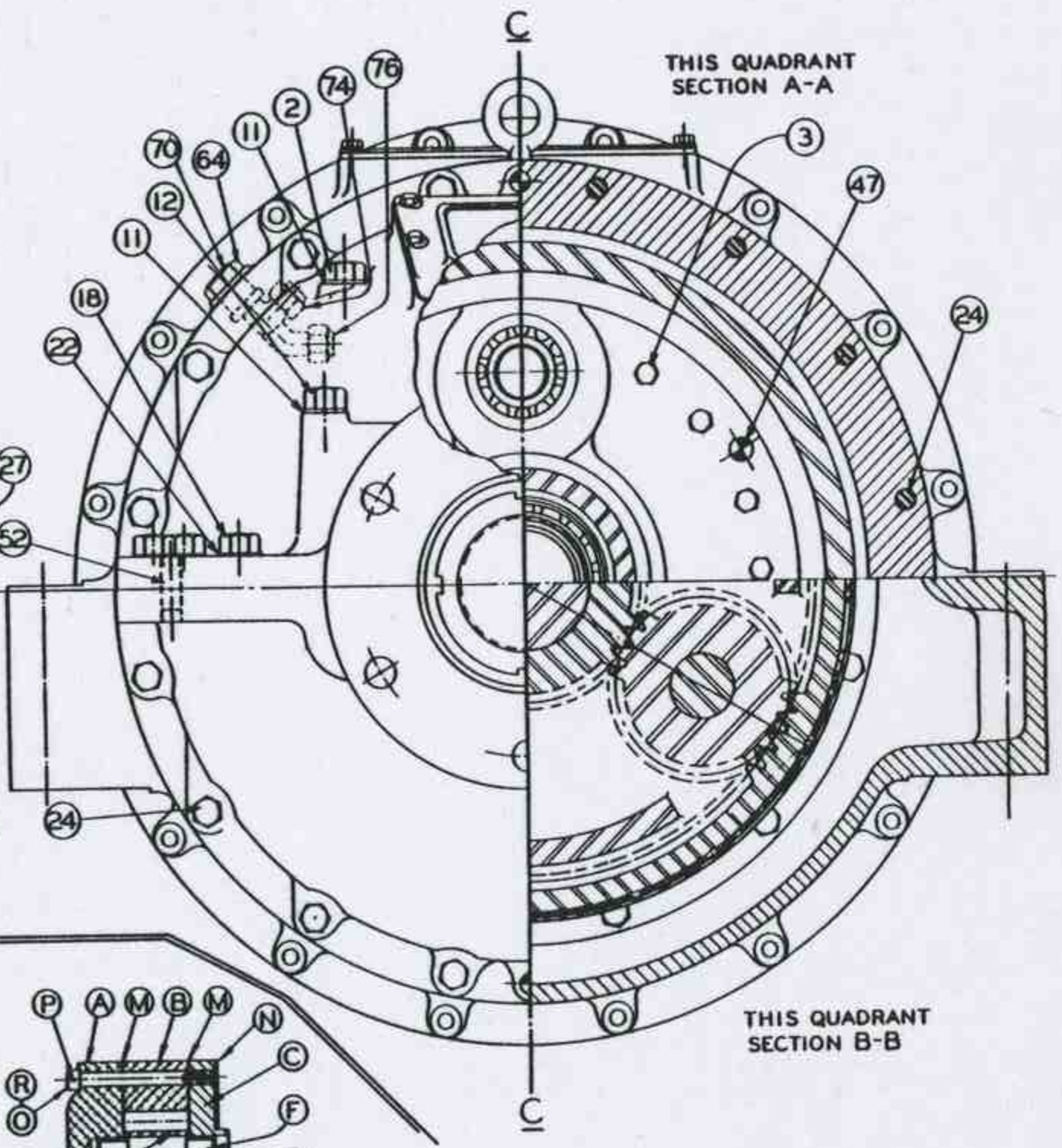
REF NO	PART NUMBER	NO USED	DESCRIPTION
	3A3301X		HOUSING ASSEMBLY - ENGINE CONTROL — Includes
*		1	HOUSING - Control
1	3A2338	2	LINER - Air Compressor Cylinder
2		1	PLUG - Welch expansion - 1-3/4" Dia.
3	3A2866	1	SLEEVE - Control Unit Air Supply Valve
4	3A3061	1	BUSHING - Control Shaft
	3A3309X		CAMSHAFT & HUB ASSEMBLY — Includes
*		1	CAMSHAFT
*		1	HUB - Camshaft Gear
*		1	KEY
	3A3318X		CONDUIT ASSEMBLY-PYROMETER CABLE — Includes
	3A2627	4	TEE - Conduit
	3A2626	1	TEE - Conduit Outlet (Center)
	3A2683	2	ELL - Conduit (End)
	3A2644	7	COVER - Conduit Tee, Ell & Box
	3A2630	6	BUSHING - Reducing
	3A1766	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1758	2	NIPPLE - Conduit -(Center Tee to Cyl. #3 & 4 Tee)
	3A1768	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1766	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A2632	1	CONNECTOR - Flex. Conduit
	3A1793	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	3A3319X		CONDUIT ASSEMBLY-PYROMETER CABLE — Include
	3A2627	6	TEE- Conduit
	3A2683	2	ELL - Conduit (End)
	3A2644	9	COVER - Conduit Tee & Ell
	3A2630	8	BUSHING - Reducing
	3A1766	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1768	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A1758	2	NIPPLE - Conduit - (Center Tee to #4 & 5 Tee)
	3A1768	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A1768	1	NIPPLE - Conduit - (Cyl. 6 to 7)
	3A1766	1	NIPPLE - Conduit - (Cyl. 7 to 8)
	3A2632	1	CONNECTOR - Flex. Conduit
	3A1794	1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	3A3320X		CONDUIT ASSEMBLY-PYROMETER CABLE — Include
	3A2627	8	TEE - Conduit
	3A2630	8	BUSHING - Reducing
	3A1768	1	NIPPLE - Conduit - (Cyl. 1 to 2)
	3A1768	1	NIPPLE - Conduit - (Cyl. 2 to 3)
	3A1768	1	NIPPLE - Conduit - (Cyl. 3 to 4)
	3A1769	1	NIPPLE - Conduit - (Cyl. 4 to 5)
	3A1768	1	NIPPLE - Conduit - (Cyl. 5 to 6)
	3A1768	1	NIPPLE - Conduit - (Cyl. 6 to 7)
	3A1768	1	NIPPLE - Conduit - (Cyl. 7 to 8)
	3A2631	1	ELBOW - Flex. Conduit
		1	CONDUIT (Flexible)
	3A2631	1	ELBOW - Flex. Conduit (Pyrometer End)
	3A2633	2	WASHER - Conduit Reducer
	3A3394X		CAMSHAFT AND HUB ASSEMBLY — Includes
*		1	CAMSHAFT
*		1	HUB - Camshaft Gear
*		1	KEY
	3A3395X		CAMSHAFT AND HUB ASSEMBLY — Includes
*		1	CAMSHAFT
*		1	HUB
*		1	KEY
	3A3396X		CAMSHAFT AND HUB ASSEMBLY — Includes
*		1	CAMSHAFT
*		1	HUB - Camshaft Gear
*		1	KEY

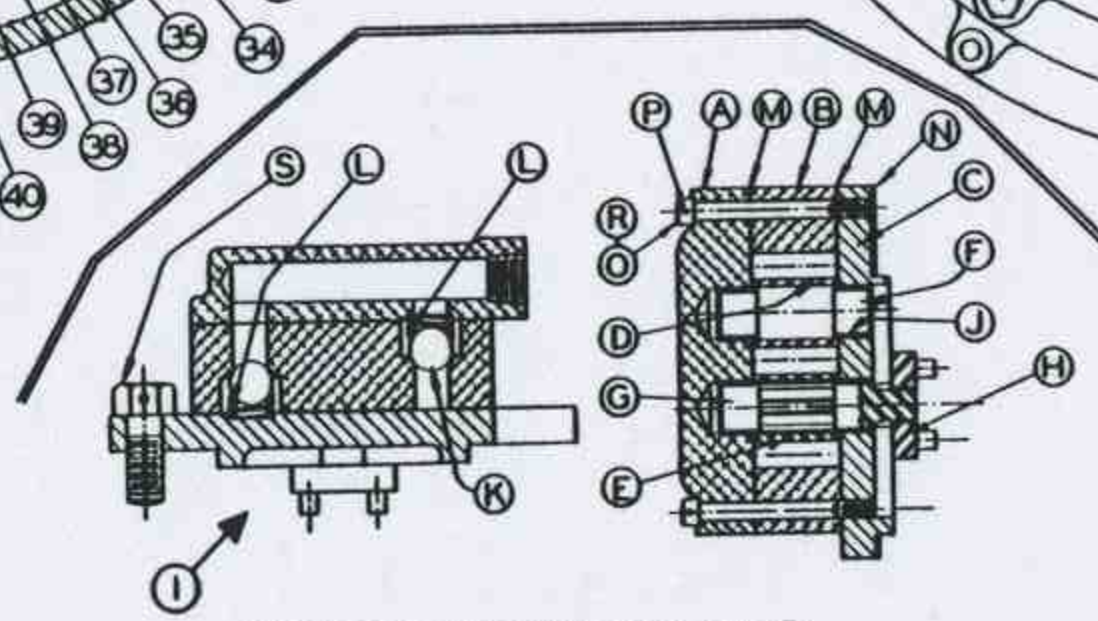
PLATE NO 3A4039

DO NOT ORDER PARTS BY REFER NUMBERS



SECTION C-C





SECTION THRU LUBE OIL PUMP

REDUCTION GEAR GROUP	MODEL 45 9×10½
BM-6387	3A4039

EXTRA COPIES TO _____ TYPED BY MLS DATE 4-24-52 CHKD. _____ ISSUED BY _____ DATE 4-24-52

CHANGES

2L2533 SH. 1 OF 3

PLATE NO. 3A4039

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO. REQD.	PART NAME [ASSEM. DRWG. NO.
1		1	BM-6387-1	1	OIL PUMP, Sub Assembly
2		2	BM-6387-2	2	CAPSCREW, Upper to Lower Hsg.
3		3	BM-6387-3	12	CAPSCREW, (drilled)
4		4	BM-6387-4	1	HAND HOLE COVER
5		5	BM-6387-5	1	SPIDER, Forward Half
6		6	BM-6387-6	6	BEARING, Spider Pinion (Hyatt)
7		7	BM-6387-7	9	RETAINING RINGS (Waldes Truarc)
8		8	BM-6387-8	3	SPACER, Pinion
9		9	BM-6387-9	3	IDLER PINION
10		10	BM-6387-10	1	LIFTING EYE
11		11	BM-6387-11	4	LOCKWASHER
12		12	BM-6387-12	2	CAPSCREW, Upper to Lower Hsg.
13		13	BM-6387-13	20	LOCKWASHER
14		14	BM-6387-14	20	CAPSCREW
15		15	BM-6387-15	1	COVER, Inspection
16		16	BM-6387-16	3	SHAFT, Idler Pinion
17		17	BM-6387-17		GASKET COMPOUND (PERMATEX)
18		18	BM-6387-18	8	CAPSCREW
19		19	BM-6387-19	24	LOCKWASHER
20		20	BM-6387-20	8	CAPSCREW, Rear Brg. Cap
21		21	BM-6387-21	1	RETAINER, Bearing (Drive Shaft Rear)
22		22	BM-6387-22	8	LOCKWASHER
23		23	BM-6387-23	1	SEAL RETAINER, Driving Shaft
24		24	BM-6387-24	16	CAPSCREW, Rear Hsg. to Forward Hsg.
25		25	BM-6387-25	3	BEARING, Locating Pinion (New Departure)
26		26	BM-6387-26	1	OIL SEAL, Garlock Split Klozure Rear
27		27	BM-6387-27	1	SHAFT, Driven
28		28	BM-6387-28	1	WASHER, Driven Shaft (Ball Brg. Lock.)
29		29	BM-6387-29	2	NUT, Driven Shaft (Ball Bearing)
30		30	BM-6387-30	1	FLANGE, Driven
31		31	BM-6387-31	2	COVER, Pinion Shaft
32		32	BM-6387-32	1	CONE SPACER, Timken Brg. Rear
33		33	BM-6387-33	1	CUP SPACER, Timken Brg. Rear
34		34	BM-6387-34	2	BEARING, Rear Thrust Timken
35		35	BM-6387-35	1	SNAP RING, Driving Shaft (Spirolox)
36		36	BM-6387-36		LOCK WIRE (As Req'd.)
37		37	BM-6387-37	12	SLOTTED NUT, Ring Gear to Driven Shaft
38		38	BM-6387-38	12	BOLT, Ring Gear to Driven Shaft
39		39	BM-6387-39	1	BEARING, Rear Pilot (Hyatt)
40		40	BM-6387-40		RETAINING RING, (Waldes Truarc)
41		41	BM-6387-41	1	NUT, Driving Shaft Rear
42		42	BM-6387-42	1	WASHER, Driving Shaft (Ball - Brg. Lock)
43		43	BM-6387-43	1	HOUSING, Lower Aft.
44					
45					
46					(Continued on Sheet 2)
47					
48					
49			Gear Complete - N. S. Co. NO. BM-6387		
50					

FOR OPP. HAND SEE _____

FOR OPP. ROT. SEE _____

NAME REDUCTION GEAR (2.50:1) AUTO ENGINE WORKS MODEL EC-9500

ORIGINALLY ISSUED FOR 8 Cyl. 9 x 10½ Mar. - Turbo.

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

NSM S-5453 REV. 10-50
PRINTED IN U.S.A.

PARTS LIST

ATLAS IMPERIAL ENGINE

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2533 SH. 1 OF 3

RA
IES TO

TYPED BY MLS DATE 4-24-52 CHK'D. ISSUED BY DATE 4-24-52

CHANGES

2L2533 SH. 2 OF 3

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A4039

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO. REQD.	PART NAME	ASSEM. DRWG. NO.
1						
2			CONTINUED FROM SHEET 1.			
3						
4		44	BM-6387-44	1	GASKET - Inspection Cover	
5		45	BM-6387-45	1	HOUSING, Upper Aft.	
6		46	BM-6387-46	1	SPIDER, Rear Half	
7		47	BM-6387-47	3	DOWEL, Spider	
8		48	BM-6387-48	1	KEY, Sun Gear	
9		49	BM-6387-49	1	SOUND DAMPENER	
10		50	BM-6387-50	1	RING GEAR	
11		51	BM-6387-51	16	CAPSCREW, Spider to Forward Hsg.	
12		52	BM-6387-52	2	DOWEL, Upper to Lower Hsg.	
13		53	BM-6387-53	1	SUN GEAR	
14		54	BM-6387-54	1	NUT, Fwd. Driving Shaft	
15		55	BM-6387-55	1	WASHER, Fwd. Driving Shaft	
16		56	BM-6387-56	1	BEARING, Fwd. (Timken)	
17		57	BM-6387-57	1	HOUSING	
18		58	BM-6387-58	1	OIL SLINGER	
19		59	BM-6387-59	1	FORWARD BRG. CAP	
20		60	BM-6387-60	1	DRIVING SHAFT	
21		61	BM-6387-61	6	CAPSCREW, Fwd. Brg. Cap	
22		62	BM-6387-62	3	NUT, pinion Shaft (Ball Brg.)	
23		63	BM-6387-63	3	WASHER, Pinion Shaft	
24		64	BM-6387-64	2	B.B. LOCKNUT	
25		65	BM-6387-65	1	SOUND DAMPER BAND	
26		66	BM-6387-66		CEMENT - Sound Damper (As Req'd.)	
27		67	BM-6387-67	1	BREATHER FITTING	
28		68	BM-6387-68	1	PIPING - Suction	
29		69	BM-6387-69	1	PIPING - #1 Pressure	
30		70	BM-6387-70	2	BULKHEAD UNION - Oil Piping	
31		71	BM-6387-71	1	NIPPLE	
32		72	BM-6387-72	1	ELBOW	
33		73	BM-6387-73	3	S.A.E. HALF UNION COUPLING	
34		74	BM-6387-74	2	S.A.E. HALF UNION ELBOW	
35		75	BM-6387-75	1	PIPING - Lubrication	
36		76	BM-6387-76	1	45° HALF UNION ELBOW	
37		77	BM-6387-77	1	GASKET - Bearing Retainer	
38		78	BM-6387-78	1	PIPE PLUG	
39						
40						
41						
42						
43						
44						
45						
46						

NOTE: This list copies from Auto Eng. Works drawings as follows:
EC-9500 dated 1-23-52

(Continued on Sheet 3)

R OPP. HAND SEE

R OPP. ROT. SEE

NAME REDUCTION GEAR (2.50:1) AUTO ENGINE WORKS, MODEL EC-9500

ORIGINALLY ISSUED FOR 8 Cyl. 9 x 10½ Mar. - Turbo

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

RM 5-5453 REV. 10-50
INTED IN U.S.A.

PARTS LIST ATLAS IMPERIAL ENGINE

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2533 SH. 2 OF 3

XTRA COPIES TO _____ TYPED BY MLS DATE 4-24-52 CHKD. _____ ISSUED BY _____ DATE 4-24-52

CHANGES

2L2533 SH. 3 OF 3

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO. 3A4039

LINE NO.	DRWG. NO.	REF. NO.	PART NO.	NO. REQD.	PART NAME	ASSEM. DRWG. NO.
1						
2			PARTS LIST - OIL PUMP - EC-9520 (Item 1)			
3						
4		A	BM-6387-100	1	COVER, Oil Pump	
5		B	BM-6387-101	1	BODY, Oil Pump	
6		C	BM-6387-102	1	ADAPTER, Oil Pump	
7		D	BM-6387-103	1	IDLER GEAR, Pump	
8		E	BM-6387-104	1	DRIVE GEAR, Pump	
9		F	BM-6387-105	1	IDLER SHAFT, Pump	
10		G	BM-6387-106	1	DRIVE SHAFT, Pump	
11		H	BM-6387-107	1	COUPLING, Pump Drive	
12		J	BM-6387-108	4	BUSHING	
13		K	BM-6387-109	4	BALL, Pump Check	
14		L	BM-6387-110	4	SPRING, Pump Check	
15		M	BM-6387-111	2	GASKET	
16		N	BM-6387-112	1	GASKET, Mt'g.	
17		O	BM-6387-113	6	CAPSCREW, Sk't. Hd. (Drilled)	
18		P	BM-6387-114		LOCKWIRE (as. req'd.)	
19		R	BM-6387-115	2	CAPSCREW, Sk't. Hd. (Drilled)	
20		S	BM-6387-116	2	CAPSCREW, Hex Hd. (Drilled)	
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47	NOTE: This list copied from Auto Eng. Works drawings as follows:					
48	EC-9520 dated 1-3-52					
49						
50						

FOR OPP. HAND SEE

FOR OPP. ROT. SEE

NAME REDUCTION GEAR (2.50:1) AUTO ENGINE WORKS. MODEL EC-9500

ORIGINALLY ISSUED FOR 8 Cyl. 9 x 10½ Mar. - Turbo

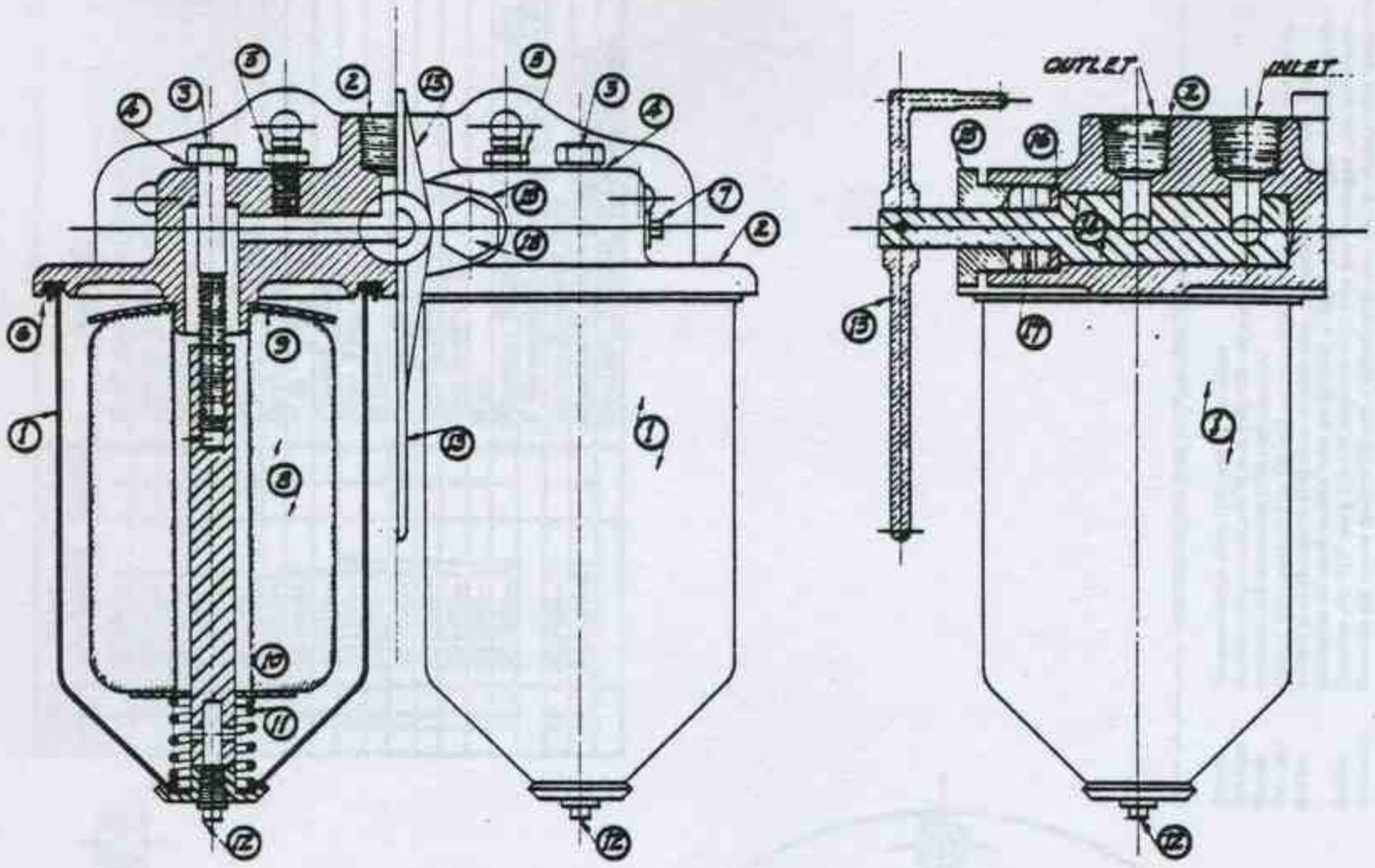
FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D GIVEN ABOVE BY NO. REQ'D FOR GROUP GIVEN ON INDEX SHEET

FORM S-5493 REV. 10-50
PRINTED IN U.S.A.

PARTS LIST ATLAS IMPERIAL ENGINE

THE NATIONAL SUPPLY CO.
ENGINE DIVISION SPRINGFIELD, OHIO

2L2533 SH. 3 OF 3



FUEL OIL FILTER
Part No. 3A2536

REF. NO.	PART NUMBER	NO. REQD.	NAME
1	3A2536P1	2	Shell Assembly
2	3A2536P2	1	Head
3	3A2536P3	2	Capscrew
4	3A2536P4	2	Gasket - (Bolt Head)
5	3A2536P5	2	Air Vent Screw
6	3A2536P6	2	Gasket
7	3A2536P7	2	Pipe Plug
8	3A2536P8	2	Element
9	3A2536P9	2	Washer - Element

REF. NO.	PART NUMBER	NO. REQD	NAME
10-11	3A2536P10	2	Spring & Washer Assem.
12	3A2536P12	2	Pipe Plug
13	3A2536P13	1	Handle - Valve
14	3A2536P14	1	Valve
15	3A2536P15	1	Gland - Packing
16	3A2536P16	1	Washer - Packing
17	3A2536P17	1	Packing
18	3A2536P18	2	Capscrew - Gland

VALVE OPERATION

A: Both units on and in operation when valve handle is in vertical position.

B: Unit No. 1. only is in operation when valve handle is in horizontal position with pointer hard against top of Unit No. 1.

C: Unit No. 2. only is in operation when valve handle is in horizontal position with pointer hard against top of Unit No. 2.

INSTRUCTIONS FOR REPLACING ELEMENT

First: Turn valve handle to correct position so unit will be free of oil flow.

Second: Remove drain plug (12) and drain filter.

Third: Remove head cap screw (3) and bolt Gasket (4) and drop off shell (1), then remove old element (8). Clean shell (1) thoroughly.

Fourth: Be sure spring & washer assembly (10 & 11) are in place.

Fifth: Install new element (8) into shell (1) and over center stud.

Sixth: Replace gasket (6) and be sure gasket (6) lies flat in groove.

Seventh: Install shell (1) in place and hold against gasket (6) until bolt gasket (4) and head cap screw (3) are installed. then tighten down in place.

Eighth: Install drain plug (12).

Ninth: Open air bleeder valve (5), then turn valve handle to vertical position. When fuel spouts through air bleeder valve (5), close tight. Inspect filter for leaks.

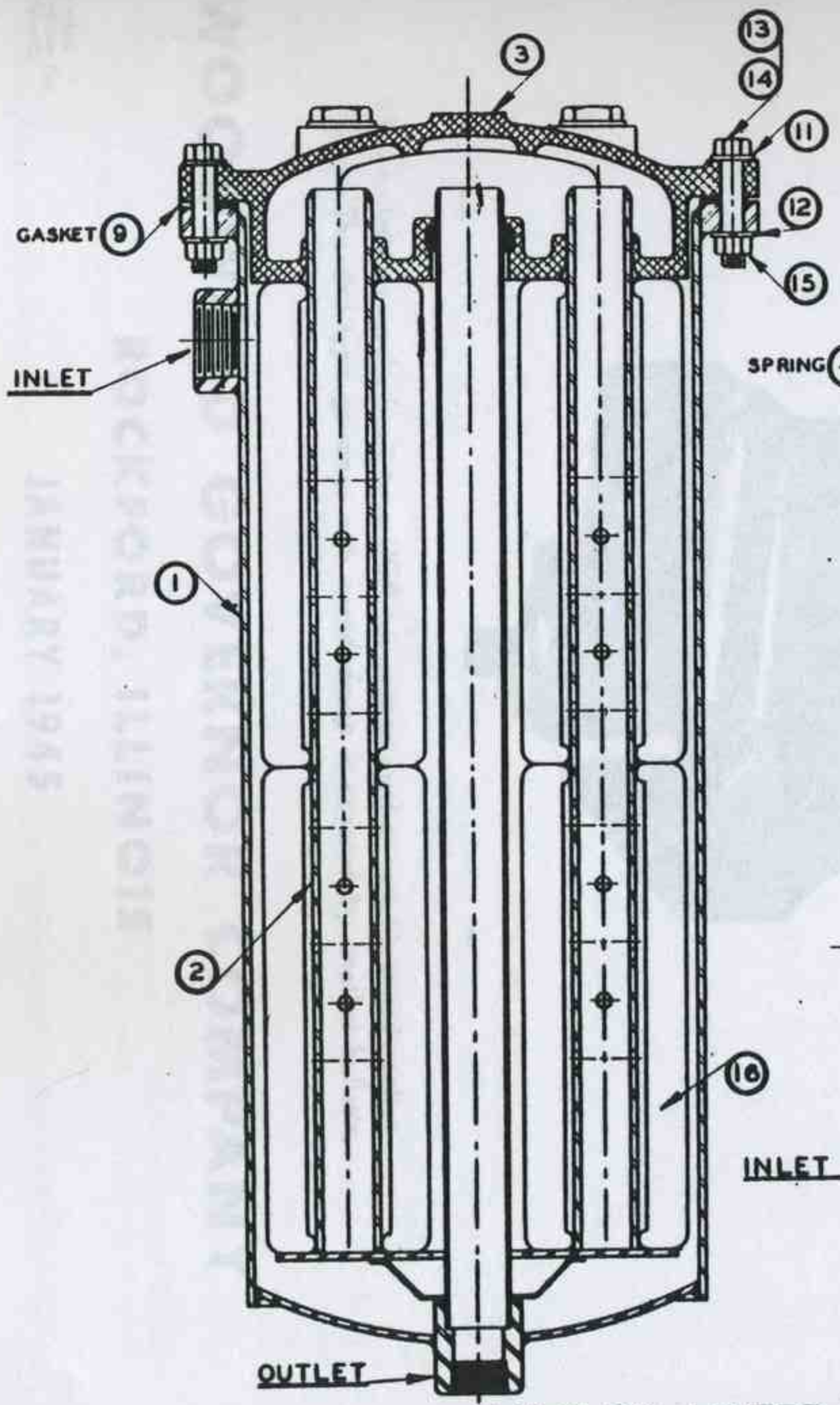
Tenth: Repeat above instructions for replacing element in unit of opposite side, turning valve handle to proper position.

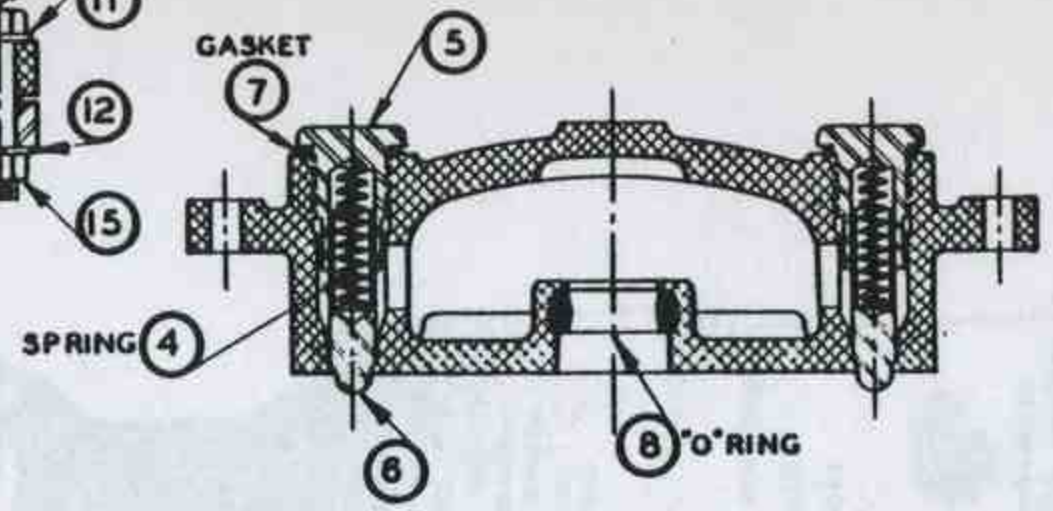
Note: Either element can be replaced without shutting down engine.

Important Notes: Filter and lines should at all times be kept free of leaks, since any leak could cause air locks in the fuel system.

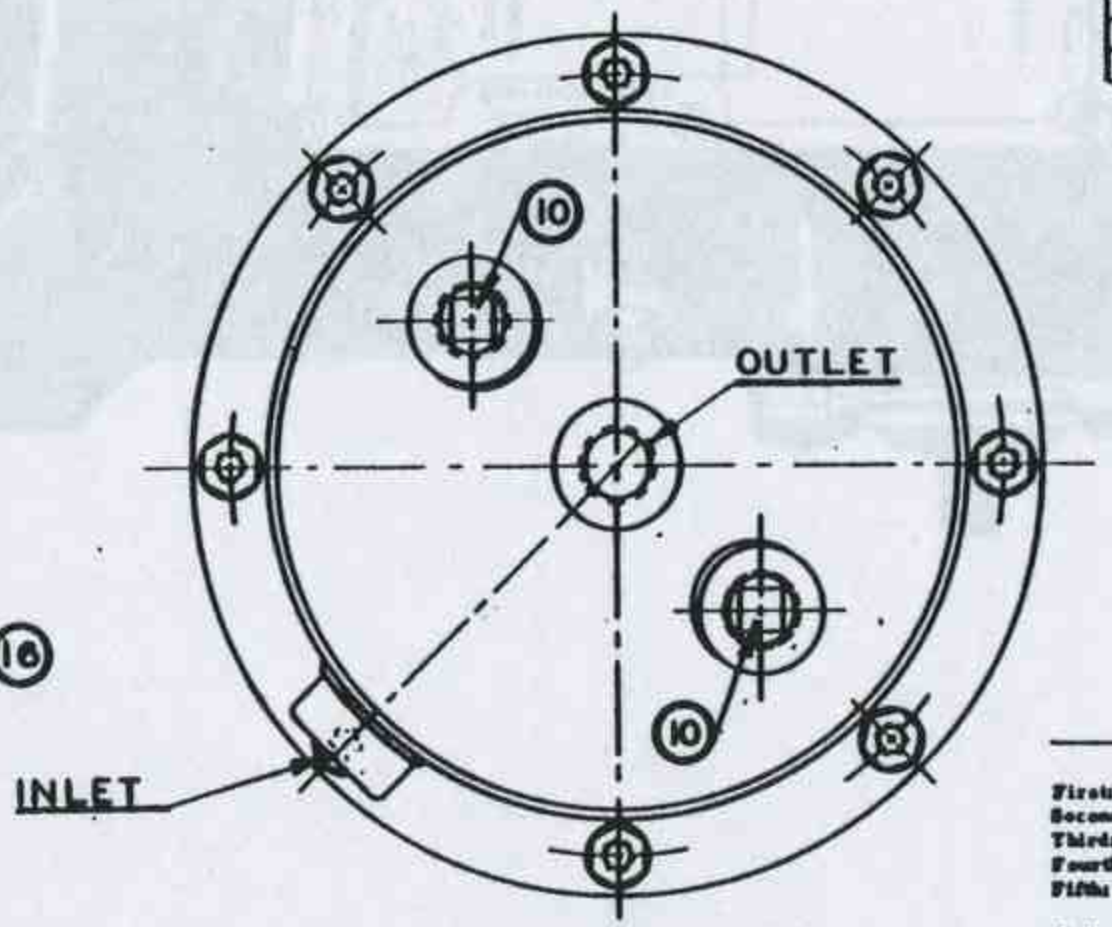
Element should be changed when flow rate decreases to point where equipment no longer can operate efficiently.

In order to increase element life the filter should be drained at periodic intervals between element changes. This servicing is beneficial, since one of the major fuel oil contaminants is moisture. Regular drains prevent water level from rising and sealing element.





SECTION THRU COVER
SHOWING BY-PASSES



BOTTOM VIEW

REF. No.	PART NUMBER	No. REQD.	NAME
1	4D1006-1	1	Shell Assembly (Single Unit)
2	4D1006-2	1	Center Tube Assembly
3	4D1006-3	1	Cover
4	4D1006-4	4	Spring - By Pass
5	4D1006-5	4	Retainer - By Pass
6	4D1006-6	4	Piston - By Pass
7	4D1006-7	4	Gasket - Retainer, By Pass
8	4D1006-8	1	" O " Ring
9	4D1006-9	1	Gasket - Cover 105-G
10	4D1006-10	2	Pipe Plug - Drain
11	4D1006-11	8	Washer
12	4D1006-12	6	Lockwasher
13	4D1006-13	6	Cap Screw 3/8 x 2
14	4D1006-14	2	Cap Screw 3/8 x 3
15	4D1006-15	8	Nuts
16	4D1006-16	1	Element Replacement Kit -- Includes 8 Elements & 1 each of Ref. Nos. 8 & 9
19	4D1006-19		Single Element Only
21	4D1006-21	2	Bracket Assembly No. 5 Includes Bracket, Screws, Washers & Nuts.

INSTRUCTIONS FOR REPLACING ELEMENTS

First: Remove drain plug (10) and drain filter.
Second: Remove cap screws (13) and (14) lift off cover (3).
Third: Remove old elements (16) and discard.
Fourth: Center tube assemblies (2) can be removed for cleaning shells if necessary.
Fifth: Install new elements (16) over center tube assemblies (2). Note: Two elements on each center tube or a total of eight required per shell assembly.
Sixth: Remove old "O" ring (8) and replace with new one packaged with elements.
Seventh: Remove old cover gasket (9) and replace with new one furnished with elements.
Eighth: Install cover (3) over center tubes (2) through holes in cover, then install cap screws (13) and (14) and tighten down in place.
Ninth: Install drain plug (10)
Tenth: Add additional oil to system to make allowance for filter capacity. (1-1/4 Gal. for single unit).
Eleventh: Start engine and inspect for leaks.

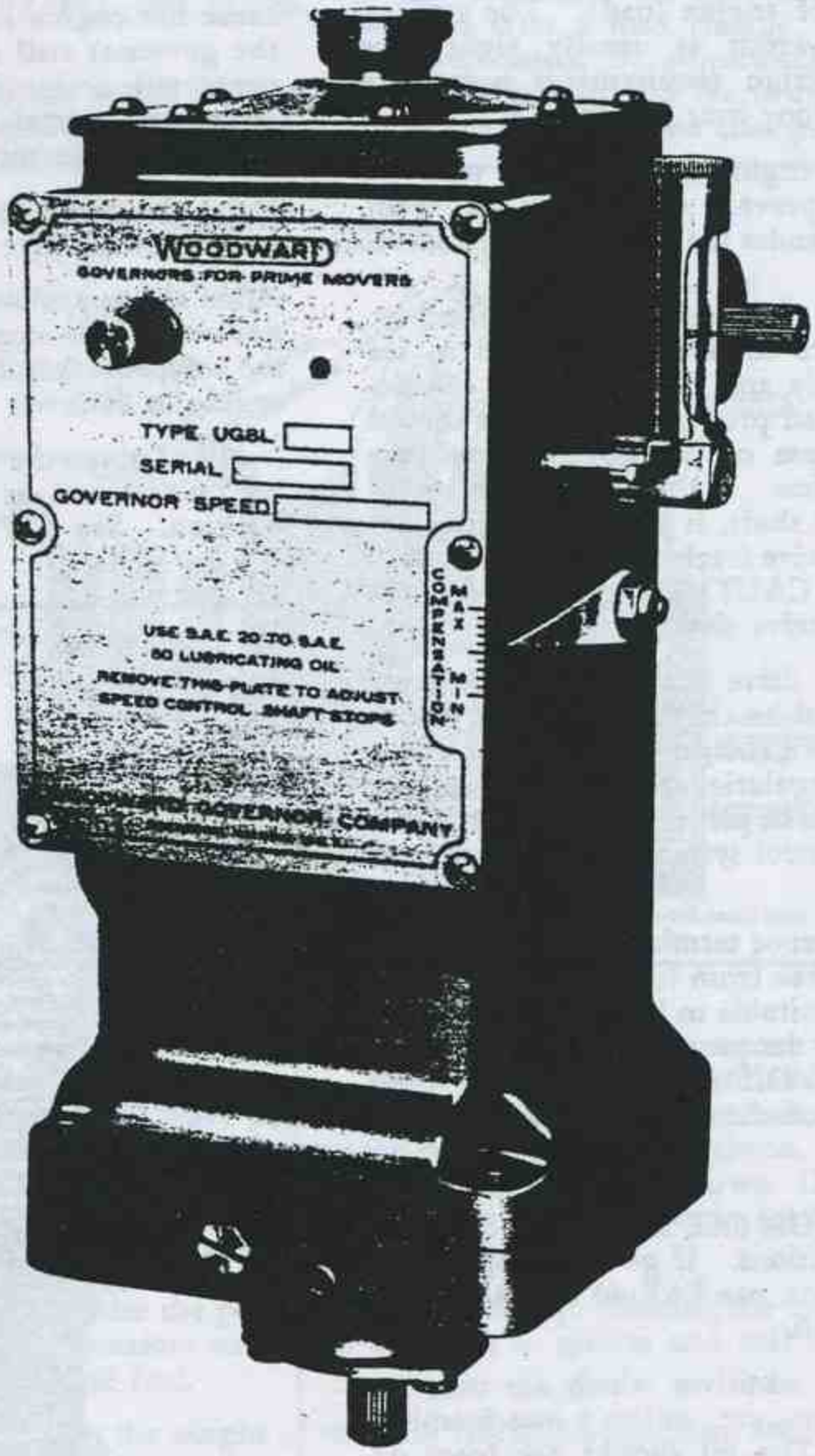
LUBE OIL FILTER (SINGLE UNIT)
PART No. 4D1006A

WOODWARD

UG8 GOVERNOR

LEVER CONTROL

BULLETIN 03005



This bulletin covers the basic type UG8 governor as used on variable speed applications. The dial type governor with speed droop is covered by another bulletin.

WOODWARD GOVERNOR COMPANY

ROCKFORD, ILLINOIS

JANUARY 1945

UG8 Ggovernor

LEVER CONTROL

PART ONE

GENERAL INFORMATION — INSTALLATION — ADJUSTMENT — OPERATION

GENERAL: The UG8 lever type governor is of the hydraulic type and is isochronous (will maintain same engine speed regardless of engine load). The stalling work capacity of the governor is usually eight foot pounds. Occasionally design requirements necessitate reducing the capacity to four foot pounds.

It is desirable that the engine be equipped with an overspeed trip device to prevent runaway in the event of any failure which may render the governor inoperative.

INSTALLATION: When the governor is installed on the engine, particular care should be exercised to see that it is mounted squarely and that the drive connection to the engine is aligned properly. A gasket should be placed between the base of the governor and the mounting pad on the engine. If the governor is equipped with a serrated drive shaft, it should slip into the internal serrations of the drive freely enough to drop into place of its own weight. CAUTION: Do not drop or rest the governor on its drive shaft.

If a keyed type governor drive shaft is used, the gear placed on this shaft should be checked to insure that it is meshing properly. There should be neither excessive backlash nor binding. Irregularies caused by uneven gear teeth, shaft runout, etc., will be picked up by the governor, transmitted to the fuel control system, and will result in erratic governing.

The linkage from the governor terminal shaft to the fuel control system should be free from lost motion or excessive friction. It is often desirable to install a light spring acting to decrease fuel for the purpose of taking up lost motion due to wear. AVOID EXCEEDING THE WORKING CAPACITY of the governor by using too strong a spring.

OIL SPECIFICATIONS: Use SAE 20 or SAE 30 oil for ordinary temperature conditions. If governor operating conditions are extremely hot, use SAE 40 or SAE 50; if extremely cold, use SAE 10.

The oil must not contain additives which are used to free up rings, remove carbon, etc., unless a non-foaming additive is also present. The oil should not foam or sludge excessively when agitated, or form gummy deposits when heated.

DIRTY OIL CAUSES MOST GOVERNOR TROUBLES. Use clean, new oil or filtered oil. All containers must be clean and should be rinsed with light grade fuel oil before using.

Keep governor oil at correct level in oil gauge.

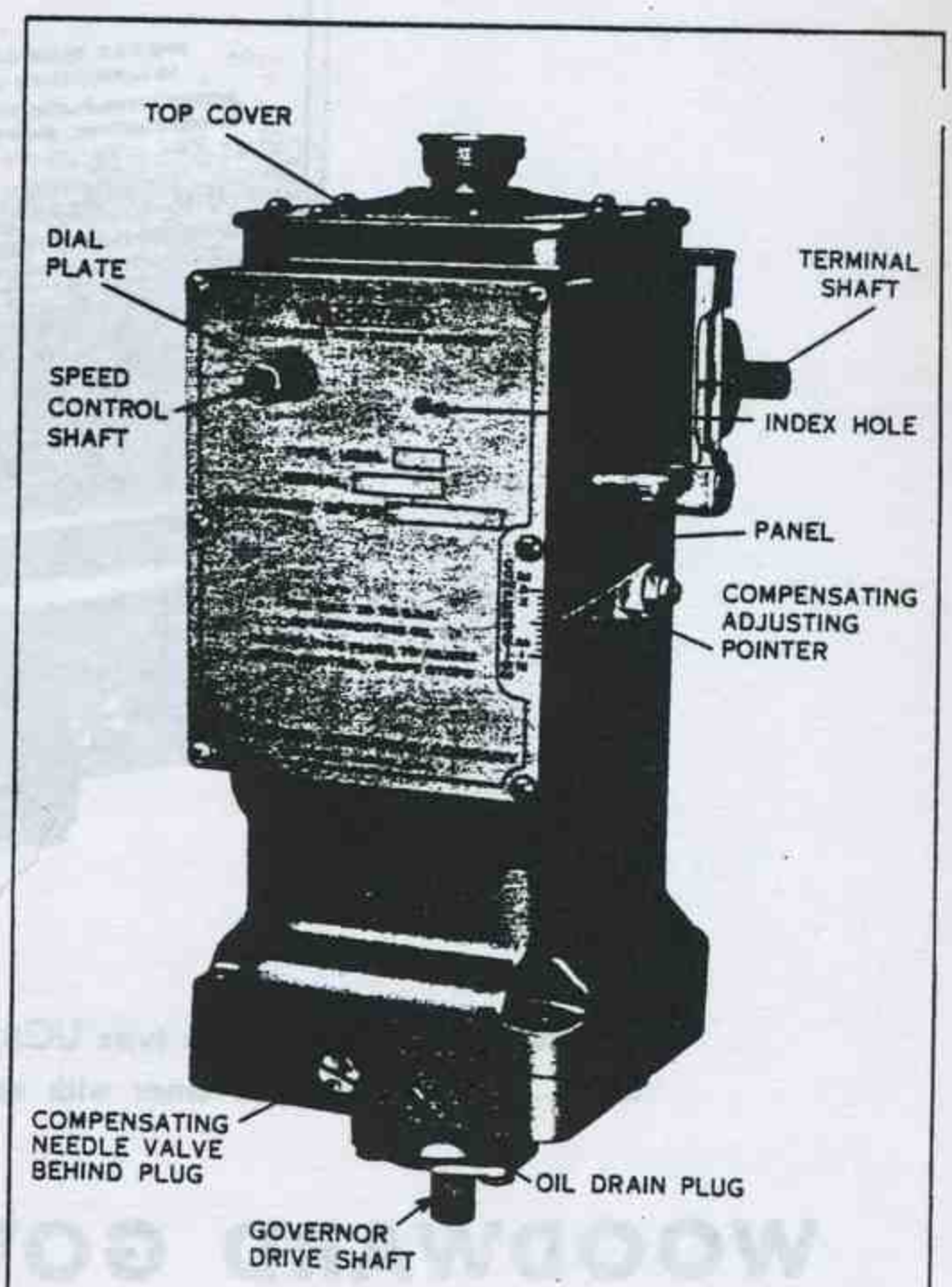
STARTING ENGINE: When starting the engine, set throttle to idle speed position.

COMPENSATING ADJUSTMENTS: Although the governor may appear to be operating satisfactorily because the engine runs at constant speed (without load) the governor still may not be adjusted correctly. High overspeeds and underspeeds after load changes and slow return to normal speed are results of incorrect compensation adjustments.

Make the following adjustments to be certain that the governor will give optimum control.

After the temperature of the engine and the oil in the governor have reached their normal operating values, the compensation should be adjusted without load on the engine as follows:

(1) Loosen the nut holding the compensating adjusting pointer and set the pointer at its extreme downward position. See Cut No. 1.



Cut No. 1

(2) Remove the plug, open compensating needle valve two or three turns with a screwdriver, and allow the engine to hunt or surge for about one half minute to bleed trapped air from governor oil passages.

(3) Gradually close needle valve until hunting just stops. Do not go beyond this position. Check the amount of needle valve opening by closing the valve completely, noting the amount of a full turn required to close. Open the valve to the previously determined opening at which hunting stopped. Test action by manually disturbing engine speed. If the needle valve is now less than 1/2 turn open and more than 1/8 turn open, the adjustment is satisfactory and (4), (5), (6), and (7) instructions should be ignored.

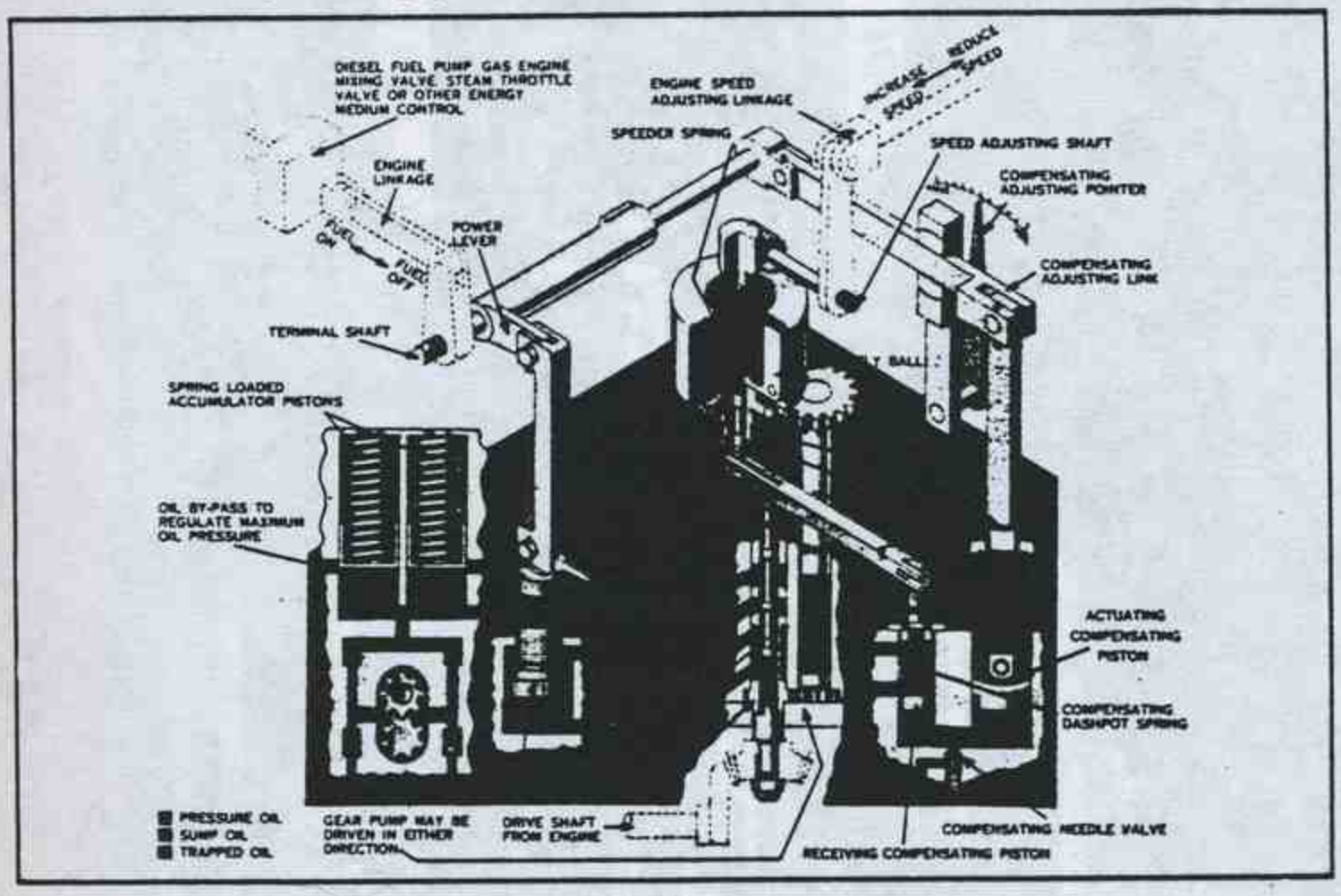
(4) If hunting did not stop with the needle valve at least 1/8 turn open, raise the compensating pointer two divisions of the scale and continue with the following instructions.

(5) Open needle valve approximately one turn to allow engine to hunt.

(6) Proceed with instruction (3).

(7) If necessary repeat (4), (5), and (3) until adjustment is satisfactory. Desirable needle velve opening is from 1/8 to 1/4 turn open.

(8) It is desirable to have as little compensation as possible. Closing the needle valve farther than necessary will make the governor slow to return to normal speed after a load change. Excessive dashpot plunger travel caused by adjustment of the compensating adjusting pointer too far toward maximum position will cause excessive speed change upon load change.



Cut No. 2

SCHEMATIC DIAGRAM: The schematic diagram shows a UG8 lever control governor without auxiliary equipment. A differential type of servomotor is used in this governor. There is always full accumulator oil pressure on the top area of the power piston (regardless of pilot valve position) which will turn the terminal shaft in the direction to shut off fuel if there is no pressure (or low enough pressure) on the bottom area of the piston. The pilot valve will supply this same oil pressure to the bottom area of the power piston if the valve is moved down. Due to the difference of areas on the top and bottom of the piston a greater force on the bottom will then overcome the force on the top side and will move the piston turning the terminal shaft in the direction to increase fuel.

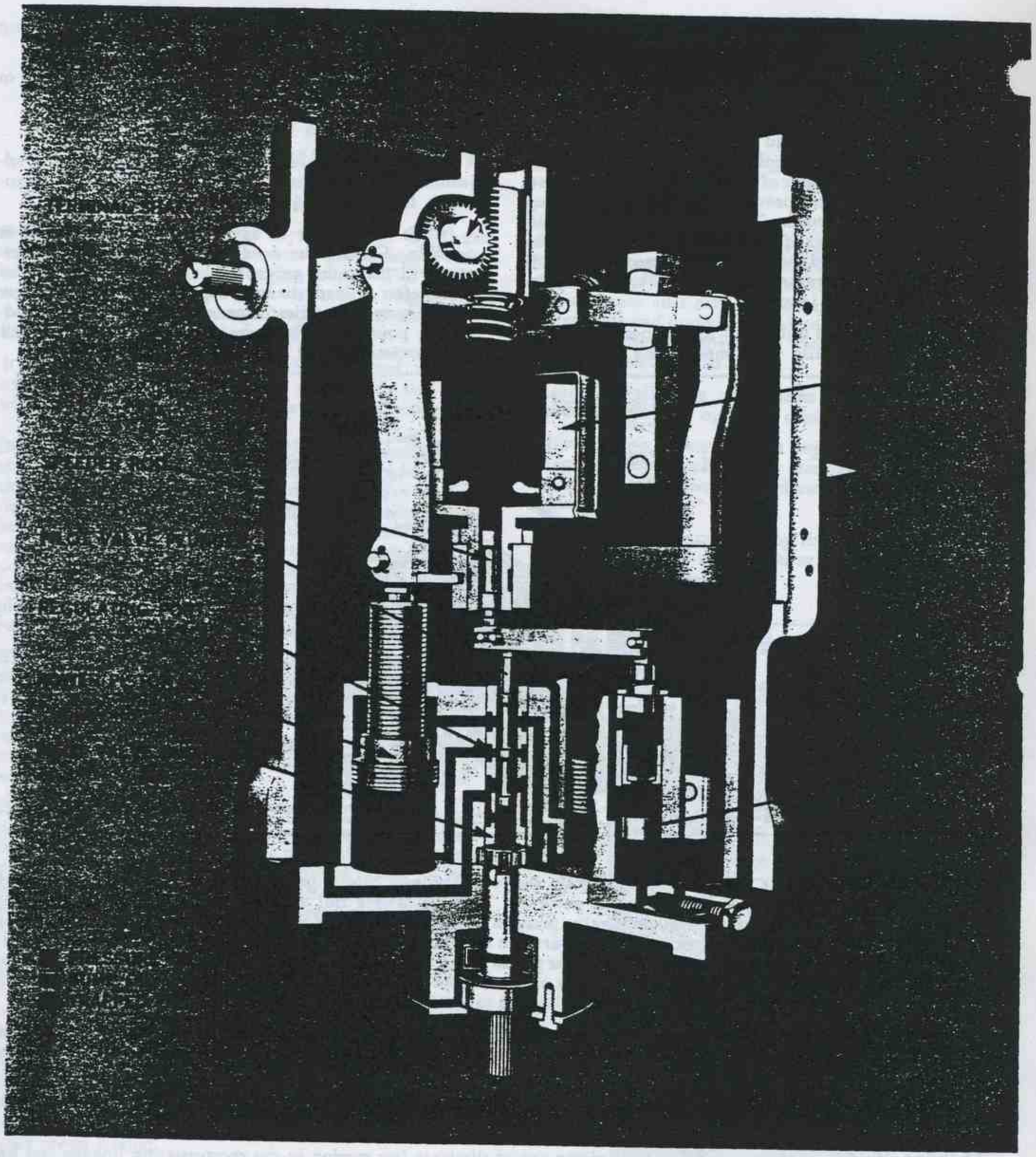
If the pilot valve is moved up the area under the piston is opened to sump, reducing the force exerted on the bottom of the piston. The force exerted by the oil pressure on the top will then be greater and will move the piston, turning the terminal shaft in the direction to decrease fuel.

The spring under the pilot valve supports the weight of the pilot valve, floating lever, etc., and has no effect in the operation of the governor.

The spring above the compensating actuating piston acts to eliminate lost motion in the compensating linkage and has no effect in the normal operation of the governor.

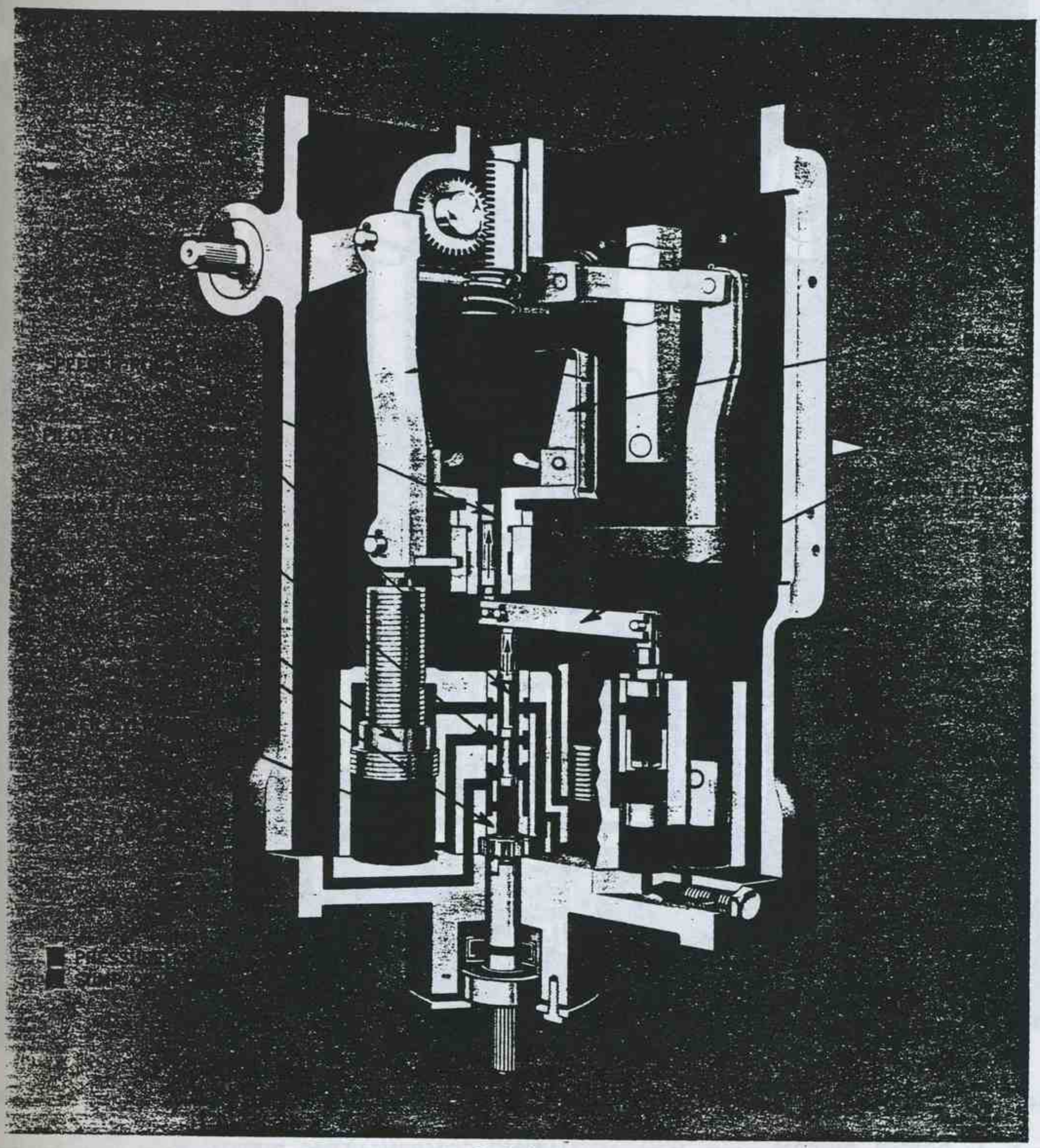
DESCRIPTION OF OPERATION: The photographs showing operation of the governor, Cut No. 3 to Cut No. 10, inclusive, have been simplified by removing the top cover and panel.

This description is based upon speed changes resulting from load changes. However, the same sequence of governor movements would occur if the governor speed setting were changed by repositioning the throttle.
Movements of the operating parts of the governor are actually proportional to the amount of speed change, but have been greatly exaggerated in the photographs to make them more visible.



Cut No. 3

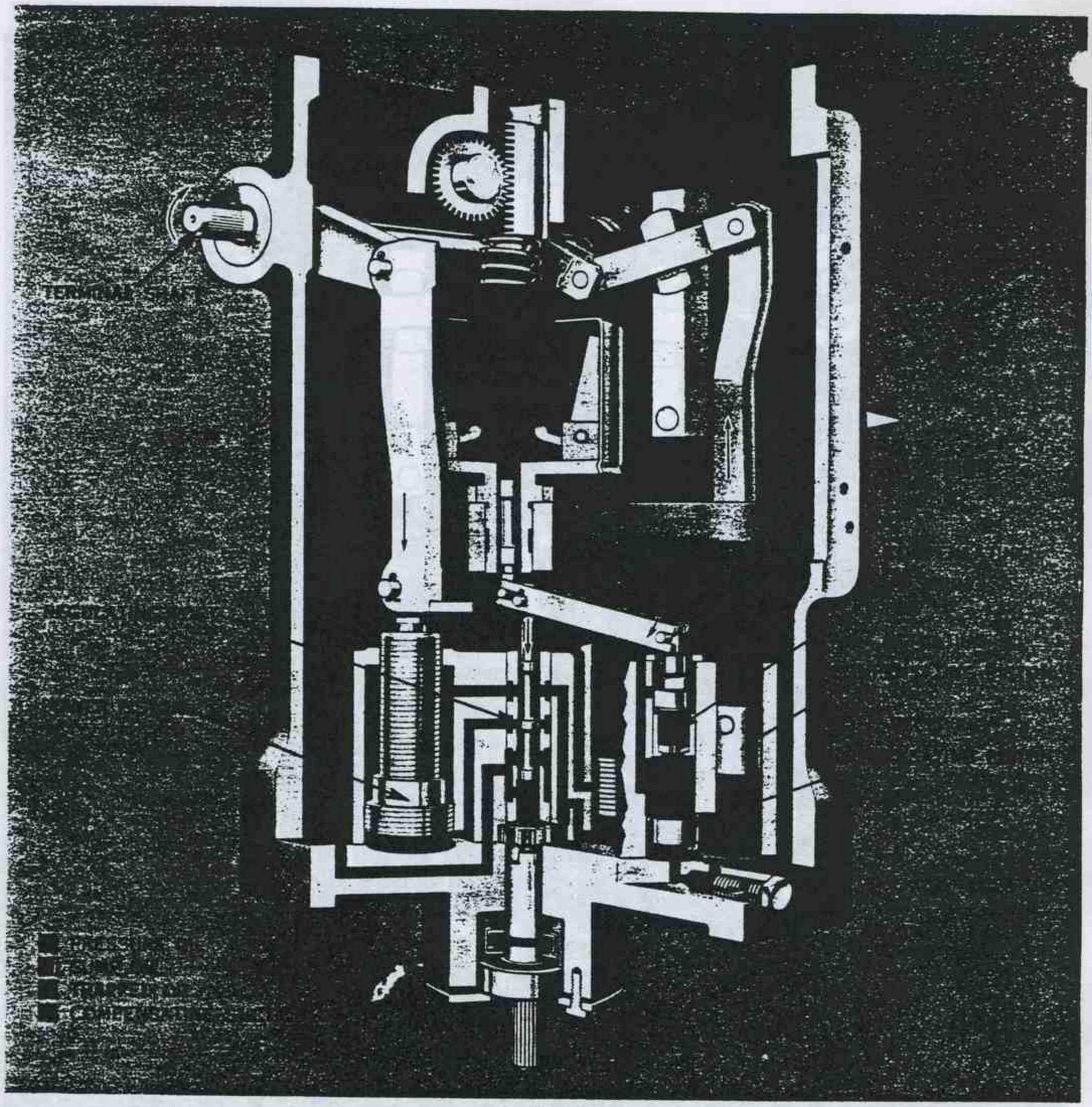
1. Engine is running at normal speed under steady load.
2. FLYBALLS, SPEEDER ROD, PILOT VALVE PLUNGER, and RECEIVING COMPENSATING PISTON are in normal positions; REGULATING PORT in PILOT VALVE BUSHING is covered by land on PILOT VALVE PLUNGER.
3. POWER PISTON and TERMINAL SHAFT are stationary.



Cut No. 4

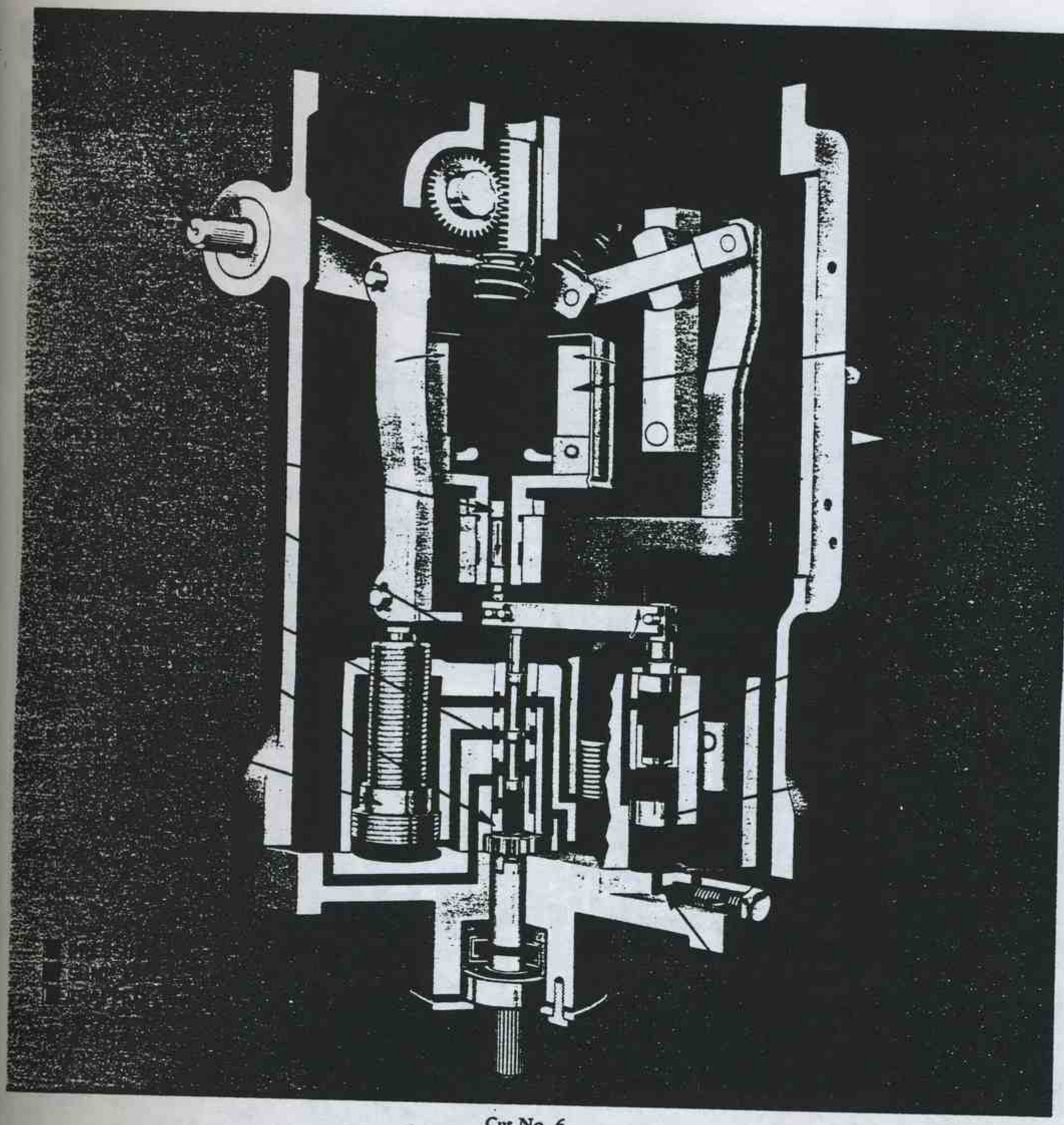
LOAD REDUCTION:

1. Load is decreased and speed increases.
2. As speed increases, FLYBALLS move out raising SPEEDER ROD and inner end of FLOATING LEVER, thus raising PILOT VALVE PLUNGER and uncovering REGULATING PORT in PILOT VALVE BUSHING.
3. Uncovering of REGULATING PORT opens bottom of POWER CYLINDER to sump and will allow oil pressure in top of POWER CYLINDER to move POWER PISTON down.



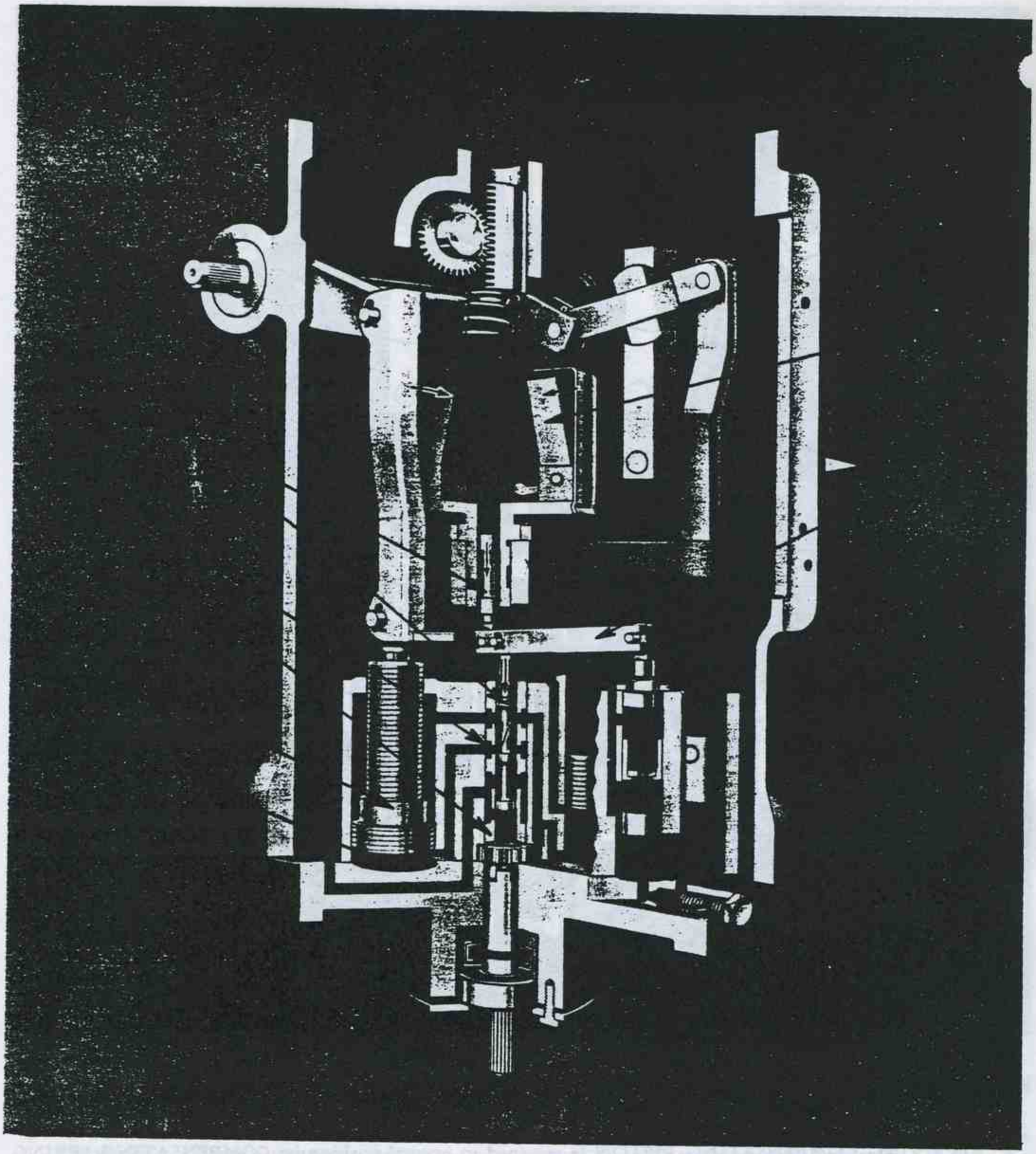
Cut No. 5

1. Oil pressure moves POWER PISTON down rotating TERMINAL SHAFT in the direction to decrease fuel.
2. As POWER PISTON moves down, ACTUATING COMPENSATING PISTON moves up and draws RECEIVING COMPENSATING PISTON down compressing COMPENSATING SPRING and lowering outer end of FLOATING LEVER and PILOT VALVE PLUNGER.
3. Movement of POWER PISTON, ACTUATING COMPENSATING PISTON, RECEIVING COMPENSATING PISTON and PILOT VALVE PLUNGER continues until REGULATING PORT in BUSHING is covered by land on PLUNGER.
4. As soon as REGULATING PORT is covered, POWER PISTON and TERMINAL SHAFT are stopped at a position corresponding to decreased fuel needed to run engine at normal speed under decreased load.



Cut No. 6

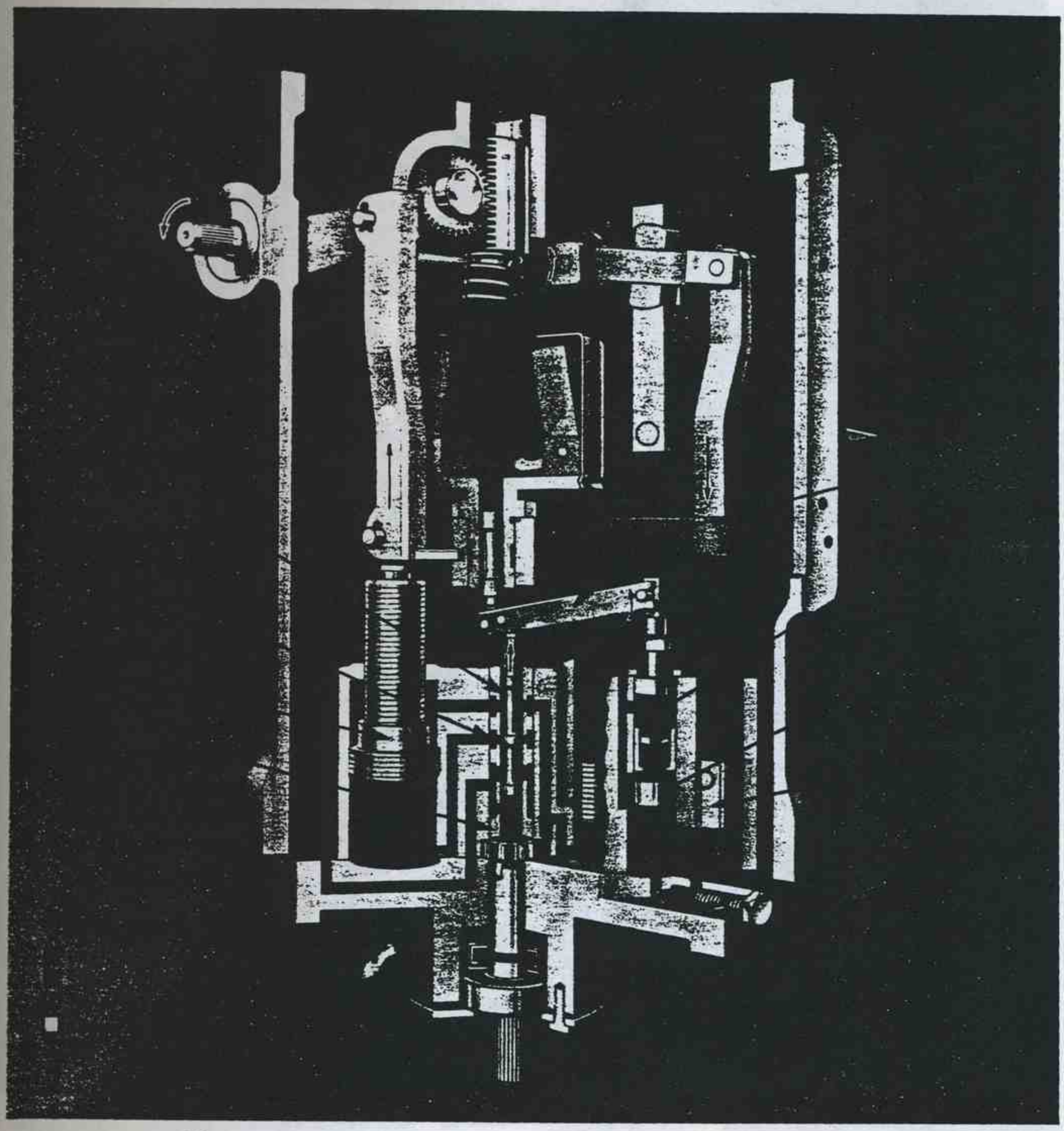
1. As speed decreases to normal, FLYBALLS return to normal position lowering SPEEDER ROD to normal position.
2. RECEIVING COMPENSATING PISTON is returned to normal position by COMPENSATING SPRING at the same rate as SPEEDER ROD thus keeping REGULATING PORT in PILOT VALVE BUSHING covered by land on PILOT VALVE PLUNGER; flow of oil through COMPENSATING NEEDLE VALVE determines rate at which RECEIVING COMPENSATING PISTON is returned to normal.
3. At completion of cycle, FLYBALLS, SPEEDER ROD, PILOT VALVE PLUNGER, and RECEIVING COMPENSATING PISTON are in normal positions; POWER PISTON and TERMINAL SHAFT are stationary at a position corresponding to decreased fuel necessary to run engine at normal speed under decreased load.



Cut No. 7

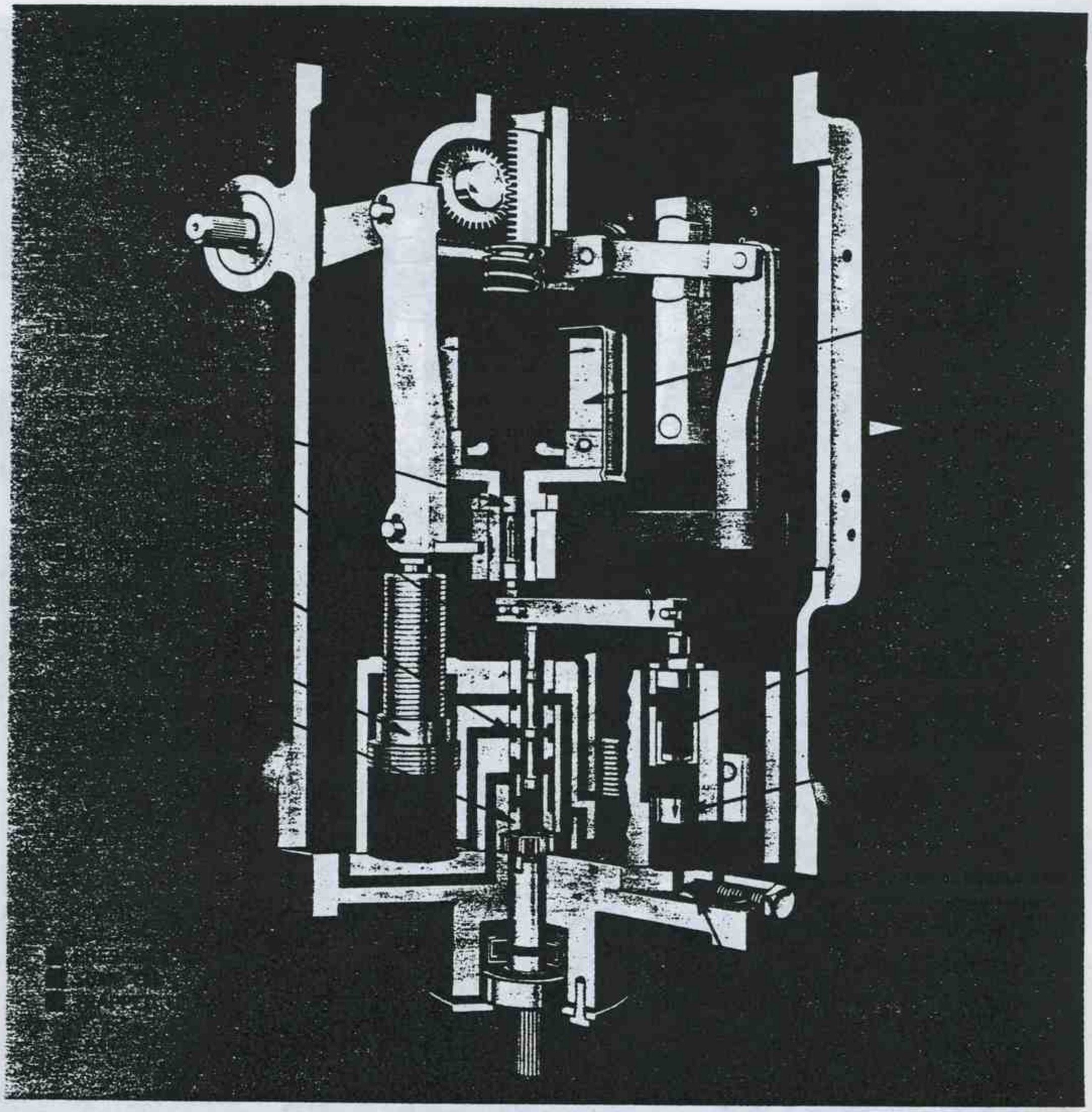
LOAD INCREASE:

1. Load is increased and speed decreases.
2. As speed decreases, FLYBALLS move in lowering SPEEDER ROD and inner end of FLOATING LEVER, thus lowering PILOT VALVE PLUNGER and uncovering regulating port of PILOT VALVE BUSHING.
3. Uncovering of REGULATING PORT admits pressure oil to bottom of POWER CYLINDER; since bottom area of POWER PISTON is greater than top area, oil pressure will move PISTON up.



Cut No. 8

1. Oil pressure moves POWER PISTON up and rotates TERMINAL SHAFT in direction to increase fuel.
2. As POWER PISTON moves up, ACTUATING COMPENSATING PISTON moves down and forces RECEIVING COMPENSATING PISTON up compressing COMPENSATING SPRING and raising outer end of FLOATING LEVER and PILOT VALVE PLUNGER.
3. Movement of POWER PISTON, ACTUATING COMPENSATING PISTON, RECEIVING COMPENSATING PISTON, and PILOT VALVE PLUNGER continues until REGULATING PORT in PILOT VALVE BUSHING is covered by land on PLUNGER.
4. As soon as REGULATING PORT is covered, POWER PISTON and TERMINAL SHAFT are stopped at a position corresponding to increased fuel needed to run engine at normal speed under increased load.

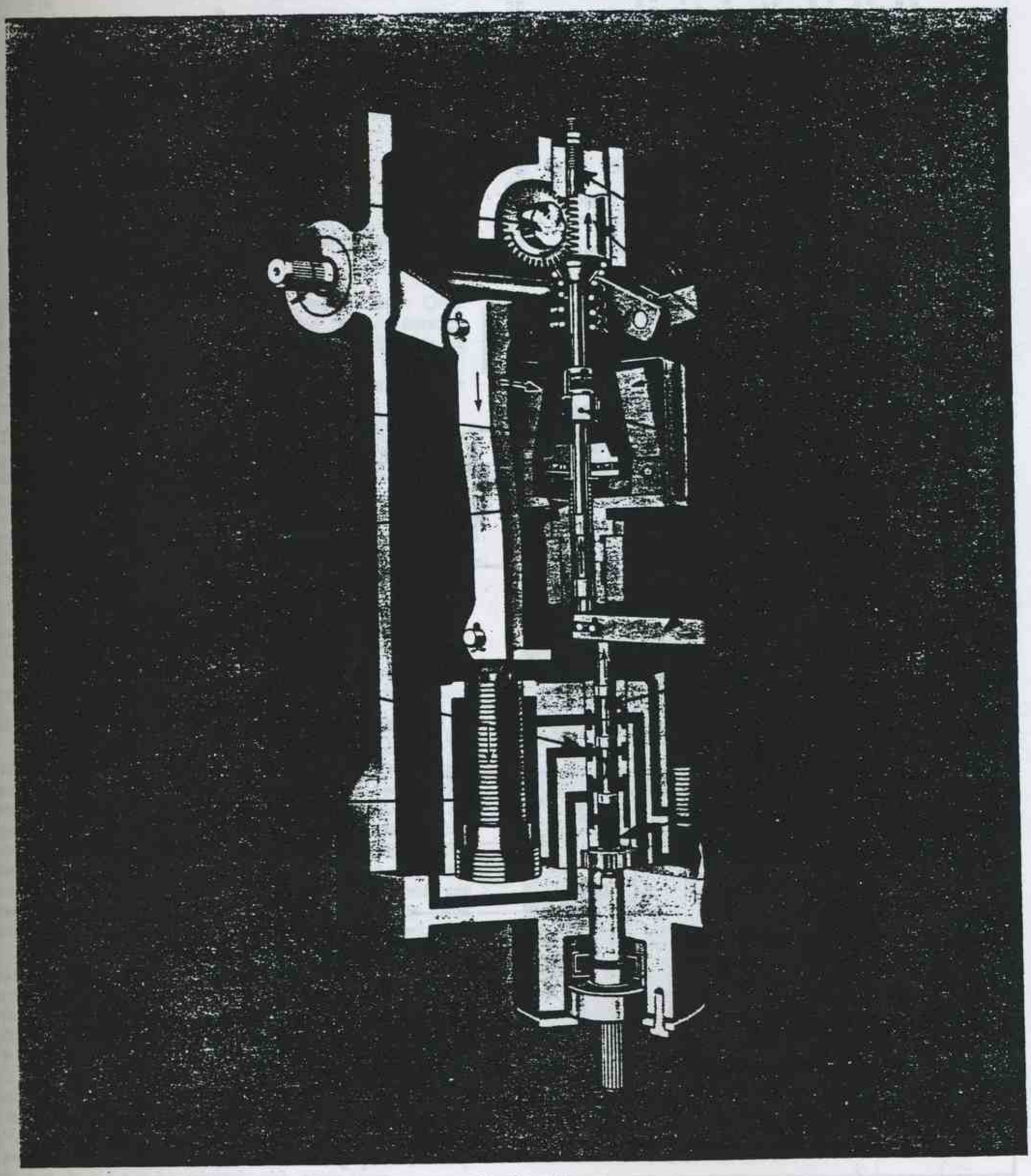


Cut No. 9

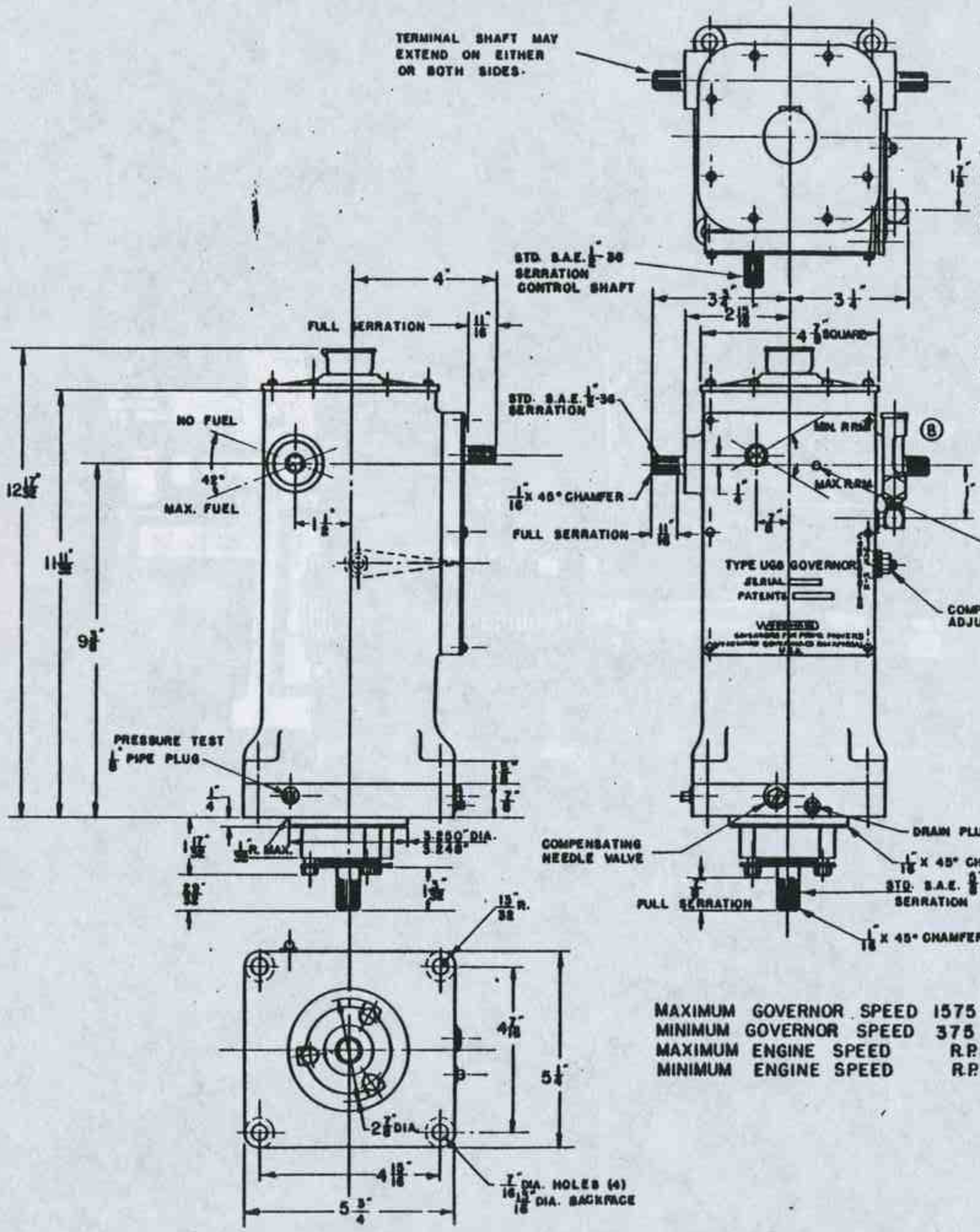
1. As speed increases to normal, FLYBALLS return to normal position raising SPEEDER ROD to normal position.
2. RECEIVING COMPENSATING PISTON is returned to normal position by COMPENSATING SPRING at the same rate as SPEEDER ROD thus keeping REGULATING PORT in PILOT VALVE BUSHING covered by land on PILOT VALVE PLUNGER; flow of oil through COMPENSATING NEEDLE VALVE determines rate at which RECEIVING COMPENSATING PISTON is returned to normal
3. At completion of cycle, FLYBALLS, SPEEDER ROD, PILOT VALVE PLUNGER, and RECEIVING COMPENSATING PISTON are in normal positions; POWER PISTON and TERMINAL SHAFT are stationary at a position corresponding to increased fuel necessary to run engine at normal speed under increased load.

UG8 LEVER TYPE GOVERNOR WITH SHUT DOWN ROD: If it is desired that the engine be shut down from the throttle position, the governor may be equipped with a shut down rod operating as follows: (See Cut No. 10)

When the throttle is moved toward the shut down position, the speeder plug rises contacting the nut on the shut down rod. Further movement lifts the shut down rod, lifting speeder rod and inner end of floating lever, thus raising pilot valve plunger and uncovering the regulating port in the pilot valve bushing. This permits oil under the power piston to flow to sump. Oil pressure in top of power cylinder forces power piston down to zero fuel position. If linkage to engine is properly adjusted, the engine will shut down.



Cut No. 10



(8)

VARIABLE SPEED (4:1) OIL PRESSURE GOVERNOR
WITH SELF CONTAINED OIL PUMP AND ACCUMULATORS.

CAPACITY: 8 FOOT POUNDS (WORK) IN EITHER DIRECTION THROUGH TERMINAL SHAFT ROTATION OF 42° THROUGH DIFFERENTIAL PRESSURE SERVO MOTOR. OCCASIONALLY DESIGN REQUIREMENTS NECESSITATE REDUCING THE CAPACITY TO 4 FOOT POUNDS.

WEIGHT: 45 POUNDS WITHOUT AUXILIARY EQUIPMENT.

POWER: APPROXIMATELY 3/10 H.P. REQUIRED AT DRIVE SHAFT.

STANDARD FEATURES:—

1. SPEED ADJUSTMENT— SPEED MAY BE ADJUSTED BY POSITIONING THE SHAFT PROJECTING FROM THE PANEL. ADJUSTABLE STOPS ARE PROVIDED BACK OF THE DIAL PLATE FOR MAXIMUM HIGH SPEED AND MINIMUM LOW SPEED FUEL POSITIONS.
2. COMPENSATING ADJUSTMENTS— COMPENSATION AND COMPENSATING NEEDLE VALVE EXTERNALLY CONTROLLED.
3. SIGHT OIL GAUGE— INDICATES CORRECT OIL LEVEL.
4. OIL FILLER— A SCREEN EQUIPPED OIL CUP PERMITS ADDING SMALL QUANTITIES OF OIL.
5. DRIVE SHAFT SPEED RANGE— 375-1500 R.P.M. DRIVE IS VERTICAL (FROM BELOW) AND MAY ROTATE CLOCKWISE OR COUNTERCLOCKWISE. BUILT IN SPRING DRIVE IS PROVIDED.

MAXIMUM GOVERNOR SPEED	1575 R.P.M.
MINIMUM GOVERNOR SPEED	375 R.P.M.
MAXIMUM ENGINE SPEED	R.P.M.
MINIMUM ENGINE SPEED	R.P.M.

DRIVE SHAFT TO CARRY GEAR-OPTIONAL

OUTLINE DRAWING OF TYPICAL
UG8 LEVER CONTROL GOVERNOR

UG8 GOVERNOR

LEVER CONTROL

PART TWO

MAINTENANCE—INTERNAL ADJUSTMENT

INFORMATION AND PARTS REPLACEMENT: When requesting information concerning governor operation and maintenance or ordering replacements parts, it is very essential that the following information accompany the request:

1. Governor serial number (shown on governor name-plate).
2. Bulletin number.
3. Part number, name of part, or description of part. See Pages 22, 23 and 24.

OIL CHANGES: See Oil Specifications in Part One. The governor oil should be clean and free of foreign particles. Under favorable conditions, the oil may be used for approximately six months without changing. If the governor does not operate properly, dirty oil may be the cause of the trouble.

To change the oil, take off the top cover, remove the governor from the engine, drain by turning upside down, and flush thoroughly with clean light grade fuel oil to remove any foreign matter. No parts of the governor will come out unless intentionally disassembled. Drain thoroughly and refill with clean governor oil. Follow the above procedure whenever the governor is removed from the engine for any reason.

If it is not possible to shut down long enough to remove the governor from the engine, drain the oil from the governor, fill with clean light grade fuel oil, run for approximately thirty seconds with the needle valve open, drain, and refill with clean governor oil.

If the governor is stored, it should be filled with oil.

WORK REQUIREMENTS: It is suggested that the best mechanic available (preferably one experienced with small parts assembly) be permanently assigned to all governor repair work. Cleanliness of tools and work space is essential. A work bench, vise, arbor press, speed lathe, air line, and containers for cleaning solvents should be provided if possible. The usual small hand tools are required, and a few special Woodward governor tools are desirable if subassemblies are to be disassembled.

GENERAL INSTRUCTION: The governor consists of seven main subassemblies; A, top cover; B, panel; C, case; D, base; E, controlet; F, ballhead; and G, drive shaft. If the governor is to be completely disassembled it should be taken apart in order: A, B, C, D, E, F, and G. If only a part of the governor is to be repaired or adjusted, refer to the particular instruction for that work only, and considerable time and work may be eliminated. *No force is required to separate or reassemble the governor into its subassemblies.* Connecting pins are slip fit and should not be marred with plier jaws.

DISASSEMBLIES INTO MAIN SUBASSEMBLIES:

A. Top Cover (See Cut No. 1)

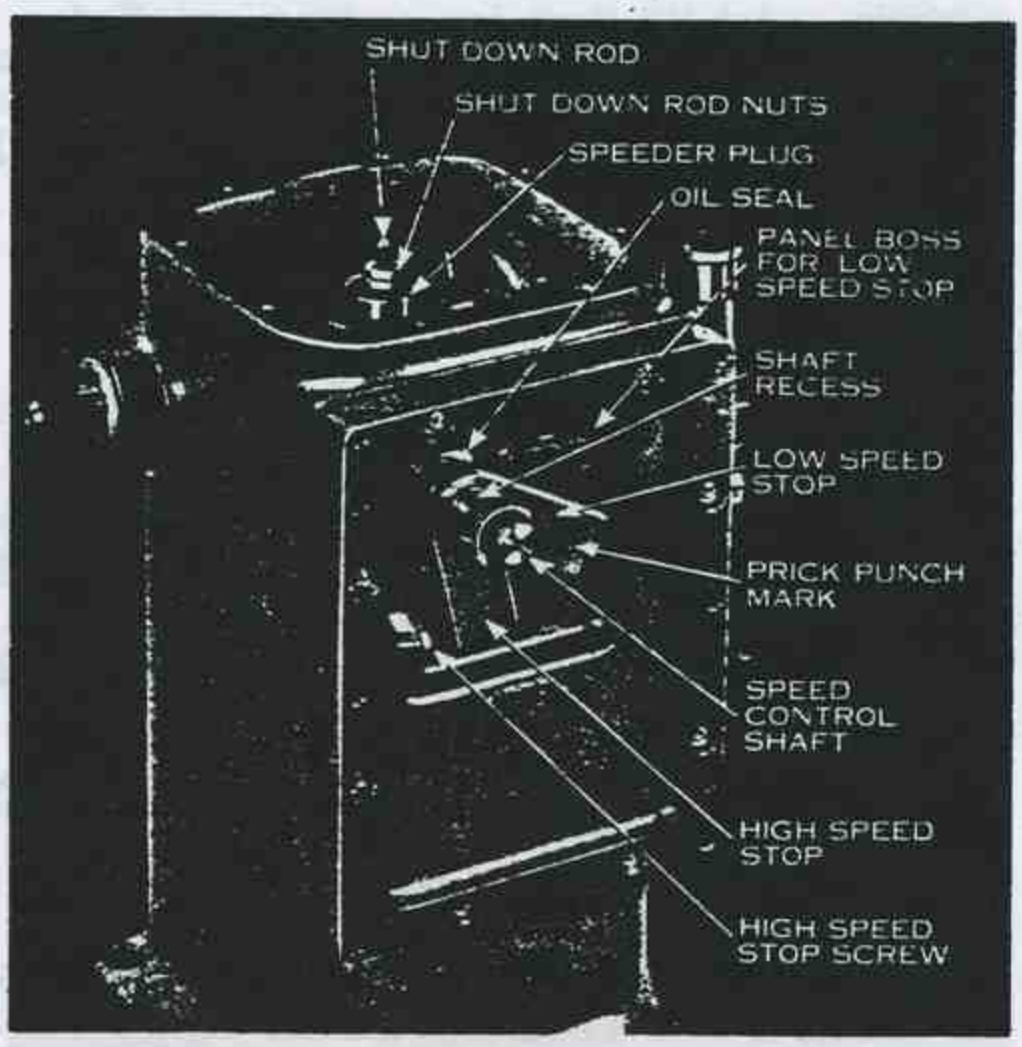
1. Remove eight cover screws and washers, and lift off.

B. Panel (See Cut No. 1 and Cut No. 12.)

1. Drain governor oil by inverting governor; flush with fuel oil and drain again.
2. Remove nuts on shut down rod (if used).
3. Remove screws and take off dial plate.
4. Slip speed limit stop levers off speed control shaft.
5. Rotate speed control shaft in direction shown to remove speeder plug. If governor has a shut down rod, remove it by sliding rod out of slot in speeder rod nut. See Cut No. 10.
6. Remove 8 panel screws and washers.
7. Tap panel with plastic hammer or wood block to break panel gasket loose from case.
8. Remove panel and speeder spring.

C. Case (See Cut No. 13.)

1. Remove cotter and pull out power link pin.

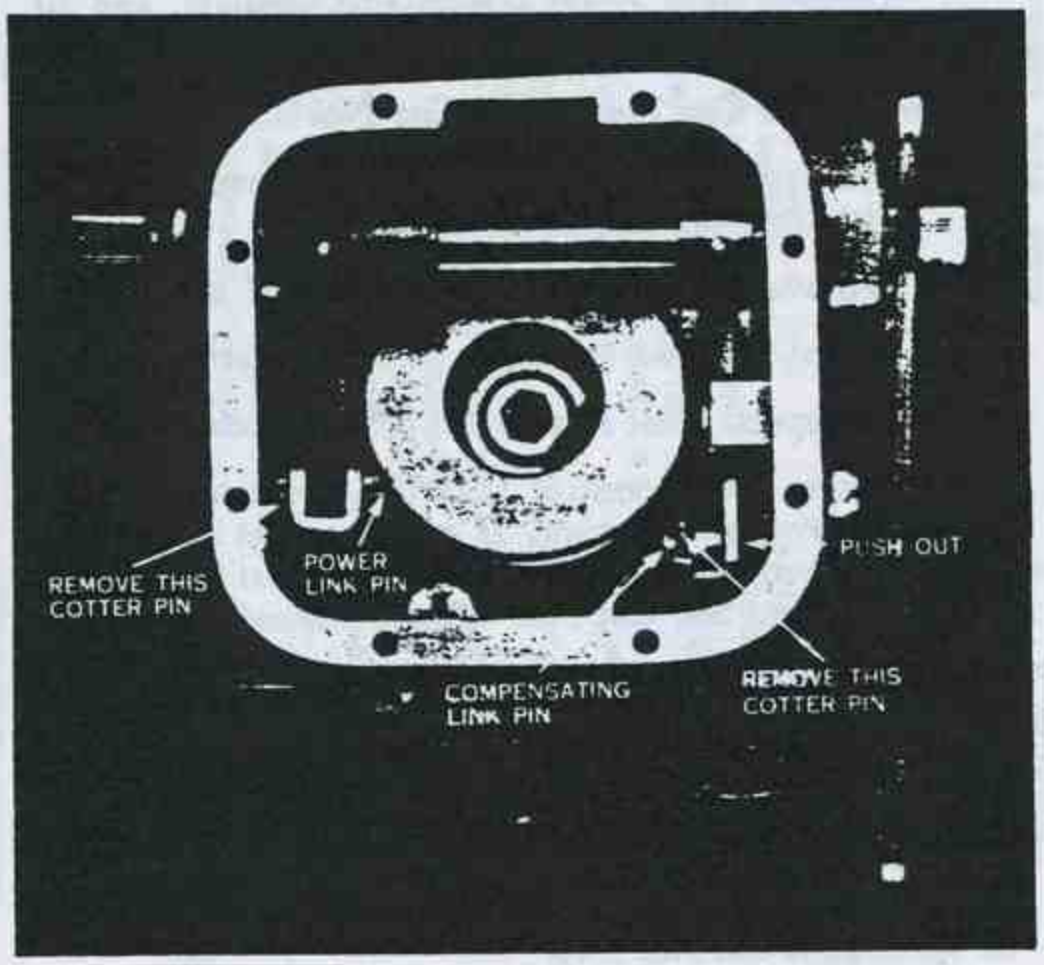


Cut No. 12

2. Remove cotter and push out compensating link pin with bent wire or hook scriber.
3. Invert governor on bench (no parts will fall out). Remove the four outside nuts.
4. Hold case and base together and set governor upright. Lift case off base. It may be necessary to tap case lightly to break gasket joint loose and free case from dowel pins in base.

D. Ballhead.

1. Remove inside cotter and pull out pilot valve pin. (Cut No. 14.)



Cut No. 13

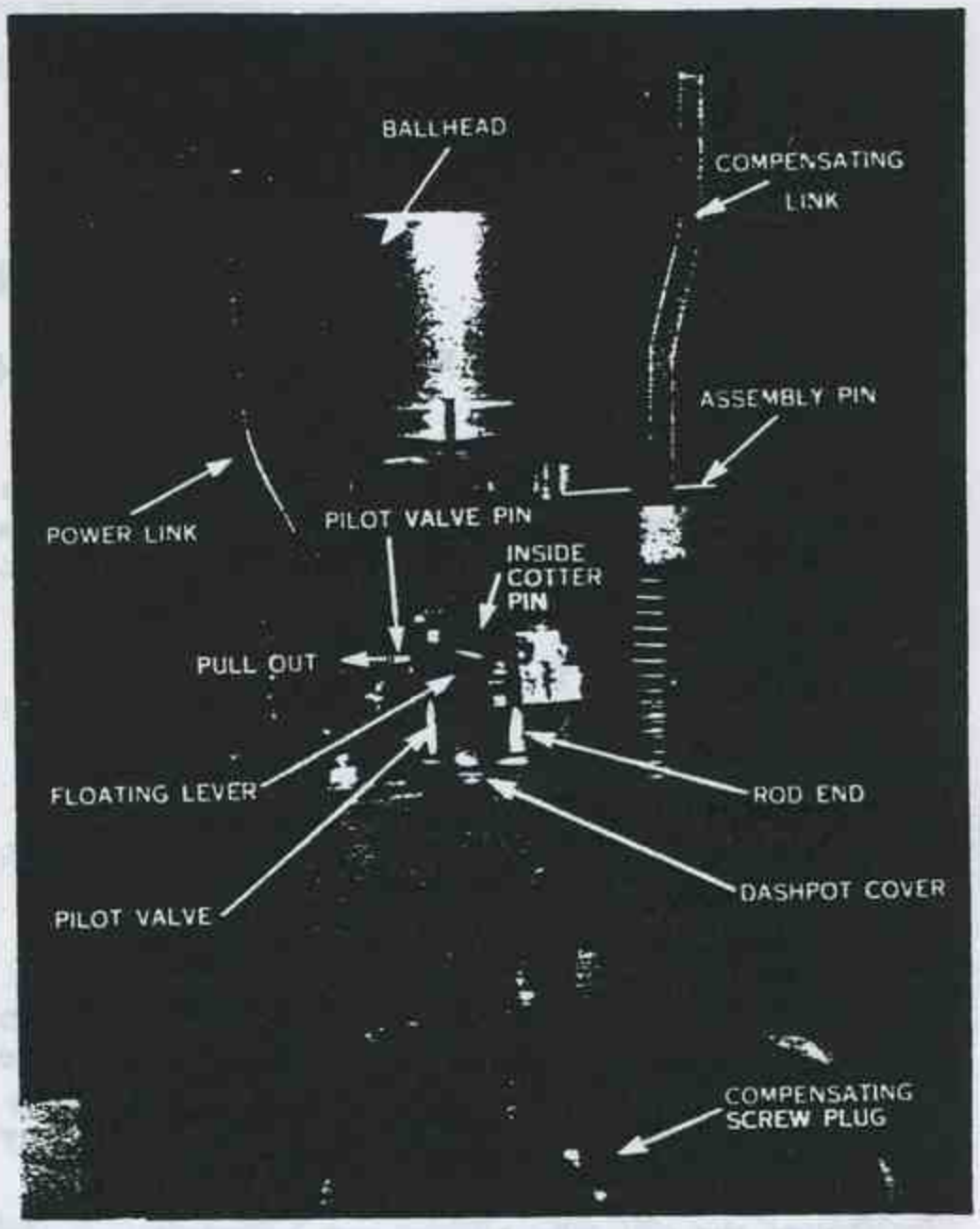
2. Lift up inner end of floating lever, push down on rod end with screw driver, slip lever backwards releasing lever from rod end pin. (Cut No. 15.) Remove lever.
3. Lift out ballhead assembly.

E. Controlet

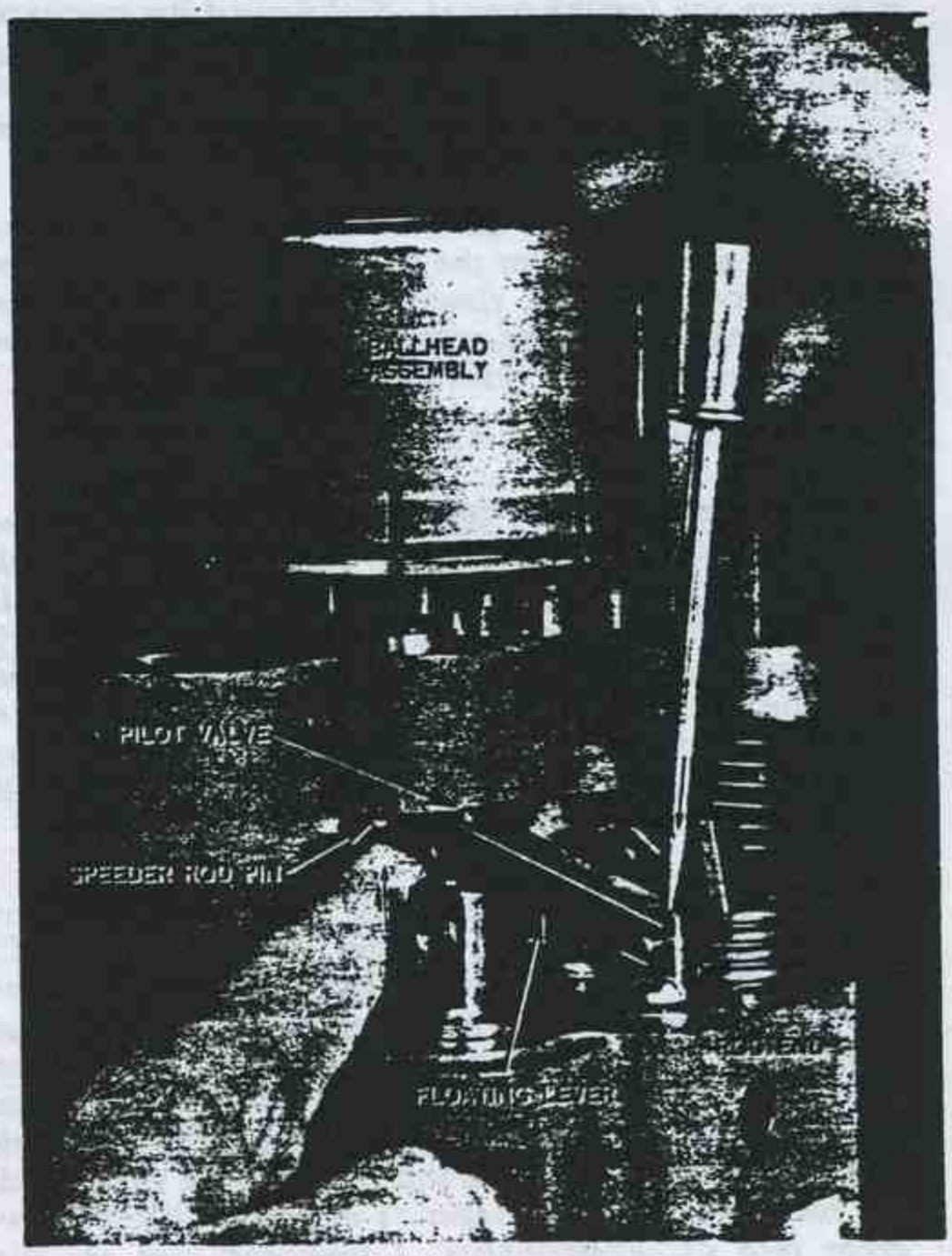
1. Pull up compensating link. Insert assembly pin or rod through hole. (Cut No. 14.)
2. Invert assembly and remove five nuts. If clamped in vise, do not use unnecessary force, and clamp at sides as shown in (Cut No. 16.)
3. Tap base lightly with plastic hammer and lift off carefully.
4. Let controlet remain in this position unless it is to be adjusted or repaired.

F. Base. (Cut No. 17.)

1. Clamp base inverted in vise, cut lock wire and remove three screws and retainer plate.
2. Pull out drive shaft assembly, oil seal retainer, and remove seal gasket in bearing bore.



Cut No. 14



Cut No. 15

3. If ground surface of base is not perfectly flat, has deep scratches, or is grooved from the pump gears, it must be resurfaced. Drive out dowel pins and surface grind not more than .010" or, if not possible to surface grind, lap smooth on a flat plate.

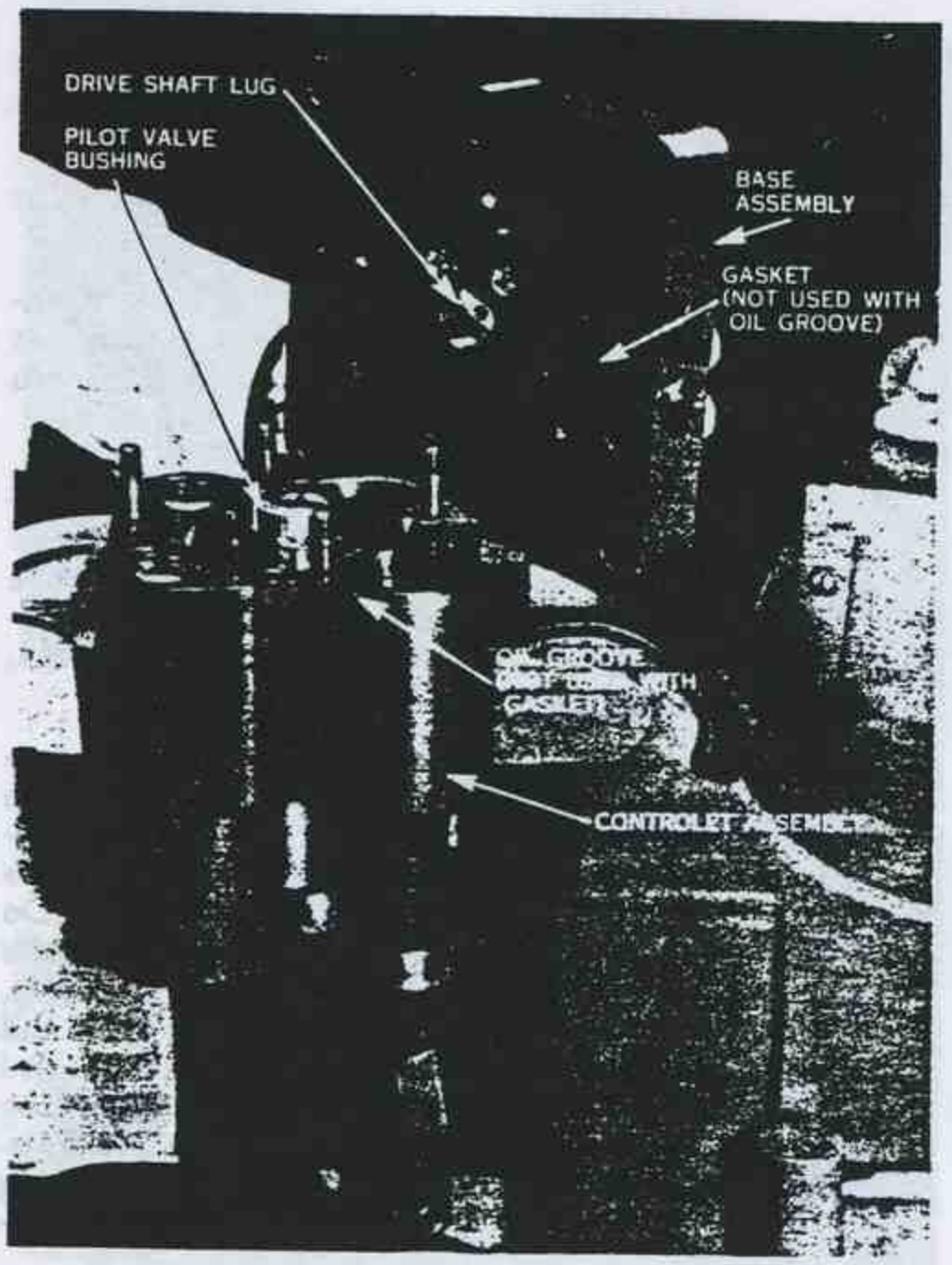
G. Drive Shaft

1. Pull off oil seal retainer if on shaft.
2. Remove snap ring. (See Cut No. 18.)
3. Press drive shaft out of bearing.

MAXIMUM OR MINIMUM SPEED LIMIT ADJUSTMENT: These adjustments must be made on a governor test stand or on the engine while running.

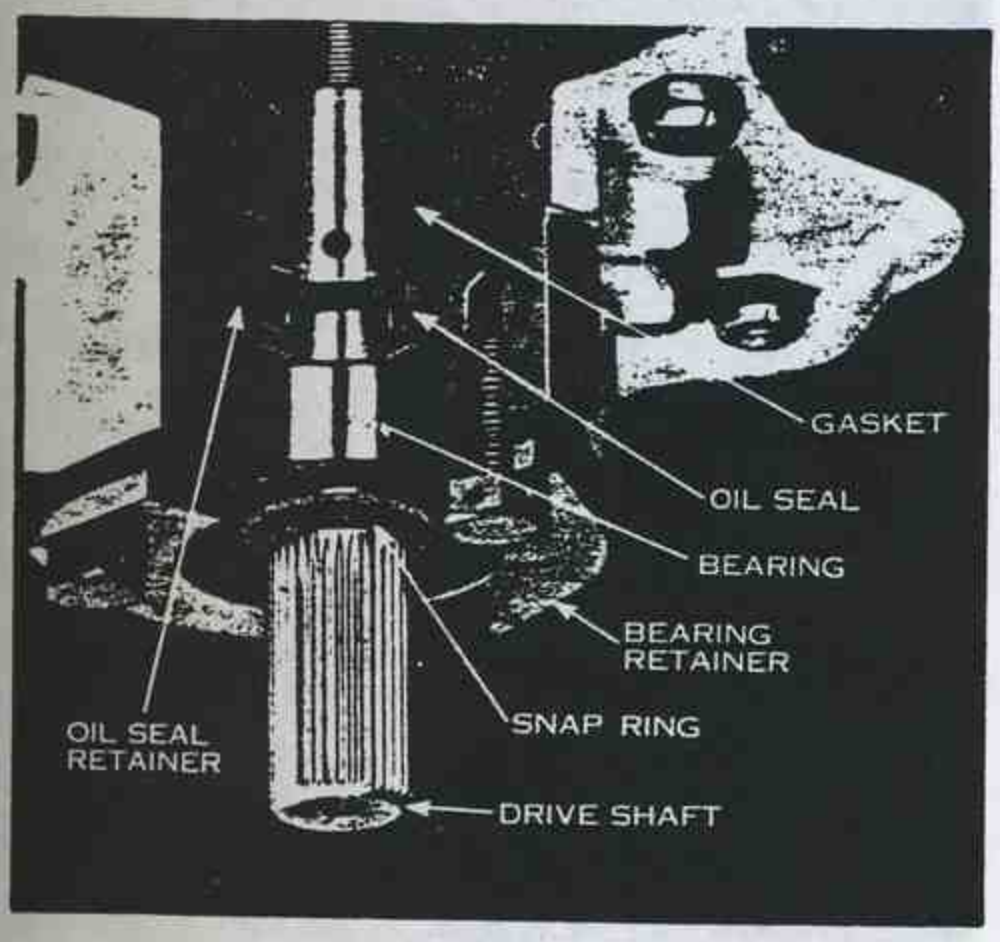
1. Remove lever on speed control shaft, remove dial plate and replace lever. Pull stop levers out into recess on speed control shaft. See Cut No. 12.
2. Start engine, set throttle to high speed position and adjust throttle-to-governor linkage to bring engine to desired high speed.
3. Slip high speed stop lever (the inner lever) back onto serrated portion of shaft. Stop lever should contact stop screw. Adjust screw if necessary.
4. Set throttle to low speed.
5. Slip low speed stop lever (the outer lever) back onto serrated portion of shaft. Stop lever should contact boss at top of panel. If desired adjustment cannot be obtained by the 10° steps provided by the serrations, the lever may be filed to provide an intermediate setting.
6. Mark position of lever on speed control shaft before removing to replace dial plate.

NOTE: 1. If the governor has a shut down rod, the low speed stop lever should be set so that the prick punch mark on the lever will appear opposite the index hole in the dial plate. See Cut No. 1. Stop lever should *not* contact boss on panel in order to allow the overtravel required for shut down.

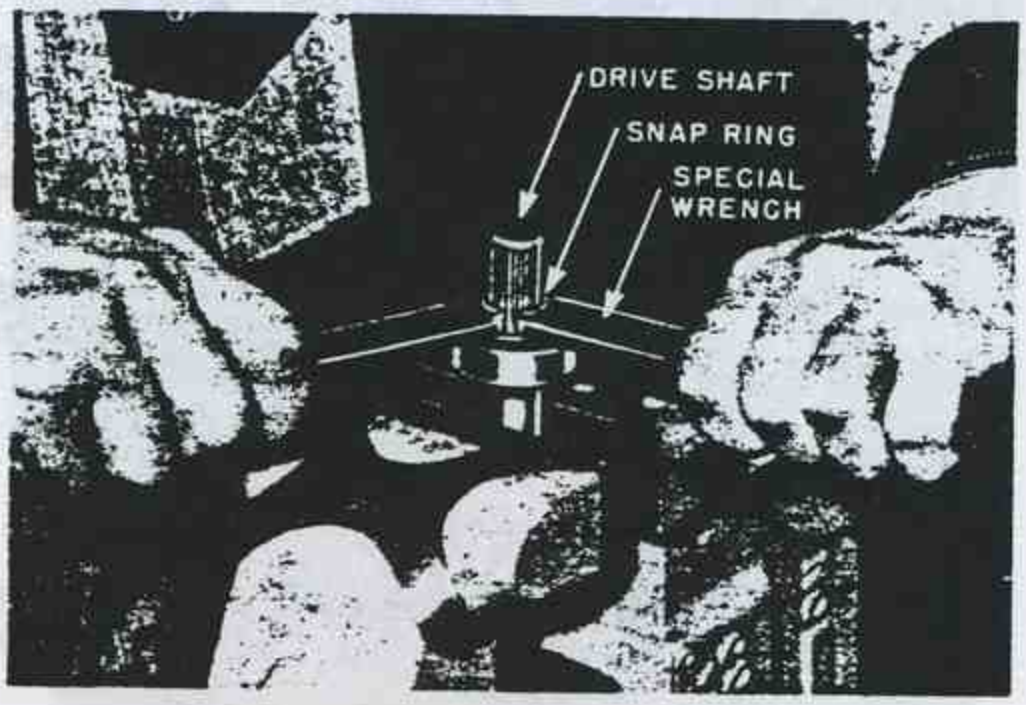


Cut No. 16

2. Rotate speed control shaft 10° below minimum speed position. This will be equivalent to 19/64" movement of the end of the stop lever.
3. Screw nut down on shut down rod until it contacts speeder plug and engine starts to shut down. Secure lock nut if used.



Cut No. 17



Cut No. 18

COMPENSATING SPRING ADJUSTMENT:

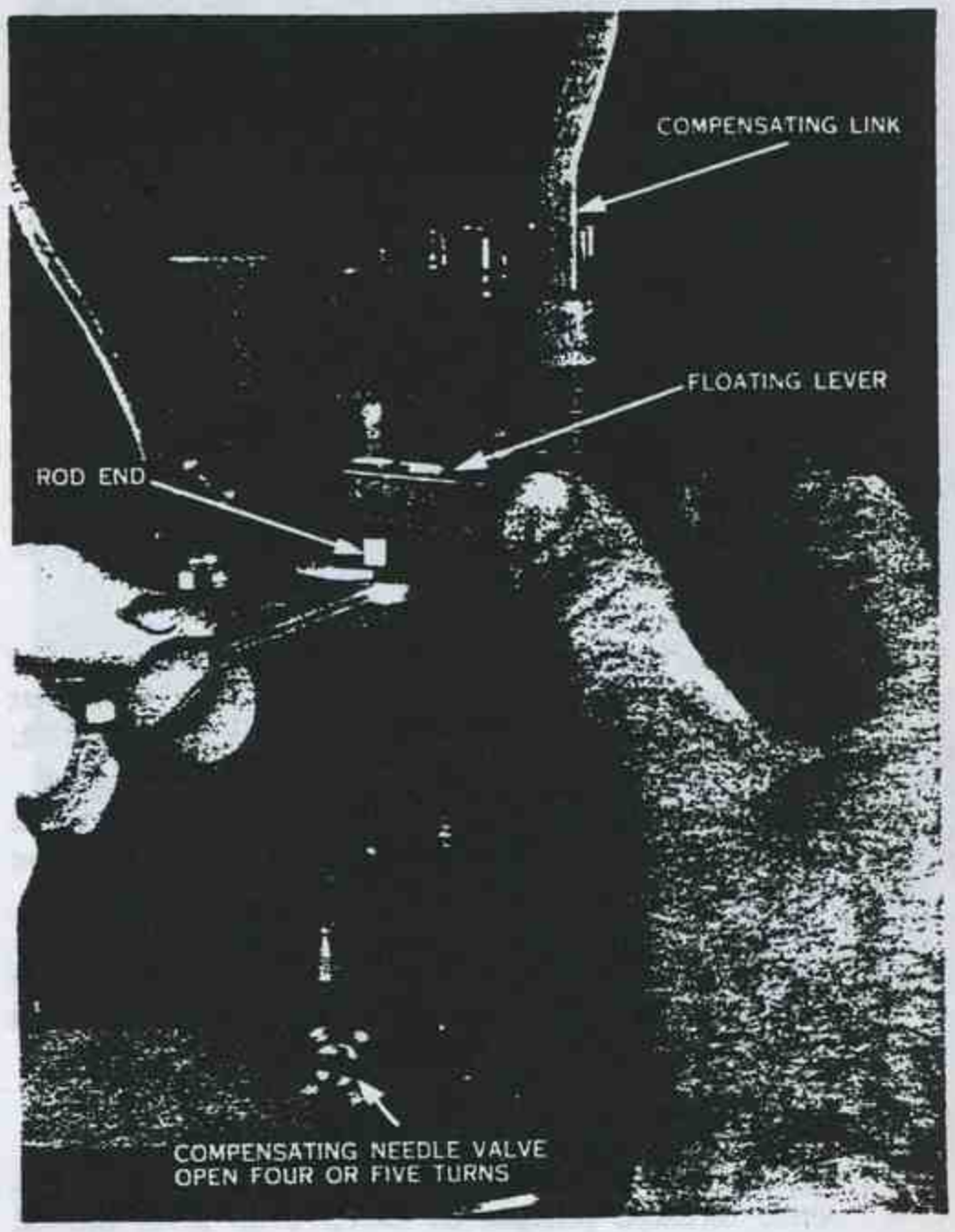
1. Make disassemblies A, B, C and D.
2. Remove compensating screw plug and open compensating needle valve four or five full turns. (Cut No. 1.)
3. Submerge assembly into solvent. Move compensating link up and down several times to flush out oil. Blow out controlet and base assemblies with air hose.
4. Remove dashpot cover. (See Cut No. 14.)
5. Unlock rod end and lock nut. Use floating lever for wrench on rod end. (Cut No. 19.) Remove rod end. Unscrew lock nut to make clearance between nut and spring collar when nut is lifted. (Cut No. 20.) Replace rod end.
6. Measure precompression. (Cut No. 21.) The precompression ranges from .005" to .040". This dimension may be checked with a steel scale graduated in 64ths with an allowable tolerance of plus or minus .005". Do not use dial indicator. Do not change the amount of precompression unless instructions given in Compensation Adjustments, Installation, and Oil Specifications, Part One, and Oil Changes, Part Two, have been followed and operation is still not satisfactory. After once being set for the particular engine and load characteristics, the setting should not be changed. Operating troubles will usually be caused by some other factor.

   To eliminate a hunt (small speed swings) remove a .010" shim to reduce precompression.

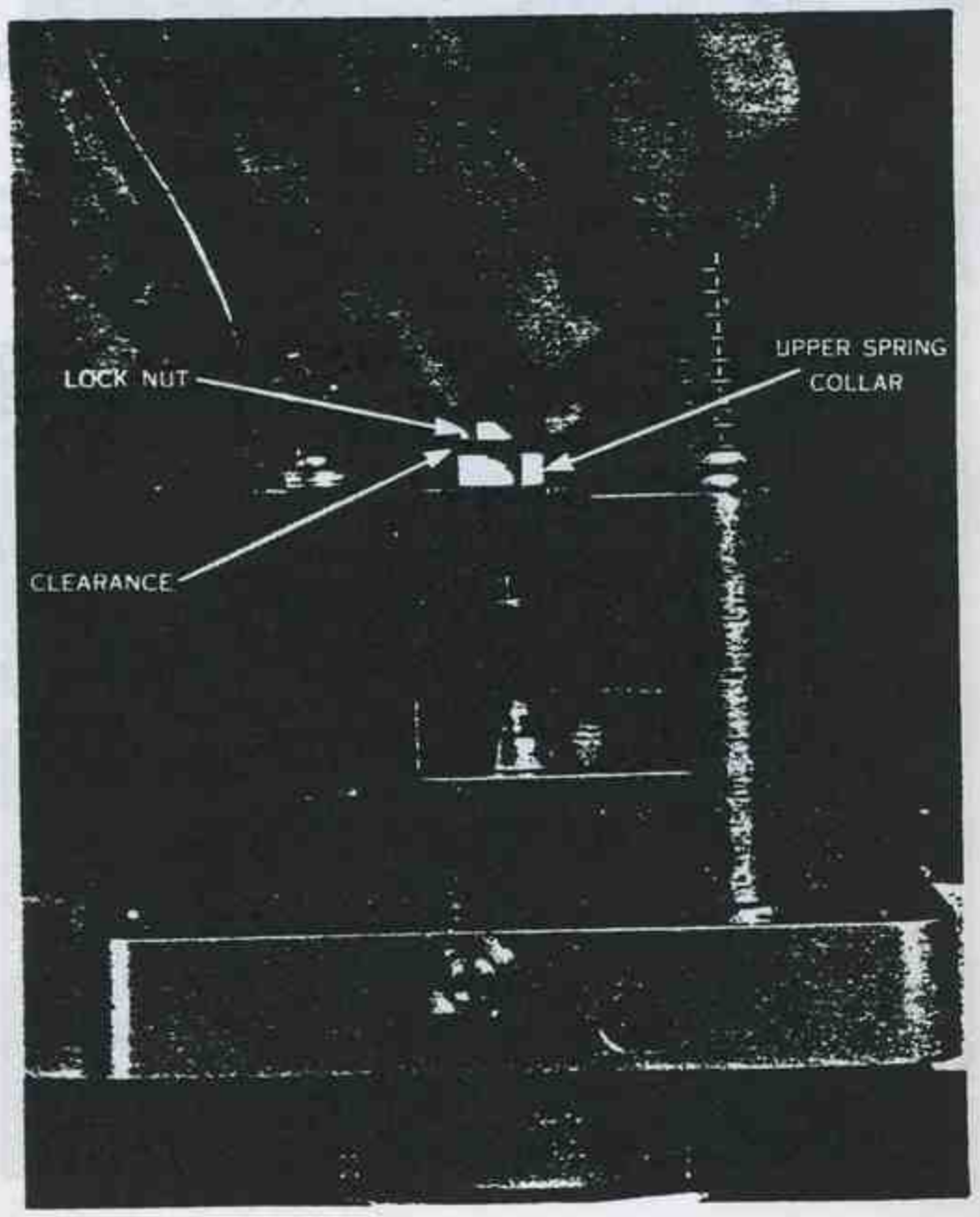
   To eliminate a surge (violent speed swings) add a .010" or .020" shim to increase precompression. Make several tries if unsuccessful.
7. Tighten nut on plunger stem until upper spring collar becomes exactly flush with machined surface. Sight over top as shown in Cut No. 22 while making this adjustment.
8. Replace rod end and lock to nut using floating lever as a rod end wrench. Do not disturb flush adjustment.
9. Replace dashpot cover.
10. Test for lost motion by very delicately moving the rod end up and down with the finger tips (Cut No. 23.) No end play or lost motion allowed. (*Use no force.* The compensating spring will be compressed and the test will be worthless.)
11. If lost motion is felt, it indicates the upper spring collar is not flush with the machined surface as shown in Cut No. 22.

PILOT VALVE ADJUSTMENT:

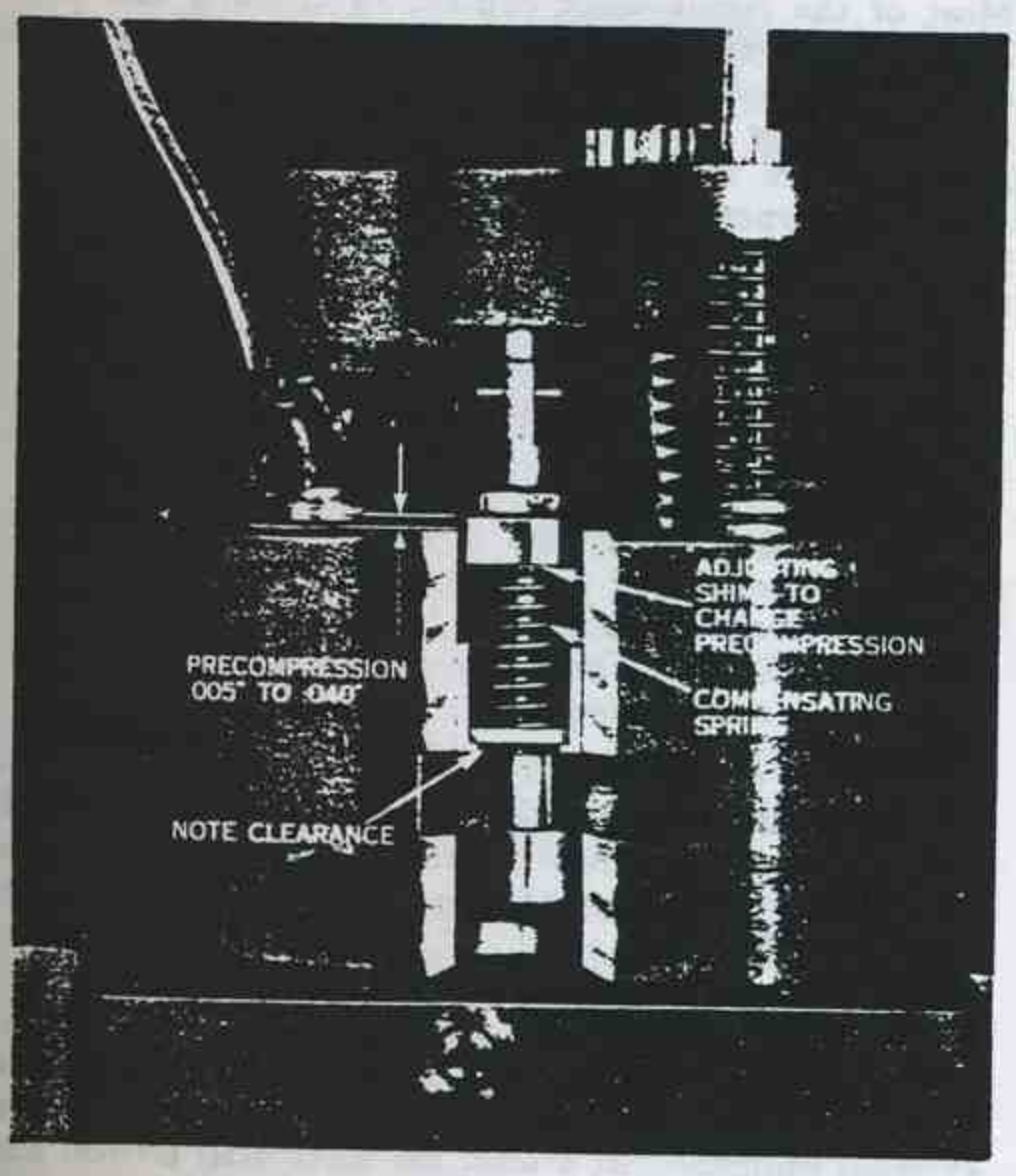
1. Make disassemblies A, B, and C.
2. Remove pipe plug in passage to control port, (Cut No. 24.) Use flashlight to inspect port opening.



Cut No. 19



Cut No. 20

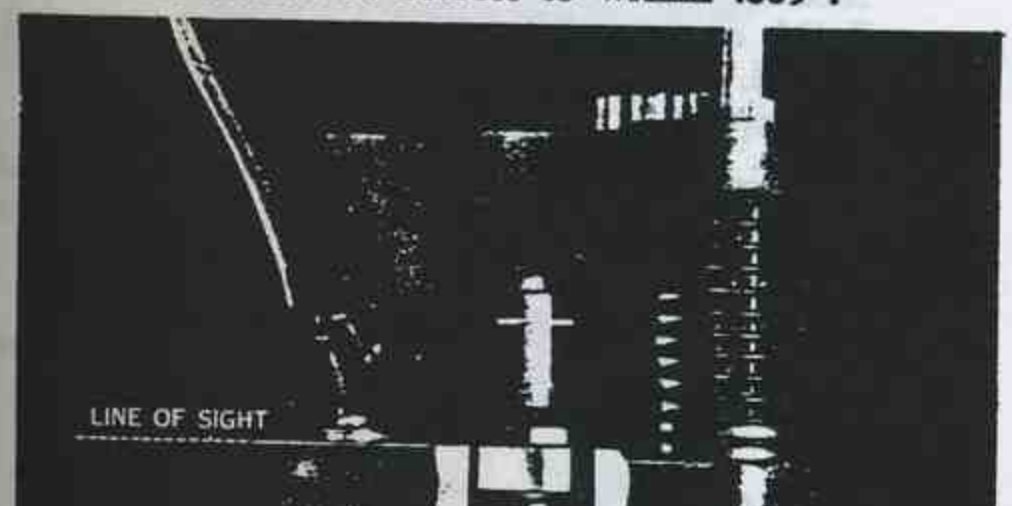


Cut No. 21

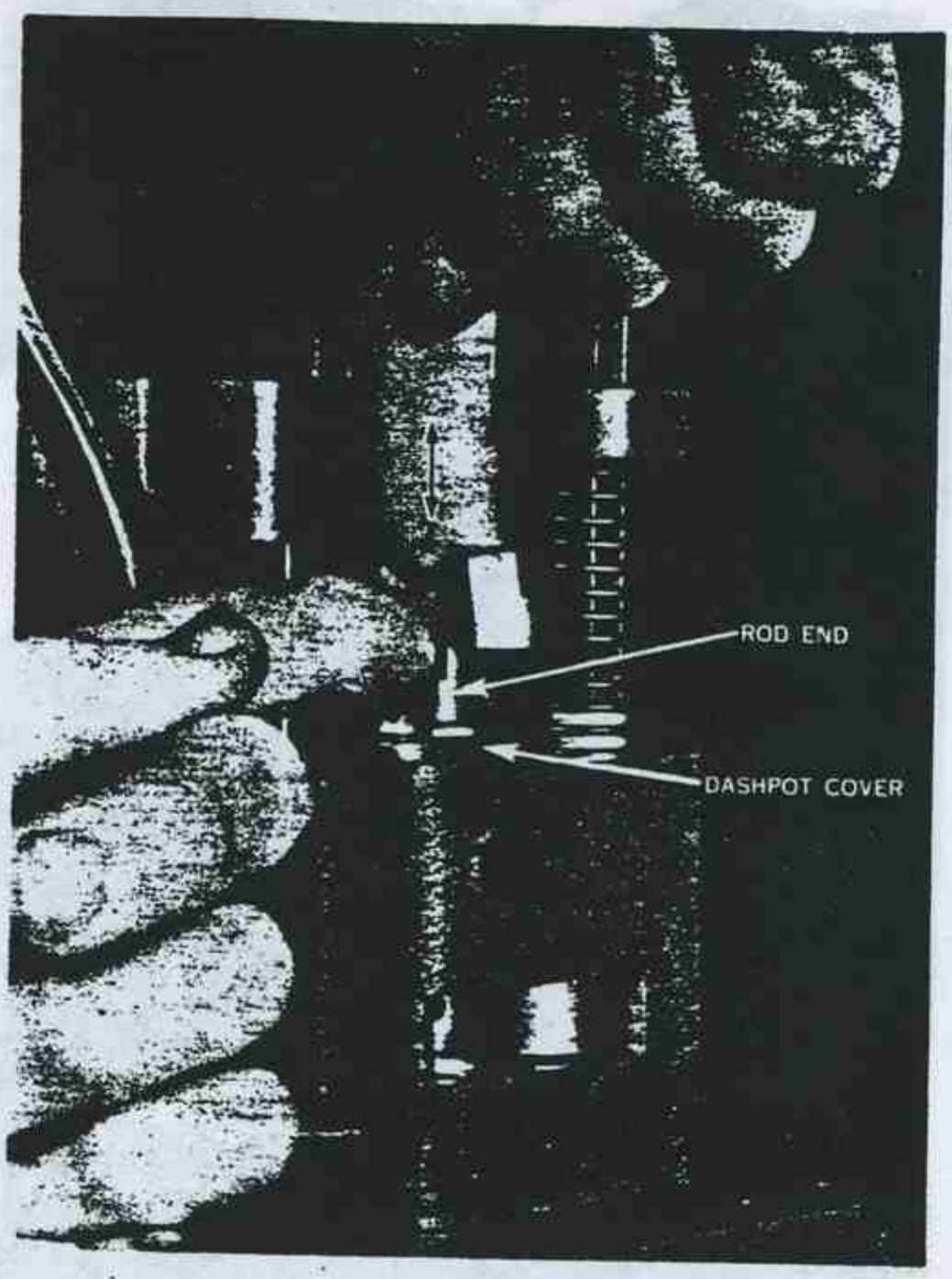
3. Push down on speeder rod, (Cut No. 25). This will move flyballs to inner position. Note amount of port opening.

4. Continue holding speeder rod down and move flyballs to outer position raising the pilot valve land, (Cut No. 26). Note amount of port opening.

5. The amount of opening for inner and outer positions of the flyballs should be exactly the same and should be correct to within .005".



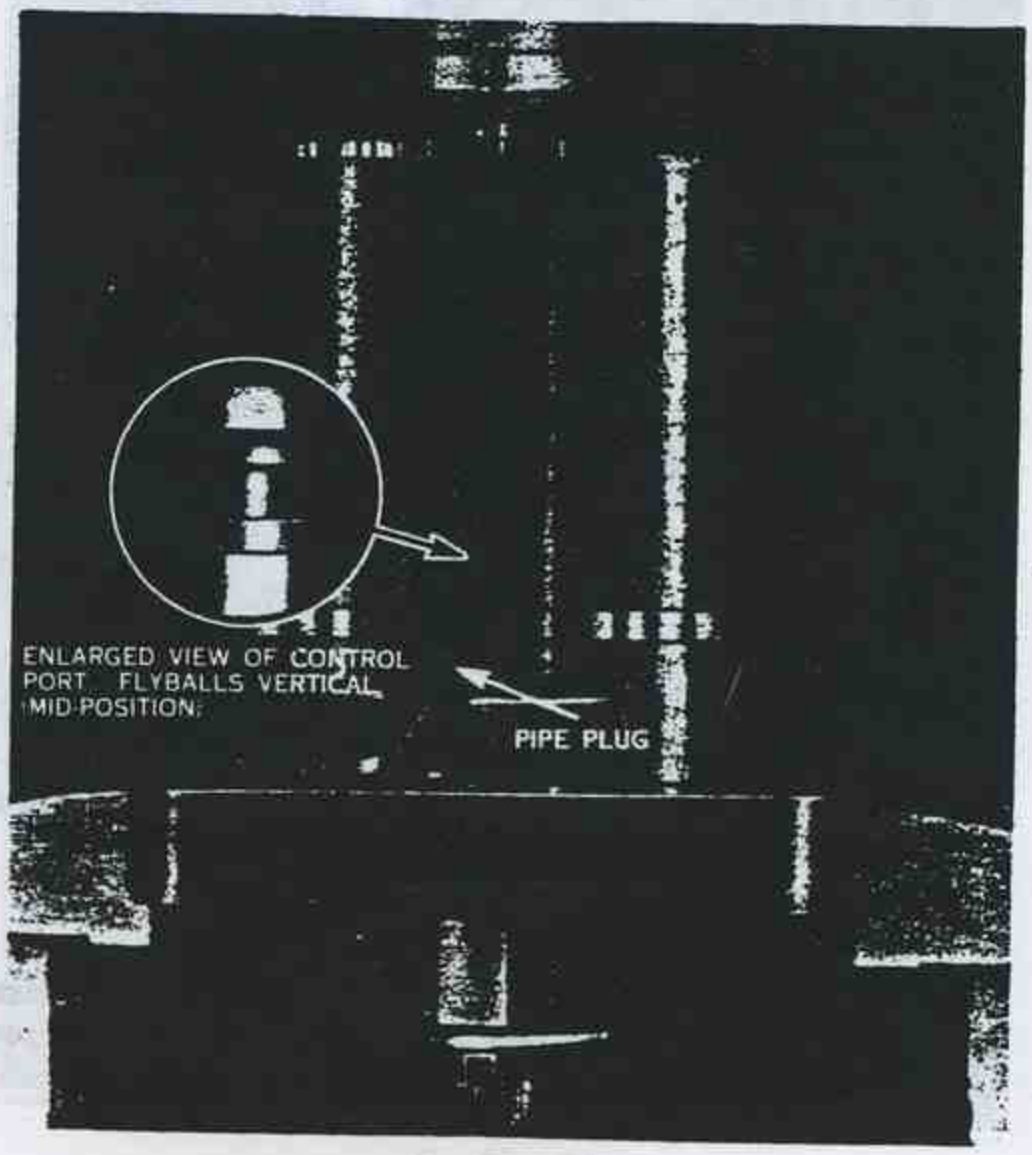
Cut No. 22



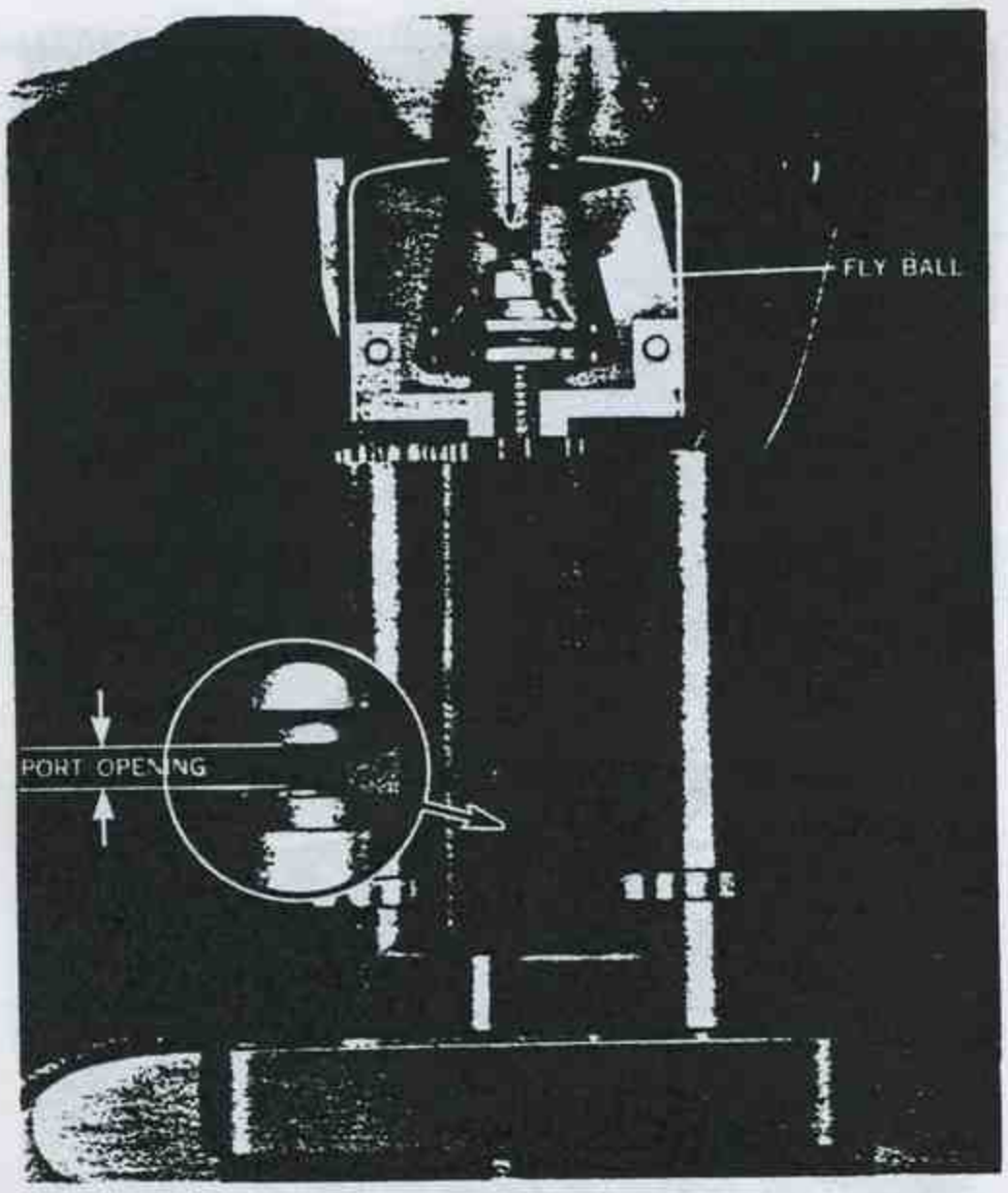
Cut No. 23

6. If the pilot valve land needs to be raised, turn speeder rod nut clockwise and vice versa. Recheck adjustment.

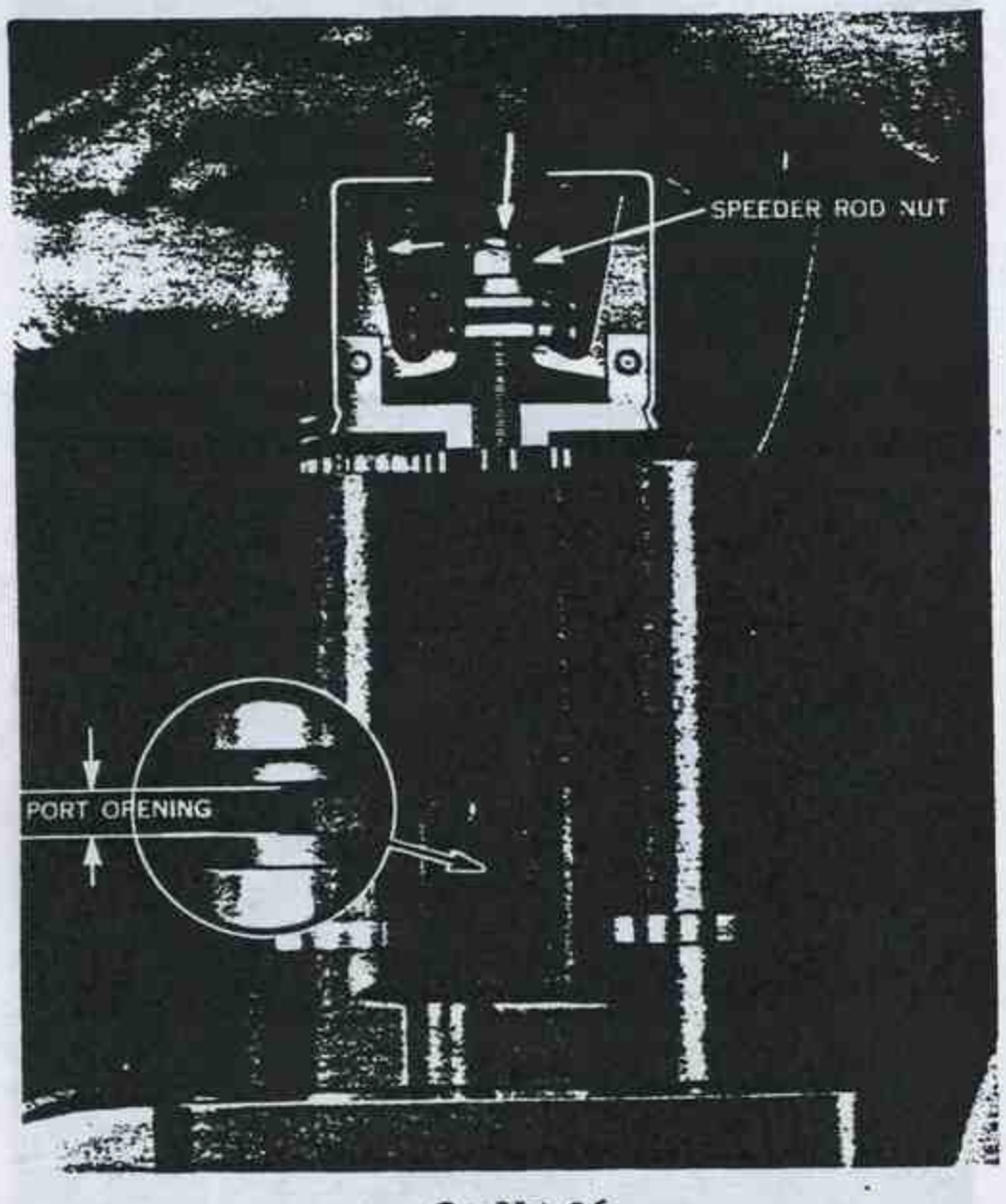
7. *Replace pipe plug.*



Cut No. 24



Cut No. 25



Cut No. 26

GENERAL REPAIR INSTRUCTIONS: Refer to paragraphs on Work Requirements and General Instruction, Page 13.

Most of the repair work consists of cleaning and polishing the governor parts. All pistons, plungers, valves, and rods should move freely without binding or catching. The receiving compensating piston and its spring collars frequently give trouble from this cause. Use three cornered scraper to break milled slot and bored hole edges. Do not lap in parts if possible to free up by other means.

Be extremely careful when polishing the pilot valve plunger land; *broken corners on the land will ruin this part.* Leave corners sharp.

DIAL PANEL LEAKAGE: If oil is visible at the dial panel, remove the dial plate and tighten the panel screws. If this does not eliminate the leak, inspect the oil seal. (See Cut No. 12.) The panel oil seal seldom leaks; do not replace unless necessary.

If necessary to replace the oil seal, remove panel (disassemblies A and B), drive out taper pin in gear, and pull shaft. Oil seal may now be removed and replaced. In assembly, use care in inserting shaft to prevent damage to lip of oil seal.

DRIVE SHAFT OIL SEAL AND DRIVE SHAFT BEARING: If necessary to add a small quantity of oil to the governor oftener than once a week, and there is no external indication of a leak, the drive shaft oil seal has been worn or damaged, allowing oil to leak from the governor into the engine housing.

1. Make disassembly A-1. Drain oil out of governor, flush and invert.
2. Make disassembly F and G-1. (Cut No. 17.)
3. Replace oil seal with lip towards chamfered end of oil seal retainer.
4. Inspect drive bearing for wear and freeness of rotation and the shaft for wear from oil seal. Polish or replace if necessary. Remove snap ring if used. (See Cut No. 18.) Press bearing off shaft and replace if worn or rough turning.
5. Replace bearing and snap ring if used. Insert oil seal and retainer on shaft, using special care not to damage leather lip of oil seal.

ASSEMBLY INSTRUCTION: A few precautions must be taken when reassembling the governor.

I. *Do not drop or rest governor on its drive shaft.*

II. Assembly of Drive Shaft Assembly to Base Assembly.

1. Be certain that the vellumoid gasket is in place in the bearing bore between the shoulder and the oil seal retainer. Use new gasket if it appears to be reduced in thickness (Cut No. 17).
2. Do not press the drive shaft assembly into the bore of the base with an arbor press.
3. Avoid tightening the retainer plate screws too much; it is not necessary, and may bend the plate. There should be 1/8" space between the plate and the boss.

III. Assembly of Controlet Assembly and Base Assembly.

1. Check all pistons and plungers for free movement in bores. Do not lap in if it is possible to free up by removing burrs.

2. Do not shellac the gasket between the base and controlet. If the old gasket is damaged or less than .0025" thick, replace it with a new one. (See Cut No. 16.) Inspect controlet surface for scratches, nicks, dirt particles, etc. Coat controlet surface with oil, place gasket on controlet (if used), space it evenly around bores for pump gears, place 1/4" or 3/8" dia. ball on gasket at dowel pin holes and *tap* out for dowel pins.

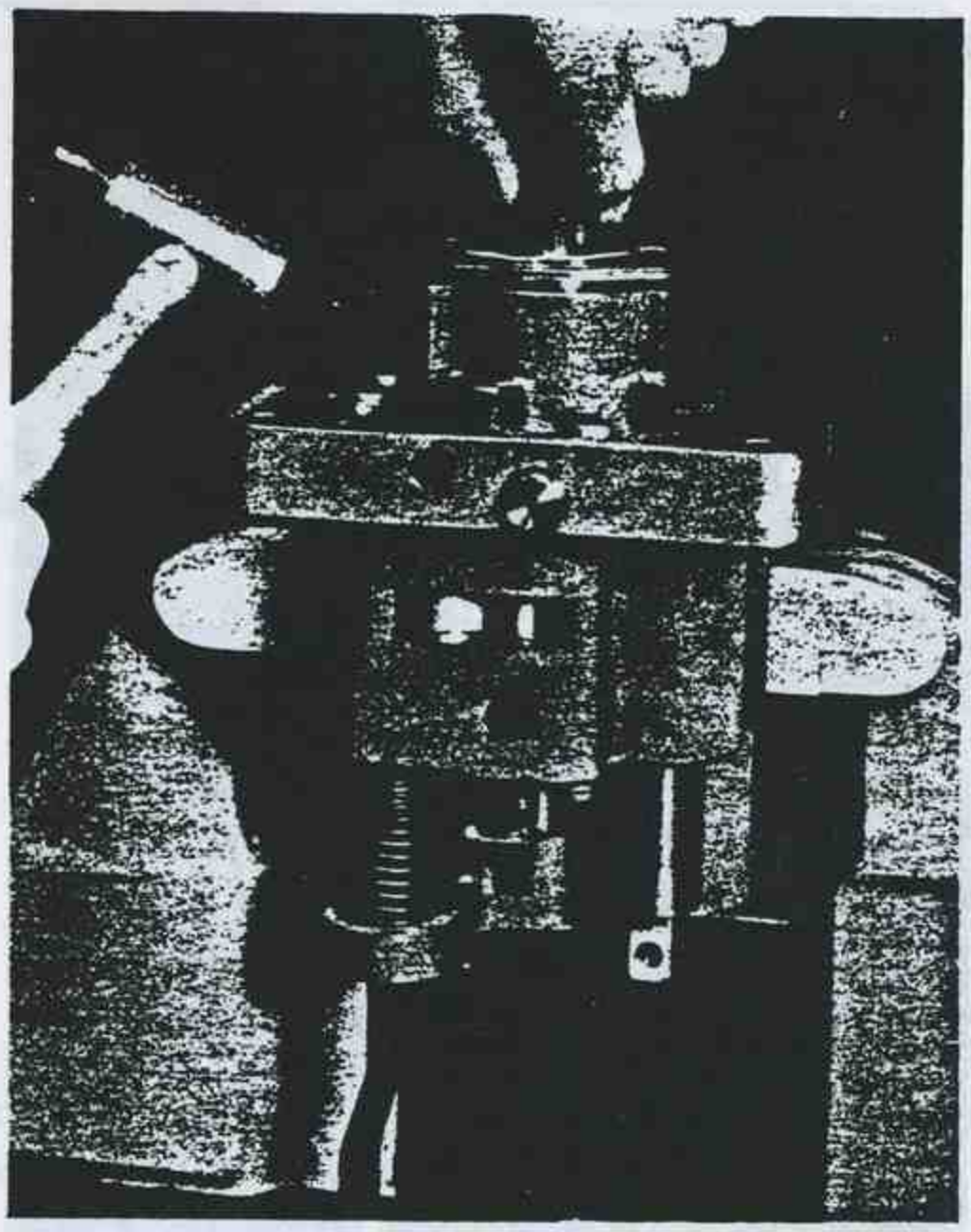
   NOTE: A gasket is *not* used if controlet has an oil groove. (See Cut No. 16.)

3. The pilot valve bushing, pilot valve plunger, pilot valve spring, and spring tip must be in place before setting on the base.

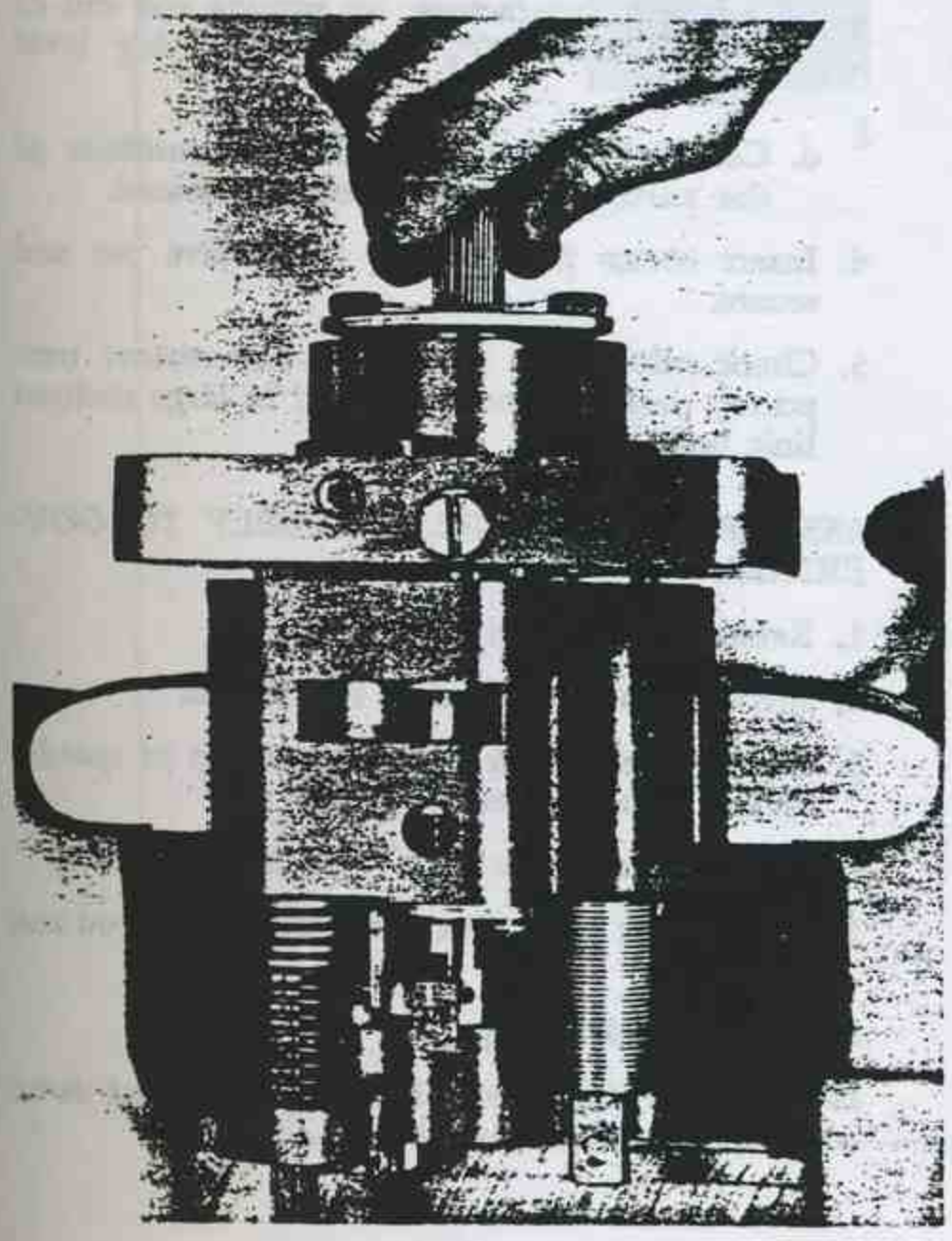
4. Clamp controlet lightly in vise (inverted), place base assembly, (Cut No. 16), and turn drive shaft to cause lug on shaft to drop into slot in pilot valve bushing. (Cut No. 27.)

5. Place and tighten nuts. Use cylinder head method for drawing down. Do not exert too much force; the threads may strip.

6. Turn drive shaft. If not free, it must be aligned by loosening nuts and striking at corners of base with plastic or light babbit hammer until shaft turns free, (Cut No. 28). If this does not free up the shaft, remove base and turn drive shaft lug 180°. (See Cut No. 16.)



Cut No. 28



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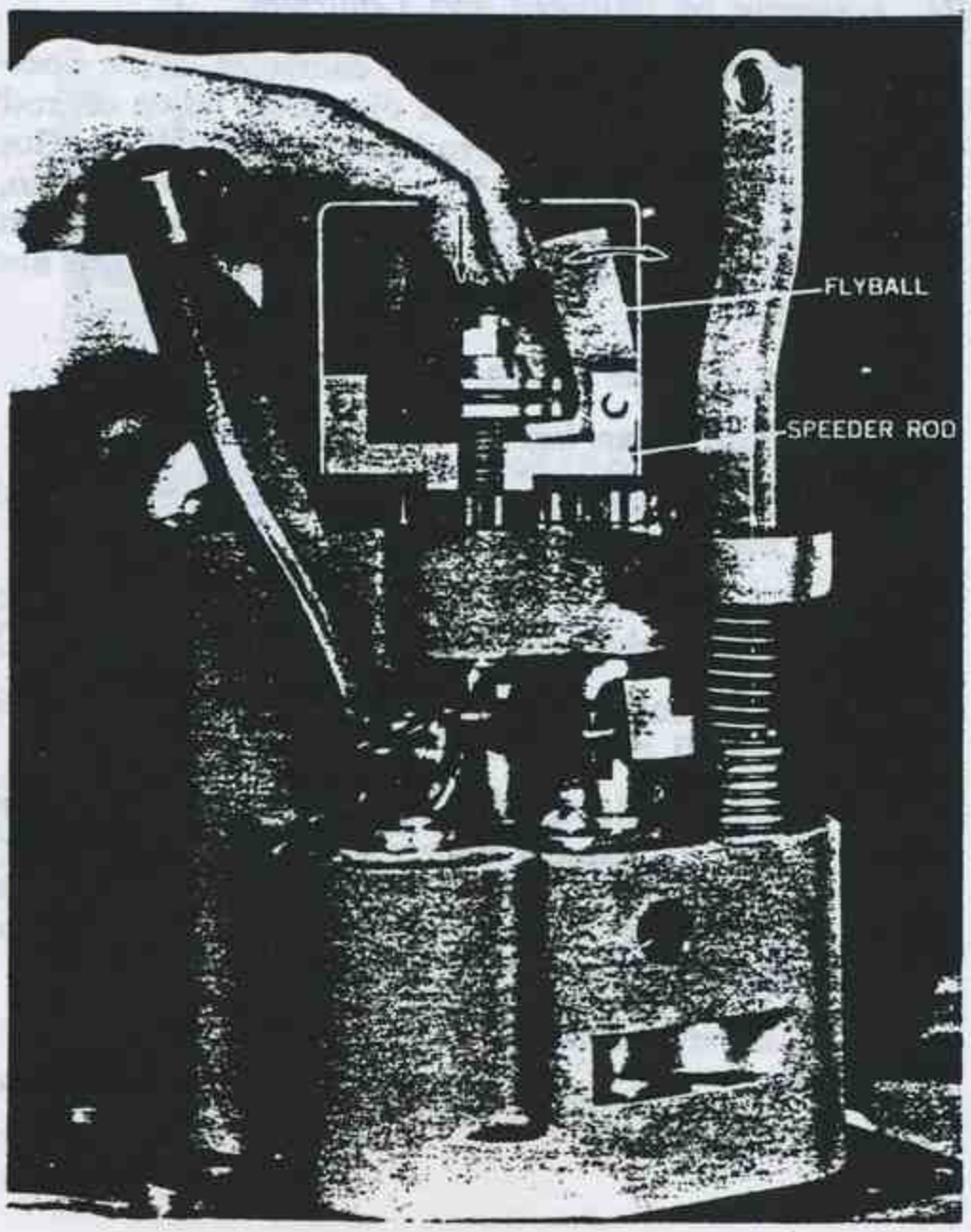
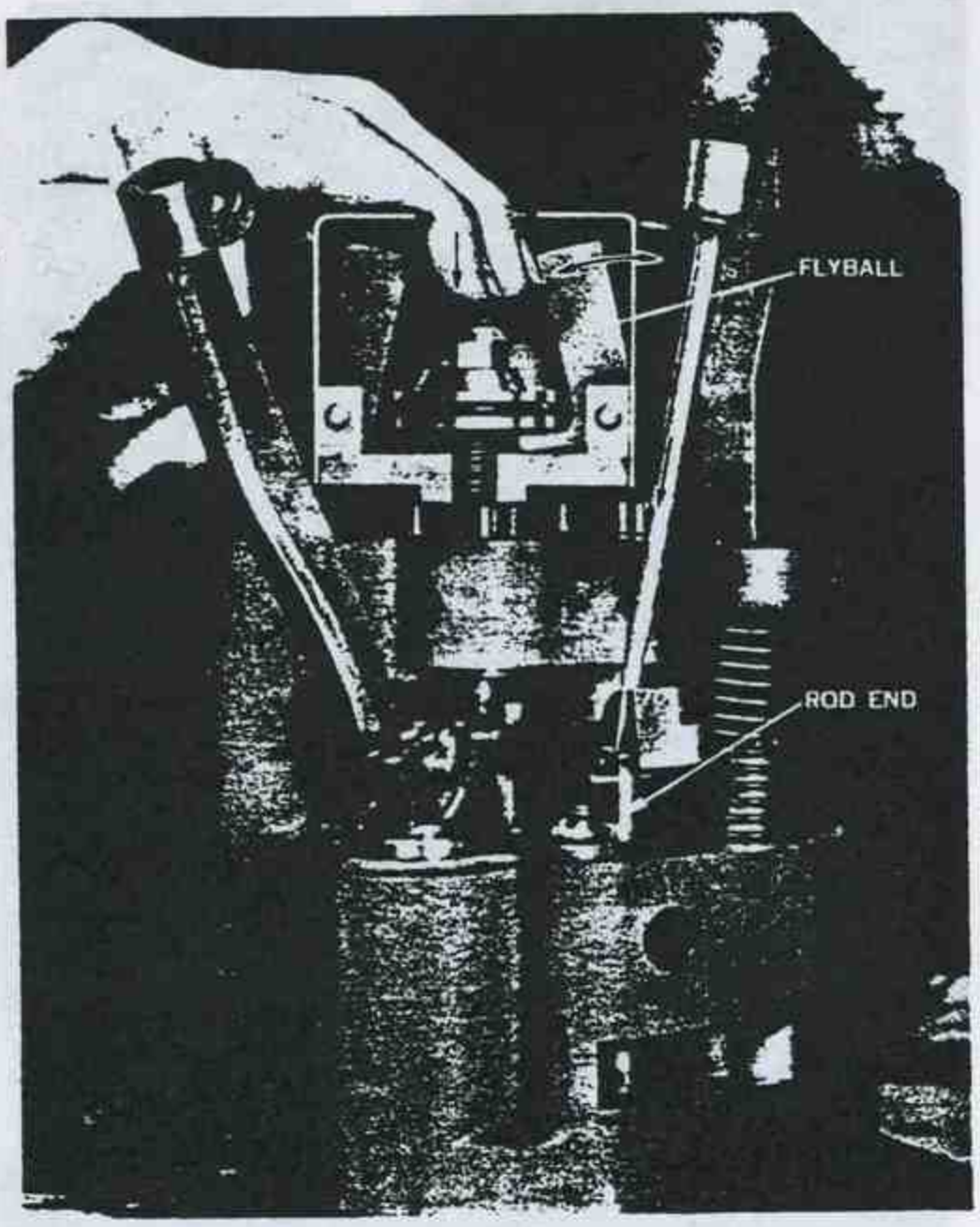


Cut No. 29



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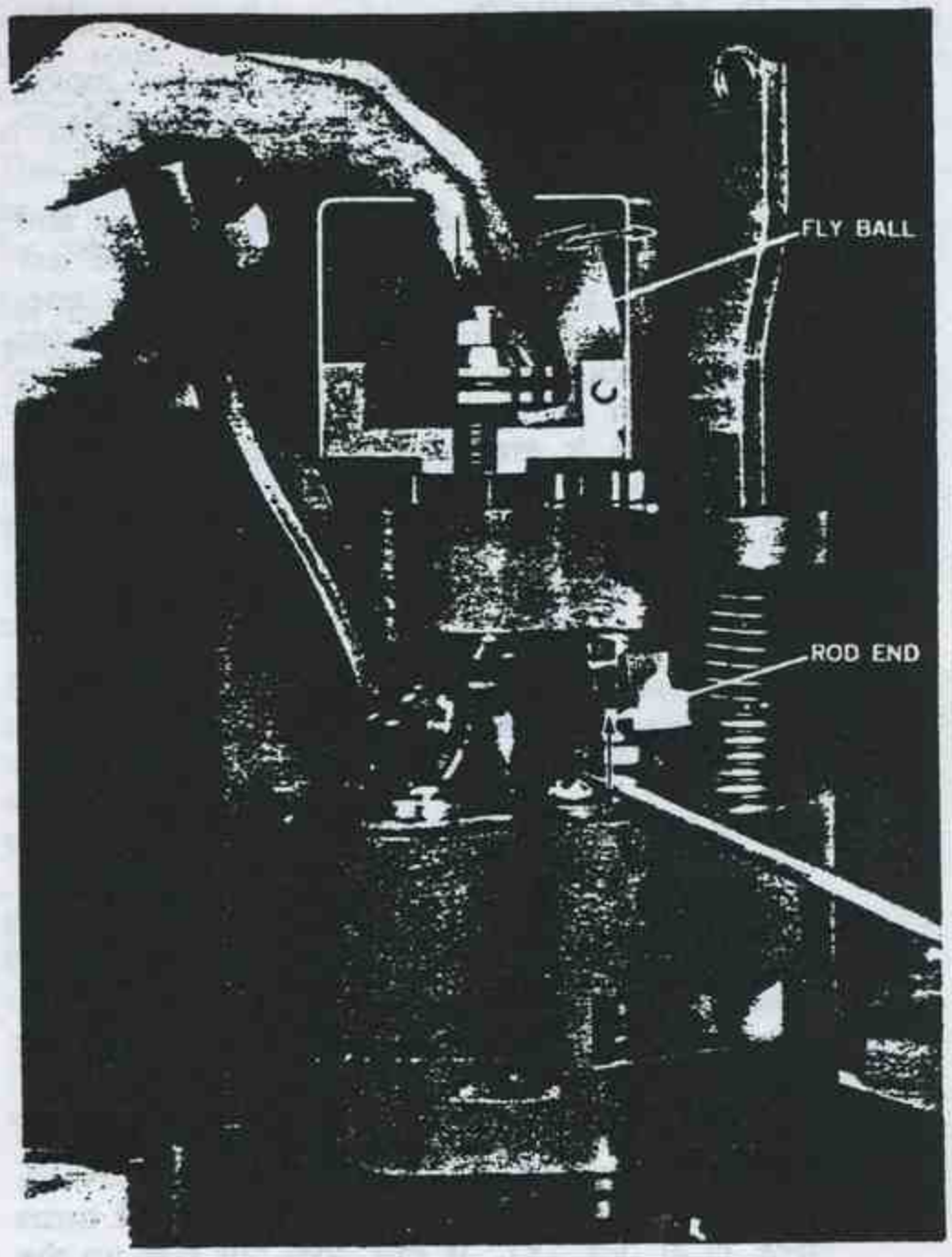


Cut No. 31

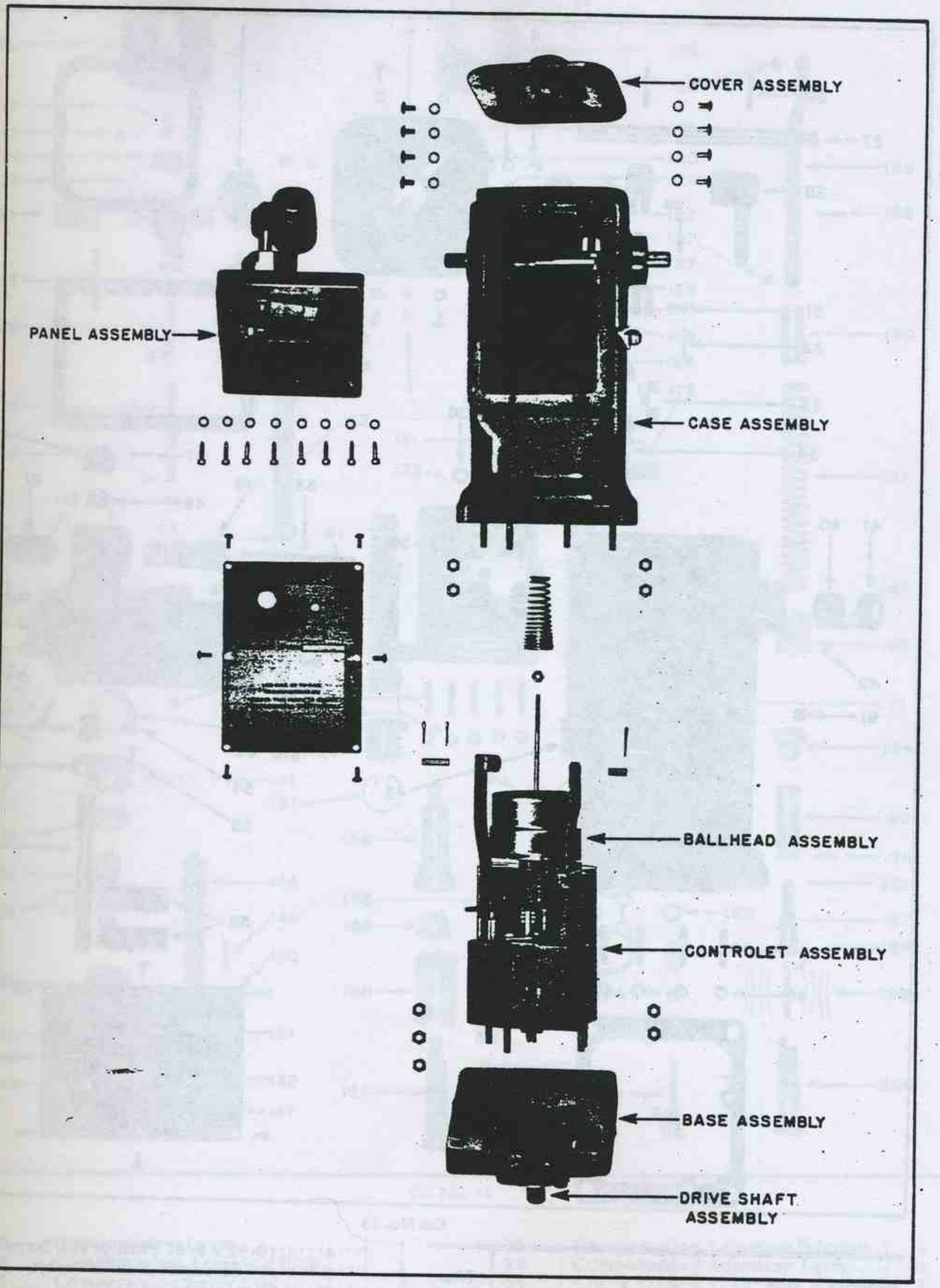
IV. Assembly of Ballhead and Controlet.

1. Place ballhead assembly in controlet. Slide floating lever on speeder rod pin, press down on rod end, and slip lever on rod end pin, straddling pilot valve. (Cut No. 15.) Insert pilot valve pin, (Cut No. 14.) If it will not enter easily, turn pilot valve plunger 180° and try again. Do not cotter yet.
2. Test for free action of floating lever.
   a. Push down lightly on speeder rod.
   b. Move one flyball through full travel several times. (Cut No. 29.)
   c. Press down 1/4" approximately on rod end, and move flyball through full travel. (Cut No. 30.)
   d. Lift rod end 1/4" approximately and move flyball through full travel. (Cut No. 31.)
3. If floating lever is not perfectly free under any of the conditions under 2, it will be necessary to try various arrangements of positions of the speeder rod, pilot valve plunger, rod end, and floating lever.
   a. Invert floating lever and test.
   b. If unsatisfactory, turn pilot valve plunger 180°, and test.
   c. If still unsatisfactory, try turning rod end or speeder rod 180°, or invert floating lever again.
   d. Continue with combinations of positions of the parts until free action is obtained.
4. Insert cotter pin through pilot valve pin and secure.
5. Check pilot valve adjustment and remove temporary dashpot assembly pin if in large dashpot link hole.

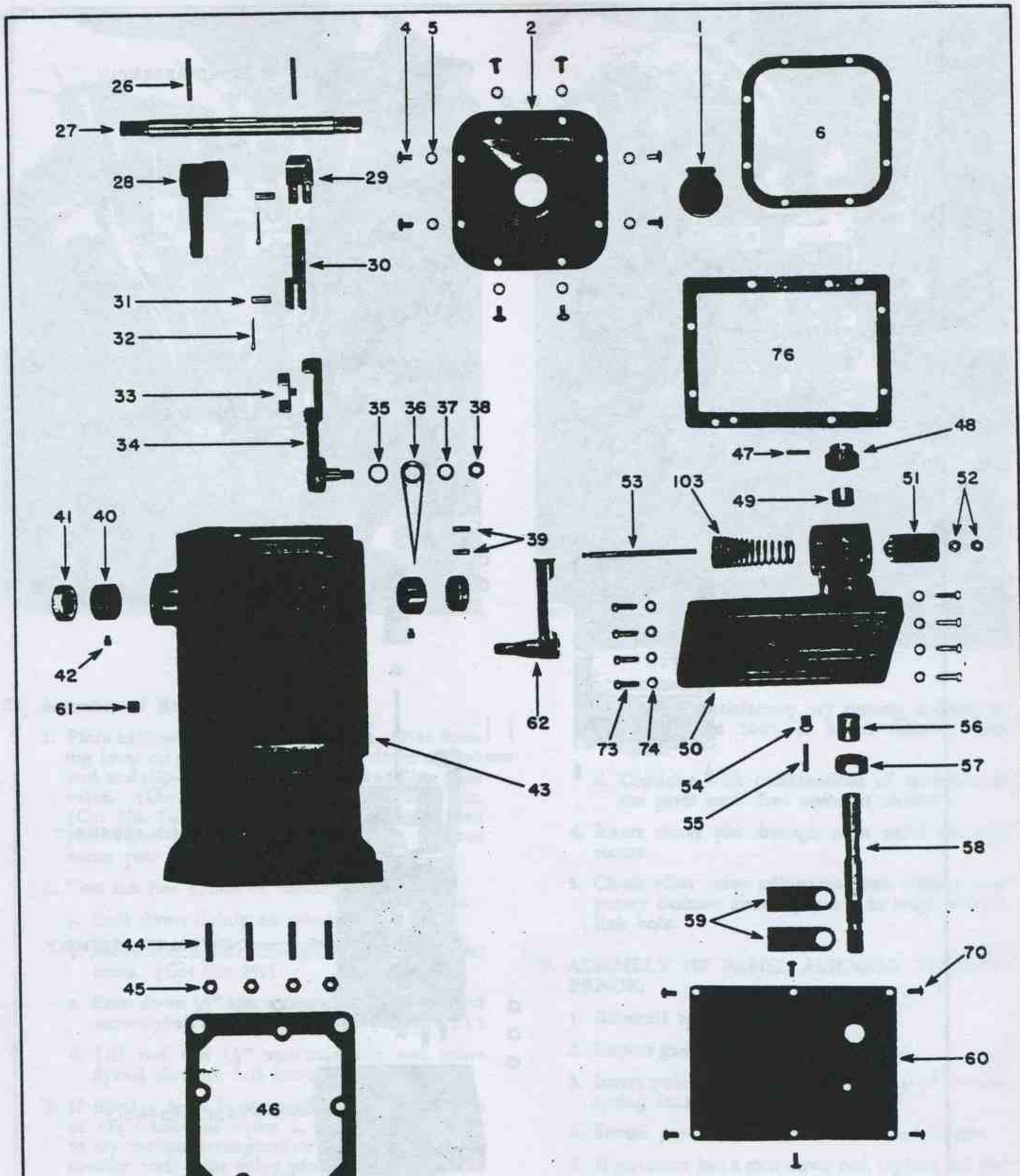
V. ASSEMBLY OF PANEL ASSEMBLY TO GOVERNOR.

1. Reinstall speeder spring.
2. Inspect gasket and replace if damaged.
3. Insert panel taking care to insert top of speeder spring into speeder plug hole.
4. Secure panel with lock washers and screws.
5. If governor has a shut down rod, replace rod and nut.
6. Insert speeder plug.

NOTE: To reset speed limit stops and shut down nut see instructions Page 15.

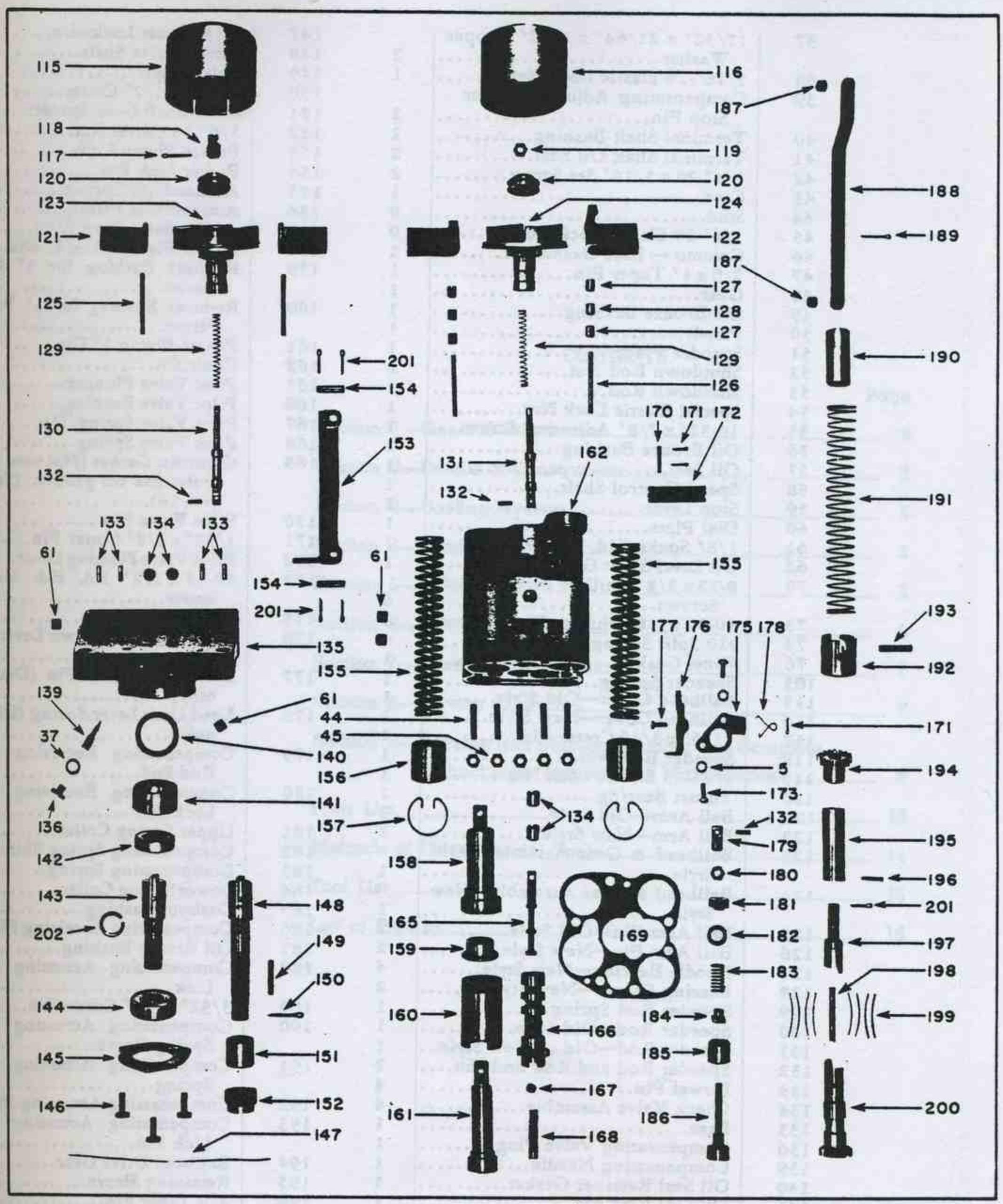

COVER ASSEMBLY
PANEL ASSEMBLY
CASE ASSEMBLY
BALLHEAD ASSEMBLY
CONTROLET ASSEMBLY
BASE ASSEMBLY
DRIVE SHAFT ASSEMBLY

Cut No. 32



Cut No. 33

Number of Part	Name of Part	No. Req'd.
1	Oil Filler Cup	1
2	Cover	1
4	10-32 x 3/8" Phillips Hd. Screw	8
5	#10 Shakeproof Lockwasher	10
6	Case — Cover Gasket	1
26	Taper Pin	2
27	Terminal Shaft	1
28	Power Lever	1



Cut No. 34

29	Compensating Lever.....	1	33	Compensating Adjusting Fulcrum..	1
30	Compensating Adjusting Link.....	1	34	Compensating Adjusting Lever....	1
31	Compensating Lever Pin.....	2	35	5/8" x 7/16" x 1/32" Seal Washer.	1
32	1/16" x 7/8" Cotter Pin.....	2	36	Compensating Adjusting Pointer..	1

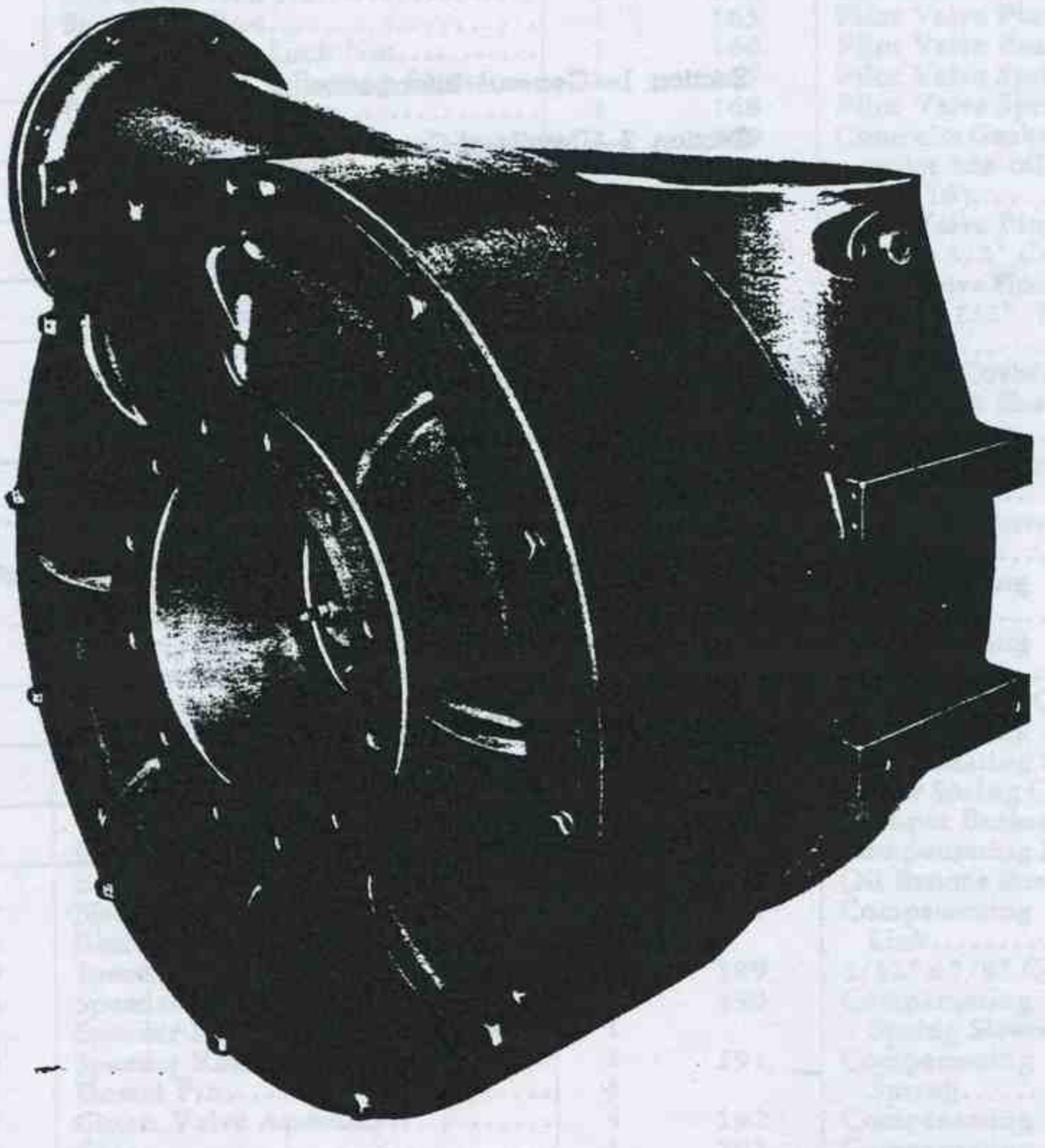
37	17/32" x 21/64" x 1/32" Copper Washer	2
38	5/16"-24 Elastic Lock Nut	1
39	Compensating Adjusting Lever Stop Pin	2
40	Terminal Shaft Bushing	2
41	Terminal Shaft Oil Seal	2
42	1/4"-28 x 5/16" Set Screw	2
43	Case	1
44	Stud	9
45	1/4"-28 Elastic Lock Nut	9
46	Column — Base Gasket	1
47	2/0 x 1" Taper Pin	1
48	Gear	1
49	Oil Bronze Bushing	1
50	Panel	1
51	Speeder Plug	1
52	Shutdown Rod Nut	2
53	Shutdown Rod	1
54	Special Elastic Lock Nut	1
55	10-32" x 7/8" Adjusting Screw	1
56	Oil Bronze Bushing	1
57	Oil Seal	1
58	Speed Control Shaft	1
59	Stop Lever	2
60	Dial Plate	1
61	1/8" Socket Hd. Pipe Plug	7
62	Oil Level Sight Gauge	1
70	8-32 x 3/8" Phillips Binding Head Screws	6
73	10-32 x 5/8" Phillips Fil. Hd. Screw	8
74	#10 Split Spring Lock Washer	8
76	Panel Gasket	1
103	Speeder Spring	1
115	Ballhead Cover—Old Style	1
116	Ballhead Cover—New Style	1
117	1/16" x 3/4" Cotter Pin	1
118	Speeder Rod Nut	1
119	1/4"-28 Elastic Lock Nut	1
120	Thrust Bearing	1
121	Ball Arm—Old Style	2
122	Ball Arm—New Style	2
123	Ballhead & Gear Assembly—Old Style	1
124	Ballhead & Gear Assembly—New Style	1
125	Ball Arm Pin—Old Style	2
126	Ball Arm Pin—New Style	2
127	Needle Bearing—New Style	4
128	Bearing Spacer—New Style	2
129	Speeder Rod Spring	1
130	Speeder Rod—Old Style	1
131	Speeder Rod—Old or New Style	1
132	Speeder Rod and Rod End Pin	2
133	Dowel Pin	4
134	Check Valve Assembly	4
135	Base	1
136	Compensating Valve Plug	1
139	Compensating Needle	1
140	Oil Seal Retainer Gasket	1
141	Oil Seal Retainer	1
142	Oil Seal	1
143	Serrated Drive Shaft	1
144	Double Shield Bearing	1
145	Bearing Retainer	1
146	1/4"-28 x 5/8" Hex. Screw—Head Drilled #50 for Wire	3
147	.035" Brass Lockwire	
148	Keyed Drive Shaft	
149	Drive Key	
150	1/8" x 1-1/2" Cotter	
151	Drive Shaft Gear Spacer	
152	5/8"-18 Castle Nut	
153	Power Piston Link	
154	Power Link Pin	
155	Accumulator Spring	
156	Accumulator Piston	
157	Accumulator Snap Ring	
158	Power Piston—1-3/8" Dia.	
159	Reducer Bushing for 1" P Piston	
160	Reducer Bushing for 1" Pc Piston	
161	Power Piston 1" Dia.	
162	Controlet	
165	Pilot Valve Plunger	
166	Pilot Valve Bushing	
167	Pilot Valve Spring Tip	
168	Pilot Valve Spring	
169	Controlet Gasket (Not used i trolet has oil groove. (Se No. 16)	
170	Pilot Valve Pin	
171	1/32" x 3/8" Cotter Pin	
172	Pilot Valve Floating Lever	
173	10-32 x 1/2" Rd. Hd. Ma Screw	
175	Dashpot Cover	
176	Load Limit Shutdown Lever Gov. only)	
177	Load Limit Lever Pin (Dial only)	
178	Load Limit Lever Spring (Di only)	
179	Compensating Receiving F Rod End	
180	Compensating Receiving I Lock Nut	
181	Upper Spring Collar	
182	Compensating Spring Shim	
183	Compensating Spring	
184	Lower Spring Collar	
185	Dashpot Bushing	
186	Compensating Receiving Pistor	
187	Oil Bronze Bushing	
188	Compensating Actuating Pist Link	
189	3/32" x 7/8" Cotter Pin	
190	Compensating Actuating F Spring Sleeve	
191	Compensating Actuating F Spring	
192	Compensating Actuating Pis	
193	Compensating Actuating I Link Pin	
194	Ballhead Drive Gear	
195	Retaining Sleeve	
196	2/0 Taper Pin	
197	Ballhead Gear Driver	
198	Spacer Pin	
199	Spring Drive Lamination	
200	Pump Driven Gear	
201	1/16" x 1/2" Cotter Pin	
202	Snap Ring	

CONTENTS

INSTRUCTIONS

For Installation, Operation and Maintenance of

ELLIOTT TYPE "L" LOW-PRESSURE TURBOCHARGERS



INSTRUCTION BOOK TC-20-A

SECTION 1
GENERAL INFORMATION

The Elliott turbocharger is a self-contained unit, composed of a gas turbine and a centrifugal blower, mounted on a common shaft with the necessary surrounding casings, (Fig. 8). The exhaust gas from the power cylinders of the Diesel engine is conveyed through multiple manifolds to the turbine, which utilizes some of the energy in the exhaust gas, otherwise wasted. This energy is used to drive the blower, which furnishes all the air required by the engine, at a pressure above atmospheric, through a conventional air intake manifold.

The turbocharger unit is used in conjunction with the Buchi system of pressure charging and scavenging a four-stroke cycle Diesel engine. In this system the compressed air delivered by the turbocharger accomplishes two ends: first, it scavenges the hot residual gases otherwise left in the cylinder at the end of the exhaust stroke, and replaces these with cooler fresh air; second, it fills the cylinder with an air charge of higher density at the end of the suction stroke. The provision of a greater amount of fresh air permits the combustion of a correspondingly greater amount of fuel and consequently a higher output from a turbocharged engine than from one not so equipped.

The valve timing of an engine arranged for the Buchi system of pressure charging differs primarily from that of the same engine normally aspirated in that the exhaust valves of the pressure-charged engine close later, and the inlet valves open earlier. Thus, the valve overlap, or period when both valves are open simultaneously, is considerably greater, permitting effective scavenging of the cylinders. Timing of the valves and dimensions of the exhaust manifold are determined so that timed pressure fluctuations are propagated in the exhaust manifold. Both valves are open when the fluctuating pressure in the exhaust manifold is at a minimum, thus permitting scavenging with lower blower pressure than would otherwise be possible.

Scavenging the combustion space with cool air effects a considerable degree of cooling of the cylinder head, cylinder walls, valves. and piston. For this reason, a greater amount of fuel can be burned, and greater power developed by an engine turbocharged with the Buchi system without harmful effects on these engine parts due to excessive heat.

No control over the turbocharger is necessary, as the correlated action of the turbine and blower is entirely automatic. The speed and output of the turbocharger vary automatically and practically instantaneously with variations in load, speed, or both, of the engine. No consideration need be given to direction of rotation of the turbocharger when applied to a direct reversing engine. The turbocharger rotates in one direction only, regardless of the direction of rotation of the engine.

SECTION 2
DETAILS OF CONSTRUCTION

(Numbers in parentheses refer to part numbers on the cross-sectional assembly and outline, Figs. 7, 8,9 and 10 respectively, and Parts List, page 13)

Essentially, the Elliott turbocharger consists of a single-stage turbine wheel and a single-stage centrifugal blower impeller mounted on a common shaft, with the necessary surrounding casings. The turbocharger rotor is entirely independent of the rotating parts of the engine. (Fig. 1).

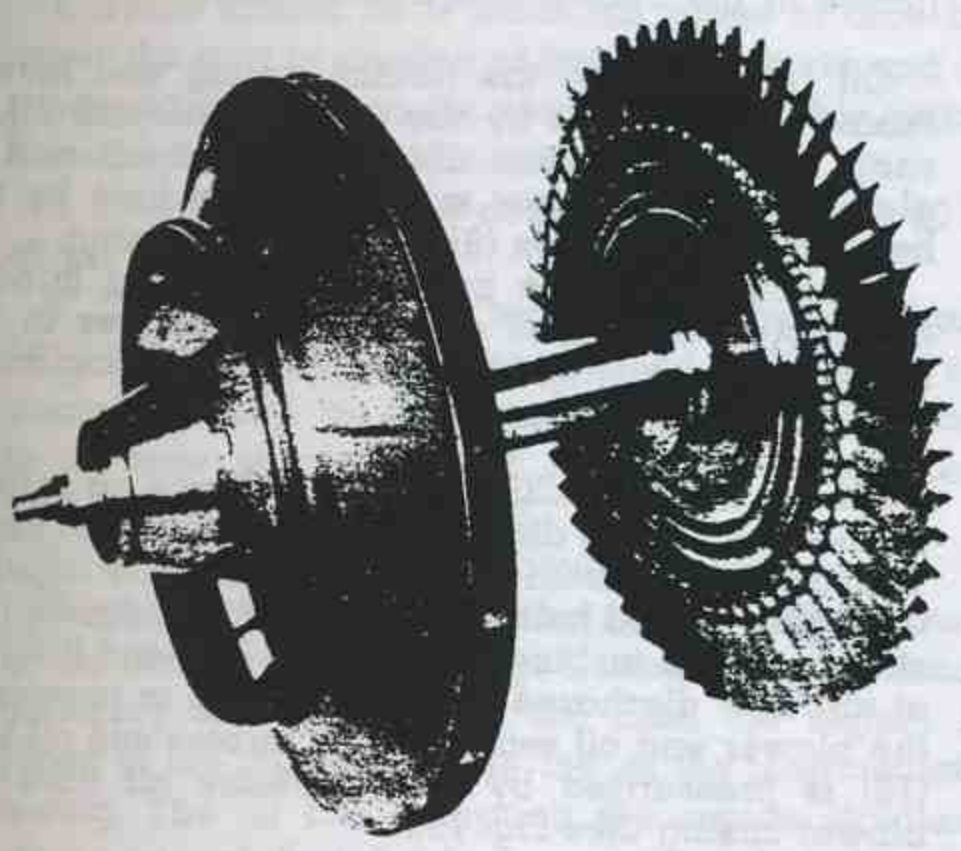


Fig. 1—Rotor Assembly.

The engine exhaust gases are conducted to the cast inlet casing (50) by several exhaust manifolds. The number and arrangement of the manifolds is dependent on the number of engine cylinders. The turbine nozzle ring (59), is centered on and attached to the turbine inlet casing by bolts (62) wired together (63).

The nozzle ring comprises a special heat resisting Ni-Resist casting with stainless steel guide vanes cast into place. The outer ring is split into several segments to give greater freedom for radial expansion of the blades. A bayonet lock clamps the nozzle segments against the inlet casing, thus preventing thermal distortion but permitting full freedom for radial expansions. The nozzle ring directs the exhaust gases to the turbine blades (76) at the proper angle.

The turbine casing (1) is a Meehanite casting, cored to provide cooling water passages. A flat oval flange is provided for exhaust connection. Pads are supplied at three points for supporting bracket connections.

The intermediate casing (9) is of the same material as the turbine casing, and forms the division between the turbine casing and the blower casing. It is also cored for cooling water. The intermediate casing is

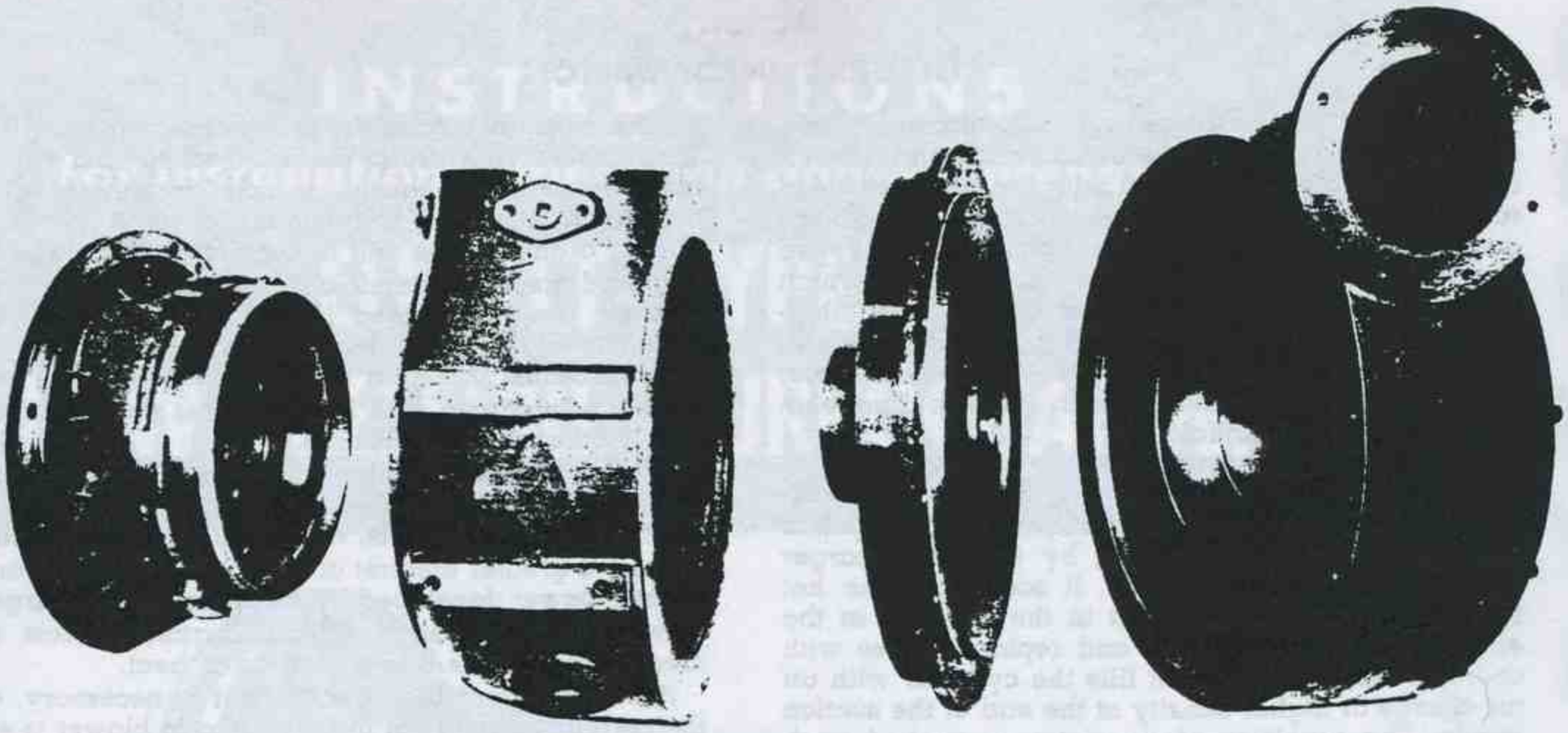


Fig. 2—Left to right: Inlet Casing Assembly, Turbine Casing, Intermediate Casing, Blower Casing Assembly.

attached to the turbine casing by cap screws (11), and to the blower casing by cap screws (28) for the L-20 and studs (27) for the L-10, L-40 and L-60.

The blower housing assembly comprises two Meehanite castings, a blower casing (26) and ribbed blower inlet (37). These are bolted together with cap screws (38). Air enters the blower inlet axially and is discharged radially from the blower impeller (80) through the diffuser passage into the blower casing collector and it is discharged tangentially. For some applications a vaned diffuser is used. The vaned diffuser (44) is a precision aluminum casting which is attached the blower inlet by flat head machine screws (45) peened for locking, and is clamped between the blower inlet and intermediate casing.

The rotor assembly is made up of the following components: turbine disk (75), turbine blades (76), shaft (78), thrust collar (82), impeller (80), nose piece (85), stud (79), elastic stop nut (86), spline washer (88) and spline washer key (84). A counterbore is provided in the shaft to receive the projection on the turbine wheel. There is a slight press fit at this point to assure concentricity. Positive torque transmission to the shaft is assured by the axial dowel pins (77). The impeller fits snugly against the thrust collar (82) and is driven by the spline washer (88), which is keyed to the shaft. The entire assembly is held together by the stud and elastic stop nut combination.

The turbine disk and blades (75 and 76 respectively) are made of an austenitic stainless steel, having good physical properties at elevated temperatures. The blower impeller (80) is a precision aluminum casting.

Labyrinth rings machined on the impeller shroud serve to limit the leakage of high-pressure discharge air.

After machining, the impeller is separately balanced and overspeed spin tested, then assembled with the shaft and turbine disk and the complete rotor assembly (87) is dynamically balanced. The balance of the rotor is not disturbed by disassembly and reassembly.

The bearings (19 and 20) are of the sleeve type, steel backed and babbit lined, and are pressed into the line-bored holes of the intermediate casing. Rotation of the bearings in their housing is prevented by the pins (18). The turbine end bearing flange is provided with a grooved thrust face and carries the axial thrust load of the rotor. End play is limited by the clearance between the thrust collar (82) and the flange of the blower end bearing (20).

Oil leakage into the turbine casing and blower casing is prevented by the oil seals (16 and 21). A snap ring (17) retains the turbine end oil seal in place, and the blower end oil seal is held by flat head machine screws (91) locked by peening.

Lubrication for the bearings is supplied through the cast-in steel tube and drilled passages in the intermediate casing, supply connection being made in the bushing (96) on top.

On the L10 and L20 impeller, discharge air is used to cool the turbine disk and pressurize both oil seals. This air passes from the space behind the impeller through a drilled hole in the intermediate casing (not shown), to the turbine disk. On the L-40 and L-60, air at impeller discharge pressure is used to pressurize the blower end oil seal (21). The turbine end oil seal (16) is pressurized by high pressure air from the blower casing (See Fig. 10.)

SECTION 3
COOLING SYSTEM

The turbocharger cooling system must be supplied with clean, soft water, free from any substance which will cause sludge or scale on the interior surfaces.

Cooling water is circulated through the intermediate casing (9) and the turbine casing (1). The water inlet connection is at the bottom of the intermediate casing; the water discharge connection being at the top of the turbine casing on either side. The opening opposite the piped water discharge connection must be vented to prevent formation of steam pockets in the turbine casing. The water passage holes in the turbine and intermediate casings function as metering elements to proportion the flow correctly between the two circuits.

Water circulation through the turbocharger should be regulated a such a rate that the temperature rise does not exceed 30 F. at full engine load. This will restrict thermal distortion to a reasonable amount. The discharge temperature should not exceed 190 F. for clean soft water; lower temperature may be dictated by the characteristics of the water used.

The turbocharger cooling system should be adequately vented, and, if feasible, provision made to circulate the water for a few minutes after the engine has been shut down, since in many cases there is enough heat left in the casing walls to boil away the water remaining in the jackets.

Connections or plugs (2) Figs. 7 and 8, in the turbine casing, should be removed annually (or oftener if the character of the cooling water makes it necessary), the jacket and cooling water piping inspected for scale and sludge, and any accumulation removed. Intermediate casing cooling water piping should also be removed and the casing and piping treated similarly to the turbine casing.

SECTION 4
LUBRICATING SYSTEM

Lubricating oil for the turbocharger may be supplied either directly from the engine or by a separate, self-contained system with engine driven or separately driven oil pump. The separate oiling system is recommended. By this means, light clean oil will be used for lubrication which is advantageous for long trouble-free life of the high speed journals that operate with very small bearing clearances. In either case, adequate lube oil filtration and filter servicing is recommended. The dirt and sludge acquired by Diesel oils during operation make trouble-free service difficult if these deposits are not filtered out.

The lubricating oil piping should be designed to meet the following requirements:

1. There should be a minimum lapse of time between the start of rotation of the turbocharger and oil pressure indication on the pressure gage. This period should not exceed 12-15 seconds.
2. Desired oil pressure at the turbocharger is 30 to 40 psi gage.
3. The desired inlet oil temperature range is from 130 to 160 F. and should not exceed 180 F. Inlet oil viscosity should be between 100 and 150 SSU and in no case should exceed 200. Oil heavier than SAE 40 is not recommended.
4. Sight flow indicator should be provided.

The turbocharger lubricating system is illustrated in the cutaway section, Feg. 3, and cross sectional assembly drawing, Fig. 9. Oil from the supply is piped to the bushing at the top of the intermediate casing. The oil flows through the cast-in stainless steel tube and then divides, approximately half of the flow going to each bearing. Discharge oil drains out of the drain hole near the bottom of the intermediate casing.

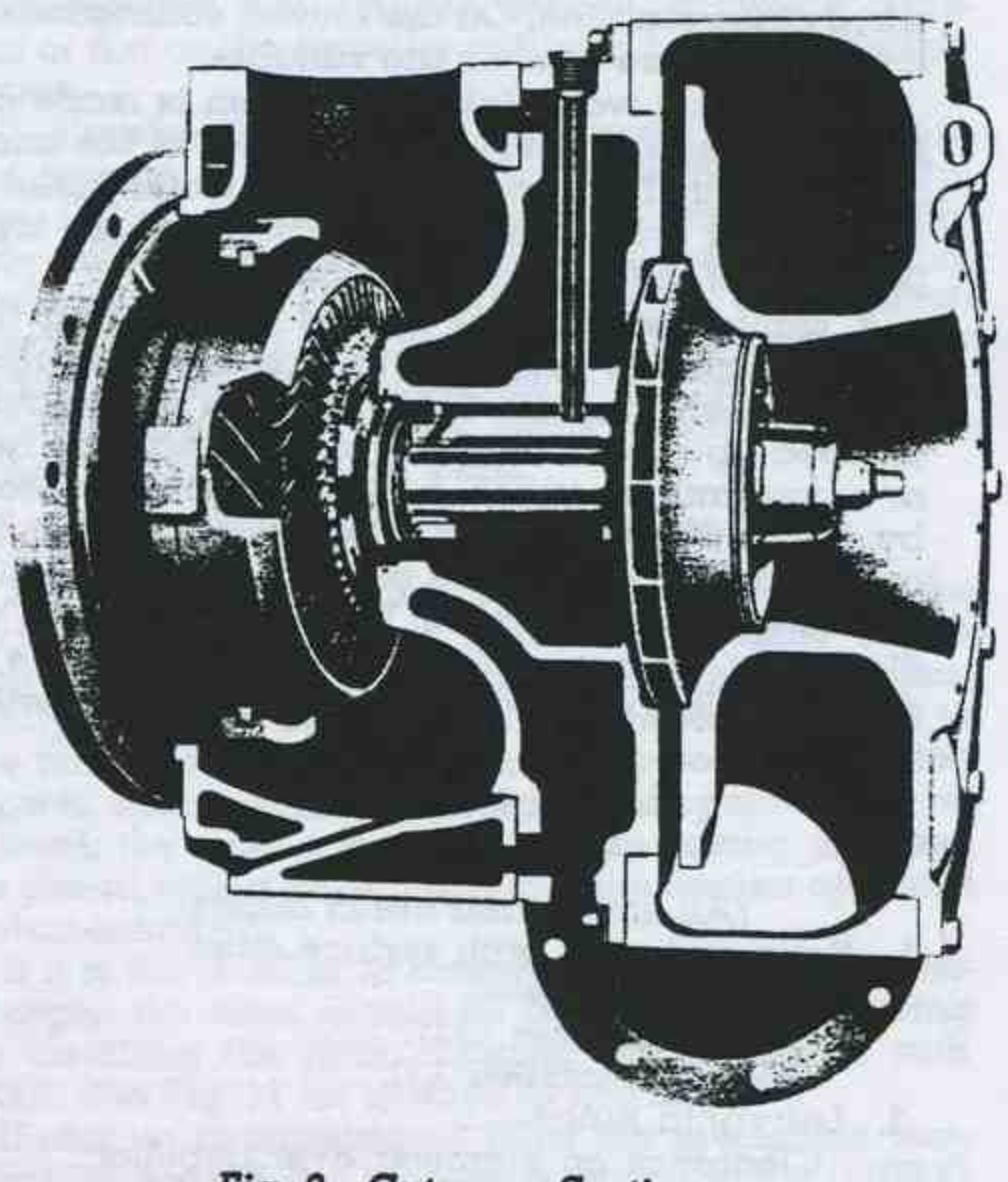


Fig. 3—Cutaway Section.

Additional information on oil piping is given in Section 5.

SECTION 5
INSTALLATION

The turbocharger is shipped completely assembled, with openings plugged to prevent entrance of foreign matter and with exposed surfaces protected against rust. Spare parts and tools are shipped separately. No dismantling is necessary before installation.

Surfaces coated with rust preventive should be cleaned with a solvent. Three mounting pads on the turbine casing are provided for mounting the unit, with tapped holes for connecting to mounting brackets. Brackets for turbocharger support must be of suitable strength and rigidity to support the turbocharger as an integral part of the engine assembly. Piping must not be depended upon for turbocharger support.

Connections are to be made to the turbine inlet, turbine outlet, blower inlet (in case the air is taken from a remote point), blower discharge, cooling water system, lubricating oil system and casing drains. All connections must be made with flexible joints or other provisions made to prevent piping strains from being transmitted to the turbocharger, and to keep it from acting as a support for any piping. On the exhaust gas inlet and outlet connections, high-temperature gaskets should be used, and threads of studs and capscrews coated with a high-temperature thread compound to prevent galling when disassembling. On the blower connections, soft low-temperature gaskets are suitable.

The cooling water inlet connection is made at the bottom (alternate connection on side) of the intermediate casing. The common cooling water outlet may be at either side of the turbine casing at the top, depending on the particular installation.

A sight-flow indicator should be installed in the water discharge line to give positive indication of flow through the unit. The discharge line should be inclined upward to the main water discharge header or surge tank, to vent the jackets and allow cooling by convection circulation after the unit is shut down, or, if feasible, a separate pressure source should be provided for this purpose. If the turbocharger water discharge line cannot be carried upward to the main discharge line or surge tank, a vent valve should be provided at the high point of the line to prevent vapor lock or siphoning.

A drain is provided for the turbine casing interior through a pipe tapped hole in the mounting pad (3) Fig. 7. The blower casing drain (32) is located at the bottom of the casing. Each of these connections should be fitted with a nipple and valve to permit drainage of any moisture that may collect during periods of shutdown. The turbine and intermediate casing water jackets may be drained by removing pipe plugs (5) or (97), Figs. 7 and 8, when unit is idle and exposed to freezing weather.

The lubricating oil connection is made in the bushing-tapped hole provided at the top of intermediate casing. One-half inch O.D. tubing is recommended from header to turbocharger. A check valve should be installed in this line near the main engine oil header to prevent drainage when the unit is shut down. A full-flow filter should be installed to insure a flow of clean oil at all times. A pressure gage should be installed as close as possible to the turbocharger to eliminate any error in pressure reading due to pressure drop in the pipe or oil filter. A pressure regulating valve, of the type which remains open at low pressures and throttles the flow when the pressure exceeds that desired, must also be incorporated in the system. After the connections have all been made, the oil piping should be disconnected and thoroughly blown out or flushed out with clean oil to insure the removal of all chips and dirt.

The oil drain line must be of adequate size with a minimum number of bends. Horizontal runs are to be avoided. A 2-in. drop per foot and ¾-in. I.D. pipe is recommended for the L-10, 1" for the L-20 and 1¼" for the L-40 and L-60. This drain should be led directly to the crankcase or some well vented housing, and the end must not be submerged.

After all connections have been made, the rotor should be spun by hand to make sure it turns freely. If it does not, the reason must be ascertained and remedied before the engine is started.

The nameplate, listing the serial number of the unit and other pertinent data, is attached directly to the turbocharger near the blower discharge flange.

SECTION 6
CLEARANCES

(All dimensions are in inches)	*Model L-10*	*Model L-20*	*Model L-40*	*Model L-60*
1. Rotor end play, with surface oiled	.006—.016	.006—.016	.006—.016	.006—.016
2. Journal Bearings—				
Shaft diameter O.D.	1,2495—1.2500	1.6205—1.6210	1.8710—1.8715	1.8710—1.8715
Bearing diameter I.D.	1.2525—1.2530	2.6240—1.6245	1.8745—1.8750	1.8745—1.8750
3. Labyrinth Rings—				
Clearance on diameter over impeller	.025—.035	.038—.048	.038—.048	.038—.048
4. Radial clearance between turbine blade O.D. and nozzle ring, cold	.010—.040	.020—.050	.030—.060	.040—.070
5. Oil Seal—				
Seal I.D.	1.691—1.692	2.192—2.193	2.692—2.693	2.692—2.693
Matching shaft diameter O.D.	1.686—1.687	2.186—2.187	2.686—2.687	2.686—2.687
Clearance on diameter	.004—.006	.005—.007	.005—.007	.005—.007

Worn parts should be replaced or adjustments made to assure that operating clearances will not exceed above values..

WHEN ORDERING THESE PARTS, THE TURBOCHARGER MODEL AND SERIAL NUMBERS MUST BE FURNISHED.

SECTION 7
STARTING INSTRUCTIONS

1. Check cooling water connections and make sure the proper valves are open. Fill the cooling water space before operating the unit. If a separate source of supply is available, start water circulation before starting the engine.

2. Pump oil into the turbocharger oil feed line, remove the oil drain line and check for oil flow from the bearings to make sure that the line between the check valve and the turbocharger is filled with oil and that the bearings are oiled for the initial start.

If there is not a continuous flow of clean oil from the drain line during the circulation period, the engine should not be started until the cause has been determined and corrected and drain line replaced.

3. Start the oil pump and operate the engine at idling or light load conditions. If lubricating oil pressure of at least 10 psi gage does not show on the gage in from 12 to 15 seconds, shut down and check for the cause. Recommended oil pressures are 30 to 40 psi gage over the operating range.

4. Operate the engine at a speed sufficient to develop normal lubricating oil pressure on the engine system. When oil pressure develops satisfactorily, set the turbocharger oil pressure at 35 psi gage.

5. The unit should be checked after the first half-hour of operation to make sure no oil leaks develop in the oiling system.

6. Check exhaust temperature before turbine at full load operation to make sure that maximum temperature is not exceeded. The turbocharger speed will adjust itself automatically to that required at the load and speed under which the engine is operating.

After the above steps have been taken, if no trouble develops, the turbocharger is ready for continuous operation.

After the turbocharger has been operating for a sufficient time to permit the unit and oil to warm up, the rotor should coast freely to a stop after the engine is shut off. If the rotor jerks to a sudden stop, the cause should be immediately determined and eliminated.

SECTION 8
SERVICE OPERATION

Performance of the turbocharger should be observed at intervals of about four hours. Data and conditions to be observed are as follows:

1. *Oil Pressure.*—Lubricating oil pressure should be kept at about 30 to 40 psi at the turbocharger speed corresponding to full engine load. The pressure relief valve and pressure gage should be observed each time the engine is started or shut down, to make sure they are operating. Particular attention should be paid to keeping the turbocharger oil clean by regular cleaning or renewing of the filter element.

2. *Oil Temperature.*—Temperature of lubricating oil supplied to the turbocharger should not exceed 170 F, and temperature at the drain should not exceed 215 F. Any sudden increase in lubricating oil temperature at the drain should be investigated, since it may be due to obstructions in the internal oil passages.

3. *Turbocharger Speed.*—Ordinarily, no attention need be paid to the speed of the turbocharger since this varies automatically with speed and load on the engine.

4. *Exhaust Gas Temperature.*—Temperature before the turbine must not exceed 1100 F for steady full-load operation, and 1200 F for a maximum of four 30-minute periods per 24 hours. The temperature before the turbine will be higher than that recorded at the exhaust elbows, and care should be exercised not to use the two temperatures interchangeably.

5. *Water Temperatures.*—Turbocharger cooling water temperatures should be checked occasionally to make sure that the temperature rise across the turbocharger does not exceed 30 to 40 F. A high rise across the machine indicates stoppage or plugging of the circulating passages.

6. *Vibration.*—Operation of the unit should be observed frequently to detect any noticeable vibration. If noticeable vibration develops, the unit should be shut down and the cause determined. Vibration might be caused by damage to the impeller, shaft, or turbine wheel or by worn or loose bearings in the turbocharger: Any uneven deposit of foreign material or dirt on the impeller will also be a contributing factor.

7. *Turbine Casing Drain.*—No water will collect in the interior of the casing during continuous operation. During an extended shutdown, however, water may collect in this space due to condensation, leaky gaskets, or other causes. After any but a brief shutdown, therefore, the casing interior (not the water jacket) should be drained before starting up again. If oil collects in this space, check for oil leakage between the shaft and oil seals.

EMERGENCY OPERATION

Should an accident or failure of some part of the turbocharger prevent or render inadvisable operation of the unit, the engine can be operated as a normally aspirated engine until repairs can be made to the turbocharger. If possible, the turbocharger rotor, blower casing and intermediate casing should be removed; the open end of the turbine casing can then be closed with a steel plate, and the engine operated unturbocharged.

If it is not feasible to remove any part of the turbocharger, the rotor should be prevented from turning by installing the rotor blocking rig (furnished with tools). See Fig. 11 for method of installing.

Under no circumstances must the preturbine temperature exceed the maximum temperature (1100 F) stamped on the turbocharger nameplate, and cooling water circulation through the turbine casing and intermediate casing must be continued.

If the engine has been operated under the above conditions, the turbocharger should be completely disassembled and inspected as described in Section 9, Inspection and Maintenance, before putting it back to normal operation.

SECTION 9
IMPELLER AND DIFFUSER CLEANING
and
COMPLETE TURBOCHARGER INSPECTION AND MAINTENANCE

Impeller and Diffuser Cleaning:

The impeller and diffuser should be cleaned every 4,000 hours or less, depending on service conditions, to maintain optimum turbocharger performance. Remove the blower inlet cap screws (38), Fig. 9. Using these cap screws as jacking screws, break the flange connection between the blower inlet and the blower casing. With the aid of the lifting lug and an overhead lift remove the blower inlet (37) (see Fig. 6). This part must be pulled out along the rotational axis to avoid damaging the impeller shroud labyrinth seal rings. The impeller, diffuser and blower casing may now be cleaned with bendix cleaner. Never use a caustic solution, wire brush, or scraper on these parts.

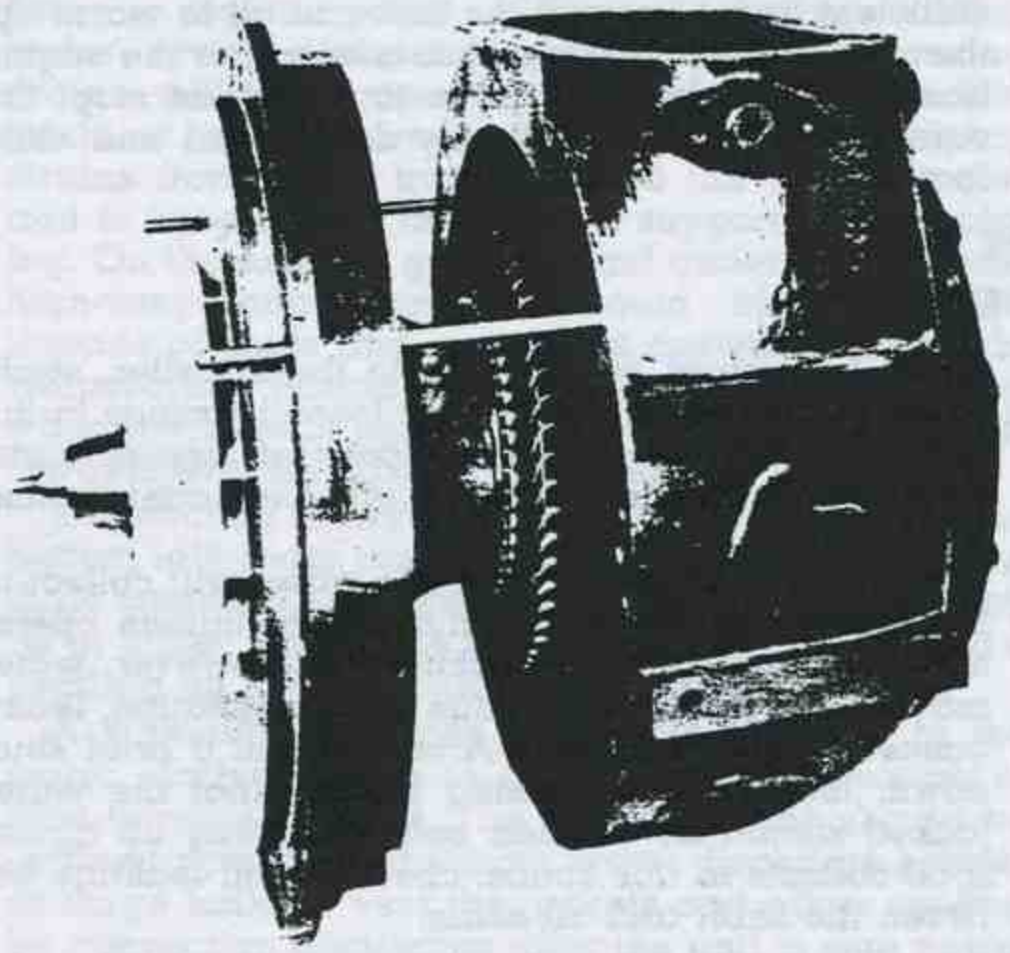


Fig. 4—Intermediate and Turbine Casing—Method of Assembly and Disassembly.

Complete Turbocharger Inspection:

The complete turbocharger should be cleaned and inspected every 8,000 hours. Procedure for dismantling, cleanout, inspection and reassembly of the unit is as follows:

Dismantling Procedure:

1. Remove all air inlet equipment (piping, silencer or air cleaner).

2. Remove the intermediate casing to blower casing cap screws (28) on the L-20 and nuts (29) on the L-10, L-40 and L-60. Using these cap screws or blower inlet cap screws (38) as jacking screws in the threaded holes provided, break the joint. With the aid of the cast lug on the blower inlet and a sling, remove the blower casing assembly. (See Fig. 5.) This assembly must be pulled out along the rotational axis to avoid damaging the impeller shroud labyrinth seal rings.

3. Remove intermediate casing to turbine casing cap screws (11) install intermediate casing guide pins (103) and special jacking screws (102) (see Figs. 4 and 11) and break the joint. Remove special jacking screws.

4. Slide the intermediate casing and rotor assembly clear of the nozzle ring to avoid damaging the turbine blades (see Fig. 4).

5. The intermediate casing may now be supported with the eye bolt (15) for disassembly of the rotor.

6. It will not be necessary to "break" the joint between the turbine inlet casing (50) and turbine casing (1) or between the nozzle ring (59) and the turbine inlet casing, unless leakage is evident or if the nozzle ring is to be replaced. If the nozzle ring is to be replaced, remove locking wire (63) and bolts (62). Install nozzle ring wrench (111), (see Fig. 12) and rotate nozzle ring until bayonet lock is disengaged.

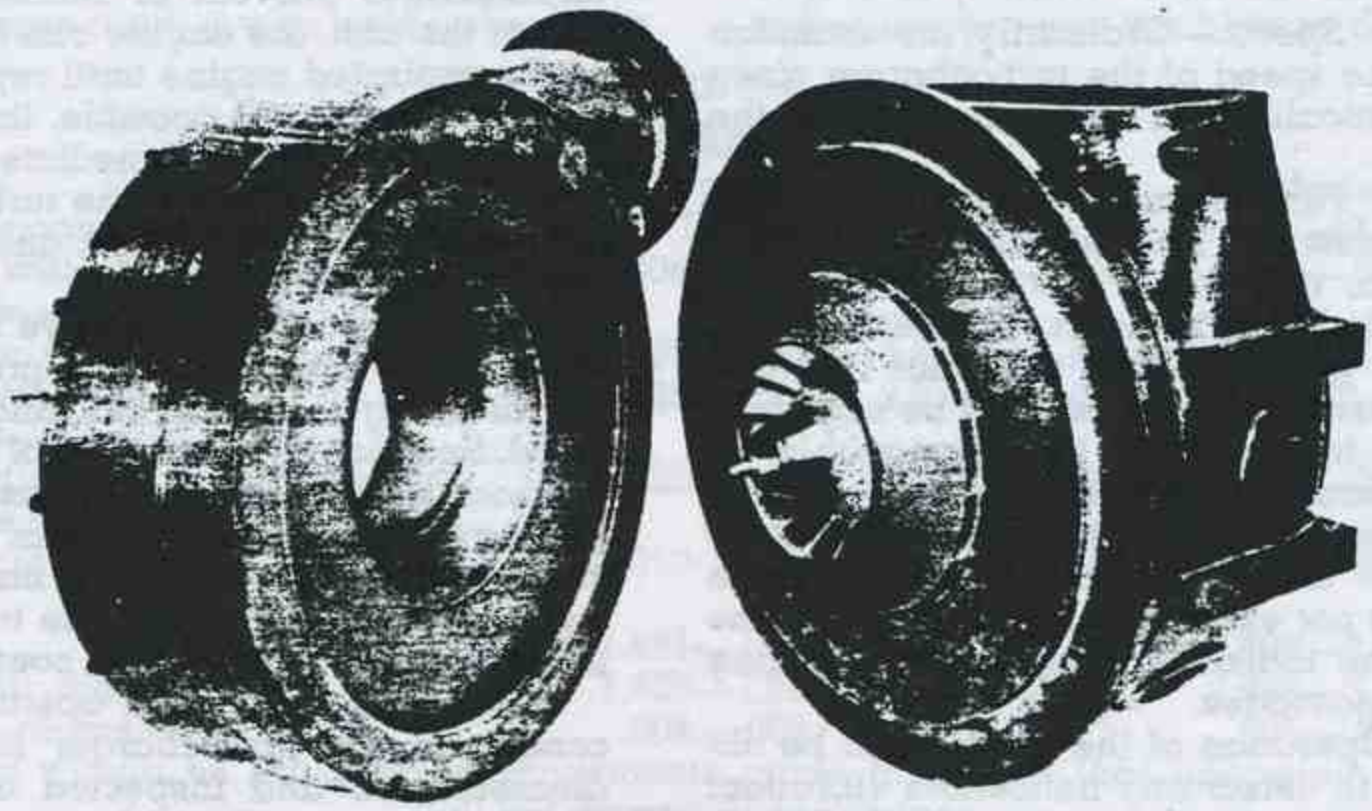


Fig. 5—Partially Dismantled View Showing Blower End Sub-Assembly with Vaneless Diffuser and Turbine and Intermediate Casing Assembled with Rotor.

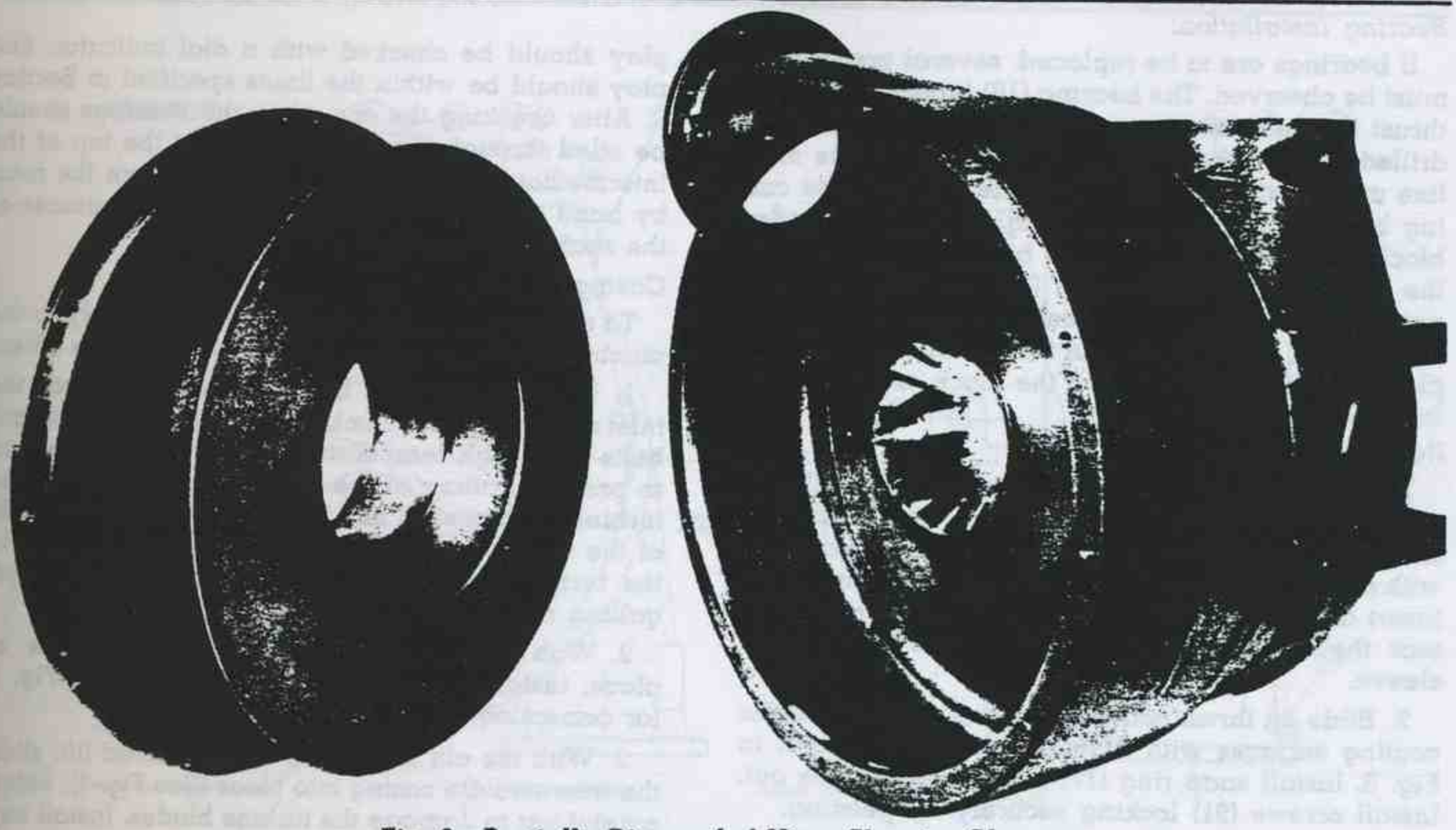


Fig. 6—Partially Dismantled View Showing Blower Inlet Removed for Cleaning.

Rotor Disassembly:

1. Prevent rotor rotation by applying a wrench to the projected flats on the front of the stud (79), Fig. 9. and remove the elastic stop nut (86) and nosepiece (85). Support the turbine disk by hand and with a soft hammer tap the free end of the stud forcing the turbine disk from its mounting. Do not remove the stud from the turbine disk.

2. With the special pliers provided in the tool kit, remove the turbine end snap ring (17).

3. Remove the shaft and turbine end oil seal with the aid of the shaft puller assembly provided for this purpose (see Fig. 11). Support impeller by hand during this operation.

Cleaning:

The component parts of the unit are now ready for cleaning and inspection. The diffuser, nozzle ring, as well as mating surfaces should be cleaned with a good solvent or kerosene, and all deposits of grease, dirt, carbon and gasket compound removed. Turbine casing and intermediate casing water jackets should be cleaned of any deposit of scale or sludge in the same manner used in cleaning engine water jackets. If an acid is used to remove scale, the water jackets should be thoroughly flushed out and the acid neutralized. Oil and air passages in the intermediate casing should be blown out thoroughly.

The turbine disk and impeller should be cleaned in Bendix cleaner. Never use a caustic solution, wire brush or scraper on these parts. Extreme care should be exercised in handling the rotor parts. Slight damage to the disk or impeller may cause serious damage to the rotor, when reinstalled.

Inspection:

The bearings and the mating surfaces on the shaft are the only normal wearing parts of the machine. The bearings can be inspected both for size and surface finish without removal. Bearings should be replaced if worn beyond the limits set forth in Section 6, or if the surface shows pitting, corrosion or local wear. If the mating journal surfaces are scored, the finish should be improved by polishing with crocus cloth. Slight scoring of the thrust face is not objectionable if tolerances are within the limits as given in Section 6.

If bearings must be replaced, remove the screws (91) holding the oil seal, and pull out the bearings with the bearing puller. (See Fig. 11.) The blower end oil seal (21) and thrust washer (82) will come out with the blower end bearing (20). The turbine end bearing (19) may be similarly removed. (See Fig. 11.) Precautions must be taken to prevent damage to bearing housing bore.

Normally, the oil seals are subject to little wear but the inside diameter should be checked to make sure that wear has not occurred. The oil seal clearances should be within the limits as given in Section 6.

The turbine disk should be inspected for mechanical condition, blade tightness, etc. The blower impeller should be checked for evidence of rubbing or mechanical wear and condition of the labyrinth seals.

The turbine nozzle ring should be examined for cracks and distortion or warping of blades. This part of the unit is always subject to cyclic elevated temperatures and should be checked carefully. Do not remove the nozzle ring from the inlet casing unless it is to be replaced.

Assembly Procedure:

Before assembly, all parts should be thoroughly cleaned and flushed and all passages blown out with air. Gasket (10) should be renewed.

Bearing Installation:

If bearings are to be replaced, several precautions must be observed. The bearing (19) having a grooved thrust flange must be put in on the turbine side. The drilled hole on the back of the bearing flange must line up with the locating pin in the intermediate casing before inserting the bearing. A special wooden block is furnished and it is to be used when driving the bearing into its housing, (See Fig. 11). A feeler gage should be used to check if bearings are properly seated. When driving in the turbine end bearing, place a soft gasket between the block and the thrust face to protect this face.

Rotor Assembly

1. Before replacing the shaft, place the shaft sleeve (See Fig. 12) on the impeller end of the shaft. The shaft and bearings are to be assembled clean and with a light film of oil. With the shaft sleeve in place, insert the shaft into the bearings taking care not to mar the bearing surfaces. Then remove the shaft sleeve.

2. Slide on thrust collar (82) Fig. 9. Insert oil seals coating surfaces with Permatex No. 1 as shown in Fig. 9. Install snap ring (17) with bevelled side out. Install screws (91) locking securely by peening.

3. Coat the disk hub with anti-seizing compound (see Fig. 9). Tap the turbine disk and stud assembly in place. The turbine disk will mount only one way, determined by the relative polar position of the pins (77) in the shaft and matching holes in the disk.

4. Assemble impeller (80) and spline washer (88). These parts must be assembled so that the punch marks line up to maintain rotor balance. Coat impeller and spline washer portions of shaft with anti-seizing compound (See Fig. 9).

Slip this assembly on the shaft. After the impeller has been pushed on by hand as far as possible, insert key (84), place nose-piece (85) in position and draw assembly tight with elastic stop nut (86). A torque of 35 foot-pounds should be used for the L-10, 50 foot-pounds on the L-20 and L-40 and 90 foot-pounds for the L-60. Hold centering stud with wrench on flats provided while tightening the elastic stop nut.

play should be checked with a dial indicator. End play should be within the limits specified in Section 6. After checking the end play, the bearings should be oiled through the lube oil inlet at the top of the intermediate casing (9) Figs. 7 and 8. Turn the rotor by hand to be sure that the oil gets to all surfaces of the shaft and bearings.

Casing Assembly:

To assemble the casings and rotor assembly to the machine proper, the following steps should be taken:

1. If the nozzle ring has been removed from the inlet casing, upon assembly, coat the cap screws and bolts with high temperature anti-galling compound to prevent galling of the threads due to heat. If the turbine inlet casing has been removed, the threads of the cap screws used to secure the inlet casing to the turbine casing should be coated with an anti-galling compound. (See Fig. 9.)

2. With the intermediate casing guide pins in place, install a new casing gasket (10). See Fig. 9 for cementing.

3. With the aid of eyebolt and overhead lift, slide the intermediate casing into place (See Fig. 4), being careful not to damage the turbine blades. Install cap screws (11) Fig. 7 and tighten evenly.

4. The intermediate casing and blower casing machined surfaces should be coated lightly with Permatex No. 1 cement (see Fig. 9).

5. Mount the blower casing assembly into place being careful not to damage the labyrinth rings on the shroud of the impeller. Install the blower casing cap screws and lockwashers (28 and 30) for L-20 or nuts and lockwashers (29) and (30) for the L-10, L-40 and L-60, and tighten evenly.

Check oil supply lines; they should be clean and fittings in good condition. If oil filter element is not in first class condition, it should be replaced.

With reasonable care and adherence to good shop practice, no trouble should be encountered in dismantling and assemblying the turbocharger. Check air inlet equipment. It should be clean and tight to prevent entry of foreign particles.

GENERAL MAINTENANCE COMMENTS

If the machine is to be shut down for an extended period of time, the turbocharger must be dismantled and the shaft surfaces and all bearings thoroughly covered with vaseline for protection. All exposed surfaces should be slushed with rust preventive compound. Before placing the unit in operation again, clean all parts thoroughly and remove the protective coating.

The turbocharger is designed and constructed to eliminate entirely hand fitting of moving parts. All repair parts should be entirely interchangeable without forcing or fitting. It is essential in assembly and repair of the turbocharger that parts be handled carefully and kept clean, since tolerances on some parts are such that nicks, burrs or dirt will interfere with proper operation of the machine.

It is recommended that a reasonable amount of spare parts be maintained with the unit for emergencies.

Experienced field service men are available when required.

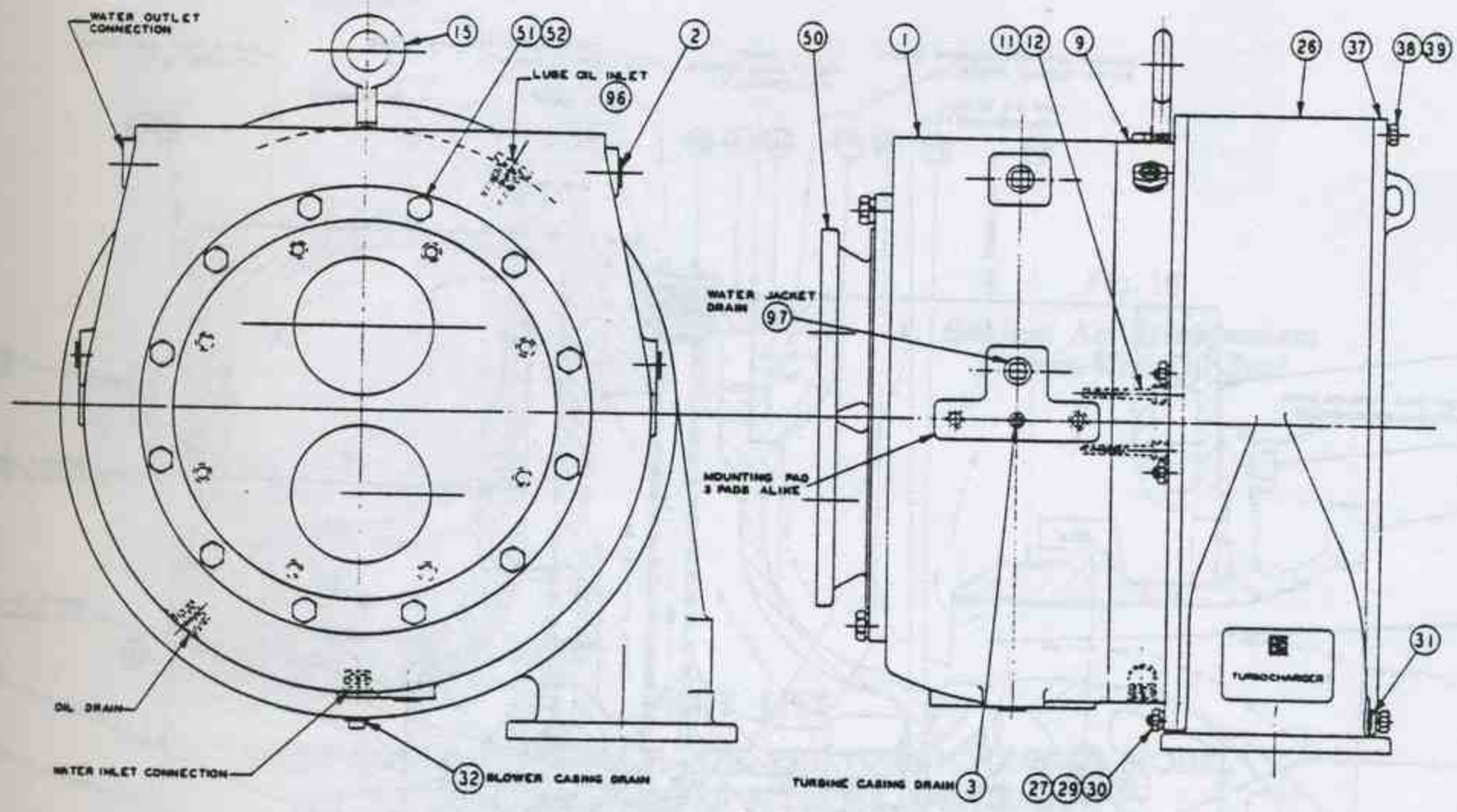


Fig. 7—Outline Drawing L 10 Turbocharger

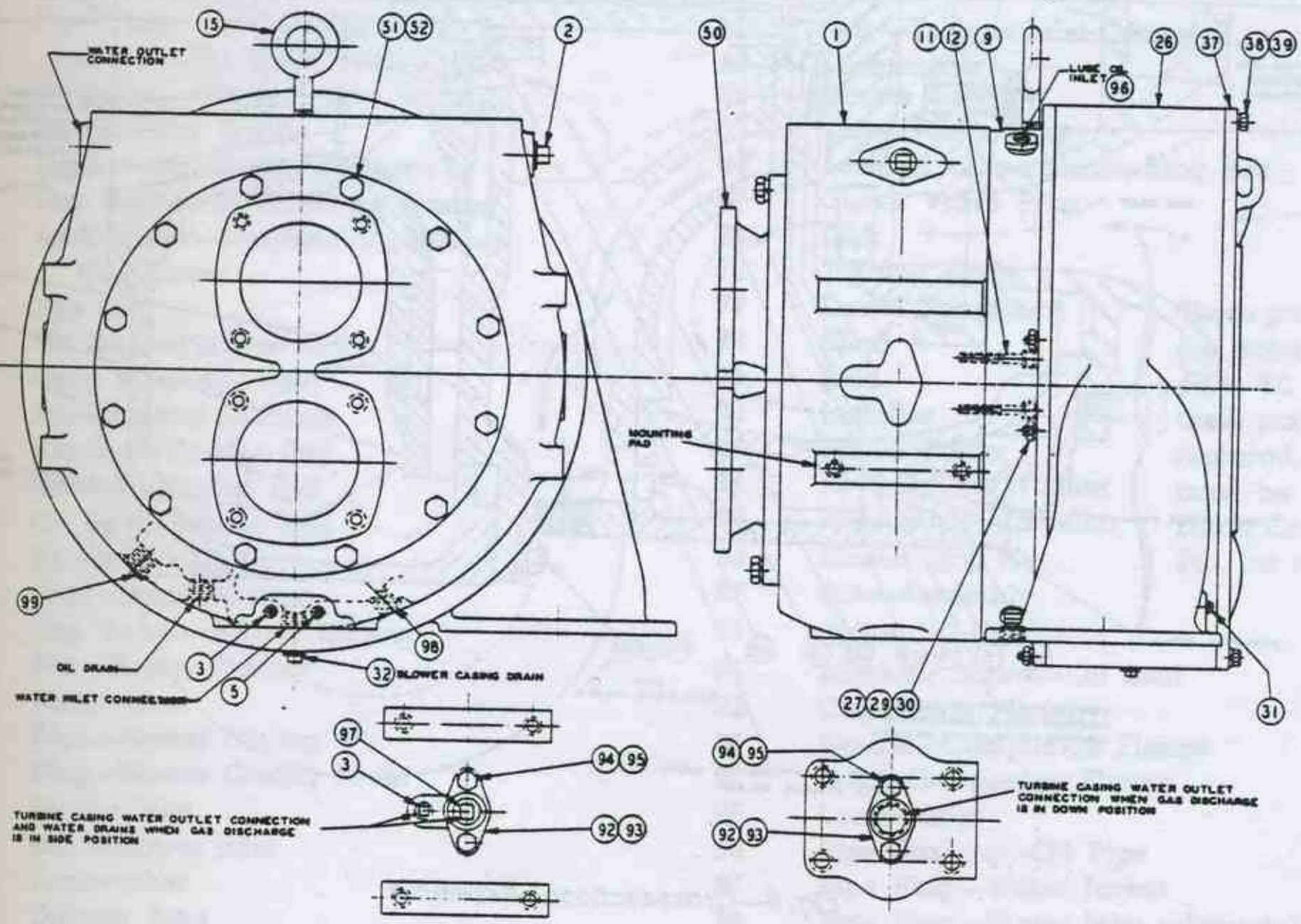


Fig. 8—Outline Drawing L 20, L 40 and L 60 Turbocharger

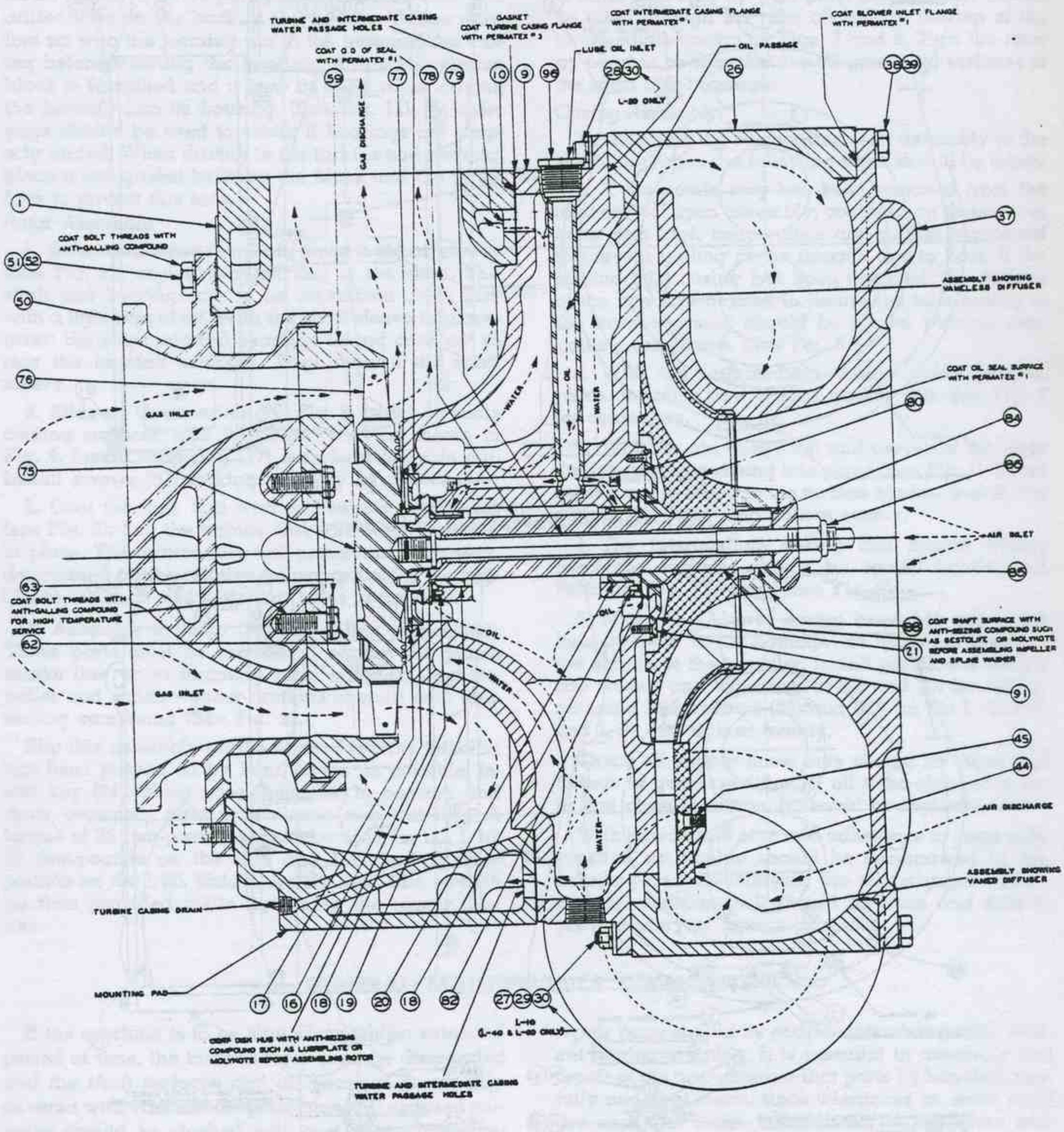


Fig. 9—Cross-sectional Assembly

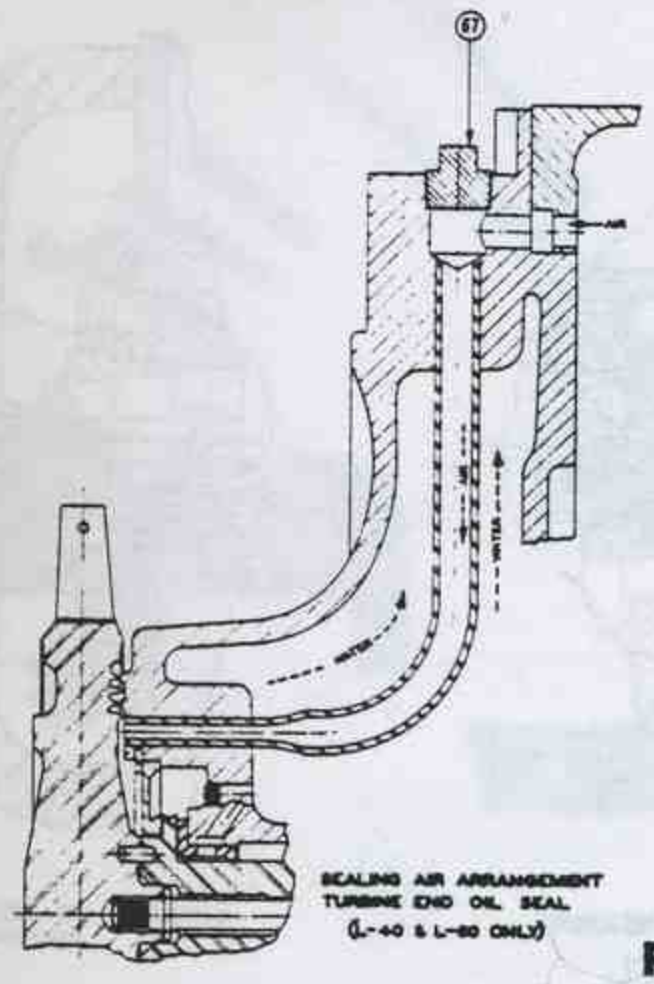


Fig. 10

Sealing Air Arrangement
Turbine End Oil Seal

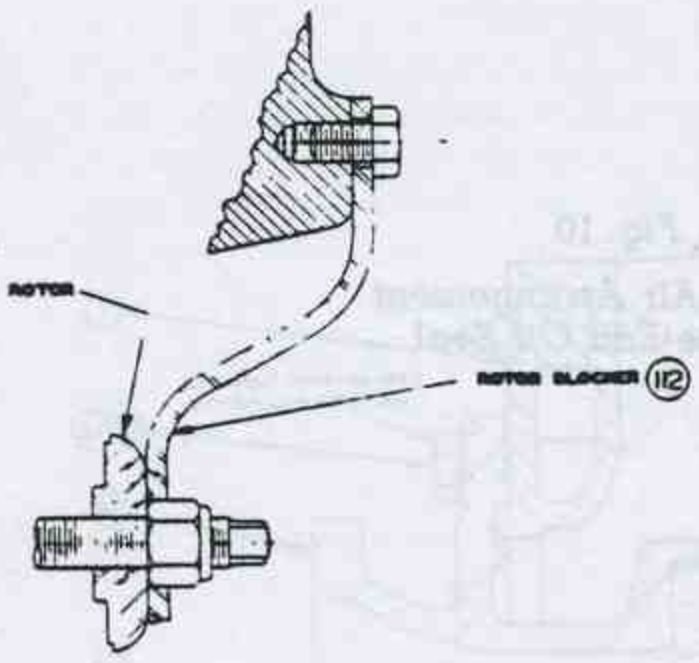
PART LIST

WHEN ORDERING THESE PARTS, THE TURBOCHARGER MODEL AND SERIAL NUMBER MUST BE FURNISHED

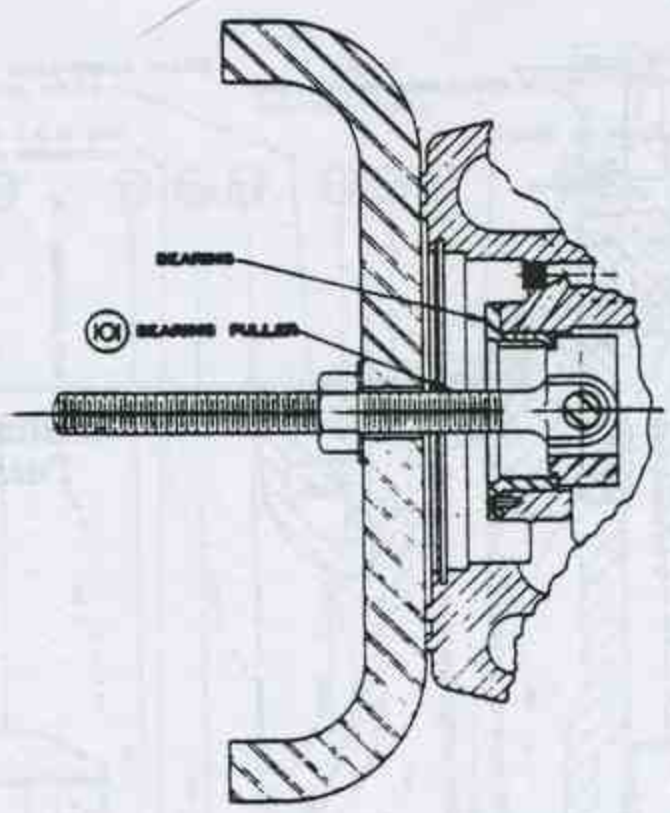
Number	Name of Part
1	Turbine Casing
2	Pipe Plug—Turbine Casing
3	Pipe Plug—Turbine Casing Drain
5	Pipe Plug—Water Jacket Drain
9	Intermediate Casing
10	Gasket—Intermediate Casing
11	Cap Screw—Intermediate Casing
12	Lockwasher—Intermediate Casing Cap Screw
15	Eye Bolt
16	Oil Seal—Turbine End
17	Snap Ring—Oil Seal
18	Pin—Bearing Locating
19	Bearing—Turbine End
20	Bearing—Blower End
21	Oil Seal—Blower End
26	Blower Casing
27	Stud—Blower Casing
28	Cap Screw—Blower Casing
29	Nut—Blower Casing
30	Lockwasher
31	Plug—Blower Casing
32	Plug—Blower Casing Drain
37	Blower Inlet
38	Bolt—Blower Inlet
39	Lockwasher
44	Diffuser Ring
45	Machine Screw—Diffuser Ring
50	Turbine Inlet Casing
51	Bolt—Turbine Inlet Casing
52	Lockwasher
59	Nozzle Ring
62	Bolt—Nozzle Ring
63	Locking Wire—Nozzle Ring Bolt
67	Check Valve Plug
75	Disk
76	Turbine Blade
77	Dowel Pin—Shaft
78	Shaft
79	Stud
80	Impeller
82	Thrust Collar
84	Key—Spline Washer
85	Nose Piece—Impeller
86	Elastic Stop Nut
87	Rotor-Assembly
88	Spline Washer
91	Machine Screw—Oil Seal
92	Companion Flange
93	Gasket—Companion Flange
94	Bolt—Companion Flange
95	Lockwasher
96	Pipe Bushing—Oil Pipe
97	Pipe Plug—Water Jacket
98	Pipe Plug—Water Inlet (alternate)
99	Pipe Plug—Oil Drain (alternate)

These parts make up the rotor assembly, part 87. If any of these parts are to be replaced, the rotor must be returned to Elliott Co., Jeannette, Pa., for rebalancing.

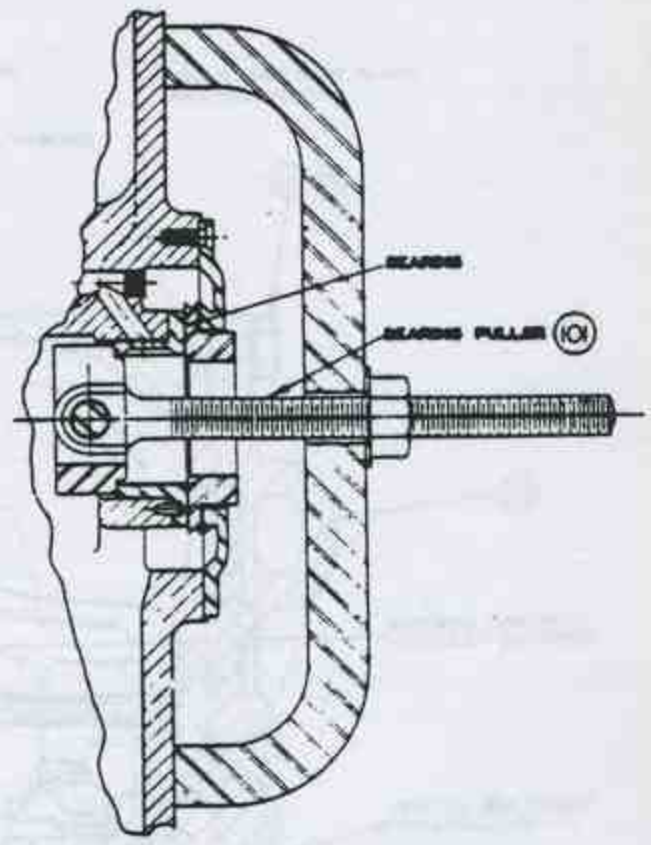
METHODS OF USING SPECIAL TOOLS



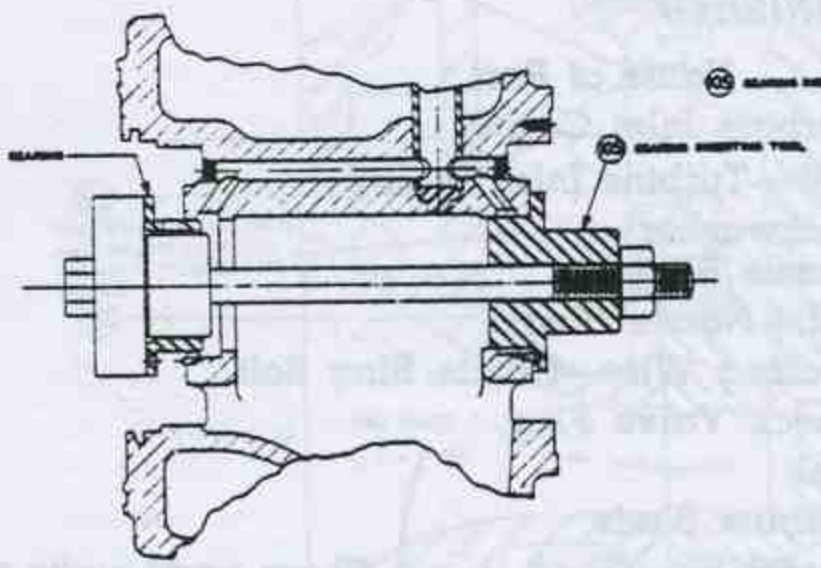
METHOD OF BLOCKING ROTOR



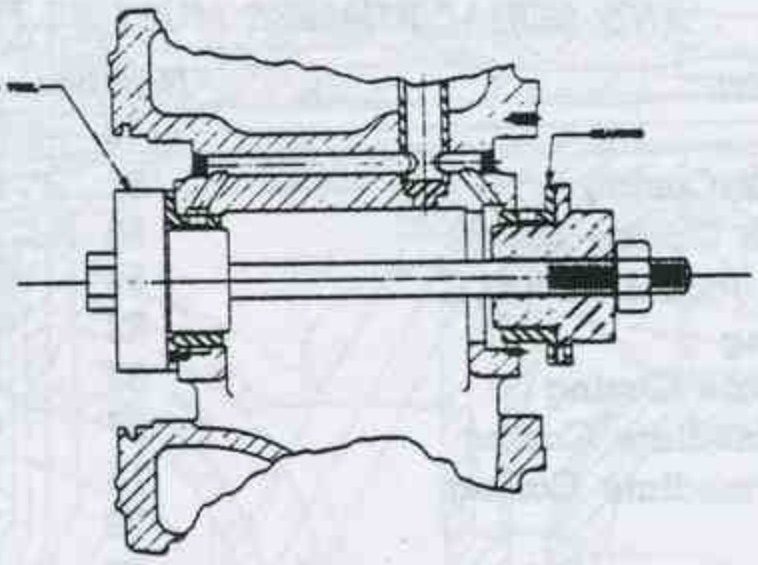
METHOD OF REMOVING BEARING
(TURBINE END)



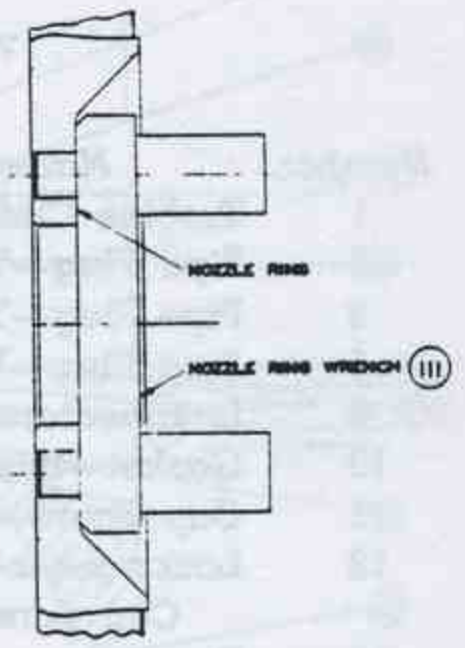
METHOD OF REMOVING BEARING
(BLOWER END)



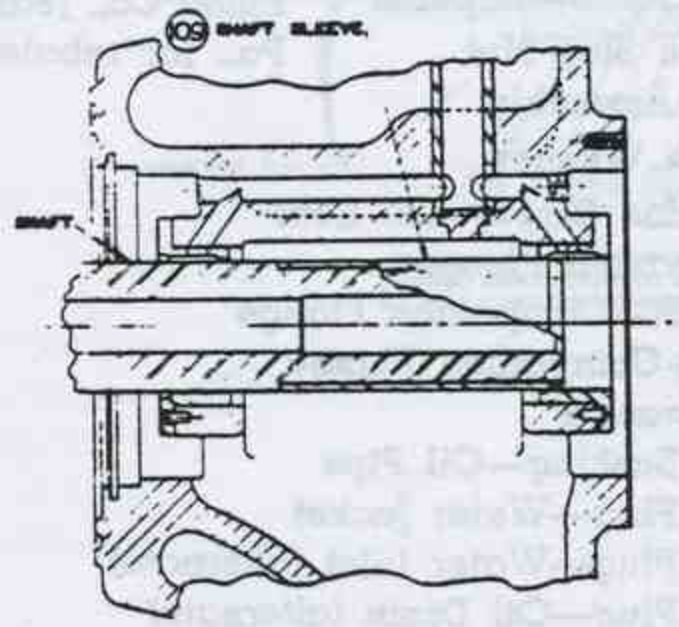
METHOD OF INSERTING BEARING
(TURBINE END)



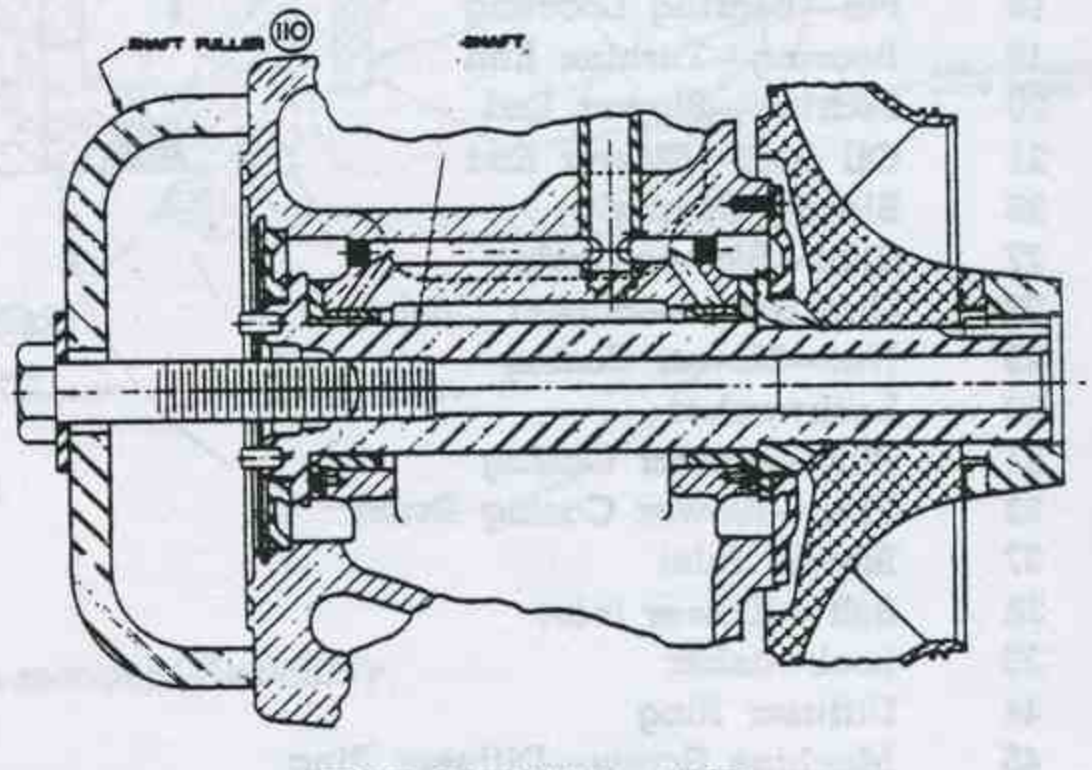
METHOD OF INSERTING BEARING
(BLOWER END)



METHOD OF REMOVING NOZZLE RING



METHOD OF INSERTING SHAFT



METHOD OF REMOVING SHAFT

Fig. 11—Method of Using Special Tools

TOOL LIST

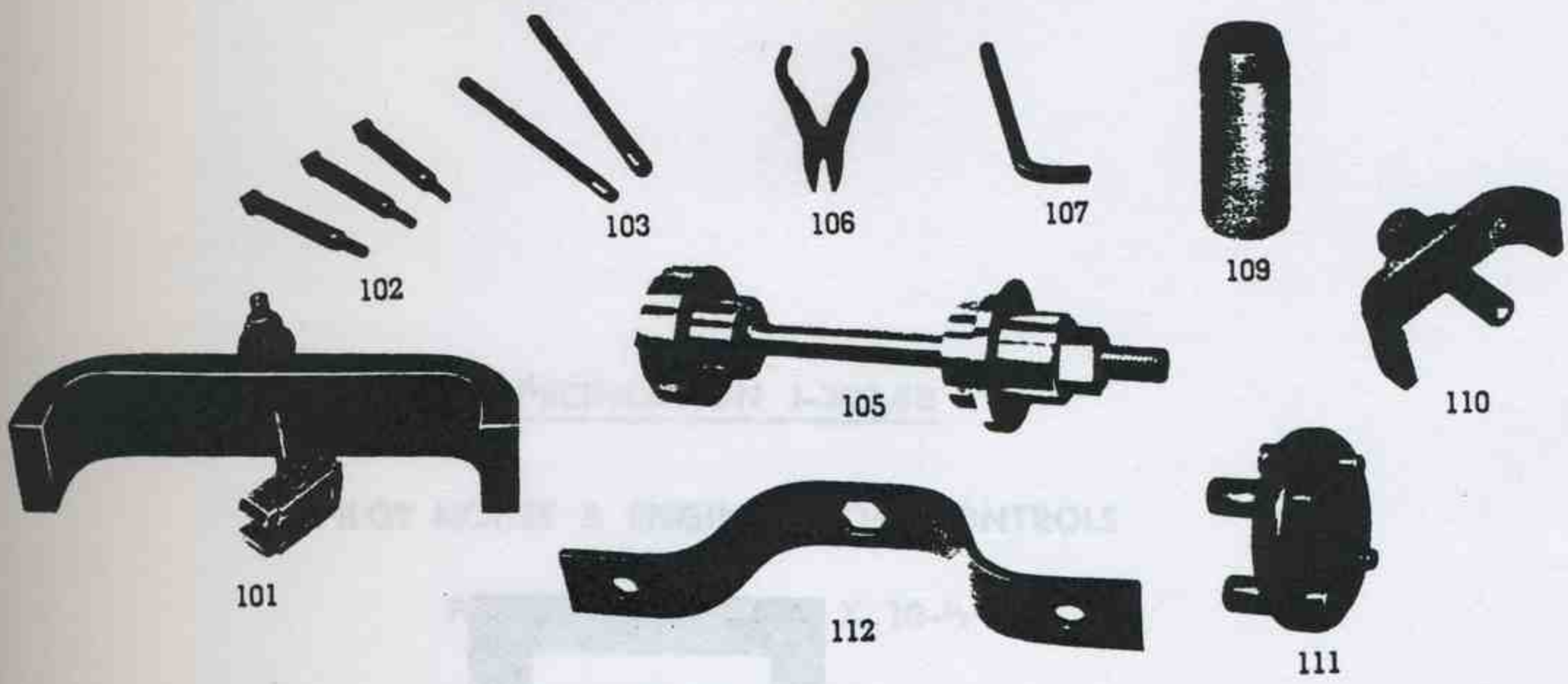
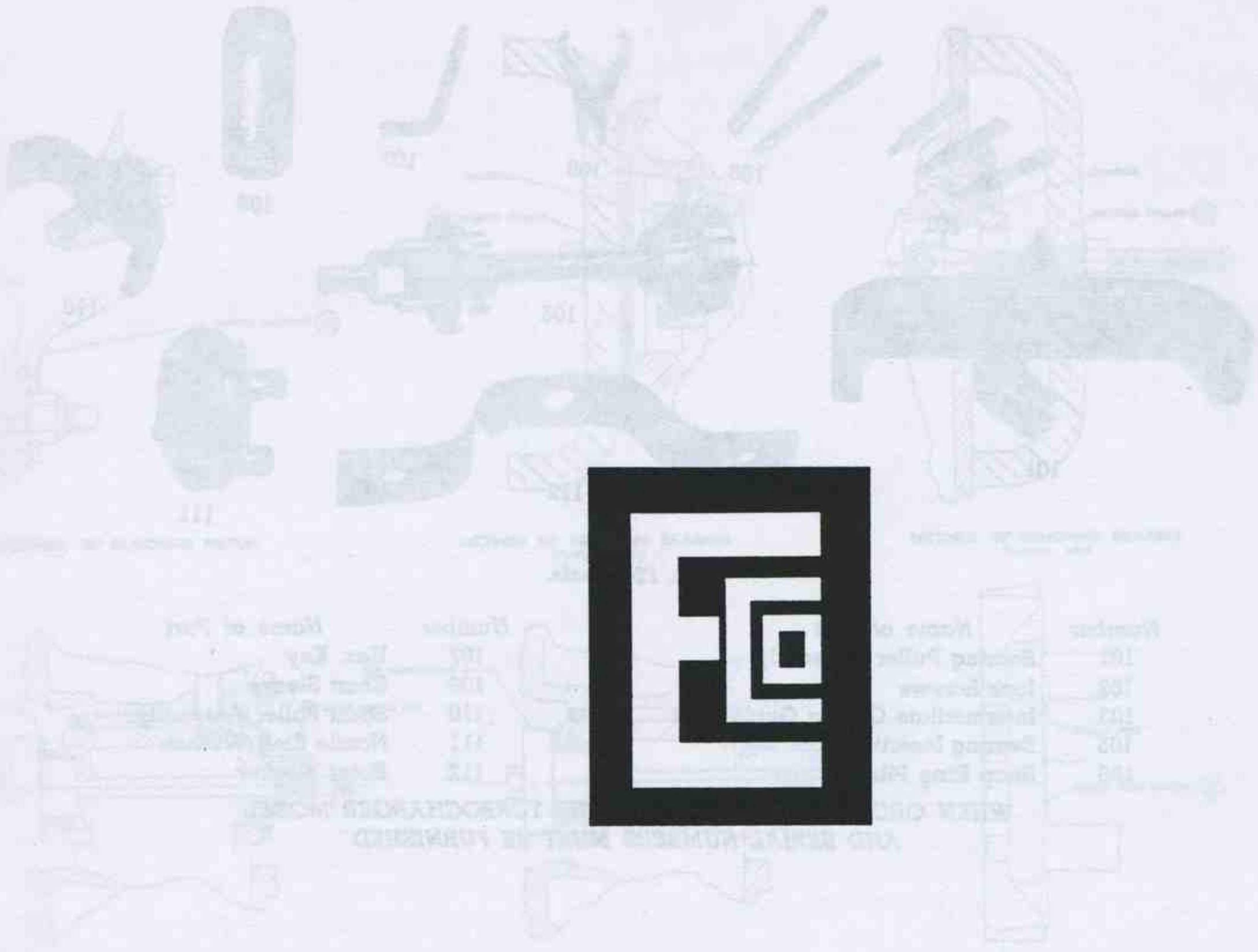


Fig. 12—Tools.

Number	*Name of Part*	*Number*	*Name of Part*
101	Bearing Puller Assembly	107	Hex. Key
102	Jack Screws	109	Shaft Sleeve
103	Intermediate Casing Guide Pins	110	Shaft Puller Assembly
105	Bearing Inserting Tool	111	Nozzle Ring Wrench
106	Snap Ring Pliers	112	Rotor Blocker

WHEN ORDERING THESE PARTS, THE TURBOCHARGER MODEL AND SERIAL NUMBERS MUST BE FURNISHED

LIST OF FIGURES



ELLIOTT COMPANY

Supercharger Department—Jeannette, Pa.

District Offices in Principal Cities

INSTRUCTION BOOK TC-20A

LITHO IN U

SPECIFICATION I-302.8B

PILOT HOUSE & ENGINE ROOM CONTROLS

FOR ONE ATLAS 9" X 10-½"

REVERSING ENGINE

THE
WESTINGHOUSE
AIR BRAKE COMPANY

IPD 413

SPECIFICATION I-302.8B

PILOT HOUSE & ENGINE ROOM CONTROLS FOR ONE ATLAS 9'' x 10-1/2'' REVERSING ENGINE

Pilot House-Control Stand
Engine Room-No Control Stand

Ref. Sketches
S-302.3B-1/4 ED.2
S-302.5 1/4

Ref.	Quantity	Description	Wt. Each Pounds	Pc. No.	Dwg. No.
		PILOT HOUSE			
1	1	CB-1A Control Stand (Non-Magnetic)	77	850781	ID-78672-51 ID-78673-51
		ENGINE ROOM			
2a	1	2A-2B Controlair	24	850652	C-77511-51
2c	1	Red Alarm Light	1/8	529990	F-72047-52
2d	1	Green Alarm Light	1/8	529989	F-72047-51
2e	1	A-5-A Rotair Valve	4	529014	F-70107-52
3	3	#18-A Double Check Valve	1-1/2	521774	F-50439-1
4	1	#22-A Double Check Valve	3-1/8	540107	E-73850-52
5	2	C-1-B Pilotair Valves (to read ahead and astern positions of the cam shaft to intercept starting air until the shift is completed)	2-1/4	531315	E-72824-54
6	1	H-5 Relayair (to intercept start line) 50 psi Spring	6-5/8	530530	D-71244-64
7	1	#18-A Double Check Valve (to supply Item 6)	1-1/2	521774	F-50439-1
8	1	D-1-A Relayair Valve (to start engine)	18-1/2	526408	D-70779-52

Ref.	Quantity	Description	Wt. Each Pounds	Pc. No.	Dwg. No.
Ref. No.					
9	1	H-5 Relayair Valve (to stop engine) 50 psi Spring	6-5/8	530530	D-71244-64
10	1	#18-A Double Check Valve (to supply Item 9)	1-1/2	521774	F-50439-1
11	1	Directional Interlock Valve (for 8-3/4'' Dia. Shaft)	11-1/4	533195	D-72155-55
12	1	Fuel Cut Off Cylinder (to cut off fuel in stop and in reversing)	4-1/2	528187	D-72458-52
13	1	#18-A Double Check Valve (to supply Item 12)	1-1/2	521774	F-50439-1
14	1	AA-1 Actuator (with type B rod end) to Operate Governor	9	850650	C-69872-55
24	1	Fuel Limit Cylinder 1-1/2'' x 1/2'' Single Acting Cylinder	2-1/2	523159	E-70816
25	2	H-5 Relayair Valve (to operate cam shift cylinder) 50 psi Spring	6-5/8	530530	D-71244-64
26	1	H-5 Relayair Valve (to operate air starting check valve actuator 50 psi Spring	6-5/8	530530	D-71244-64
		AIR SUPPLY			
18	1	Low Pressure Alarm Switch	2	530038	E-75289-51
19	1	3-1/2'' Air Gage (0-160 psi)	1	527967	D-76455-1
20	1	3/8'' Vented Cock	1-1/8	523369	F-70019-1
21	2	1/4'' Unvented Cock	1-3/8	520647	F-70019-1
22	2	1/4'' Vented Cock	1-3/8	520850	F-70019-1
23	2	D-1 Reducing Valve	12-3/4	524083	D-69517

Total Weight 231

NOTES: 1. Installation, tubing and fittings not included. Customer to provide brackets for mounting devices and necessary linkages for mechanical connections.

2. This specification presumes the existence of an adequate supply of reasonably clean dry air at a nominal pressure of 250 psi.

WESTINGHOUSE AIR BRAKE COMPANY
Industrial Products Division
WILMERDING, PENNSYLVANIA

RCB:mim
10-16-51

Revised: 10-24-51:MFM
12-13-51:MFM-Omit Air Gage, Ref. 2b.
4-15-52:MFM-Item 1 was CB-1 Control Stand, Pc. 850651

PNEUMATIC CONTROL EQUIPMENT FOR REMOTE CONTROL OF A DIRECT REVERSING ATLAS 9'' x 10-1/2'' DIESEL ENGINE

The chief features of this equipment are as follows:

1. Single handle control of all engine operations such as direction of engine rotation, starting, stopping and engine speed is provided.

2. Remote operation can be accomplished from either the pilot house or the engine room.

3. Interlocks are provided to prevent the admission of starting air to the engine until the engine cams have been completely shifted.

4. During the starting period the movement of the fuel shaft is limited by the Fuel Limit Cylinder to prevent flooding of the engine.

5. Interlocks are provided to prevent the engine from starting on a bounce and running in the opposite direction from that called for by the 2A-2-B Controlairs in the control stations.

6. Operation of the equipment is sequential.

7. After the engines have been started, they will run at idle speed until speeded up by the movement of the Controlair handle.

8. Any desired engine speed is maintained automatically at the handle position selected. Provision is made for locking the handle in any position.

SPECIFICATION I-302.8B

DESCRIPTION AND OPERATION

This equipment is specified on Specification I-302.8B and shown on sketches S-302.5-1/4 and S-302.3B-1/4. To better understand the following description, reference should be made to this material.

Let us start with the air supply equipment. Air for the pneumatic system is obtained from the ship's air supply at approximately 250 psi pressure. Ship's supply passes to the 3/8'' Vented Cut Out Cock, Item 20. When this cock is closed the ship's supply will be cut off and the control system will be vented to atmosphere through the side vent of the cock. From this point the ship's air passes to the Low Pressure Alarm Switch, Item 18. Item 18 is a pneumatically operated S.P.D.T. switch. Thus when the ship's air pressure is above a predetermined level, the switch will be positioned to light the Green Indicator Lights, Items 1d and 2d, at the pilot house and engine room control stations. This will indicate to the operator that the system pressure is within the safe operating range. Should the ship's pressure drop to a point where the loss of control becomes imminent the Alarm Switch will be operated to light the Red Indicator Lights, Items 1c and 2c, in the pilot house and engine room control stations. This will warn the operator that his air pressure has dropped to a dangerous level.

Ship's pressure now passes to the two parallel reducing stations consisting of Vented Cocks, Items 22; D-1 Reducing Valves, Items 23; and Cut Out Cocks, Items 21. The cut out cocks serve as a means of isolating either Reducing Valve for servicing, setting the valves or in case of the failure of one valve. The D-1 Reducing Valves, Item 23, are installed in parallel to provide increased capacity as well as a measure of protection in case of the failure of one valve. The Reducing Valves provide and maintain a reduced control pressure for operation of the pneumatic system.

The control pressure will be indicated on the 3-1/2'' Air Gage, Item 19, and will pass to two places.

1. Control pressure passes to the engine at port 9 of H-5 Relayair Valve, Item 9. As long as no pressure is present in either the AHEAD or ASTERN line, Item 9 will be positioned so that port 9 will be connected to port 11 and supply pressure will pass through the valve to the #18-A Double Check Valve, Item 13. This pressure will force over the shuttle of the double check and will pass out the side outlet to the Fuel Cut Off Cylinder, Item 12. This pressure will actuate the cylinder, and the fuel will be held in the off position as long as no pressure is supplied to either the AHEAD or ASTERN lines.

2. Control pressure will also pass to port 1 of the A-5-A Rotair Valve, Item 2e, located at the engine room control station. This valve provides a means of transferring control between the engine room and the pilot house. With the A-5-A Rotair in the LOCAL position, supply pressure at port 1 will be connected to port 2 and will pass to port 12 of the 2A-2-B Controlair, Item 2a, at the engine room control station. The gage will serve to indicate that the complete engine control will be vested in the engine room control station. The pilot house Controlair will be vented to atmosphere at the Rotair Valve. The pilot house Controlairs will be ineffective.

With the A-5-A Rotair in REMOTE position, the supply pressure at port 1 will be connected to port 3 and will pass to port 12 of the pilot house Controlair, Item 1a. The gage, Item 1b, in the Control Stand will indicate that the pilot house has control of the engine. The engine room Controlair will be vented to atmosphere at the Rotair Valve and will be ineffective.

Let us now follow a complete operating cycle of the pneumatic controls. Since the operation will be the same in either the AHEAD or ASTERN direction or from the pilot house or engine room, we will assume that operation is to be in the AHEAD direction from the pilot house control stand. The A-5-A Rotair must be placed in REMOTE position to give the pilot house control of the engine operation. Gage, Item 1b, and the Green Indicator Light, Item 1d, in the pilot house control stand will indicate that the system is ready for operation.

To start the engine AHEAD the 2A-2-B Controlair handle is moved forward to the IDLE position which is positively defined by means of a detent. In this position the AHEAD on-and-off direction valve of the Controlair is opened to admit control pressure to the AHEAD line at port 1 of the 2A-2-B Controlair. AHEAD line pressure will pass out the side outlet of the #18-A Double Check Valve, Item 3, to the AHEAD line to the engine.

AHEAD line pressure will pass to the following places:

1. Through the #18-A Double Check Valve, Item 10, to port 10 of H-5 Relayair Valve, Item 9. This pressure will operate Item 9 to connect port 11 to port 12. This will connect the Fuel Cut Off Cylinder, Item 12, through the #18-A Double Check Valve, Item 13, to atmosphere at port 12 of the H-5 Relayair, Item 9.

2. To port 10 of the cam shift H-5 Relayair Valve, Item 25. This pressure will operate the valve to connect port 11 to port 12. This will connect the 250 psi supply to the proper end of the cam shift cylinder and will operate the cylinder. This will position the engine cams for operation in the AHEAD direction.

3. With the cam shift cylinder in its neutral position both C-1-B Pilotair Valves, Item 5, will be depressed. Thus both the AHEAD and ASTERN lines will be connected through Item 7 to port 10 of H-5 Relayair Valve, Item 6. With pressure in the AHEAD line, Item 6 will be operated to connect port 11 to port 12 and the START line will be interrupted. When the cam shift has been completed, the Pilotair Valve cam on the cam shift lever will be positioned so that its detent will line up with the ahead C-1-B Pilotair Valve. This will permit the plunger of the C-1-B Pilotair Valve to rise and will interrupt the AHEAD line. This action will also connect port 10 of H-5 Relayair, Item 6, to atmosphere through the C-1-B Pilotair Valve. Item 6 will now be positioned so that port 9 and port 11 are connected. The START line will now be connected through Item 6 to the Fuel Limit Cylinder, Item 24; to port 16 of the D-1-A Relayair Valve, Item 8; and port 7 of the Directional Interlock, Item 11. Since the START line is not pressurized at this stage of operation, the engine will not be started.

4. AHEAD line pressure will also pass to port 1 of the Directional Interlock, Item 11. If the last operation of the engine had been in the AHEAD direction, the AHEADline pressure will be cut off at port 1 of Item 11; and the Fuel Cut Off Cylinder, Item 12, will be vented to atmosphere through port 13 to port 3 of the Directional Interlock to the unused ASTERN line. If the last operation of the engine had been ASTERN, the Directional Interlock would be positioned to connect the AHEAD line pressure at port 1 to port 13. This pressure would pass through the #18A double check valve, Item 13 to the fuel cut-off cylinder, Item 12,to Port 10, Item 26 and to the cylinder pressure release valves. Item 26 will be then positioned so that Port 11 and port 12 are connected. Thus the air starting check valve actuators would be charged, the cylinder pressure released and the engine fuel cut off. As the pilot house control air is moved into "start" position, the engine allows the starting "air" to brake and start the engine until proper rotation has been established and the directional interlock is positioned to read the ahead direction.

To actually start the engine the pilot house 2A-2-B Controlair handle is moved sideways into the ahead START notch. This action opens the START valve of the Controlair and admits pressure through port 7 to the START line. START line pressure will pass out the side outlet of the #18-A Double Check Valve, Item 3, to the engine to port 9 of H-5 Relayair Valve, Item 6. If the cam shift is completed, the START line will be connected through Item 6 (port 9 to port 11) and START pressure will pass to the following points:

1. To the Fuel Limit Cylinder, Item 24. This will actuate the cylinder to prevent the engine governor from running the fuel shaft to the full fuel position and flooding the engine.

2. To port 16 of the D-1-A Relayair Valve, Item 8. This will operate the D-1-A Relayair to admit 250 psi starting air to the engine.

3. To port 7 of the Directional Interlock, Item 11. This will raise the shoe of the Directional Interlock to contact the engine shaft extension. If the engine is starting in the AHEAD direction as called for by the pilot house Controlair, the Fuel Cut Off Cylinder will be exhausted through the Interlock, and fuel will be admitted to the engine. Should the engine start on a bounce and begin to run in the opposite direction from that called for, the Directional Interlock Shoe will be carried in the opposite direction, and AHEAD line pressure will be admitted to the Fuel Cut Off Cylinder to prevent the engine from running in the wrong direction. The cylinder pressure release valves and the air starting check valves actuators would also be activated.

Once the engine has caught, the 2A-2-B Controlair handle is returned from the START notch to the IDLE position. This will vent the START line and exhaust the Fuel Limit Cylinder, Item 24; the D-1-A Relayair Valve, Item 8; and the Directional Interlock, Item 11. Thus the fuel shaft will be free for control by the Actuator, Item 14, starting air will be cut off, and the shoe of the Directional Interlock will drop out of contact with the engine shaft extension.

With the 2A-2-B Controlair handle in IDLE position, the engine will run at IDLE speed. To increase speed, the handle is moved forward in the speed zone to the desired position. This will supply pressure proportional to the handle position to port 8 of the pilot house Controlair. This pressure will pass through the SPEED line to the AA-1 Actuator, Item 14, on the engine. SPEED line pressure will position the AA-1 Actuator which will in turn position the engine fuel shaft to provide the desired speed.

To stop the engine the Controlair handle is returned to NEUTRAL position. In this position the AHEAD, ASTERN, START, and SPEED lines will be exhausted. Supply pressure through the SUPPLY line through Item 9 will pass to the Fuel Cut Off Cylinder, Item 12. The fuel supply will be cut off, and the engine will stop.

Operation in the ASTERN direction is identical to that described above except for the lines and valves involved. For more detailed information on the individual devices involved in the system, reference should be made to the descriptive literature included with this write-up.

WESTINGHOUSE AIR BRAKE COMPANY
Industrial Products Division
WILMERDING: PENNSYLVANIA

2A-2-B CONTROLAIR

OPERATION AND MAINTENANCE

The 2A-2-B Controlair provides control through a single handle of the speed, starting, stopping and direction of marine type direct-reversing engines. Any number of engines coupled to a single drive may be controlled by means of a single 2A-2-B Controlair. Since the only connections necessary between the Controlair and the engines are small diameter copper tubes conveying air, the Controlair may with equal facility be mounted directly on the engine to provide a simple, compact local control, in an engineer's control stand to provide centralized one-man control of several engines, or in a remote station such as the pilot house, bridge wing, or afterdeck. Combinations of any or all of these control locations are frequently installed to permit selective control from any desired position.

The 2A-2-B Controlair is intended primarily to establish the direction of engine rotation through a double acting cylinder or rams controlling the engine cam shaft, provide starting by operating a starting valve or air distributor, and control the engine speed through an Actuator connected to the governor, fuel shaft or throttle valve.

Basically, the 2A-2-B Controlair consists of a speed regulating or graduating valve unit (an H-3 Controlair portion), two on-and-off or three-way valve units used to establish the direction of operation, and one similar on-and-off valve unit used to start the engine.

All piping connections are made to the pipe bracket located on the bottom of the Controlair. The Controlair may be removed from the pipe bracket without breaking any of the pipe connections. All control pipe connections are 1/4''-18 NPT to permit the use of 3/8 inch O.D. copper tubing between the Controlair and the other devices in the control system. Since the supply pipe may be of considerable length, the supply pipe connection is 3/8''-18 NPT to permit the use of 1/2 inch O.D. copper tubing. The following identifies the port connections of the pipe bracket:

Port No.	Legend
1	Ahead
3	Astern
7	Start
8	Speed
12	Supply
6	Plugged
10	Plugged

For best operation the supply pressure should be at least 70 psi, but must not exceed 125 psi maximum.

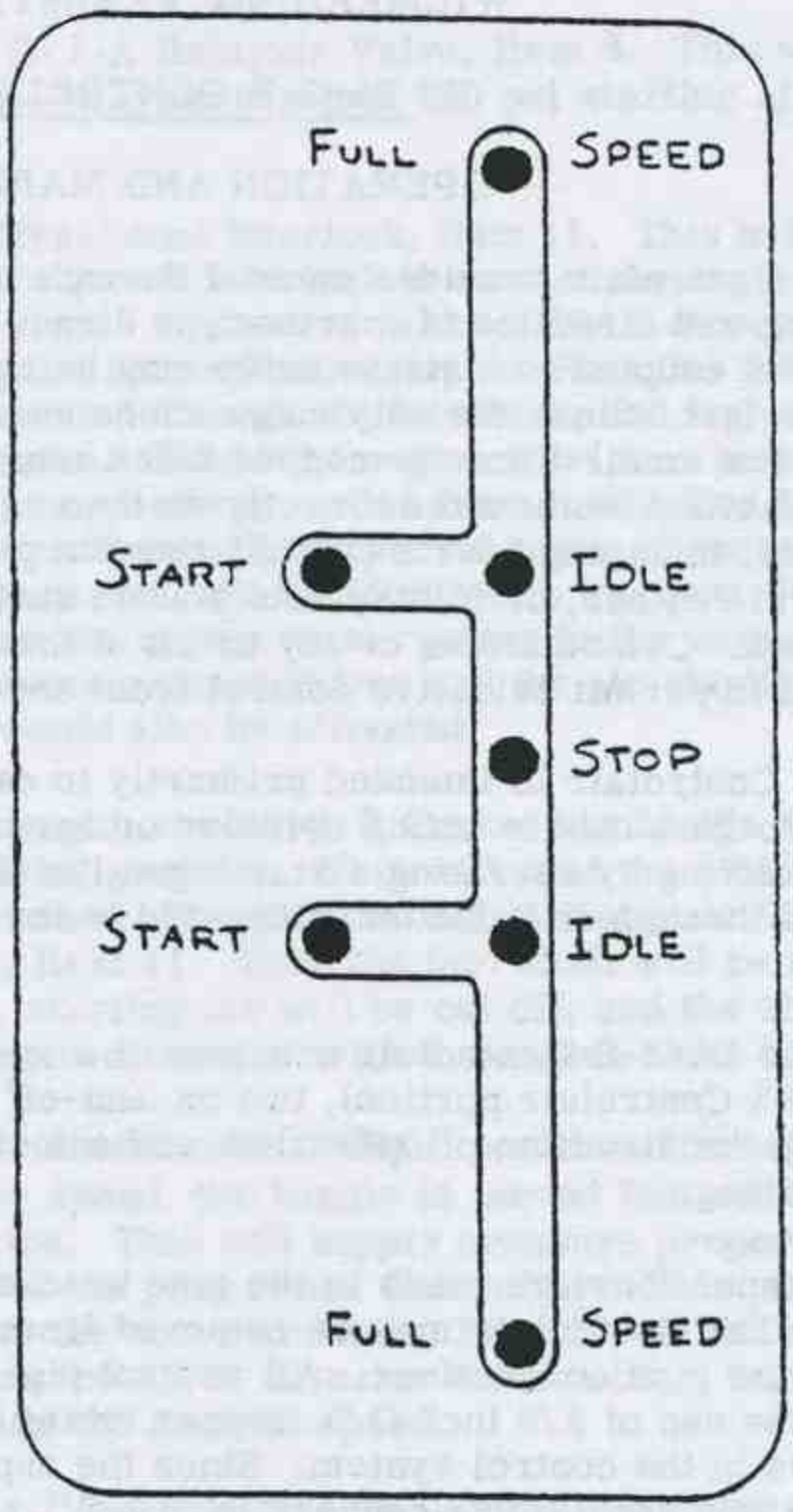


FIG. I INSTRUCTION PLATE

To initiate the various control functions, the operating handle is moved through a slot in the top cover. On the adapter plate alongside the top cover is an instruction plate which diagrams the several operating positions of the handle. Figure I shows the instruction plate and it will serve as a handle position diagram in the description to follow.

It is seen that STOP position is in the center of the slot. With the handle in this position, the engine is stopped and the cam shaft (or other reversing means) is positioned to re-start in the same direction as the last operation.

To start the engine AHEAD, the handle is moved forward to IDLE position which is positively defined by means of a detent. In this position the AHEAD on-and-off direction valve is opened to admit control pressure of 70 psi to the AHEAD line at port 1. This pressure will set up the engine cams for AHEAD operation.

The handle is then moved sideways into the START AHEAD notch to actually start the engine. This action opens the START on-and-off valve to admit control pressure to the START line at port 7. This pressure will operate a starting valve or air distributor to admit start air to the engine. As soon as the engine starts, the handle is returned to the IDLE position where the engine will run at IDLE speed. The START on-and-off valve will now be closed and the START line vented.

The engine speed may now be increased by moving the Controlair handle forward in the SPEED slot. This will operate the pressure graduating portion of the Controlair to supply a pressure proportional to the handle position through port 8 to the SPEED line. Thus the engine speed can be increased or decreased in graduations of any desired degree by moving the handle forward or back.

To stop the engine, the handle is moved into the STOP position. To start the engine ASTERN, the handle is moved into IDLE ASTERN, sideways into the START notch, and returned to IDLE, after which the speed can be varied as desired between IDLE and FULL SPEED ASTERN.

The control system can be provided with interlocks so that a 'flash' reversal can be safely accomplished by moving the handle directly from any position in one speed zone to the opposite START notch. If interlocks are not provided, motion should be arrested in STOP position until the engine has stopped before starting in the reverse direction.

The handle may be locked in any desired position by rotating the handle grip to the right. In speed positions, the rotation required is nominal and easily obtainable. In STOP and IDLE positions the rotation required is slightly greater as a locking indicator for these positions. When the vessel is secured, the Controlair handle should be locked in STOP position.

MAINTENANCE

Piping should be maintained with a minimum of leakage. While the Controlair will compensate for a moderate leakage in the pipes, a loss of air causes unnecessary demand on the vessel's air supply. Care should be exercised in piping installation to avoid pockets in which moisture might accumulate. If a condition exists, provision should be made to drain accumulated moisture daily.

It is recommended that the Controlair be periodically dismantled for inspection, cleaning and lubrication, and parts replaced if worn or defective in any way. This should not be done on the installation, but at a suitable bench in a well lighted location.

When dismantling the Controlair care must be exercised to avoid distortion of bolts, studs, nuts, etc. Care must be taken to avoid mutilation or damage to springs, gaskets, diaphragms, valves and valve seats. It is possible to assemble or disassemble all parts of the device readily. If the force required seems excessive, investigate immediately to determine the cause of the difficulty.

All parts should be cleaned with an approved non-inflammable solvent.

There are filter elements in the pipe bracket face which can be withdrawn when the Controlair has been dismantled from the pipe bracket. Filters should be thoroughly washed in solvent and blown off with a low-pressure air jet.

Rubber packing rings should be carefully inspected and replaced if cracked or worn. Packing rings should be coated with grease upon assembly.

WESTINGHOUSE AIR BRAKE COMPANY
PIECE LIST A-2380-A4

2A-2-B CONTROLAIR

Pc. No.	Ref. No.	
850652		2A-2-B Controlair, Complete with Short Handle
850661		2A-2-B Controlair, Complete with Long Handle
528067		Control Portion, H-3 Controlair, Complete (See IDI-9356-27.30)
850407	2	Controlair Body, Complete (Includes 5)
85148	4	Top Cover Stud (5/16-18 NC-3 x 1-3/8) 4 Req'd (See 15)
83784	5	3/8-16 x 2-5/8 Stud with Hex. Nut
850379	6	Cam
522818	7	Cam Shaft
521230	8	3/8-16 NC-3 Cam Set Screw
520955	9	3/8-16 NC-3 Set Screw Jam Nut
522816	10	Clutch Valve Shaft (Includes 11)
521166	11	Valve Shaft Pin
850380	12	Handle Shaft, Complete
52474	13	Handle Shaft Fulcrum (1/4-20 NC-3 x 1-1/4 Hex. Hd. Mch. Bolt)
521216	14	Handle Shaft Fulcrum Jam Nut (1/4-20 NC-3)
523744	15	5/16-18 Thin Elastic Stop Nut (4 Req'd)
522984	16	Handle Shaft Fulcrum Sleeve
850656	27	Top Cover
850387	28	Handle Latch
850388	29	Handle Latch Spring
850660	30	Handle Grip (Short Handle for Pc. 850652-Includes two of 31)
850389	30	Long Handle (For Pc. 850661-Includes two of 31)
526761	31	1/4-20 NC-3 x 5/16 Long Dog. Point Set Screw (2 Req'd)
850397	37	Cam Dog (2 Req'd)
538445	40	Inlet Valve (3 Req'd)
539115	41	Inlet Valve Spring (3 Req'd)
539111	42	Inlet Valve Spring Retainer Ring (3 Req'd)
539112	43	Inlet Valve Seat (3 Req'd)
523734	44	Packing Ring (7/8 O.D. - 3 Req'd)
539113	45	Exhaust Valve Spring (3 Req'd)
539114	46	Exhaust Valve (3 Req'd)
532268	47	Packing Ring (7/16 O.D. - 3 Req'd)
850391	48	Exhaust Valve Guide (1 Req'd)
850658	49	Cap Plug
523734	50	Packing Ring (7/8 O.D.)

850396	51	Cap Nut (2 Req'd)
850392	52	Valve Lever
850394	53	Fulcrum Pin (3 Req'd-for 37 & 52)
519787	54	1/4-28 NF-3 Thin Elastic Stop Nut
850401	55	#10-32 NF-3 x 1/2 Ov. Pt. Hex. Socket Set Screw (3 Req'd-for 37 & 52)
850406	56	Pipe Bracket
526835	57	Filter (6 Req'd)
529162	58	Filter Retaining Ring (6 Req'd)
532510	59	Pipe Bracket Gasket
519848	60	1/4'' Hex. Socket Pipe Plug (2 Req'd)
537605	61	3/8-16 NC-3 x 1-5/8 Hex. Hd. Cap Screw (2 Req'd)

Prices will be quoted upon application.

Orders should give PIECE NUMBER and NAME of part wanted.

The Westinghouse Air Brake Company
"H-3" CONTROLAIRS

Operation and Maintenance Instructions

The H-3 Controlair is a self-lapping, automatic pressure reducing valve of the cam operated type. The controlair is equipped with a lever and roller upon which the cam of the associated operating device rides to increase or decrease the operating pressure.

MAINTENANCE

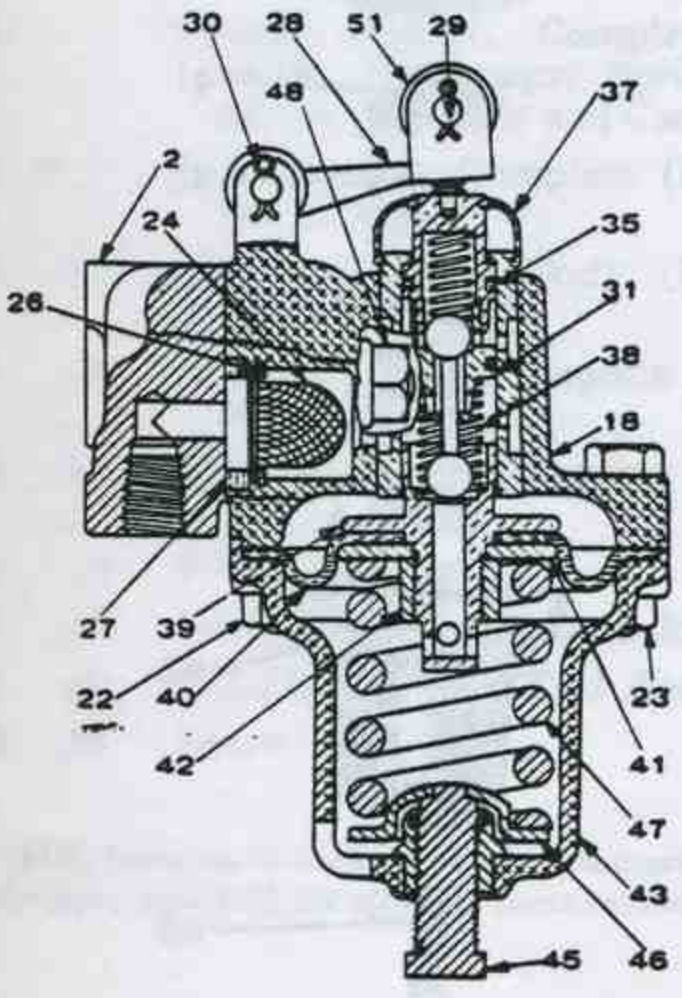
The H-3 Controlair should be dismantled periodically for inspection, cleaning and lubrication. Parts which are worn or defective should be replaced. Particular attention should be given to diaphragm 40, which should be replaced if cracked, damaged, or has broken sealing beads. All parts may be washed with an approved non-inflammable solvent, and blown dry with a low pressure air jet.

Filter 24 can be withdrawn when the Controlair has been dismounted from the pipe bracket. Rubber packing rings 35 should be carefully inspected and replaced if cracked or worn. Packing rings must be well coated with graphite grease. Leaky valves may be restored to their seats by rubbing in lightly with a fine grade valve grinding compound.

In reassembling all friction surfaces of moving parts should be lubricated with a small amount of graphite grease.

ADJUSTMENT

The only adjustment for the H-3 Controlair is screw 45. Turning the screw in raises the delivery pressure for any given roller position. Turning the screw out lowers the delivery pressure for any given roller position. It should be noted that this adjustment does not change the range of the valve, but raises or lowers the minimum and maximum operating pressures a like amount.



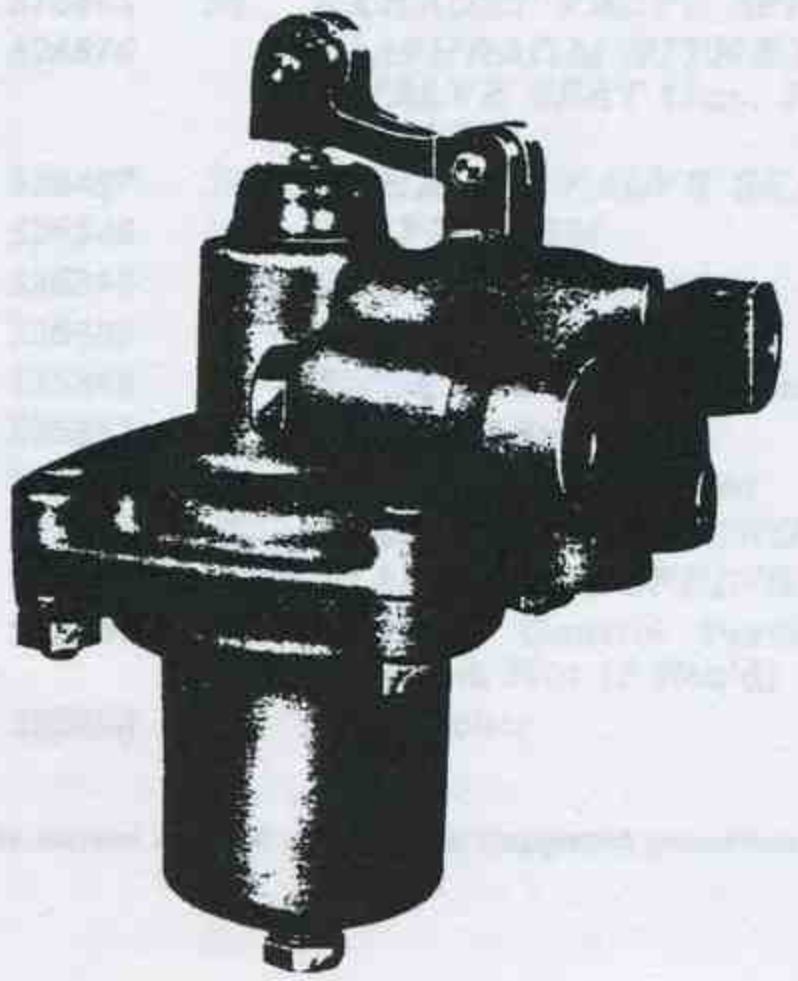


Fig. 1. Assembly and Exterior Views.

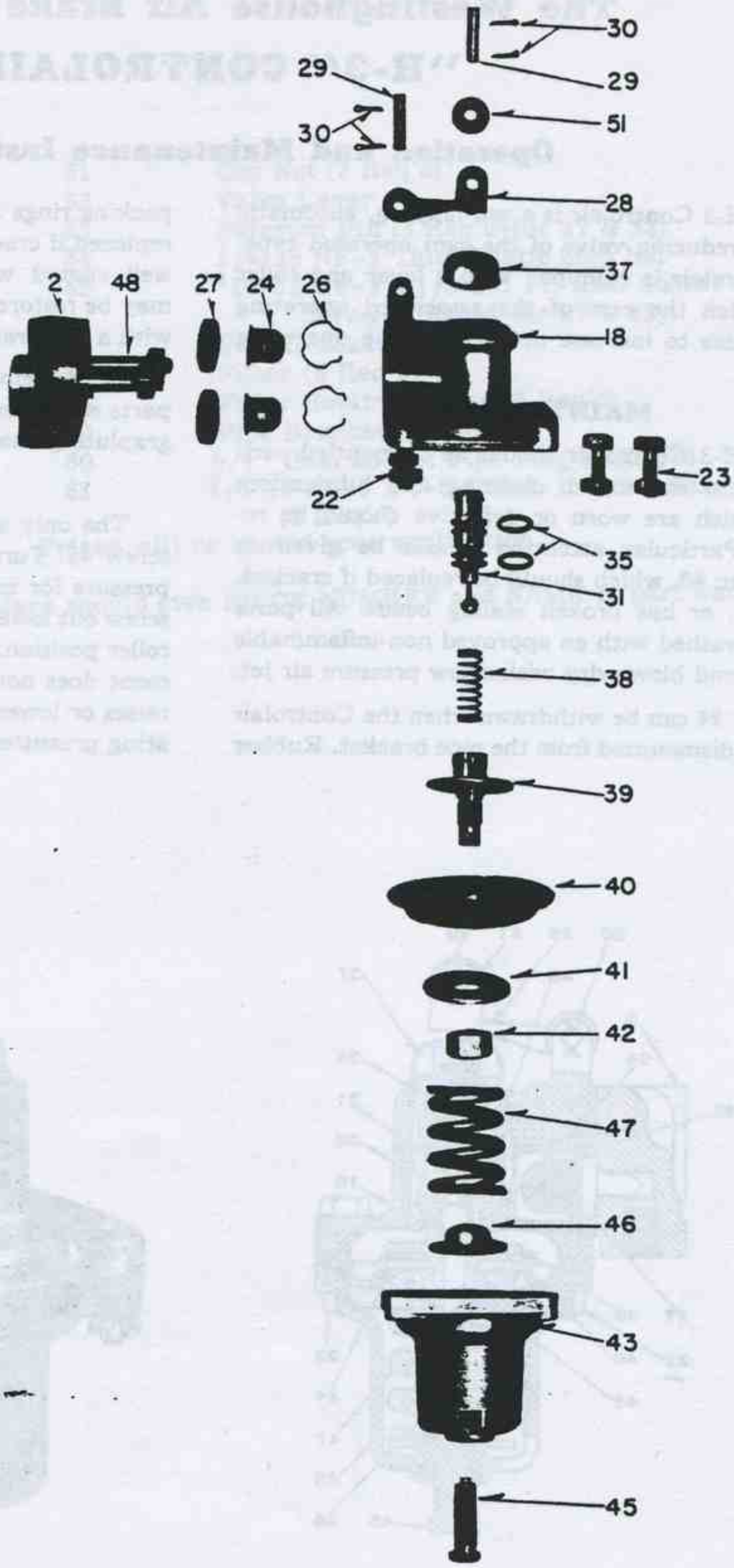


Fig. 2. Exploded View.

REPAIR PARTS LIST

"H-3" CONTROLAIR

Pc. No.	Operating Pressure (psi)
528020	60, Complete
528280	100, Complete
529382	60, Complete, less Lever and Cam Roller
527647	100, Complete, less Lever and Cam Roller
534740	60, Complete, less Pipe Bracket
531403	100, Complete, less Pipe Bracket

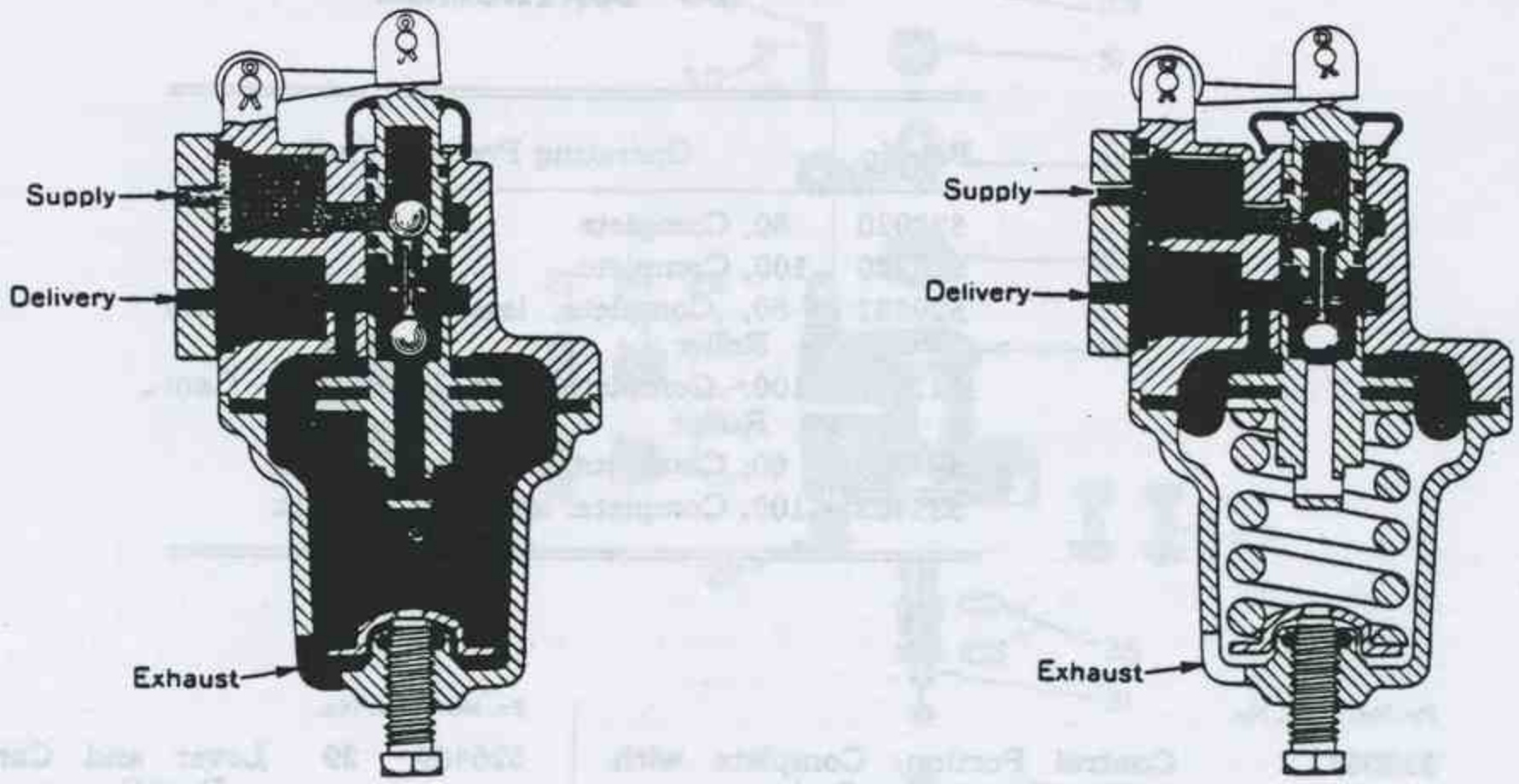
Pc. No.	Ref. No.	
528067		Control Portion, Complete with 60 # Diaphragm Spring
528291		Control Portion, Complete with 100 # Diaphragm Spring
529410		Control Portion, Complete with 60 # Diaphragm Spring less Lever and Cam Roller
529445		Control Portion, Complete with 100 # Diaphragm Spring less Lever and Cam Roller
529512		Control Portion, Complete with 100 # Diaphragm Spring and Filters less Lever and Cam Roller
527767	• 2	Pipe Bracket, Complete (Includes two of 48)
526874	18	Control Portion Body (Includes two of 22 and 26)
533084	22	$\frac{5}{16}$"x1$\frac{5}{16}$" Spring Housing Bolt & Nut (2 Req'd)
533085	23	$\frac{5}{16}$"x1$\frac{3}{8}$" Spring Housing Bolt & Nut (2 Req'd)
526835	24	Filter (2 Req'd)
529162	26	Filter Retaining Ring (2 Req'd)
99458	*27*	*FILTER GASKET (2 Req'd)*
528059	28	Lever
526469	29	Lever and Cam Roller Pin (2 Req'd)
93256	30	Lever and Cam Roller Pin Cotter (4 Req'd)
526875	*31*	*INLET AND EXHAUST VALVE UNIT, Complete (Includes two of 35)*
531868	*35*	*¾" O.D. SEAL WABCO PACKING RING (2 Req'd)*
526344	*37*	*DIRT PROTECTOR*
516445	*38*	*EXHAUST VALVE SPRING*
526876		*DIAPHRAGM WITH EXHAUST VALVE SEAT (Inc. 39, 40, 41 and 42)*
526487	*39*	*EXHAUST VALVE SEAT*
526346	*40*	*DIAPHRAGM*
526345	41	Diaphragm Follower
526489	42	Exhaust Valve Seat Nut
526348	43	Spring Housing, (Includes 45)
526352	45	Adjusting Screw
526347	46	Diaphragm Spring Seat
521141	*47*	*DIAPHRAGM SPRING (60 lb.)*
526749	*47*	*DIAPHRAGM SPRING (100 lb.)*
506967	48	$\frac{3}{8}$"x2$\frac{1}{8}$" Control Portion Body Stud & Nut (2 Req'd)
528058	51	Cam Roller

NOTE. Parts set in *italic type* are recommended spares to be carried in stock at all times. Suggested quantities are: 100% for rubber parts, and 25% for all other parts recommended.

Prices will be quoted upon application.

Orders should give PIECE NO. and NAME of part.

OPERATION



Release (After Application) — Applied

Fig. 3. Diagrammatic Views.

Normally the Controlair is in "Release" position as shown, with supply pressure on top of the inlet ball valve and delivery pressure vented to atmosphere past the exhaust ball valve.

When the operating lever is moved downward for an application, the inlet valve spring housing is carried downward seating the lower ball valve on the exhaust valve seat as the inlet valve spring is compressed. The air flows from the supply pipe past the upper ball valve to the delivery pipe until the delivery pressure, as determined by the movement of the operating lever, is reached. As the air pressure above the diaphragm increases, the diaphragm will be forced downward compressing the graduating spring, allowing the inlet valve spring to close the upper ball valve against its seat, thus cutting off the flow of supply air.

If while the Controlair is applied, the pressure in the delivery pipe should decrease due to leakage, the pressure on the diaphragm will be reduced. The graduating spring assembly will move upward and open the inlet valve to restore the proper delivery pressure. When this pressure is reached the graduating spring assembly will lower, permitting the inlet valve to reseat itself.

As the operating lever is moved to "Release" the inlet valve spring housing moves upward, with the upper ball valve held on its seat by the inlet valve spring and lifts the lower ball valve from the exhaust valve seat. Thus venting the excess pressure in the delivery pipe to atmosphere through the spring chamber. When the pressure has decreased to desired delivery pressure, the diaphragm spring will be able to raise the diaphragm and the exhaust valve seat against the lower ball valve, cutting off any further venting of excess pressure to atmosphere.

If some temperature variation occurs to change the pressure in the delivery pipe the same action will take place to restore the correct pressure.

When the operating lever moves to full "Release" all the pressure in the delivery pipe will be vented to atmosphere with the same action as above.

WESTINGHOUSE AIR BRAKE CO.
(Industrial Division)
WILMERDING, PENNSYLVANIA

10M-2
Printed in U.S.A.
March, 1949

WESTINGHOUSE AIR BRAKE COMPANY

Marine Division

WILMERDING, PENNSYLVANIA

D-1-A RELAYAIR VALVE

OPERATION AND MAINTENANCE

The D-1-A Relayair Valve is a large capacity piston operated valve designed to control the flow of a large amount of air when actuated by pressure from some relatively low capacity source. One of its principal uses is the control of starting air for Diesel engines, but it may be used wherever a large capacity Relayair Valve is required. As with other Relayair Valves it is a non-graduating valve. When sufficient pressure is applied to the pilot portion the valve will open fully. When pilot pressure is vented the valve will close off and vent the delivery side to atmosphere.

The D-1-A Relayair Valve has 1-1/4" I.P.S. supply and delivery ports, a 3/4" I.P.S. exhaust port, a 1/4" I.P.S. control port and an additional 1/4" I.P.S. port which is normally plugged but which may be used as a supply connection for some other equipment.

OPERATION

For an explanation of the operation of the valve, reference should be made to Figure 1, the assembly view. Control air enters the valve through port 16 to the chamber at the left of control piston 13, causing it to move to the right, compressing control piston spring 12. The lapped fit portion of the piston stem will first enter the bushing cutting the exhaust port off from the delivery port. Further movement of the piston will cause the piston stem to push inlet pilot valve 23 off its seat on the inlet valve 22, compressing pilot valve spring 25, venting the chamber to the right of the inlet valve. This will unbalance the pressure on the valve 22 causing it to snap to the right off its seat, compressing inlet valve spring 24, allowing air to flow through the valve from the supply port 5 to the delivery port. The control piston 13 will continue to move to the right, holding inlet pilot valve 23 open. The travel of piston 13 is terminated when the valve, which is part of the piston stem, seats against the bushing.

When the control pressure at port 16 is vented, control piston spring 12 will force control piston 12 to the left, allowing pilot valve spring 25 to close the pilot valve. Pressure will now build up at the right of the inlet valve through the small port in the side of the valve. Since the pressure is balanced, inlet valve spring 24 will force the inlet valve to the left to its seat, cutting off supply air. The delivery port will be vented to atmosphere past the control piston stem and out the exhaust port.

ADJUSTMENT

The D-1-A Relayair Valve requires no adjustment.

MAINTENANCE

The D-1-A Relayair Valve must be dismantled for cleaning, inspection of parts and relubrication at stated service intervals. All parts should be washed in solvent to remove dirt and old lubricant. Any valves that leak should be lapped to a tight fit. Gaskets which are cracked or have broken sealing beads should be replaced. The piston should be lubricated with a good grade of machine oil and good grade of grease should be applied to the valve guides.

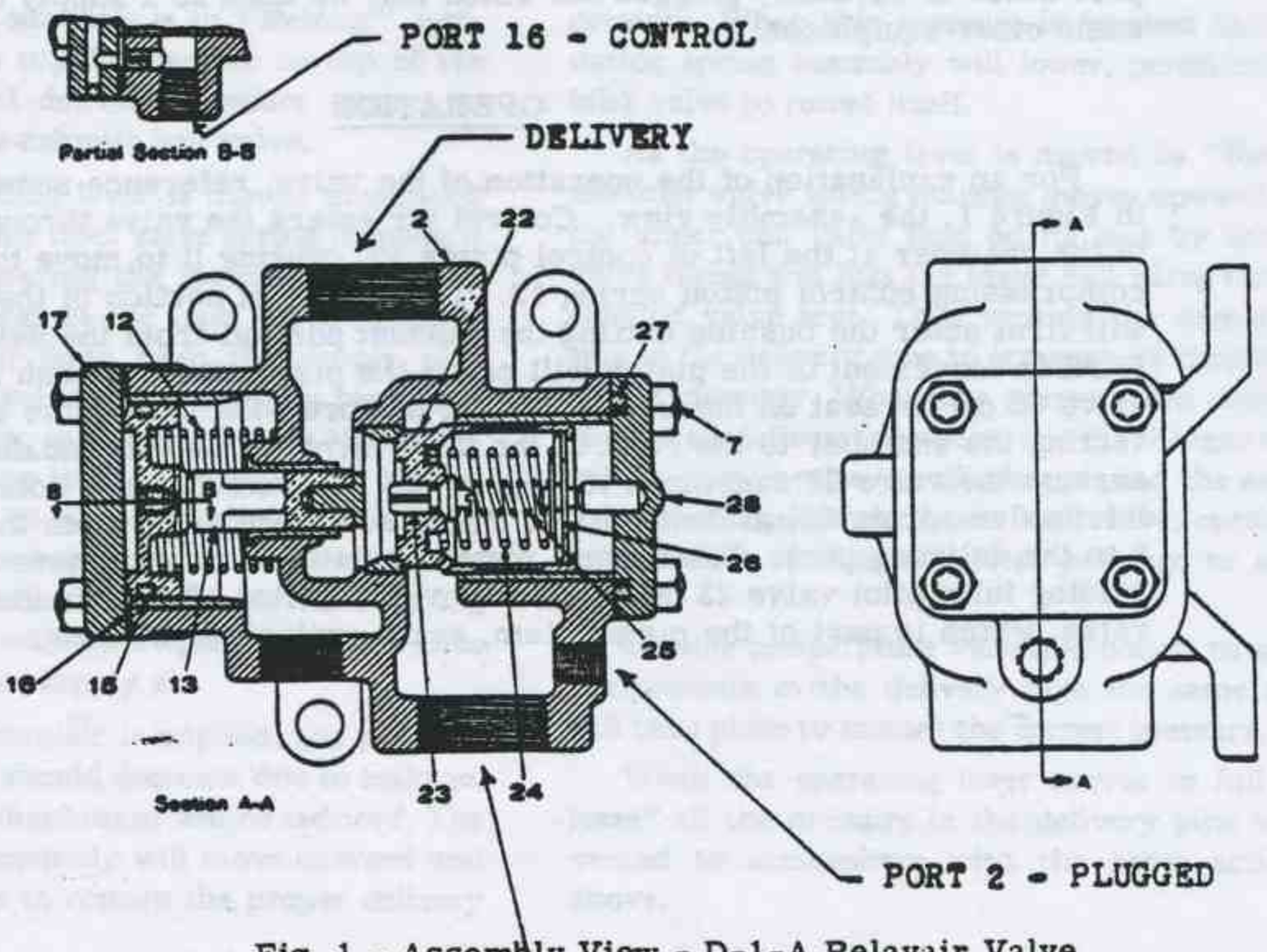


Fig. 1 - Assembly View - D-1-A Relayair Valve

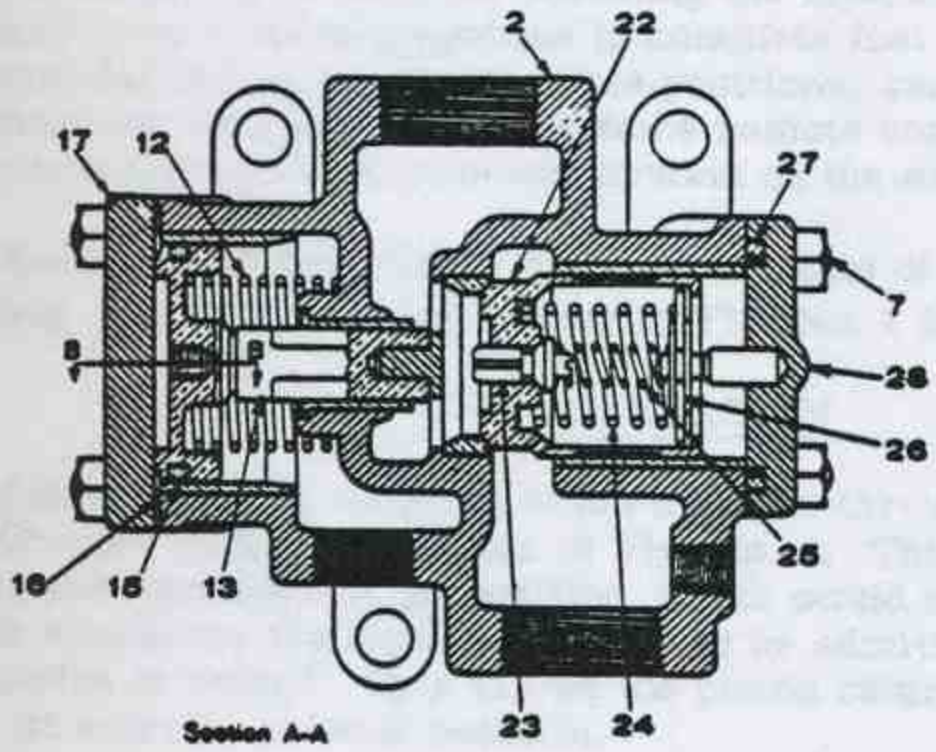
WESTINGHOUSE AIR BRAKE COMPANY

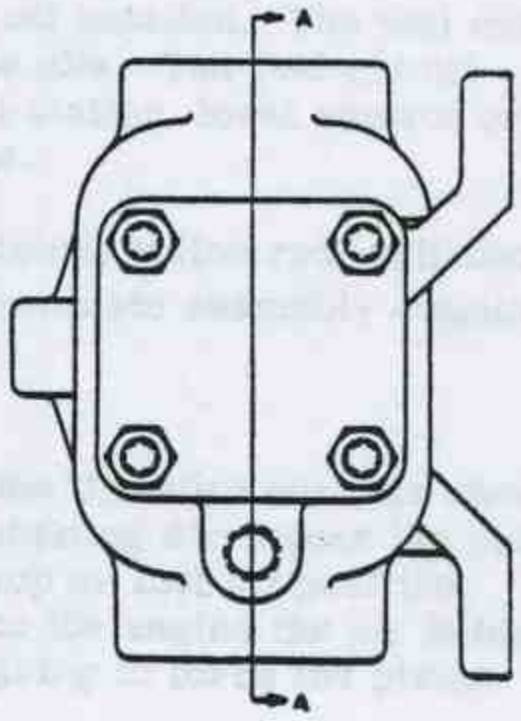
(PART CATALOG SERIES 3231)

PIECE LIST A-1670-20

D-1-A RELAYAIR VALVE

Partial Section B-B





Pc. No.	Ref. No.	
526408		D-1-A Relayair Valve, complete
522744	2	Body, complete (includes eight of 7 and 8)
84909	7	3/8'' x 1-1/2'' Stud and Nut (8 req'd)
522784	12	Control Piston Spring
526407	13	Control Piston with Tip
524617	15	2-1/2'' O.D. Seal Wabco Packing Ring
522754	16	Piston Cover Gasket
526406	17	Piston Cover
522755	22	Inlet Valve
522756	23	Inlet Pilot Valve
39574	24	Inlet Valve Spring
29082	25	Pilot Valve Spring
522757	26	Inlet Valve Spring Retainer
522758	27	Inlet End Cover Gasket
522759	28	Inlet End Cover with Stop

12-6-45 Prices will be quoted upon application.
P.F. 108.110 Orders should include PIECE NUMBER and NAME of part wanted.
1-C-1
Printed in U.S.A. (aj)

WESTINGHOUSE AIR BRAKE COMPANY

Marine Division

WILMERDING, PENNSYLVANIA

FUEL CUT OFF CYLINDER

OPERATION AND MAINTENANCE

The fuel cut off cylinder, Pc. No. 528187, is a single acting spring return cylinder. It is used for actuating the injector control shaft on Diesel engines from a running position to complete fuel cut off position. The fuel cut off cylinder allows no intermediate positions, such as idle. The fuel cut off cylinder can be controlled from some remote control station, local control or automatically by some interlock system on the engine.

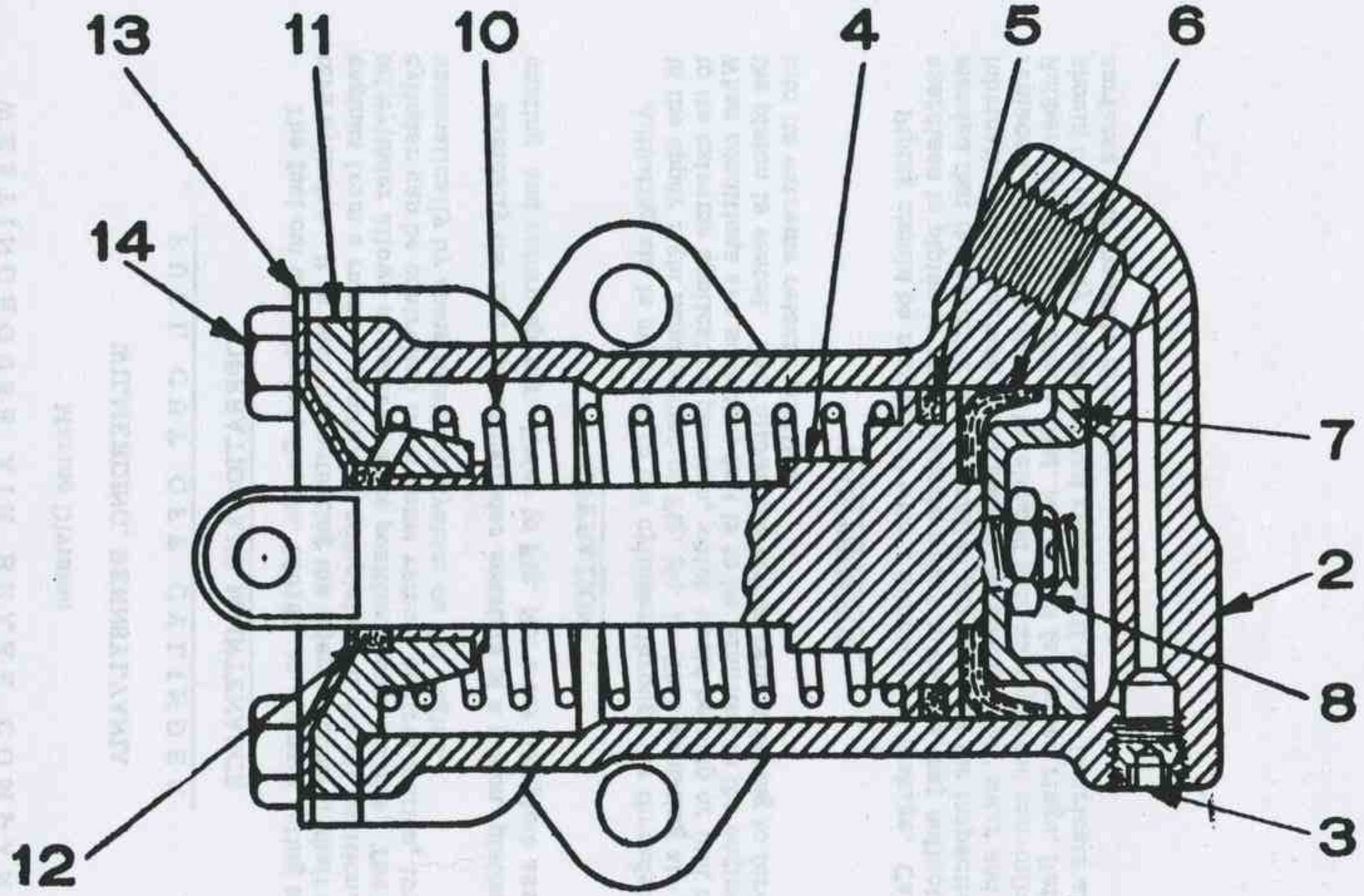
Basically the fuel cut off cylinder consists of a piston, piston rod, cylinder casting and return spring. Refer to Fig. No. 1 for complete assembly details.

OPERATION

Actuating air is supplied to the cylinder through the threaded port, as shown in the upper right hand corner of Fig. No. 1. This actuating air forces the piston to its extreme application position, which would be stop or fuel off position. When conditions are such that fuel is to be admitted to the engine the air behind the piston is vented. This allows the piston return spring to force the piston into its extreme release position.

MAINTENANCE

Piping should be maintained with a minimum of leakage. Care should be exercised in piping to avoid pockets where moisture may collect. It is recommended that the cylinder be dismantled periodically for inspection, cleaning and lubrication. All working parts should be checked for wear and all worn parts replaced. All parts should be cleaned with an approved non-inflammable solvent. Rubber packing cup, Fig. 1, Ref. No. 6, and felt wiper rings, Ref. No. 5 and 12, should be carefully inspected and replaced if worn. Lubricate all friction surfaces with graphite grease.


13
11
10
4
5
6
14
7
2
8
3
12

The handle is then moved sideways into the START AHEAD notch to actually start the engine. This action opens the START on-and-off valve to admit control pressure to the START line at port 7. This pressure will operate a starting valve or air distributor to admit start air to the engine. As soon as the engine starts, the handle is returned to the IDLE position where the engine will run at IDLE speed. The START on-and-off valve will now be closed and the START line vented.

The engine speed may now be increased by moving the Controlair handle forward in the SPEED slot. This will operate the pressure graduating portion of the Controlair to supply a pressure proportional to the handle position through port 8 to the SPEED line. Thus the engine speed can be increased or decreased in graduations of any desired degree by moving the handle forward or back.

To stop the engine, the handle is moved into the STOP position. To start the engine ASTERN, the handle is moved into IDLE ASTERN, sideways into the START notch, and returned to IDLE, after which the speed can be varied as desired between IDLE and FULL SPEED ASTERN.

The control system can be provided with interlocks so that a 'flash' reversal can be safely accomplished by moving the handle directly from any position in one speed zone to the opposite START notch. If interlocks are not provided, motion should be arrested in STOP position until the engine has stopped before starting in the reverse direction.

The handle may be locked in any desired position by rotating the handle grip to the right. In speed positions, the rotation required is nominal and easily obtainable. In STOP and IDLE positions the rotation required is slightly greater as a locking indicator for these positions. When the vessel is secured, the Controlair handle should be locked in STOP position.

MAINTENANCE

Piping should be maintained with a minimum of leakage. While the Controlair will compensate for a moderate leakage in the pipes, a loss of air causes unnecessary demand on the vessel's air supply. Care should be exercised in piping installation to avoid pockets in which moisture might accumulate. If a condition exists, provision should be made to drain accumulated moisture daily.

It is recommended that the Controlair be periodically dismantled for inspection, cleaning and lubrication, and parts replaced if worn or defective in any way. This should not be done on the installation, but at a suitable bench in a well lighted location.

When dismantling the Controlair care must be exercised to avoid distortion of bolts, studs, nuts, etc. Care must be taken to avoid mutilation or damage to springs, gaskets, diaphragms, valves and valve seats. It is possible to assemble or disassemble all parts of the device readily. If the force required seems excessive, investigate immediately to determine the cause of the difficulty.

3. With the cam shift cylinder in its neutral position both C-1-B Pilotair Valves, Item 5, will be depressed. Thus both the AHEAD and ASTERN lines will be connected through Item 7 to port 10 of H-5 Relayair Valve, Item 6. With pressure in the AHEAD line, Item 6 will be operated to connect port 11 to port 12 and the START line will be interrupted. When the cam shift has been completed, the Pilotair Valve cam on the cam shift lever will be positioned so that its detent will line up with the ahead C-1-B Pilotair Valve. This will permit the plunger of the C-1-B Pilotair Valve to rise and will interrupt the AHEAD line. This action will also connect port 10 of H-5 Relayair, Item 6, to atmosphere through the C-1-B Pilotair Valve. Item 6 will now be positioned so that port 9 and port 11 are connected. The START line will now be connected through Item 6 to the Fuel Limit Cylinder, Item 24; to port 16 of the D-1-A Relayair Valve, Item 8; and port 7 of the Directional Interlock, Item 11. Since the START line is not pressurized at this stage of operation, the engine will not be started.

4. AHEAD line pressure will also pass to port 1 of the Directional Interlock, Item 11. If the last operation of the engine had been in the AHEAD direction, the AHEADline pressure will be cut off at port 1 of Item 11; and the Fuel Cut Off Cylinder, Item 12, will be vented to atmosphere through port 13 to port 3 of the Directional Interlock to the unused ASTERN line. If the last operation of the engine had been ASTERN, the Directional Interlock would be positioned to connect the AHEAD line pressure at port 1 to port 13. This pressure would pass through the #18A double check valve, Item 13 to the fuel cut-off cylinder, Item 12,to Port 10, Item 26 and to the cylinder pressure release valves. Item 26 will be then positioned so that Port 11 and port 12 are connected. Thus the air starting check valve actuators would be charged, the cylinder pressure released and the engine fuel cut off. As the pilot house control air is moved into "start" position, the engine allows the starting "air" to brake and start the engine until proper rotation has been established and the directional interlock is positioned to read the ahead direction.

To actually start the engine the pilot house 2A-2-B Controlair handle is moved sideways into the ahead START notch. This action opens the START valve of the Controlair and admits pressure through port 7 to the START line. START line pressure will pass out the side outlet of the #18-A Double Check Valve, Item 3, to the engine to port 9 of H-5 Relayair Valve, Item 6. If the cam shift is completed, the START line will be connected through Item 6 (port 9 to port 11) and START pressure will pass to the following points:

1. To the Fuel Limit Cylinder, Item 24. This will actuate the cylinder to prevent the engine governor from running the fuel shaft to the full fuel position and flooding the engine.

2. To port 16 of the D-1-A Relayair Valve, Item 8. This will operate the D-1-A Relayair to admit 250 psi starting air to the engine.

3. To port 7 of the Directional Interlock, Item 11. This will raise the shoe of the Directional Interlock to contact the engine shaft extension. If the engine is starting in the AHEAD direction as called for by the pilot house Controlair, the Fuel Cut Off Cylinder will be exhausted through the Interlock, and fuel will be admitted to the engine. Should the engine start on a bounce and begin to run in the opposite direction from that called for, the Directional Interlock Shoe will be carried in the opposite direction, and AHEAD line pressure will be admitted to the Fuel Cut Off Cylinder to prevent the engine from running in the wrong direction. The cylinder pressure release valves and the air starting check valves actuators would also be activated.

Once the engine has caught, the 2A-2-B Controlair handle is returned from the START notch to the IDLE position. This will vent the START line and exhaust the Fuel Limit Cylinder, Item 24; the D-1-A Relayair Valve, Item 8; and the Directional Interlock, Item 11. Thus the fuel shaft will be free for control by the Actuator, Item 14, starting air will be cut off, and the shoe of the Directional Interlock will drop out of contact with the engine shaft extension.

With the 2A-2-B Controlair handle in IDLE position, the engine will run at IDLE speed. To increase speed, the handle is moved forward in the speed zone to the desired position. This will supply pressure proportional to the handle position to port 8 of the pilot house Controlair. This pressure will pass through the SPEED line to the AA-1 Actuator, Item 14, on the engine. SPEED line pressure will position the AA-1 Actuator which will in turn position the engine fuel shaft to provide the desired speed.

To stop the engine the Controlair handle is returned to NEUTRAL position. In this position the AHEAD, ASTERN, START, and SPEED lines will be exhausted. Supply pressure through the SUPPLY line through Item 9 will pass to the Fuel Cut Off Cylinder, Item 12. The fuel supply will be cut off, and the engine will stop.

Operation in the ASTERN direction is identical to that described above except for the lines and valves involved. For more detailed information on the individual devices involved in the system, reference should be made to the descriptive literature included with this write-up.

WESTINGHOUSE AIR BRAKE COMPANY
Industrial Products Division
WILMERDING: PENNSYLVANIA

2A-2-B CONTROLAIR

OPERATION AND MAINTENANCE

The 2A-2-B Controlair provides control through a single handle of the speed, starting, stopping and direction of marine type direct-reversing engines. Any number of engines coupled to a single drive may be controlled by means of a single 2A-2-B Controlair. Since the only connections necessary between the Controlair and the engines are small diameter copper tubes conveying air, the Controlair may with equal facility be mounted directly on the engine to provide a simple, compact local control, in an engineer's control stand to provide centralized one-man control of several engines, or in a remote station such as the pilot house, bridge wing, or afterdeck. Combinations of any or all of these control locations are frequently installed to permit selective control from any desired position.

The 2A-2-B Controlair is intended primarily to establish the direction of engine rotation through a double acting cylinder or rams controlling the engine cam shaft, provide starting by operating a starting valve or air distributor, and control the engine speed through an Actuator connected to the governor, fuel shaft or throttle valve.

Basically, the 2A-2-B Controlair consists of a speed regulating or graduating valve unit (an H-3 Controlair portion), two on-and-off or three-way valve units used to establish the direction of operation, and one similar on-and-off valve unit used to start the engine.

All piping connections are made to the pipe bracket located on the bottom of the Controlair. The Controlair may be removed from the pipe bracket without breaking any of the pipe connections. All control pipe connections are 1/4''-18 NPT to permit the use of 3/8 inch O.D. copper tubing between the Controlair and the other devices in the control system. Since the supply pipe may be of considerable length, the supply pipe connection is 3/8''-18 NPT to permit the use of 1/2 inch O.D. copper tubing. The following identifies the port connections of the pipe bracket:

Port No.	Legend
1	Ahead
3	Astern
7	Start
8	Speed
12	Supply
6	Plugged
10	Plugged

For best operation the supply pressure should be at least 70 psi, but must not exceed 125 psi maximum.

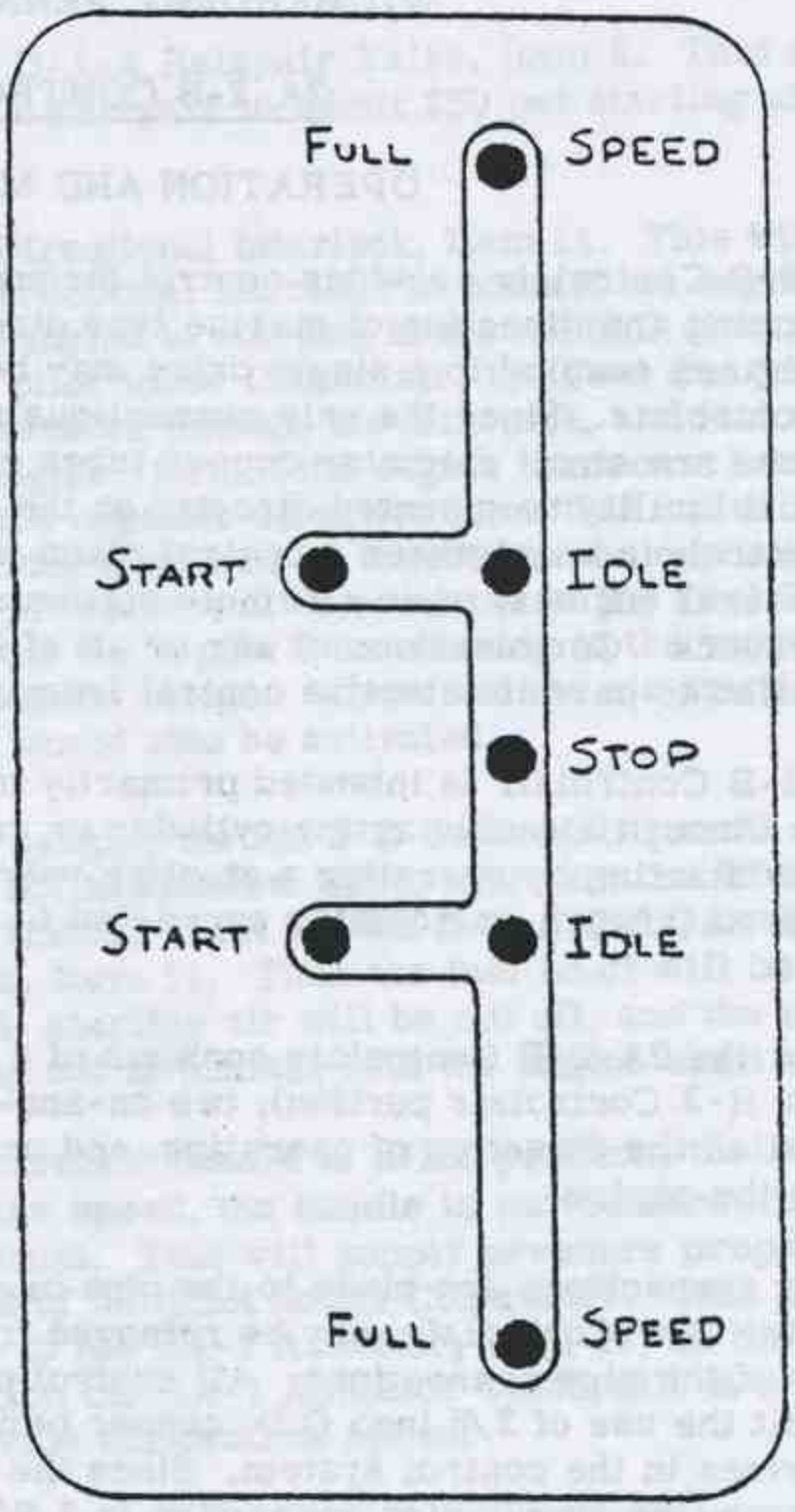


FIG. I INSTRUCTION PLATE

To initiate the various control functions, the operating handle is moved through a slot in the top cover. On the adapter plate alongside the top cover is an instruction plate which diagrams the several operating positions of the handle. Figure I shows the instruction plate and it will serve as a handle position diagram in the description to follow.

It is seen that STOP position is in the center of the slot. With the handle in this position, the engine is stopped and the cam shaft (or other reversing means) is positioned to re-start in the same direction as the last operation.

To start the engine AHEAD, the handle is moved forward to IDLE position which is positively defined by means of a detent. In this position the AHEAD on-and-off direction valve is opened to admit control pressure of 70 psi to the AHEAD line at port 1. This pressure will set up the engine cams for AHEAD operation.

The handle is then moved sideways into the START AHEAD notch to actually start the engine. This action opens the START on-and-off valve to admit control pressure to the START line at port 7. This pressure will operate a starting valve or air distributor to admit start air to the engine. As soon as the engine starts, the handle is returned to the IDLE position where the engine will run at IDLE speed. The START on-and-off valve will now be closed and the START line vented.

The engine speed may now be increased by moving the Controlair handle forward in the SPEED slot. This will operate the pressure graduating portion of the Controlair to supply a pressure proportional to the handle position through port 8 to the SPEED line. Thus the engine speed can be increased or decreased in graduations of any desired degree by moving the handle forward or back.

To stop the engine, the handle is moved into the STOP position. To start the engine ASTERN, the handle is moved into IDLE ASTERN, sideways into the START notch, and returned to IDLE, after which the speed can be varied as desired between IDLE and FULL SPEED ASTERN.

The control system can be provided with interlocks so that a 'flash' reversal can be safely accomplished by moving the handle directly from any position in one speed zone to the opposite START notch. If interlocks are not provided, motion should be arrested in STOP position until the engine has stopped before starting in the reverse direction.

The handle may be locked in any desired position by rotating the handle grip to the right. In speed positions, the rotation required is nominal and easily obtainable. In STOP and IDLE positions the rotation required is slightly greater as a locking indicator for these positions. When the vessel is secured, the Controlair handle should be locked in STOP position.

MAINTENANCE

Piping should be maintained with a minimum of leakage. While the Controlair will compensate for a moderate leakage in the pipes, a loss of air causes unnecessary demand on the vessel's air supply. Care should be exercised in piping installation to avoid pockets in which moisture might accumulate. If a condition exists, provision should be made to drain accumulated moisture daily.

It is recommended that the Controlair be periodically dismantled for inspection, cleaning and lubrication, and parts replaced if worn or defective in any way. This should not be done on the installation, but at a suitable bench in a well lighted location.

When dismantling the Controlair care must be exercised to avoid distortion of bolts, studs, nuts, etc. Care must be taken to avoid mutilation or damage to springs, gaskets, diaphragms, valves and valve seats. It is possible to assemble or disassemble all parts of the device readily. If the force required seems excessive, investigate immediately to determine the cause of the difficulty.

All parts should be cleaned with an approved non-inflammable solvent.

There are filter elements in the pipe bracket face which can be withdrawn when the Controlair has been dismantled from the pipe bracket. Filters should be thoroughly washed in solvent and blown off with a low-pressure air jet.

Rubber packing rings should be carefully inspected and replaced if cracked or worn. Packing rings should be coated with grease upon assembly.

WESTINGHOUSE AIR BRAKE COMPANY
PIECE LIST A-2380-A4

2A-2-B CONTROLAIR

Pc. No.	Ref. No.	
850652		2A-2-B Controlair, Complete with Short Handle
850661		2A-2-B Controlair, Complete with Long Handle
528067		Control Portion, H-3 Controlair, Complete (See IDI-9356-27.30)
850407	2	Controlair Body, Complete (Includes 5)
85148	4	Top Cover Stud (5/16-18 NC-3 x 1-3/8) 4 Req'd (See 15)
83784	5	3/8-16 x 2-5/8 Stud with Hex. Nut
850379	6	Cam
522818	7	Cam Shaft
521230	8	3/8-16 NC-3 Cam Set Screw
520955	9	3/8-16 NC-3 Set Screw Jam Nut
522816	10	Clutch Valve Shaft (Includes 11)
521166	11	Valve Shaft Pin
850380	12	Handle Shaft, Complete
52474	13	Handle Shaft Fulcrum (1/4-20 NC-3 x 1-1/4 Hex. Hd. Mch. Bolt)
521216	14	Handle Shaft Fulcrum Jam Nut (1/4-20 NC-3)
523744	15	5/16-18 Thin Elastic Stop Nut (4 Req'd)
522984	16	Handle Shaft Fulcrum Sleeve
850656	27	Top Cover
850387	28	Handle Latch
850388	29	Handle Latch Spring
850660	30	Handle Grip (Short Handle for Pc. 850652-Includes two of 31)
850389	30	Long Handle (For Pc. 850661-Includes two of 31)
526761	31	1/4-20 NC-3 x 5/16 Long Dog. Point Set Screw (2 Req'd)
850397	37	Cam Dog (2 Req'd)
538445	40	Inlet Valve (3 Req'd)
539115	41	Inlet Valve Spring (3 Req'd)
539111	42	Inlet Valve Spring Retainer Ring (3 Req'd)
539112	43	Inlet Valve Seat (3 Req'd)
523734	44	Packing Ring (7/8 O.D. - 3 Req'd)
539113	45	Exhaust Valve Spring (3 Req'd)
539114	46	Exhaust Valve (3 Req'd)
532268	47	Packing Ring (7/16 O.D. - 3 Req'd)
850391	48	Exhaust Valve Guide (1 Req'd)
850658	49	Cap Plug
523734	50	Packing Ring (7/8 O.D.)

850396	51	Cap Nut (2 Req'd)
850392	52	Valve Lever
850394	53	Fulcrum Pin (3 Req'd-for 37 & 52)
519787	54	1/4-28 NF-3 Thin Elastic Stop Nut
850401	55	#10-32 NF-3 x 1/2 Ov. Pt. Hex. Socket Set Screw (3 Req'd-for 37 & 52)
850406	56	Pipe Bracket
526835	57	Filter (6 Req'd)
529162	58	Filter Retaining Ring (6 Req'd)
532510	59	Pipe Bracket Gasket
519848	60	1/4'' Hex. Socket Pipe Plug (2 Req'd)
537605	61	3/8-16 NC-3 x 1-5/8 Hex. Hd. Cap Screw (2 Req'd)

Prices will be quoted upon application.

Orders should give PIECE NUMBER and NAME of part wanted.

The Westinghouse Air Brake Company

"H-3" CONTROLAIRS

Operation and Maintenance Instructions

The H-3 Controlair is a self-lapping, automatic pressure reducing valve of the cam operated type. The controlair is equipped with a lever and roller upon which the cam of the associated operating device rides to increase or decrease the operating pressure.

MAINTENANCE

The H-3 Controlair should be dismantled periodically for inspection, cleaning and lubrication. Parts which are worn or defective should be replaced. Particular attention should be given to diaphragm 40, which should be replaced if cracked, damaged, or has broken sealing beads. All parts may be washed with an approved non-inflammable solvent, and blown dry with a low pressure air jet.

Filter 24 can be withdrawn when the Controlair has been dismounted from the pipe bracket. Rubber packing rings 35 should be carefully inspected and replaced if cracked or worn. Packing rings must be well coated with graphite grease. Leaky valves may be restored to their seats by rubbing in lightly with a fine grade valve grinding compound.

In reassembling all friction surfaces of moving parts should be lubricated with a small amount of graphite grease.

ADJUSTMENT

The only adjustment for the H-3 Controlair is screw 45. Turning the screw in raises the delivery pressure for any given roller position. Turning the screw out lowers the delivery pressure for any given roller position. It should be noted that this adjustment does not change the range of the valve, but raises or lowers the minimum and maximum operating pressures a like amount.

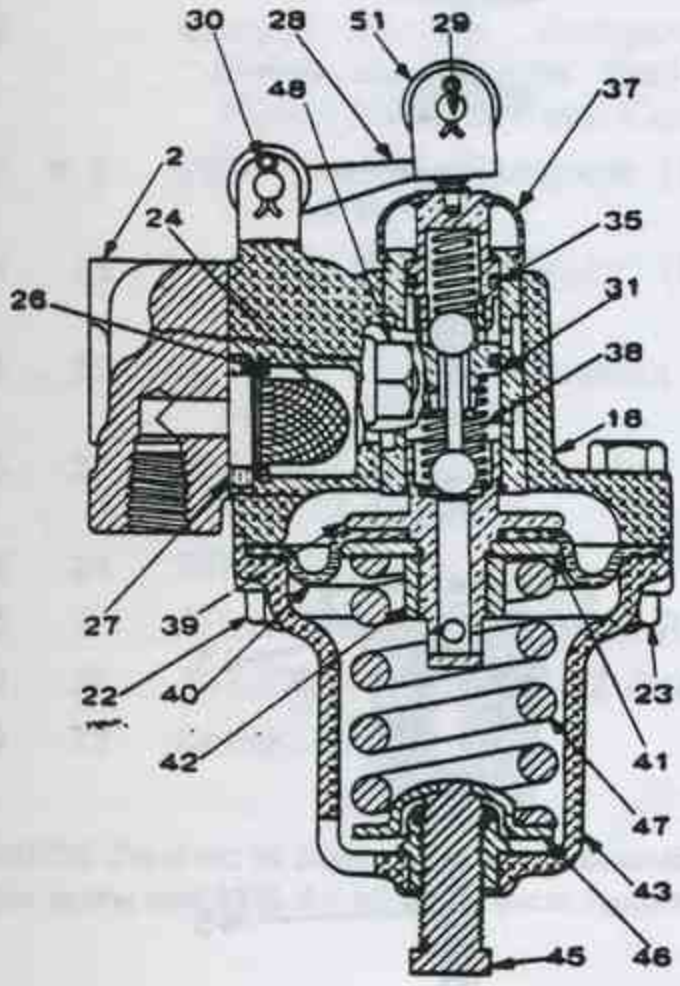


Fig. 1. Assembly and Exterior Views.

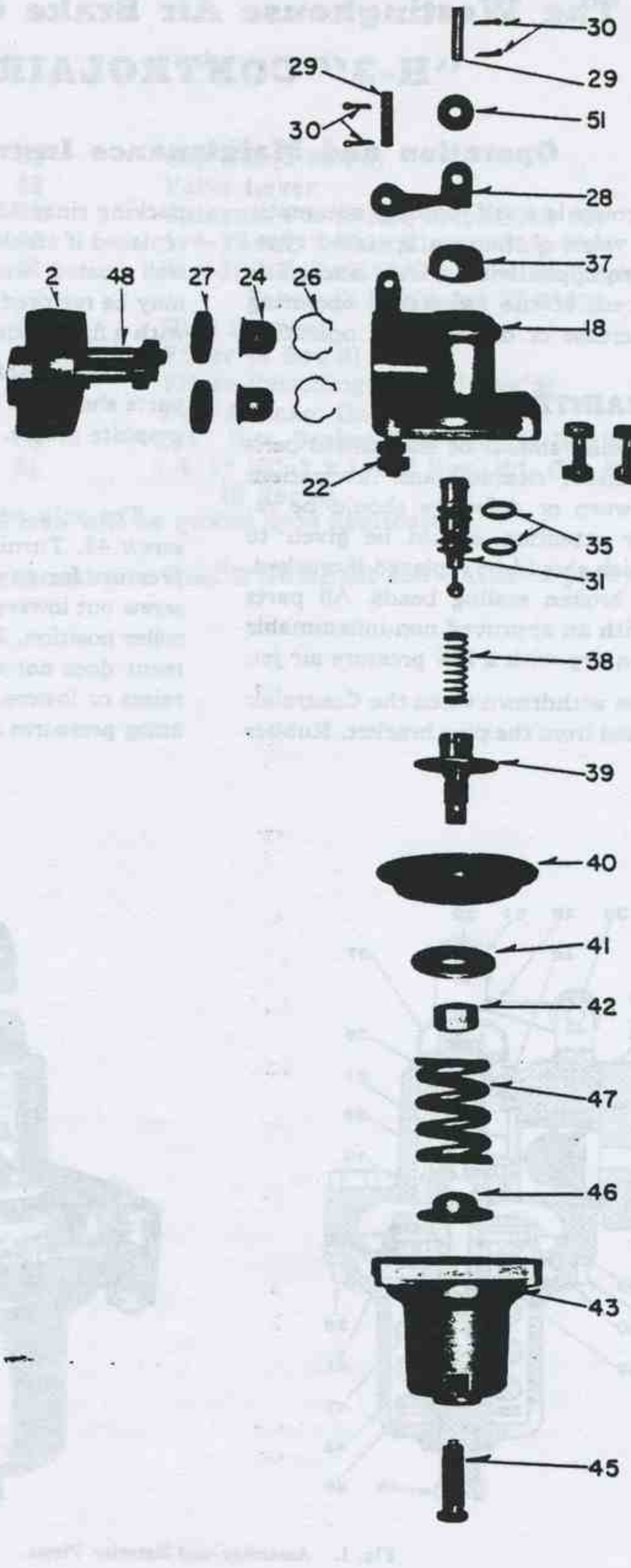


Fig. 2. Exploded View.

REPAIR PARTS LIST

"H-3" CONTROLAIR

Pc. No.	Operating Pressure (psi)
528020	60, Complete
528280	100, Complete
529382	60, Complete, less Lever and Cam Roller
527647	100, Complete, less Lever and Cam Roller
534740	60, Complete, less Pipe Bracket
531403	100, Complete, less Pipe Bracket

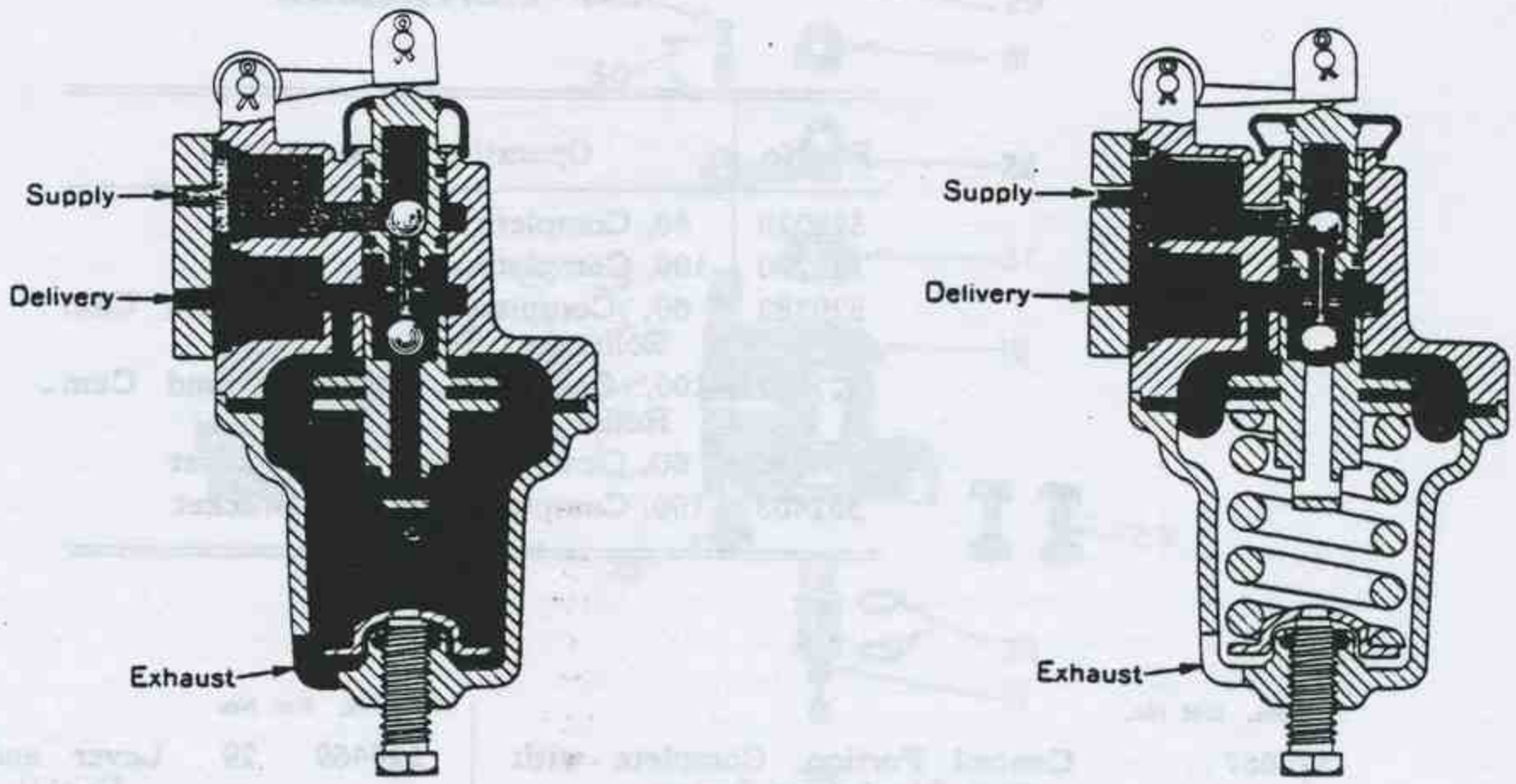
Pc. No.	Ref. No.	
528067		Control Portion, Complete with 60 # Diaphragm Spring
528291		Control Portion, Complete with 100 # Diaphragm Spring
529410		Control Portion, Complete with 60 # Diaphragm Spring less Lever and Cam Roller
529445		Control Portion, Complete with 100 # Diaphragm Spring less Lever and Cam Roller
529512		Control Portion, Complete with 100 # Diaphragm Spring and Filters less Lever and Cam Roller
527767	• 2	Pipe Bracket, Complete (Includes two of 48)
526874	18	Control Portion Body (Includes two of 22 and 26)
533084	22	$\frac{5}{16}$"x1$\frac{5}{16}$" Spring Housing Bolt & Nut (2 Req'd)
533085	23	$\frac{5}{16}$"x1$\frac{3}{8}$" Spring Housing Bolt & Nut (2 Req'd)
526835	24	Filter (2 Req'd)
529162	26	Filter Retaining Ring (2 Req'd)
99458	*27*	*FILTER GASKET (2 Req'd)*
528059	28	Lever
526469	29	Lever and Cam Roller Pin (2 Req'd)
93256	30	Lever and Cam Roller Pin Cotter (4 Req'd)
526875	*31*	*INLET AND EXHAUST VALVE UNIT, Complete (Includes two of 35)*
531868	*35*	*¾" O.D. SEAL WABCO PACKING RING (2 Req'd)*
526344	*37*	*DIRT PROTECTOR*
516445	*38*	*EXHAUST VALVE SPRING*
526876		*DIAPHRAGM WITH EXHAUST VALVE SEAT (Inc. 39, 40, 41 and 42)*
526487	*39*	*EXHAUST VALVE SEAT*
526346	*40*	*DIAPHRAGM*
526345	41	Diaphragm Follower
526489	42	Exhaust Valve Seat Nut
526348	43	Spring Housing, (Includes 45)
526352	45	Adjusting Screw
526347	46	Diaphragm Spring Seat
521141	*47*	*DIAPHRAGM SPRING (60 lb.)*
526749	*47*	*DIAPHRAGM SPRING (100 lb.)*
506967	48	⅜"x2⅛" Control Portion Body Stud & Nut (2 Req'd)
528058	51	Cam Roller

NOTE. Parts set in *italic type* are recommended spares to be carried in stock at all times. Suggested quantities are: 100% for rubber parts, and 25% for all other parts recommended.

Prices will be quoted upon application.

Orders should give PIECE NO. and NAME of part.

OPERATION



Release
(After Application)

Applied

Fig. 3. Diagrammatic Views.

Normally the Controlair is in "Release" position as shown, with supply pressure on top of the inlet ball valve and delivery pressure vented to atmosphere past the exhaust ball valve.

When the operating lever is moved downward for an application, the inlet valve spring housing is carried downward seating the lower ball valve on the exhaust valve seat as the inlet valve spring is compressed. The air flows from the supply pipe past the upper ball valve to the delivery pipe until the delivery pressure, as determined by the movement of the operating lever, is reached. As the air pressure above the diaphragm increases, the diaphragm will be forced downward compressing the graduating spring, allowing the inlet valve spring to close the upper ball valve against its seat, thus cutting off the flow of supply air.

If while the Controlair is applied, the pressure in the delivery pipe should decrease due to leakage, the pressure on the diaphragm will be reduced. The graduating spring assembly will move upward and open the inlet valve to restore the proper delivery pressure. When this pressure is reached the graduating spring assembly will lower, permitting the inlet valve to reseat itself.

As the operating lever is moved to "Release" the inlet valve spring housing moves upward, with the upper ball valve held on its seat by the inlet valve spring and lifts the lower ball valve from the exhaust valve seat. Thus venting the excess pressure in the delivery pipe to atmosphere through the spring chamber. When the pressure has decreased to desired delivery pressure, the diaphragm spring will be able to raise the diaphragm and the exhaust valve seat against the lower ball valve, cutting off any further venting of excess pressure to atmosphere.

If some temperature variation occurs to change the pressure in the delivery pipe the same action will take place to restore the correct pressure.

When the operating lever moves to full "Release" all the pressure in the delivery pipe will be vented to atmosphere with the same action as above.

WESTINGHOUSE AIR BRAKE CO.
(Industrial Division)
WILMERDING, PENNSYLVANIA

10M-2
Printed in U.S.A.
March, 1949

WESTINGHOUSE AIR BRAKE COMPANY

Marine Division

WILMERDING, PENNSYLVANIA

D-1-A RELAYAIR VALVE

OPERATION AND MAINTENANCE

The D-1-A Relayair Valve is a large capacity piston operated valve designed to control the flow of a large amount of air when actuated by pressure from some relatively low capacity source. One of its principal uses is the control of starting air for Diesel engines, but it may be used wherever a large capacity Relayair Valve is required. As with other Relayair Valves it is a non-graduating valve. When sufficient pressure is applied to the pilot portion the valve will open fully. When pilot pressure is vented the valve will close off and vent the delivery side to atmosphere.

The D-1-A Relayair Valve has 1-1/4'' I.P.S. supply and delivery ports, a 3/4'' I.P.S. exhaust port, a 1/4'' I.P.S. control port and an additional 1/4'' I.P.S. port which is normally plugged but which may be used as a supply connection for some other equipment.

OPERATION

For an explanation of the operation of the valve, reference should be made to Figure 1, the assembly view. Control air enters the valve through port 16 to the chamber at the left of control piston 13, causing it to move to the right, compressing control piston spring 12. The lapped fit portion of the piston stem will first enter the bushing cutting the exhaust port off from the delivery port. Further movement of the piston will cause the piston stem to push inlet pilot valve 23 off its seat on the inlet valve 22, compressing pilot valve spring 25, venting the chamber to the right of the inlet valve. This will unbalance the pressure on the valve 22 causing it to snap to the right off its seat, compressing inlet valve spring 24, allowing air to flow through the valve from the supply port 5 to the delivery port. The control piston 13 will continue to move to the right, holding inlet pilot valve 23 open. The travel of piston 13 is terminated when the valve, which is part of the piston stem, seats against the bushing.

When the control pressure at port 16 is vented, control piston spring 12 will force control piston 12 to the left, allowing pilot valve spring 25 to close the pilot valve. Pressure will now build up at the right of the inlet valve through the small port in the side of the valve. Since the pressure is balanced, inlet valve spring 24 will force the inlet valve to the left to its seat, cutting off supply air. The delivery port will be vented to atmosphere past the control piston stem and out the exhaust port.

ADJUSTMENT

The D-1-A Relayair Valve requires no adjustment.

MAINTENANCE

The D-1-A Relayair Valve must be dismantled for cleaning, inspection of parts and relubrication at stated service intervals. All parts should be washed in solvent to remove dirt and old lubricant. Any valves that leak should be lapped to a tight fit. Gaskets which are cracked or have broken sealing beads should be replaced. The piston should be lubricated with a good grade of machine oil and good grade of grease should be applied to the valve guides.

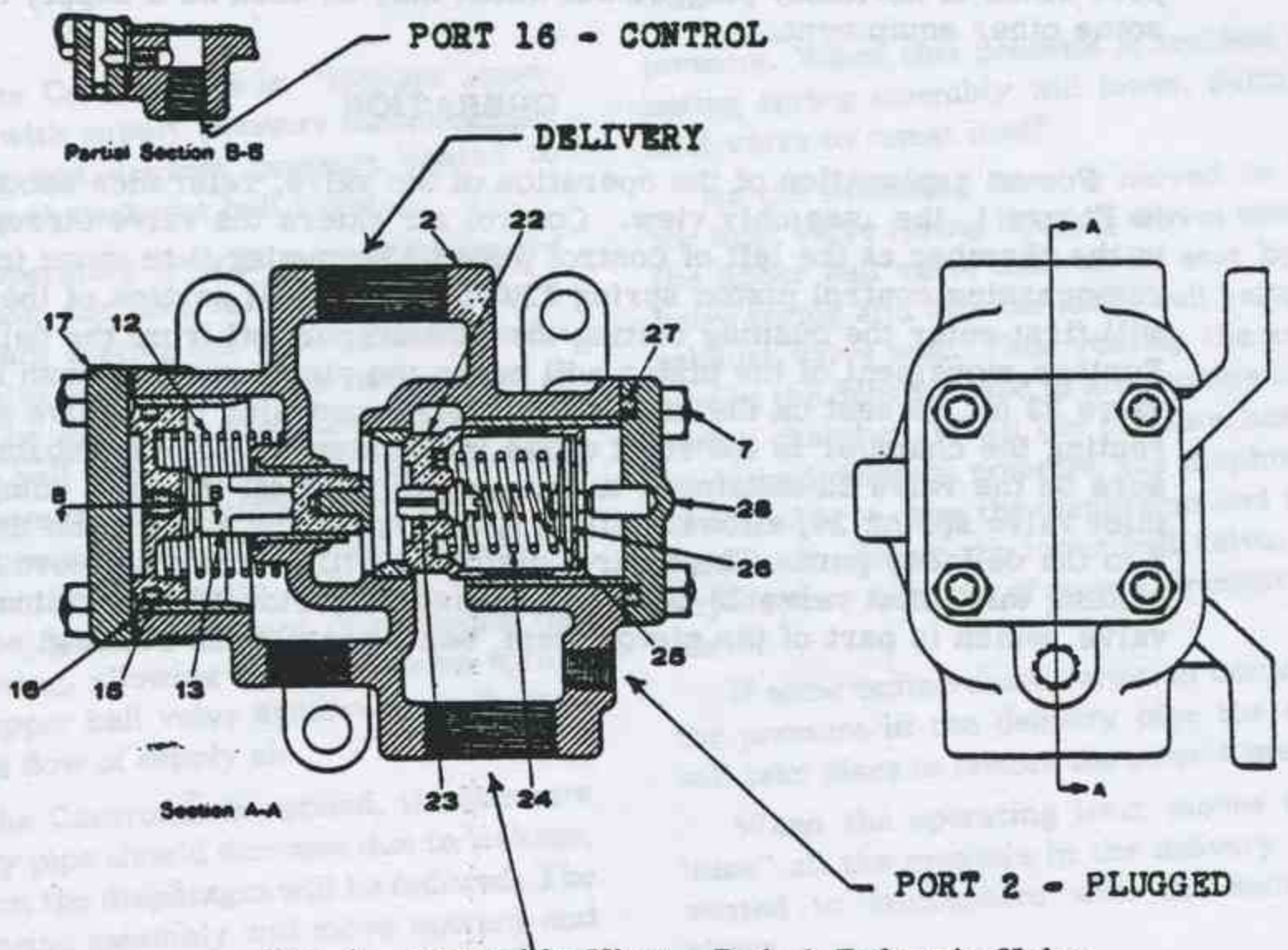


Fig. 1 - Assembly View - D-1-A Relayair Valve

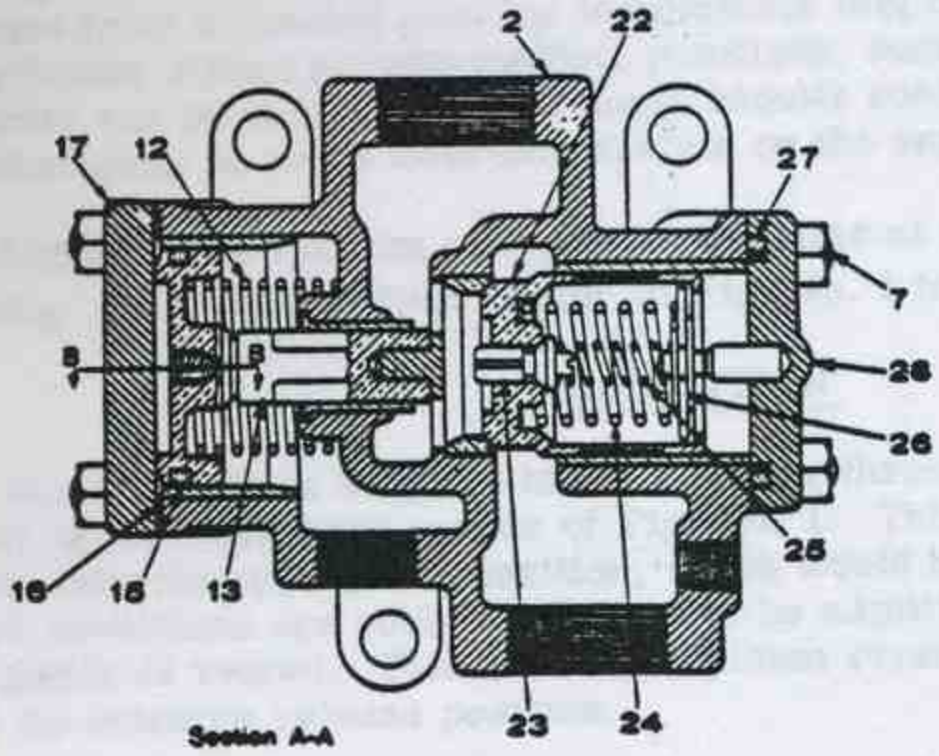
WESTINGHOUSE AIR BRAKE COMPANY

(PART CATALOG SERIES 3231)

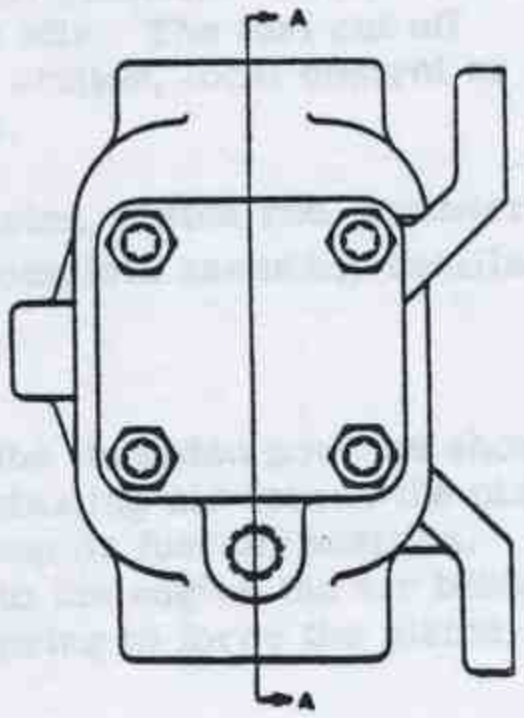
PIECE LIST A-1670-20

D-1-A RELAYAIR VALVE

Partial Section B-B



Section A-A



Pc. No.	Ref. No.	
526408		D-1-A Relayair Valve, complete
522744	2	Body, complete (includes eight of 7 and 8)
84909	7	3/8'' x 1-1/2'' Stud and Nut (8 req'd)
522784	12	Control Piston Spring
526407	13	Control Piston with Tip
524617	15	2-1/2'' O.D. Seal Wabco Packing Ring
522754	16	Piston Cover Gasket
526406	17	Piston Cover
522755	22	Inlet Valve
522756	23	Inlet Pilot Valve
39574	24	Inlet Valve Spring
29082	25	Pilot Valve Spring
522757	26	Inlet Valve Spring Retainer
522758	27	Inlet End Cover Gasket
522759	28	Inlet End Cover with Stop

12-6-45 Prices will be quoted upon application.
P.F. 108.110 Orders should include PIECE NUMBER and NAME of part wanted.
1-C-1
Printed in U.S.A. (aj)

WESTINGHOUSE AIR BRAKE COMPANY

Marine Division

WILMERDING, PENNSYLVANIA

FUEL CUT OFF CYLINDER

OPERATION AND MAINTENANCE

The fuel cut off cylinder, Pc. No. 528187, is a single acting spring return cylinder. It is used for actuating the injector control shaft on Diesel engines from a running position to complete fuel cut off position. The fuel cut off cylinder allows no intermediate positions, such as idle. The fuel cut off cylinder can be controlled from some remote control station, local control or automatically by some interlock system on the engine.

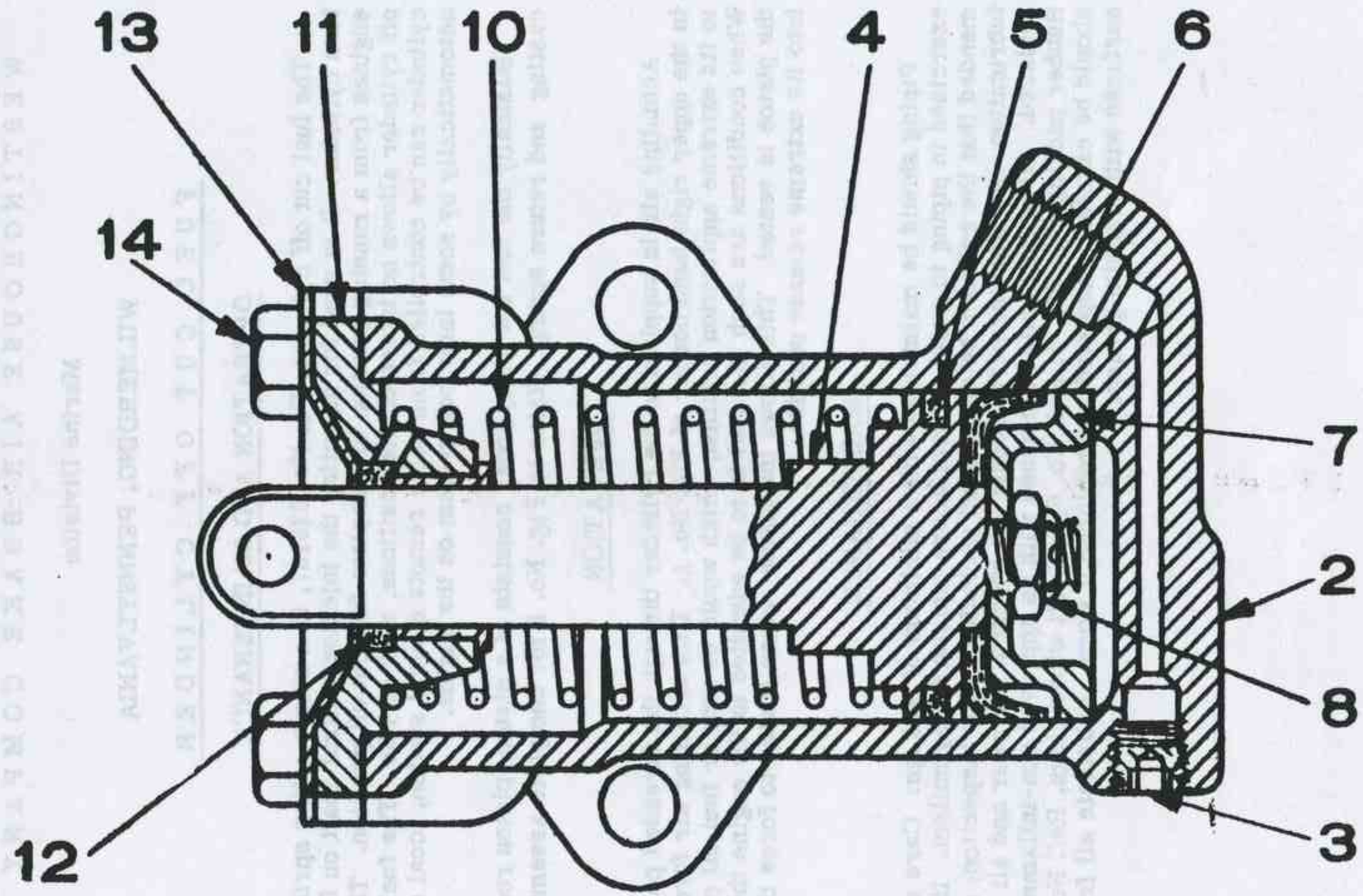
Basically the fuel cut off cylinder consists of a piston, piston rod, cylinder casting and return spring. Refer to Fig. No. 1 for complete assembly details.

OPERATION

Actuating air is supplied to the cylinder through the threaded port, as shown in the upper right hand corner of Fig. No. 1. This actuating air forces the piston to its extreme application position, which would be stop or fuel off position. When conditions are such that fuel is to be admitted to the engine the air behind the piston is vented. This allows the piston return spring to force the piston into its extreme release position.

MAINTENANCE

Piping should be maintained with a minimum of leakage. Care should be exercised in piping to avoid pockets where moisture may collect. It is recommended that the cylinder be dismantled periodically for inspection, cleaning and lubrication. All working parts should be checked for wear and all worn parts replaced. All parts should be cleaned with an approved non-inflammable solvent. Rubber packing cup, Fig. 1, Ref. No. 6, and felt wiper rings, Ref. No. 5 and 12, should be carefully inspected and replaced if worn. Lubricate all friction surfaces with graphite grease.


13
11
10
4
5
6
14
7
2
8
3
12

The handle is then moved sideways into the START AHEAD notch to actually start the engine. This action opens the START on-and-off valve to admit control pressure to the START line at port 7. This pressure will operate a starting valve or air distributor to admit start air to the engine. As soon as the engine starts, the handle is returned to the IDLE position where the engine will run at IDLE speed. The START on-and-off valve will now be closed and the START line vented.

The engine speed may now be increased by moving the Controlair handle forward in the SPEED slot. This will operate the pressure graduating portion of the Controlair to supply a pressure proportional to the handle position through port 8 to the SPEED line. Thus the engine speed can be increased or decreased in graduations of any desired degree by moving the handle forward or back.

To stop the engine, the handle is moved into the STOP position. To start the engine ASTERN, the handle is moved into IDLE ASTERN, sideways into the START notch, and returned to IDLE, after which the speed can be varied as desired between IDLE and FULL SPEED ASTERN.

The control system can be provided with interlocks so that a 'flash' reversal can be safely accomplished by moving the handle directly from any position in one speed zone to the opposite START notch. If interlocks are not provided, motion should be arrested in STOP position until the engine has stopped before starting in the reverse direction.

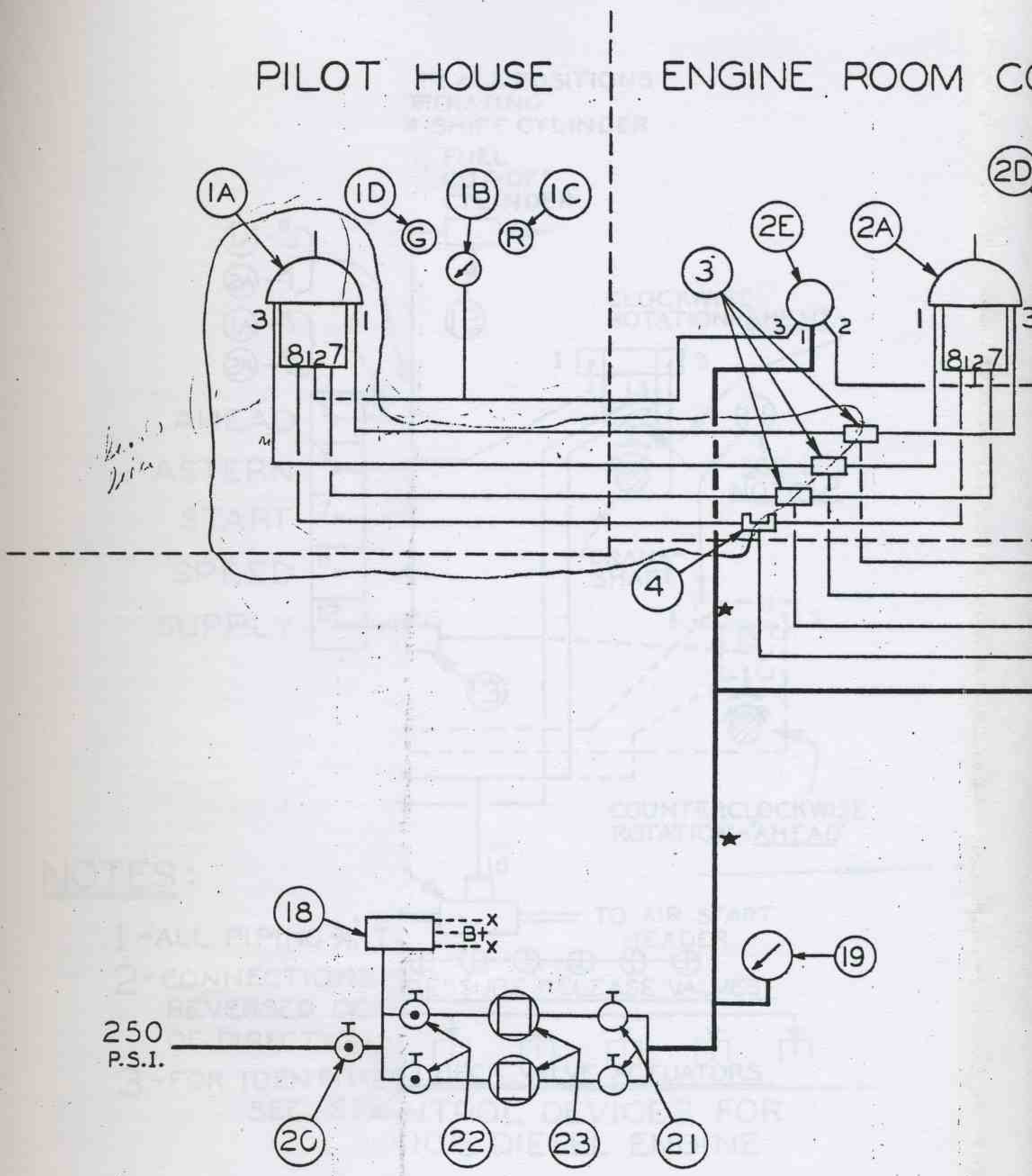
The handle may be locked in any desired position by rotating the handle grip to the right. In speed positions, the rotation required is nominal and easily obtainable. In STOP and IDLE positions the rotation required is slightly greater as a locking indicator for these positions. When the vessel is secured, the Controlair handle should be locked in STOP position.

MAINTENANCE

Piping should be maintained with a minimum of leakage. While the Controlair will compensate for a moderate leakage in the pipes, a loss of air causes unnecessary demand on the vessel's air supply. Care should be exercised in piping installation to avoid pockets in which moisture might accumulate. If a condition exists, provision should be made to drain accumulated moisture daily.

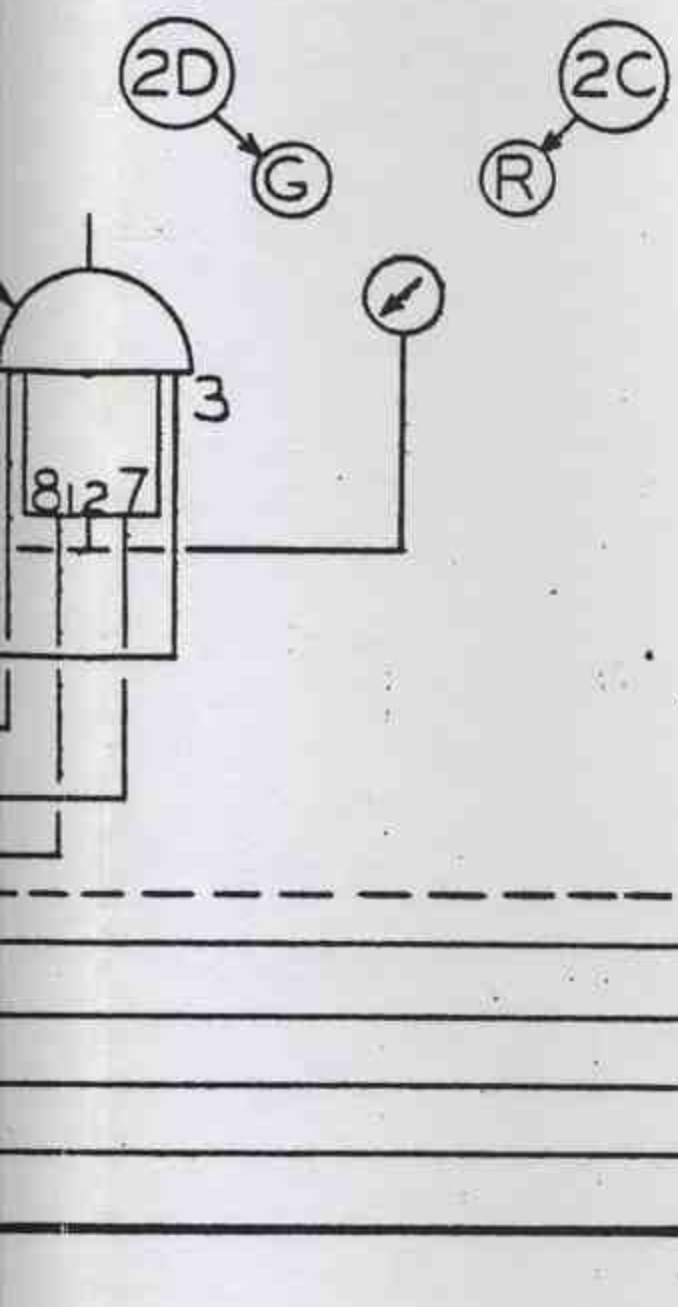
It is recommended that the Controlair be periodically dismantled for inspection, cleaning and lubrication, and parts replaced if worn or defective in any way. This should not be done on the installation, but at a suitable bench in a well lighted location.

When dismantling the Controlair care must be exercised to avoid distortion of bolts, studs, nuts, etc. Care must be taken to avoid mutilation or damage to springs, gaskets, diaphragms, valves and valve seats. It is possible to assemble or disassemble all parts of the device readily. If the force required seems excessive, investigate immediately to determine the cause of the difficulty.



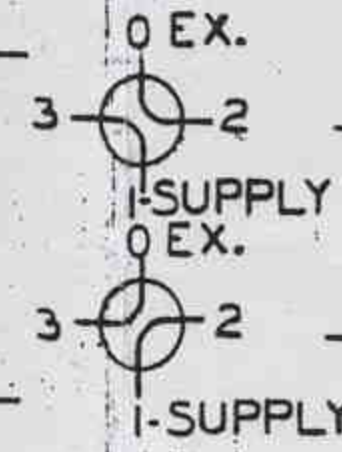
ALL TUBING '3/8" O.D. EXCEPT SUPPLY ★ WHICH IS '1/2" O.D.

M CONTROL



SEE
S-302.3B1/4

POSITIONS OF A-5A
ROTAIR, ITEM 2E



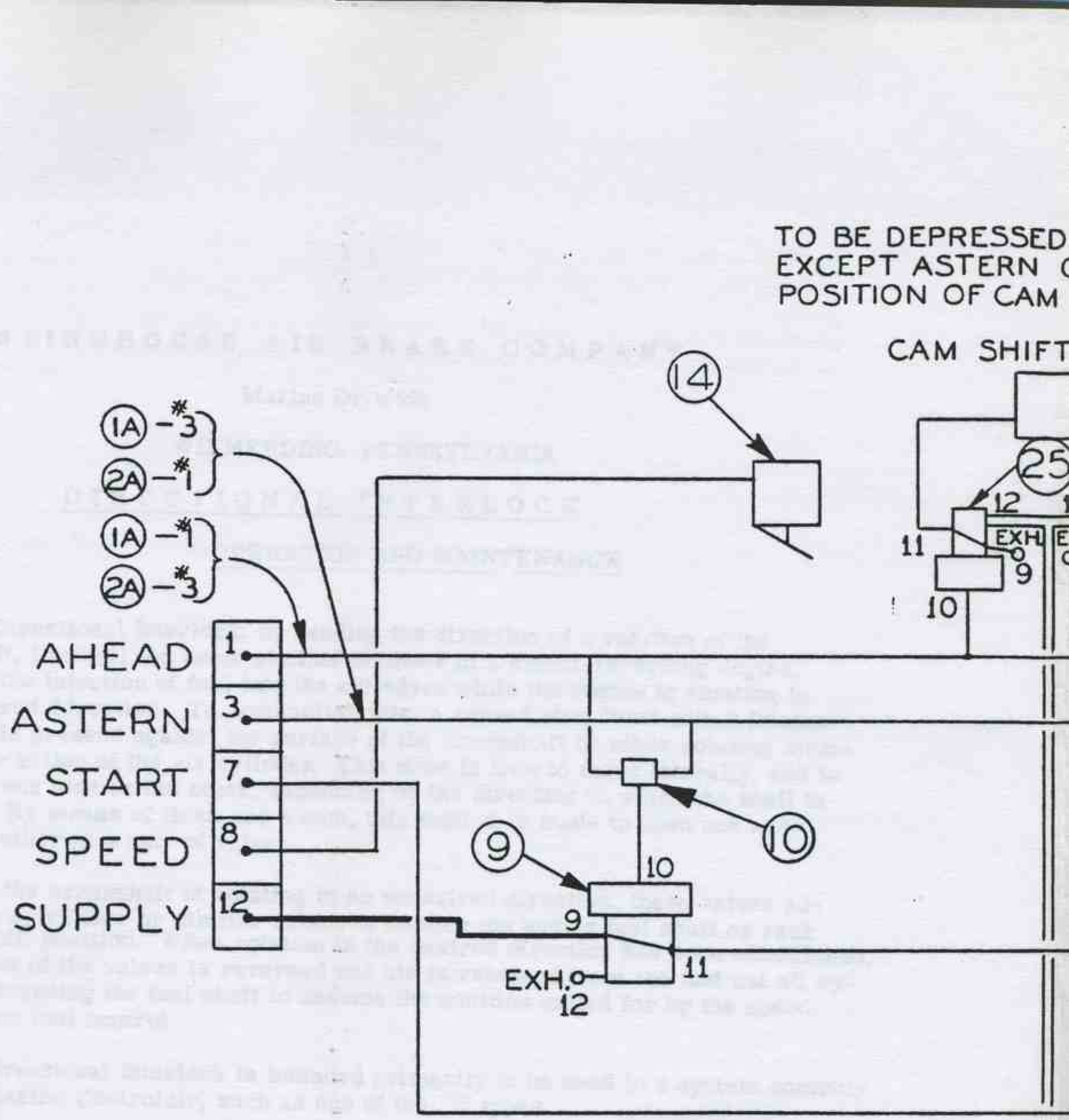
REMOTE POSITION

LOCAL POSITION

FOR IDENTITIES OF DEVICES SEE SPECIFICATION I-302.BB

TWO STATION CONTROLS FOR ONE
ATLAS 9X10 1/2 DIESEL ENGINE

S-302.5-1/4



NOTES:

1 - ALL PIPING 3/8" TUBING

2 - CONNECTIONS 1&3 OF ITEM 11 MAY BE REVERSED DEPENDING UPON MOUNTING OF DIRECTIONAL INTERLOCK & ROTATION

3 - FOR IDENTITIES OF DEVICES, SEE SPECIFICATION I-302.8B

SED IN ALL POSITIONS
RN OPERATING
AM SHIFT CYLINDER

TO BE DEPRESSED IN ALL POSITIONS
EXCEPT AHEAD OPERATING
POSITION OF CAM SHIFT CYLINDER

HIFT CYLINDER

FUEL
LIMIT
CYLINDER

FUEL
CUT-OFF
CYLINDER

CLOCKWISE
ROTATION-AHEAD

SEE NOTE #2

CRANK-
SHAFT

COUNTERCLOCKWISE
ROTATION-"AHEAD"

TO BRAKE
(IF USED)

TO AIR START
HEADER

CYLINDER PRESSURE RELEASE VALVES

AIR STARTING CHECK VALVE ACTUATORS

1¼ GLOBE VALVE

AIR SUPPLY TANK

PSI SUPPLY

ENGINE CONTROL DEVICES FOR ATLAS 9×10½ DIESEL ENGINE

S 302.3B-¼ ED2

WESTINGHOUSE AIR BRAKE COMPANY

Marine Division

WILMERDING, PENNSYLVANIA

DIRECTIONAL INTERLOCK

OPERATION AND MAINTENANCE

The Directional Interlock, by reading the direction of a rotation of the crankshaft, flywheel, or some similar member of a direct-reversing engine, prevents the injection of fuel into the cylinders while the engine is rotating in an undesired direction. To accomplish this, a curved shoe lined with a friction material is pressed against the surface of the crankshaft or other rotating member by the action of the air cylinder. This shoe is free to move laterally, and is moved to one side or the other, depending on the direction in which the shaft is rotating. By means of links and a cam, this motion is made to open one and close the other of a pair of valves.

When the crankshaft is rotating in an undesired direction, these valves admit air to a cylinder or similar means of holding the engine fuel shaft or rack in 'Fuel Off' position. When rotation in the desired direction has been established, the position of the valves is reversed and air is released from the fuel cut off cylinder, permitting the fuel shaft to assume the position called for by the speed governor or fuel control.

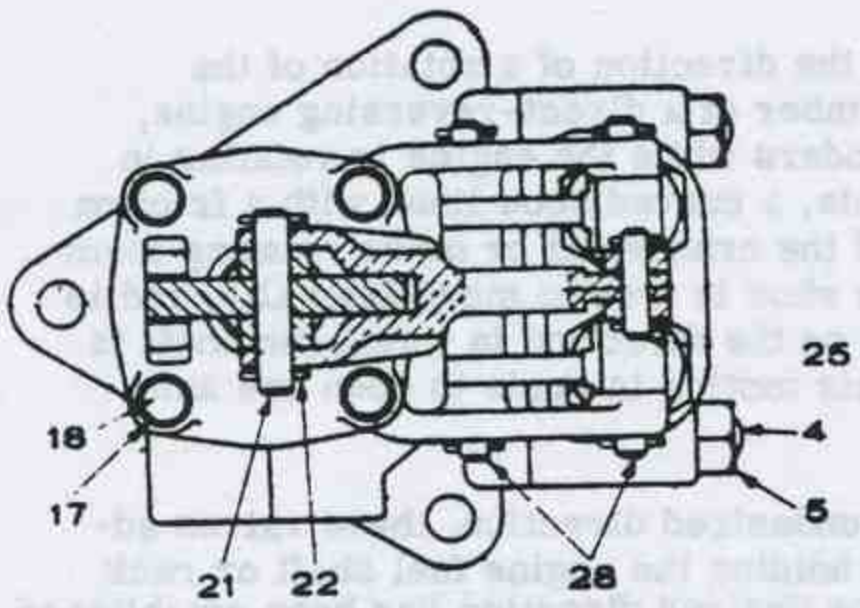
The Directional Interlock is intended primarily to be used in a system controlled by a marine Controlair, such as one of the 'F' types.

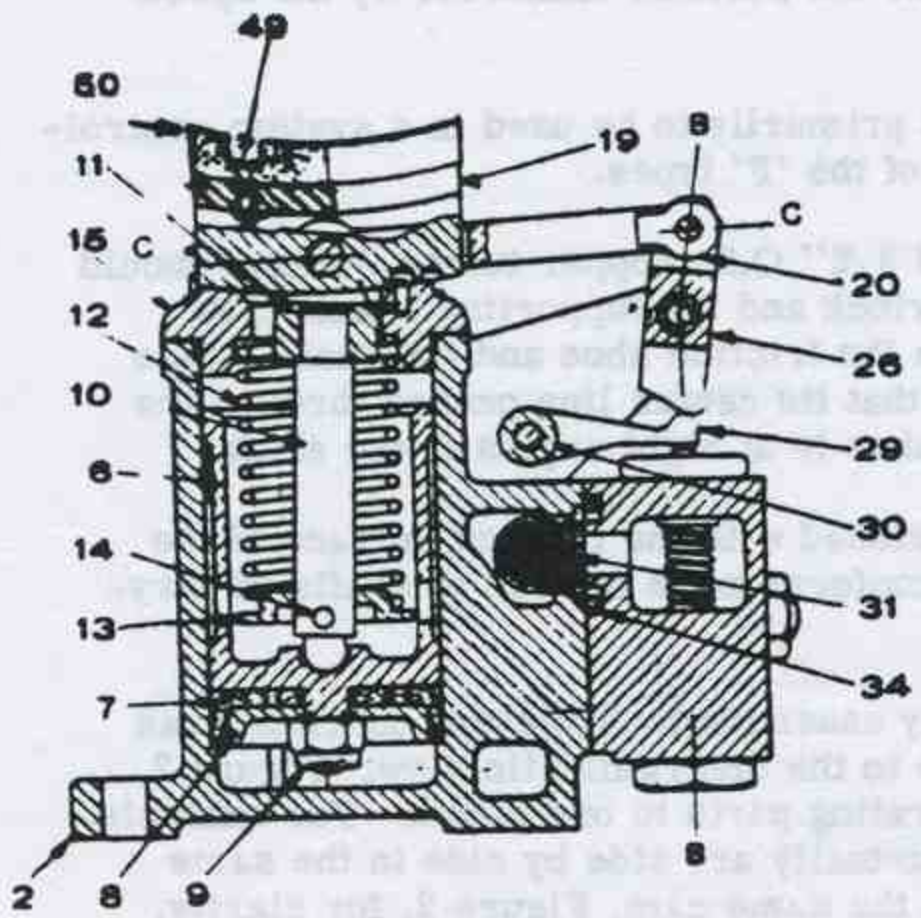
The 1/4'' pipe taps permit the use of 3/8'' O.D. copper tubing. Shims should be provided between the Directional Interlock and its supporting bracket, to permit adjustment for clearance between the friction shoe and the shaft. Care must be taken to install the Interlock so that its center line passes through the center line of the shaft, and its friction shoe is at right angles to the shaft.

It will be noted that the device is furnished with the friction surface of the shoe formed at different curvatures, to conform more or less to shafts of varying diameters.

Figure 1 shows the device as actually assembled. However, operation can be more readily understood by reference to the diagrammatic view, Figure 2, which has been distorted to show all operating parts in one plane. For example, it will be seen that while the two valves actually are side by side in the same casting and are operated by two lobes on the same cam, Figure 2, for clarity, shows them laid out on opposite sides of the cylinder and operated by separate cams.

The device is represented in the position it would assume with its shoe in contact with a shaft turning in Astern direction. Port 1 is connected to the Ahead line from the Controlair and Port 3 to the Astern line. (It should be understood that in any given installation these two connections may be reversed, depending on the way the valve is mounted in relation to the shaft, and on the normal rotation of the engine.) Port 7 is connected to the Start line, and Port 13 to the Fuel Cut-off Cylinder.





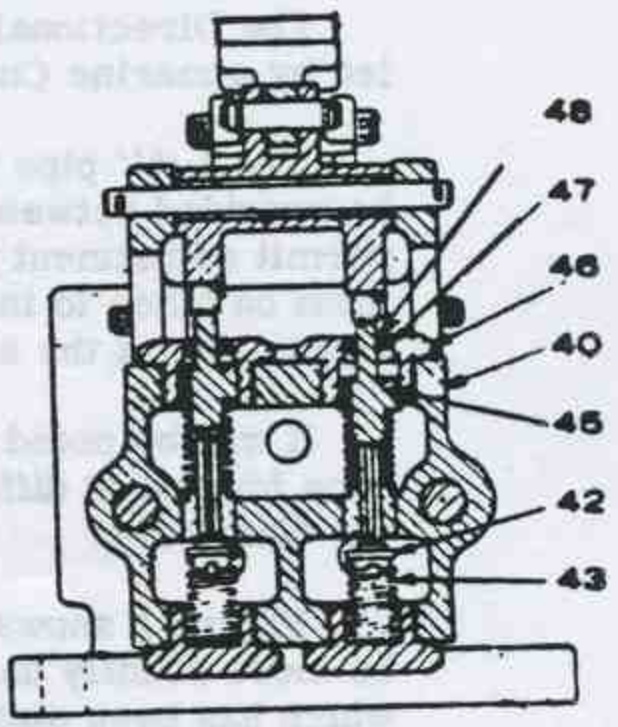


Fig. 1 - Assembly View

D-1 REDUCING VALVE

Operation and Maintenance Instructions

The reducing valve is a regulating device which serves to reduce the air pressure supply to the required delivery pressure.

The D-1 Reducing Valve delivers pressures ranging from 5 to 250 psi. from a maximum supply pressure of 600 psi. Capacity is approximately the equivalent of a .024 sq. in. orifice.

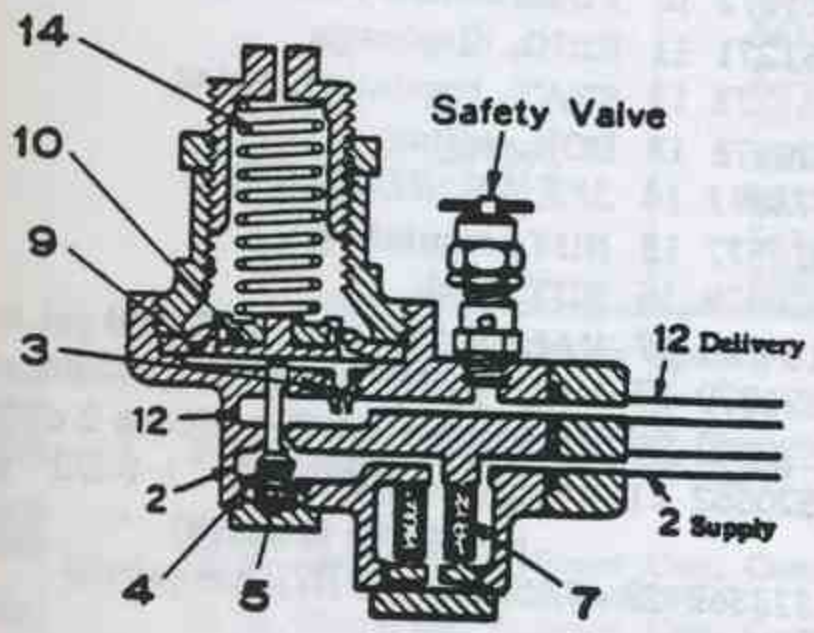


Fig. 1 Diagramatic, Open Position

It consists essentially of a regulating spring 14 acting on diaphragm 11 and controlling the position of supply valve 4. Spring pressure on diaphragm 11 is adjustable by means of regulating nut 15. Removable strainer 7 prevents the entrance of foreign matter that may be present in the air supply. A by-pass choke prevents "pumping" action of the diaphragm by providing a stabilizing action between the diaphragm and delivery passages. Safety valve 17, connected to the delivery port, protects against excessive pressure. The reducing valve is bolted to pipe bracket 20 which has two 1/4" taps for pipe connections.

MAINTENANCE

The D-1 Reducing Valve should be dismantled periodically for inspection, cleaning, and lubrication.. To remove the supply valve and spring, back out screw plug 6. Back out screw plug 8 to remove the strainer unit. The regulating spring, diaphragm assembly, and by-pass choke are accessible upon removal of spring box 13.

Wash all parts in an approved, non-inflammable solvent and dry with a low pressure air jet. Lubricate the supply valve guide sparingly with a good grade light grease. Replace gaskets 22 if they are checked or if the sealing beads are broken. A leaky valve can be restored to its seat by rubbing in lightly with a fine grade valve-grinding compound. Lubricate all friction surfaces with a grease not critical to temperature.

4

For maintenance of safety valve 17 see 9355-21.

ADJUSTMENT

To adjust the reducing valve, loosen lock nut 16 and turn regulating nut 15, clockwise to increase or counter-clockwise to reduce the delivery pressure. An air gage connected to the delivery pipe and placed close to the reducing valve should be used. Tighten lock nut 16 when the desired setting is obtained.

To adjust the safety valve 17, loosen the lock nut (lower nut) and turn the regulating nut clockwise to raise or counter-clockwise to lower blow-off point which should be 25 psi. above the delivery pipe pressure. After adjustment is completed, tighten the lock nut.

OPERATION

Supply air passes through strainer 7 and past supply valve 4 to the delivery passage and also through choke 3 to the underside of diaphragm 9. As pressure builds up in the delivery pipe, it acts on diaphragm 9 to balance the force of regulating spring 14, resulting in upward deflection of the diaphragm which allows spring 5 to close the supply valve.

When delivery pressure falls, the regulating spring force deflects the diaphragm downward, unseating the supply valve and permitting flow of supply air to maintain the desired pressure in the delivery pipe.

9355-1

REPAIR PARTS LIST

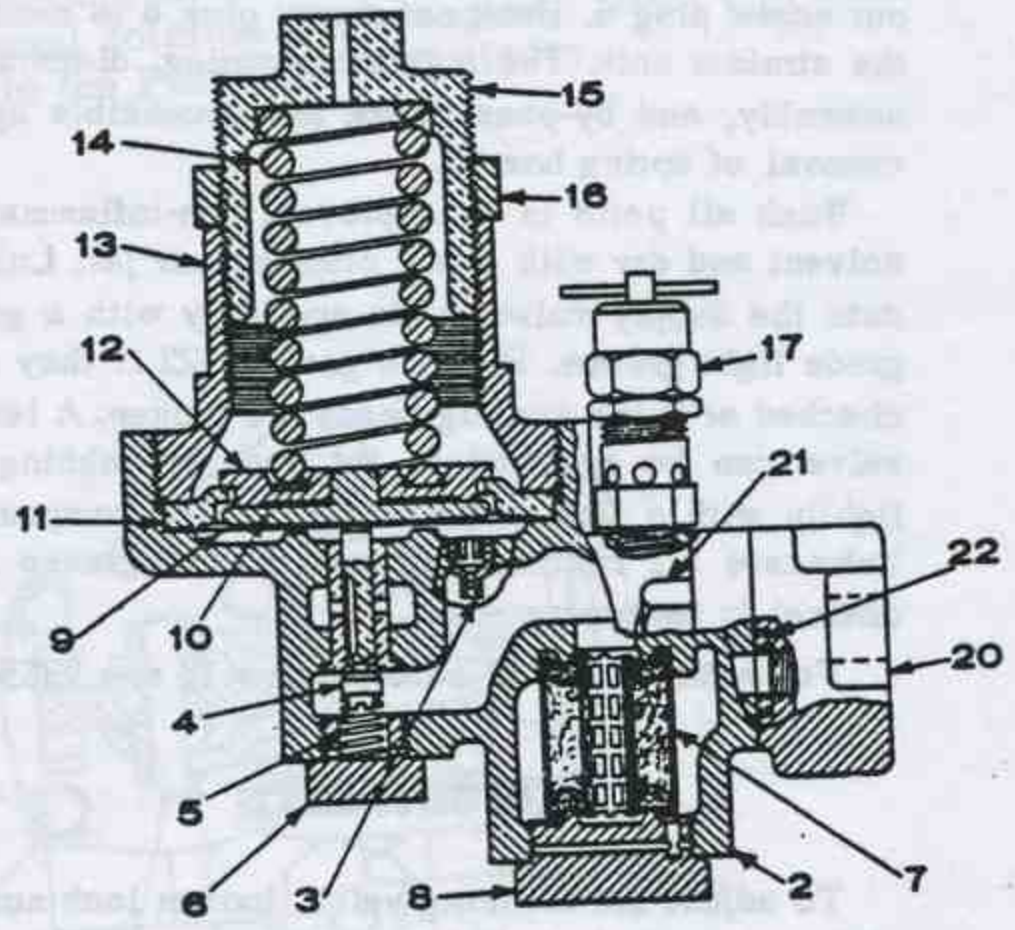


Fig. 2 D-1 Reducing Valve Assembly

4

Pc. No.	Ref. No.	
535180	2	BODY (includes 3)
96190	3	PLUG, 1/8" choke
520575	*4*	*VALVE*
521391	*5*	*SPRING, VALVE*
520576	6	NUT, cap
506630	7	STRAINER
520583	8	NUT, strainer
73901	*9*	*DIAPHRAGM (2 required)*
81272	10	FOLLOWER, diaphragm
81271	11	RING, diaphragm
81273	12	SEAT, regulating spring
520578	13	BOX, spring
73891	*14*	*SPRING, REGULATING*
520577	15	NUT, regulating
520579	16	NUT, lock
184766	17	VALVE, "F" safety (77-250 psi range)
521879	17	VALVE, "F" safety (30/140 psi range)
520580	20	BRACKET, pipe (includes 2 of 21)
520582	21	STUD and NUT, 1/2" x 1-1/2" pipe bracket (2 required)
513569	*22*	*GASKET, PORT (2 required)*

Description	Piece No.	Delivery Range psi	Safety Valve Range psi
D-1 complete	520521	5-100	30-140
D-1 less bracket	521938		
D-1 complete	524083	5-250	77-250
D-1 less bracket	524345		

NOTE. Parts set in *italic type* are recommended spares to be carried in stock at all times. Suggested quantities are: 100% for rubber parts, and 25% for all other parts recommended.

Prices will be quoted upon application.

Orders should give PIECE NO. and NAME of part.

3M-3
December, 1951
Printed in U.S.A.

REPAIR PARTS LIST

"H-5" RELAYAIR VALVES

Piece Number		Pressure (psi.)	
Valve Complete	Valve Portion	Operating	Supply (Max.)
532324	532365	*10	200
534814	534815	*15	200
529017	529027	*20	200
527561	527683	*25	200
	541537	*30	200
528561	528562	*35	200
	541539	*40	200
528681	529955	45	200
530530	530531	45	300
	541541	50	200
	528979	60	200
	541420	70	200
534671	529953	80	200
529016	541545	90	200
	541547	100	200
	529025	110	200

* Includes Outer Spring 6 only.

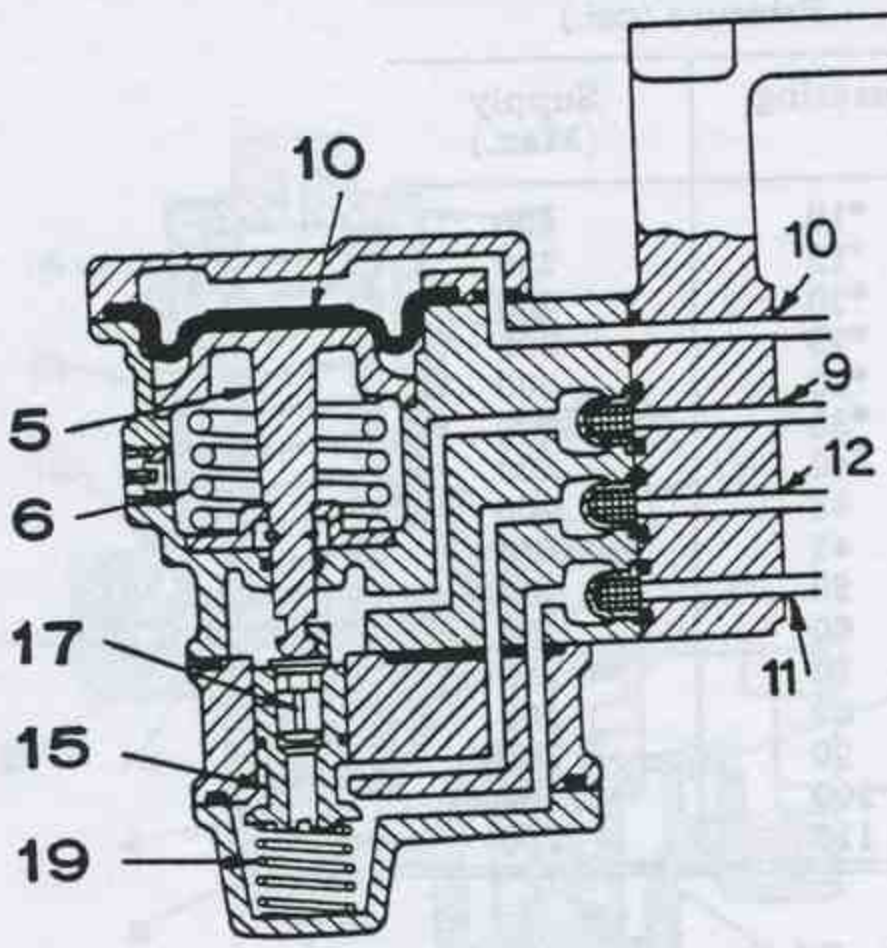
Pc. No.	Ref. No.	
527587	2	Valve Body (Incl. 4 and two of 3)
538571	3	⅜x3" Check Valve Body and Cover Stud with Nut (2 req'd)
97130	4	¼" Wasp Excluder
532364		10 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Brown], 7, 8 and 9)
528550		15 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Green], 7, 8 and 9)
529028		20 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Yellow], 7, 8 and 9)
527571		25 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Plain], 7, 8 and 9)
541538		30 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Red], 7, 8 and 9)
528981		35 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Blue], 7, 8 and 9)
541540		40 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [White], 7, 8 and 9)
529956		45 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Blue], 7, 8, 9 and 25 [Plain])
541541		50 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [White], 7, 8, 9 and 25 [Plain])
528980		60 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [White], 7, 8, 9 and 25 [Brown])
541544		70 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Brown and White], 7, 8, 9 and 25 [Brown])
529954		80 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Green and White], 7, 8, 9 and 25 [Green])
541546		90 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Red and White], 7, 8, 9 and 25 [Green])
541548		100 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Yellow and White], 7, 8, 9 and 25 [Yellow])
529026		110 lb. Diaphragm Follower Unit, Complete (incl. 5, 6 [Blue and White], 7, 8, 9 and 25 [Yellow])
527572	5	Diaphragm Follower
541453	*6*	*10 lb. Outer Diaphragm Spring (Brown)*
541454	*6*	*15 lb. Outer Diaphragm Spring (Green)*
541455	*6*	*20 lb. Outer Diaphragm Spring (Yellow)*
525125	*6*	*25 lb. Outer Diaphragm Spring (Plain)*
541457	*6*	*30 lb. Outer Diaphragm Spring (Red)*
523527	*6*	*35-40 lb. Outer Diaphragm Spring (Blue)*
528787	*6*	*40-50-60 lb. Outer Diaphragm Spring (White)*
541460	*6*	*70 lb. Outer Diaphragm Spring (Brown and White)*
541461	*6*	*80 lb. Outer Diaphragm Spring (Green and White)*
541462	*6*	*90 lb. Outer Diaphragm Spring (Red and White)*
541463	*6*	*100 lb. Outer Diaphragm Spring (Yellow and White)*
541464	*6*	*110 lb. Outer Diaphragm Spring (Blue and White)*
527573	7	Spring Seat
512612	8	Spring Seat Retainer
534662	*9*	*⅜" O.D. Seal WABCO® Packing Ring*
522980	*10*	*Diaphragm*
523619	*11*	*Port Gasket (body and diaphragm cover)*
527566	*12*	*Diaphragm Cover*
527581	*13*	*Check Valve Body Gasket*
527575	14	Check Valve Body
527578	*15*	*Supply Valve*
524612	*16*	*½" O.D. Seal WABCO Packing Ring*
527579	*17*	*Exhaust Valve*
527582	*18*	*Check Valve Body Cover Gasket*
527588	*19*	*200 lb. Supply Valve Spring*
530526	*19*	*300 lb. Supply Valve Spring*
527580	20	Check Valve Body Cover
538537	21	⅜x1⅛" Diaphragm Cover Bolt and Nut (4 req'd)
527583	23	Strainer (3 req'd)
529161	24	Strainer Retaining Ring (3 req'd)
541465	*25*	*45-50 lb. Inner Diaphragm Spring (Plain)*
528971	*25*	*60-70 lb. Inner Diaphragm Spring (Brown)*
541467	*25*	*80-90 lb. Inner Diaphragm Spring (Green)*
541468	*25*	*100-110 lb. Inner Diaphragm Spring (Yellow)*
527705	31	Pipe Bracket (incl. three of 32)
85476	32	⅜x1¼" Body Stud and Nut (3 req'd)
93840	*33*	*Strainer Gasket (3 req'd)*
513569	*34*	*Port Gasket (body and pipe bracket)*

NOTE. Parts set in *italic type* are recommended spares to be carried in stock at all times. Suggested quantities are: 100% for rubber parts. and 25% for all other parts recommended.

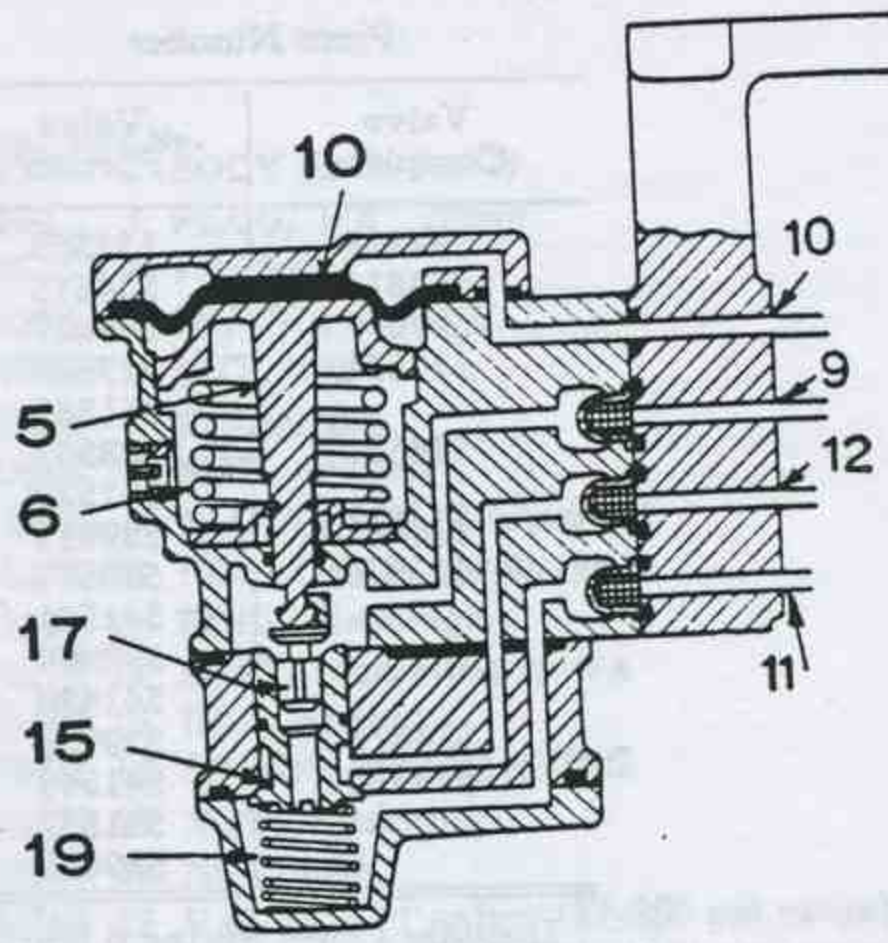
Prices will be quoted upon application.

Orders should give **PIECE NO.** and **NAME** of part.

OPERATION



APPLIED Position



RELEASED Position

Fig. 3. Diagrammatic Views

Referring to Fig. 3, piloting or control pressure enters through passage 10 to the chamber above diaphragm 10. When the pressure reaches spring setting, the diaphragm and its follower 5 move downward compressing spring 6 and seating exhaust valve 17 on the top of supply valve 15. As the downward movement continues, supply valve 15 moves away from its seat, compressing spring 19. Exhaust passage 9 is now closed by exhaust valve 17, while supply passage 12 is connected to delivery passage 11.

When control or piloting pressure above diaphragm 10 is vented, spring 6 returns diaphragm follower 5 and exhaust valve 17 to their upper positions, unseating the exhaust valve. Spring 19 then seats supply valve 15 and closes supply passage 12 while delivery passage 11 is connected to exhaust passage 9 past the unseated exhaust valve 17.

ADAPTATIONS

While ports 9, 11 and 12 are indicated above for certain purposes, this is done only to simplify the explanation, and does not mean that the ports are restricted to these particular uses. Function and direction of flow may vary according to operation desired and a variety of piloting arrangements and porting connections may be employed.

DOUBLE PILOTING

Additional flexibility of operation can be obtained by removing wasp excluder 4, Fig. 1, and using this tap as port 1 to introduce another piloting pressure below diaphragm 10. This permits double piloting, which provides that the introduction of control pressure above the diaphragm causes downward movement of the parts with corresponding port connections, while admission of pressure under the diaphragm returns diaphragm follower and parts to the upper position against the piloting pressure above the diaphragm. Pressure should never be applied below the diaphragm unless there is piloting pressure above, and the pressure below should never exceed that above the diaphragm. Lower piloting pressures may be used underneath the diaphragm since spring force assists in the upward movement.

WESTINGHOUSE AIR BRAKE CO.
(Industrial Products Division)
WILMERDING, PENNSYLVANIA

3M-3
Printed in U.S.A.
Oct., 1950

INDUSTRIAL PRODUCTS DIVISION
WESTINGHOUSE AIR BRAKE COMPANY
WILMERDING, PENNA.

9366-27

"H-5" RELAYAIR® VALVES

Operation and Maintenance Instructions

The H-5 RELAYAIR Valve is a non-graduating relay valve that is piloted by a small air flow to control the flow of air from a separate and independent supply. It can be used in a number of ways for a variety of purposes. The two basic uses are—

(a) As a relay to provide a large flow of air from a separate source when a small amount of air is admitted in the control chamber of the valve, and to stop this flow of air when the control pressure is vented.

(b) As an interlock to govern the flow of air in one circuit by placing its control in another independent air circuit.

There is a series of H-5 RELAYAIR Valves which are structurally identical except for spring variations as follows—

(a) Valves operated by a control or piloting pressure of 35 psi. or less have only one diaphragm spring. Valves operated by control or piloting pressures greater than 35 psi. have two diaphragm springs.

(b) Valves for supply pressures not exceeding 200 psi. have a light supply valve spring. Valves for supply pressures up to 300 psi. have a heavier spring.

To obtain the variety of piloting pressures, different sizes and combinations of inner and outer diaphragm springs are used. The minimum control or piloting pressure is stamped on the diaphragm cover of each valve. Under no conditions should this pressure exceed 140 psi.

The identifying piece numbers and the piloting pressures for each H-5 RELAYAIR Valve are listed on page 3.

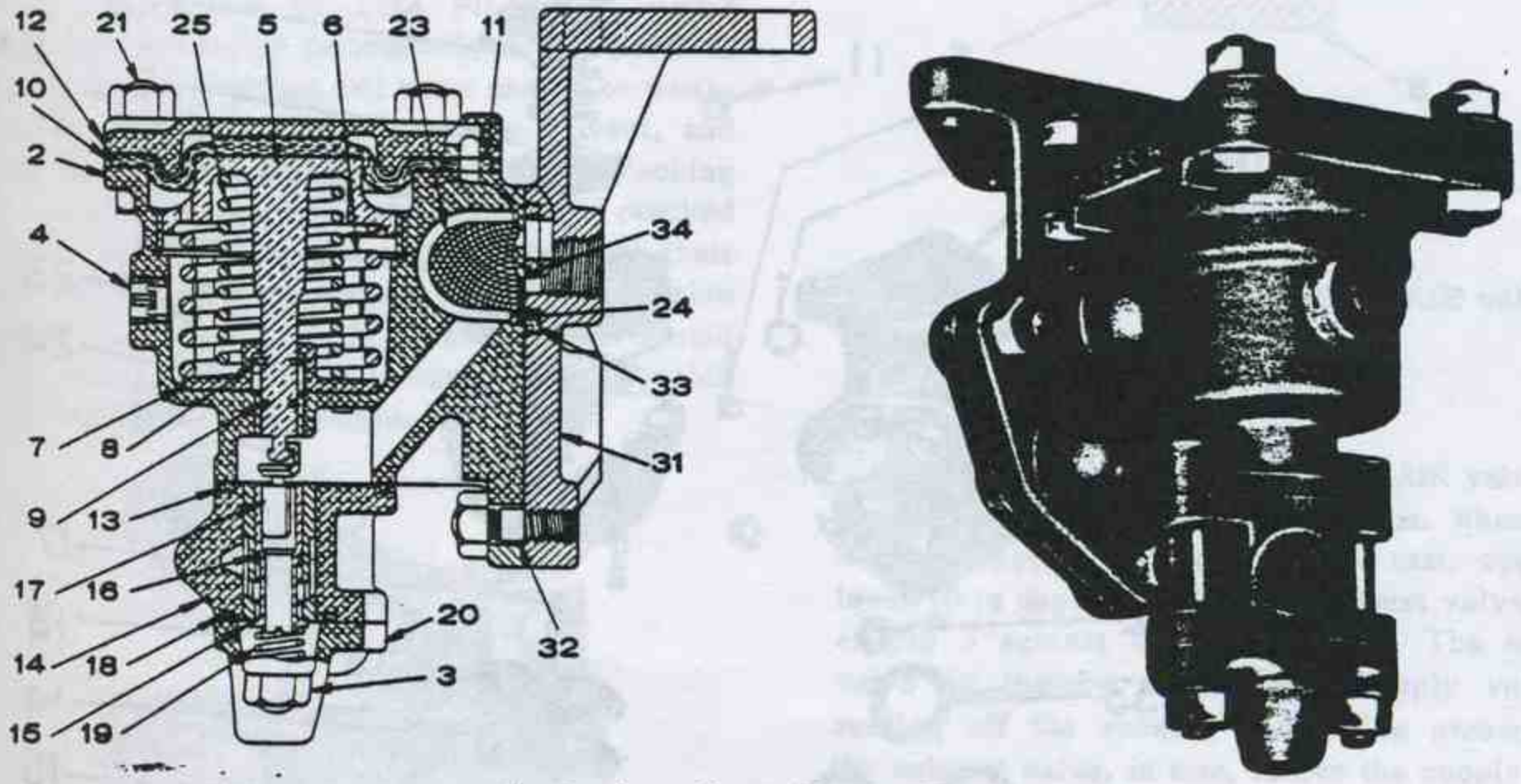


Fig. 1. Assembly and Exterior Views

MAINTENANCE

While the H-5 RELAYAIR Valves require practically no maintenance, at six month intervals they should be taken apart and inspected. Diaphragm 10 and packing rings 9 and 16 should be replaced if damaged or badly worn. Except in emergencies, never reinstall these parts if they are broken, cracked or distorted. If worn, supply valve 15 and exhaust valve 17 can be reseated by using a fine, good grade valve grinding compound.

Before reassembly, strainer 23 and all other parts should be washed in an approved non-inflammable solvent and blown dry with clean dry air. A small amount of graphite grease should be applied to the wearing surfaces at packing rings 9 and 16.

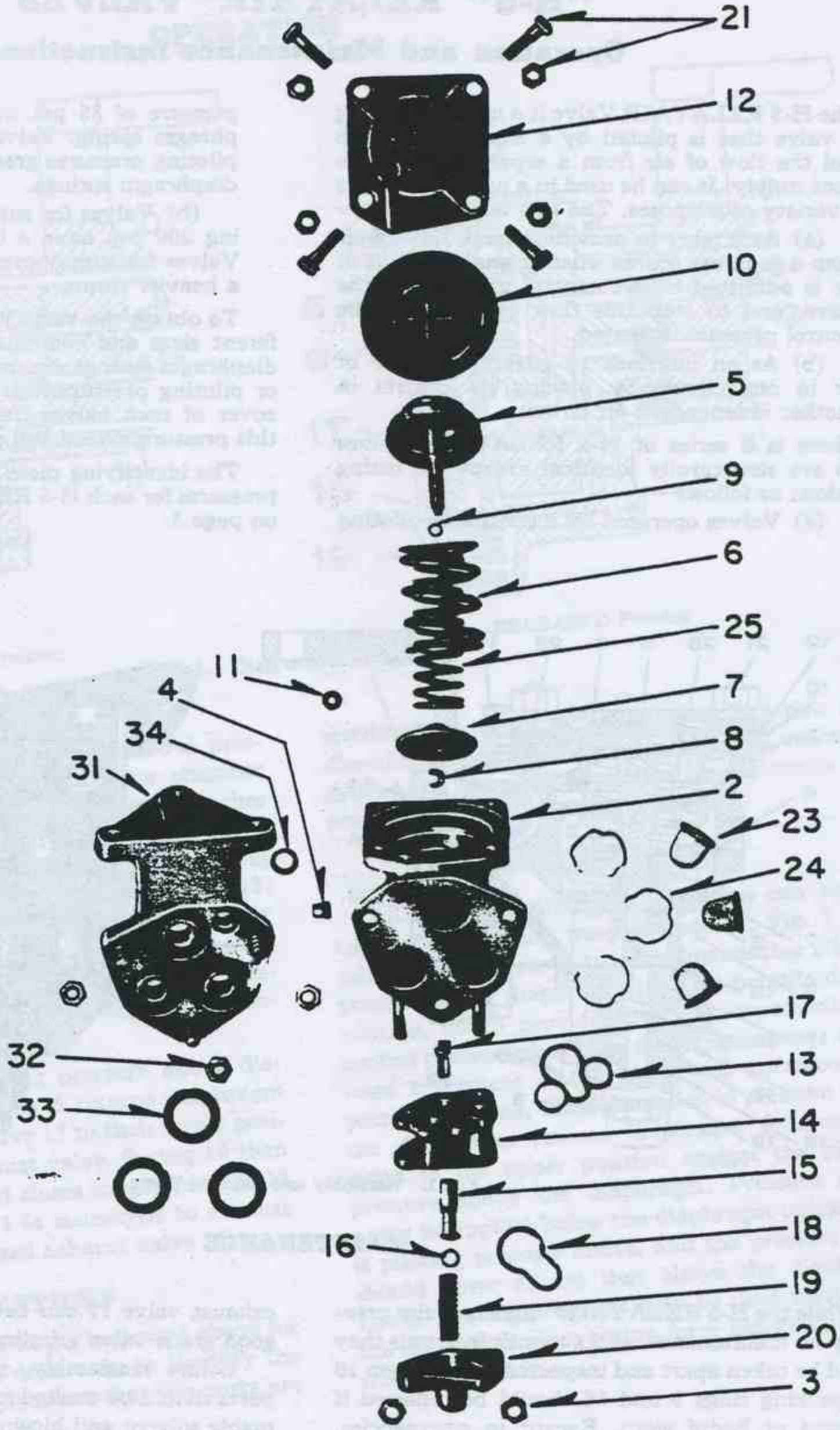


Fig. 2. Exploded View

2-C-1-B AND 2-C-1-BA PILOTAIR VALVE

Operation and Maintenance Instructions

The 2-C-1-B and 2-C-1-BA PILOTAIR valves are "on and off" type valves which are machined from solid steel blocks for greater durability. They have a 17/64" equivalent orifice capacity, and are designed to admit and discharge air from pneumatic systems. The valves are tapped for 1/4" supply and delivery pipes, and these connections are marked "In" and "Out", respectively. The 2-C-1-BA valve is designed for operation by means of a foot pedal, to be supplied by the customer, and includes a heavy mounting bracket. The 2-C-1-B is available with either a cam dog or roller.

MAINTENANCE

The 2-C-1-B and 2-C-1-BA PILOTAIR valves should be dismantled periodically for inspection, cleaning and lubrication. All parts should be washed in an approved, non-inflammable solvent, and blown dry with a low pressure air jet. Packing ring 6 should be checked, and replaced if cracked or worn. Leaking valves may be restored to their seats by rubbing lightly with a fine grade valve grinding compound. All friction surfaces should be lubricated with a small amount of grease which is not critical to temperature.

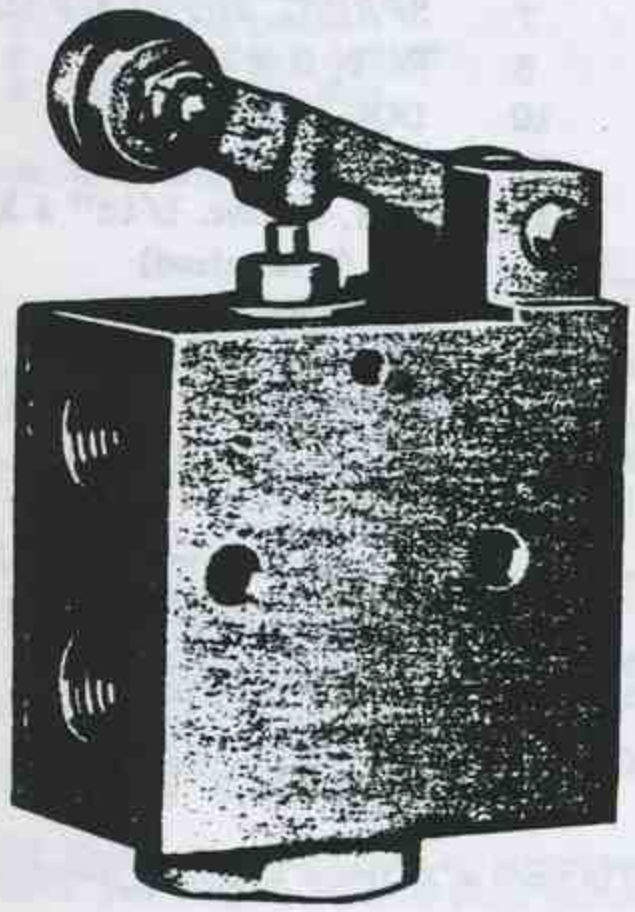


Fig. 1 Exterior View

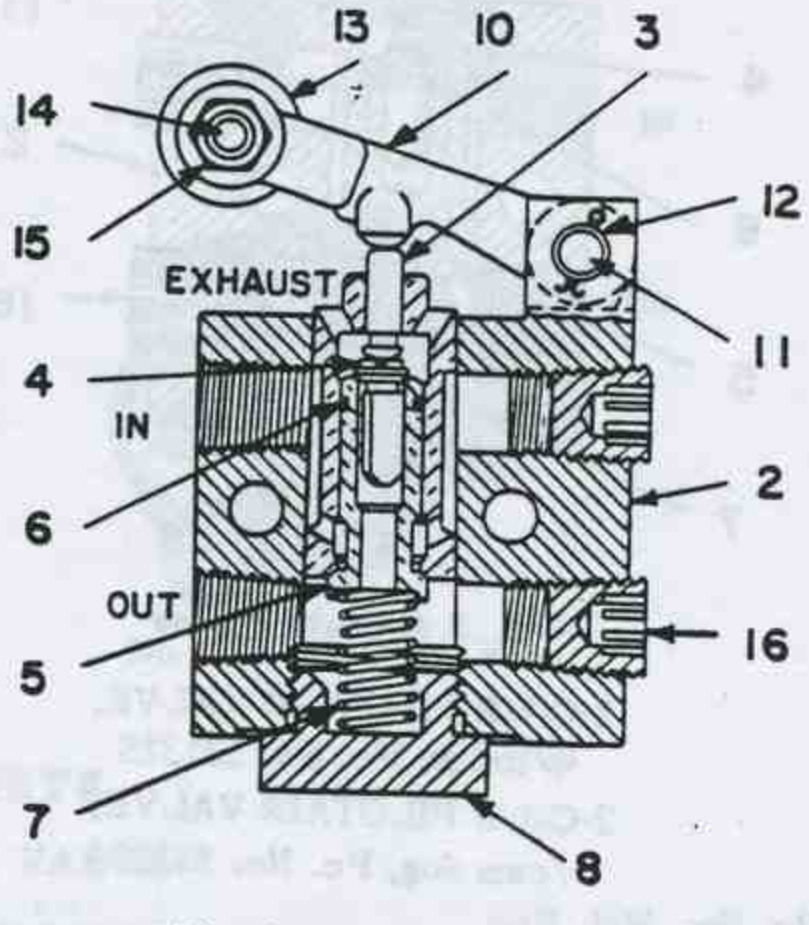


Fig. 2 Diagrammatic

ADJUSTMENT

The 2-C-1-B and 2-C-1-BA PILOTAIR valves do not require adjustment.

OPERATION

The 2-C-1-B and 2-C-1-BA PILOTAIR valves are similar in construction and operation. When pressure is applied on the roller or cam, operating lever 10 is depressed, forcing exhaust valve pusher pin 3 against exhaust valve 4. The exhaust valve is thereby seated upon supply valve 5, sealing off the exhaust ports. The pressure on the exhaust valve, in turn, forces the supply valve downward, away from its seat, connecting the supply port to the delivery port. This admits air to the pneumatic system. When pressure is removed from the actuating stem, supply valve spring 7, which was compressed by the downward movement of the valve, reseats the supply valve, closing the connection between the supply and delivery ports. Air pressure in the system lifts the exhaust valve from its seat, allowing the system to exhaust to atmosphere through the exhaust ports in the top of the valve body.

9357-33

REPAIR PARTS LIST

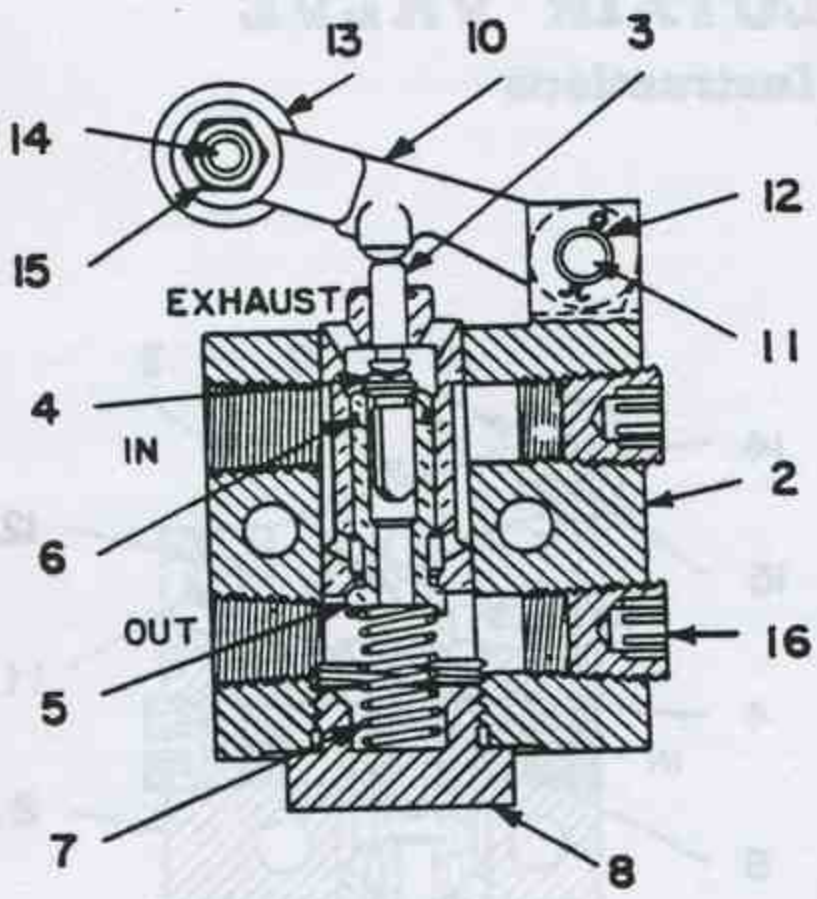


Fig. 3 Assembly View

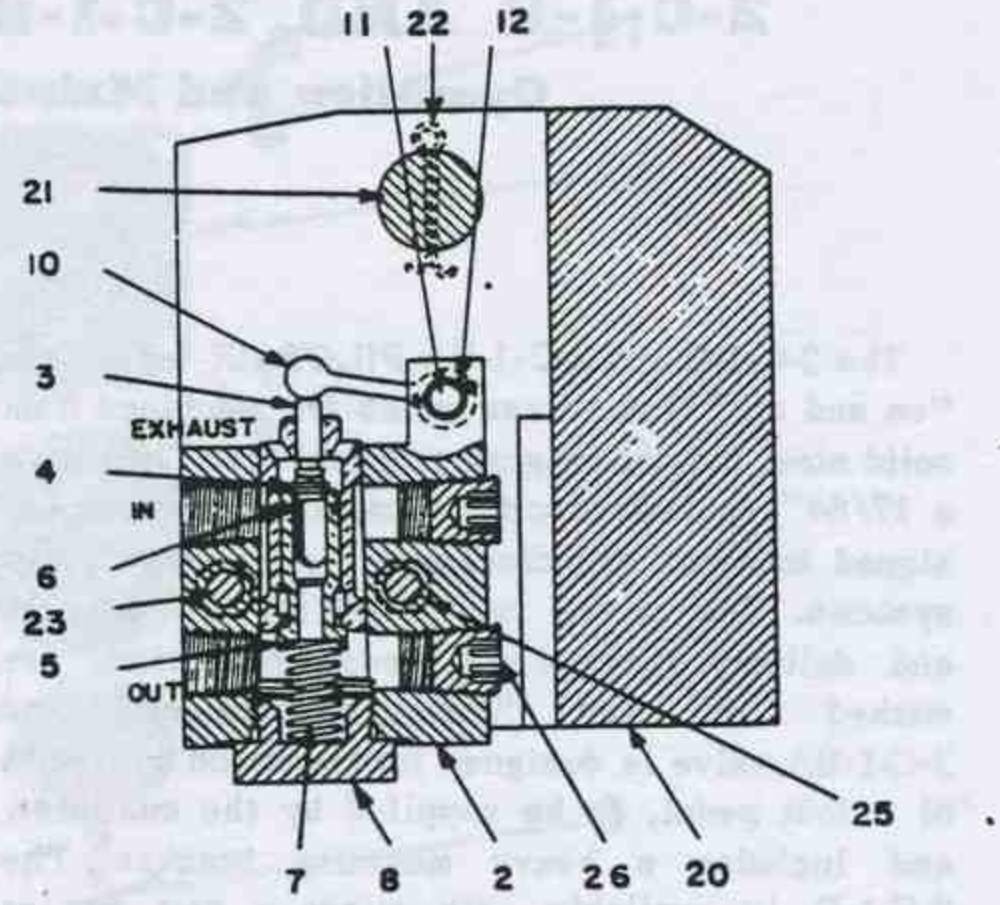


Fig. 4 Assembly View

4

2-C-1-B PILOTAIR VALVE, w/roller, Pc. No. 531315
2-C-1-B PILOTAIR VALVE, w/cam dog, Pc. No. 531104

Pc. No.	Ref. No.	
531060		VALVE, 2-C-1-B PILOTAIR, complete less lever or cam dog
531052	2	BODY
531044	3	PIN, Exhaust valve pusher
531043	*4*	*VALVE, EXHAUST*
531045	*5*	*VALVE, SUPPLY*
532268	*6*	*RING, 7/16" O.D. SEAL WABCO® PACKING*
503938	*7*	*SPRING, SUPPLY VALVE*
526378	8	NUT, cap
531056	10	LEVER (Pc.No. 531315 only)
526934	10	DOG, Cam (Pc.No. 531104 only)
531094	11	PIN, Lever or cam dog
93256	12	PIN, Cotter, 1/16" x 3/8" (2 required)
504237	13	ROLLER, (Pc.No. 531315 only)
527304	14	PIN, Roller (Pc.No. 531315 only)
521819	15	NUT, Roller pin (Pc.No. 531315 Only)
533282	16	PLUG, 1/4" Fluted socket pipe (2 required)

2-C-1-BA PILOTAIR VALVE, Pc. No. 531029

Pc. No.	Ref. No.	
531060		VALVE, 2-C-1-BA PILOTAIR, complete less cam dog and bracket
531052	2	BODY
531044	3	PIN, Exhaust valve pusher
531043	*4*	*VALVE, EXHAUST*
531045	*5*	*VALVE, SUPPLY*
532268	*6*	*RING, 7/16" O.D. SEAL WABCO PACKING*
503938	*7*	*SPRING, SUPPLY VALVE*
526378	8	NUT, Cap
526934	10	DOG, Cam
531094	11	PIN, Cam dog
93256	12	PIN, Cotter, 1/16" x 3/8" (2 required)
527242	20	BRACKET
526933	21	PIN, Double cottered
8049	22	COTTER, 3/16" x 1-1/2" (2 required)
531097	23	BOLT, 1/4" x 2-3/4" Valve (2 required)
521909	25	NUT, 1/4" Valve bolt (2 required)
533282	26	PLUG, 1/4" Fluted socket pipe (2 required)

NOTE. Parts set in *italic type* are recommended spares to be carried in stock at all times. Suggested quantities are: 100% for rubber parts, and 25% for all other parts recommended.

Prices will be quoted upon application.
Orders should give PIECE NO. and NAME of part.

34-1
Printed in U. S. A.
October, 1951

IDI 9368-31

No. 15, 18-A and No. 22-A DOUBLE CHECK VALVES

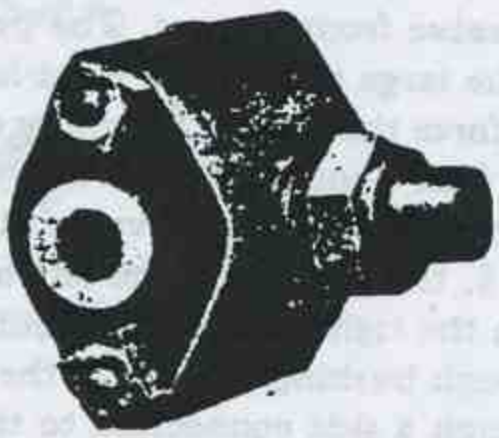
Operation and Maintenance Instructions

Double Check Valves are used in a pneumatic system to provide control of a device from two sources without inter-action between the two sources.

The function of the No. 15, 18-A and No.22-A Double Check Valves is identical, the only difference being that the No. 22-A is designed for low pressure differential work.

For the operation of the No. 15 and No. 18-A double check valves, refer to assembly views below. Assuming that air is admitted to either end port, the air pressure will force check valve 4 over to the other end against check valve seal (or gasket) 5, thereby closing connection between that end port and ports in the bushing leading to the controlled device. Air is now free to flow through the open end port and through the bushing ports to the controlled device.

18-A Double Check Valve



No. 15 Double Check Valve

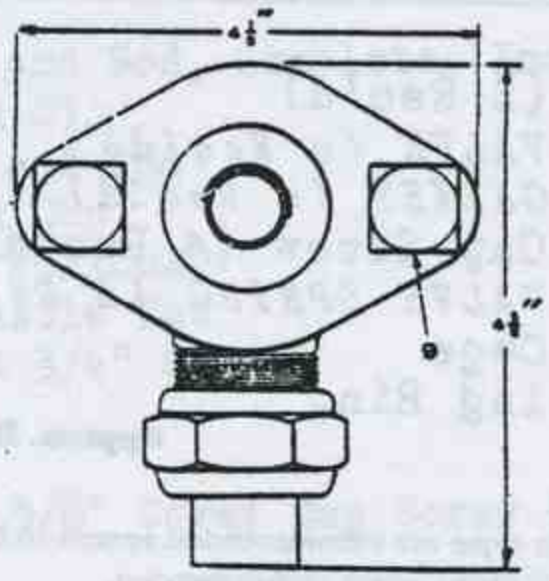
REPAIR PARTS LISTS

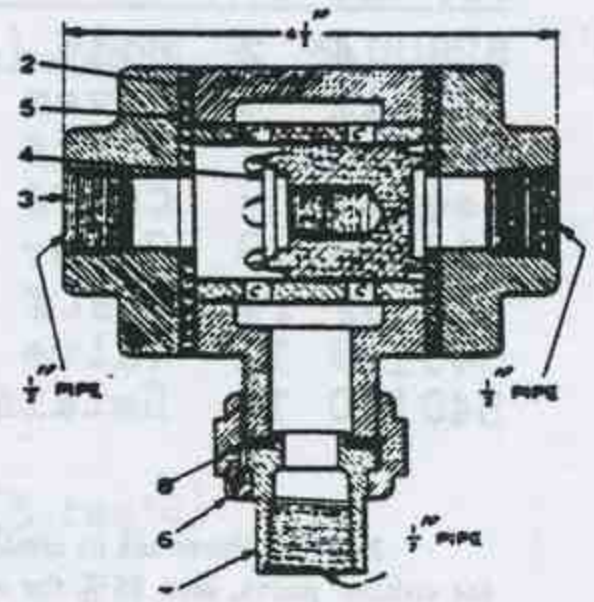
No. 15 DOUBLE CHECK VALVE

Piece No. 40182 No. 15 Double Check Valve, complete

Pr. No.	Ref. No.	
40181	2	Body, complete
40178	3	Cap (2 Req'd)
507895	*4*	*CHECK VALVE*
514261	*5*	*GASKET (2 Req'd)*
2165	6	½" Union Nut
2166	7	½" Union Swivel
81598	*8*	*½" UNION GASKET*
16809	9	Square Head Bolt and Nut (2 Req'd)

Approx. Net Weight 6¾ lbs.



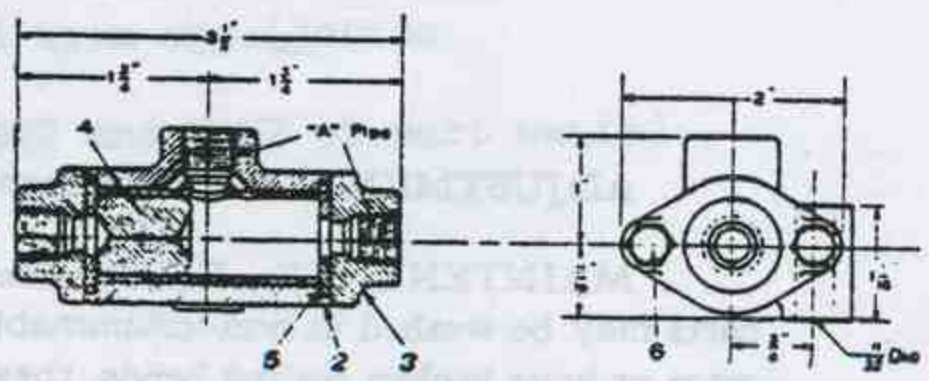


18-A DOUBLE CHECK VALVE

Piece No. 521774 18-A Double Check Valve, complete (with ¼" Pipe Taps)

Piece No. 508813 18-A Double Check Valve, complete (with ⅜" Pipe Taps)

Pc. No.	Ref. No.	
521777	2	Body (with ¼" Pipe Tap)
508758	2	Body (with ⅜" Pipe Tap)
521778	3	Flange (with ¼" Pipe Tap) (2 Req'd for Pc. 521774)
508759	3	Flange (with ⅜" Pipe Tap) (2 Req'd for Pc. 508813)
83360	*4*	*CHECK VALVE*
83362	*5*	*CHECK VALVE SEAL (2 Req'd)*
96053	6	¼"x⅝" Bolt (4 Req'd)



Approx. Net Weight 1½ lbs.

NOTE. Parts set in *italic type* are recommended spares to be carried in stock at all times. Suggested quantities are: 100% for rubber parts, and 25% for all other parts recommended.

Prices will be quoted upon application.

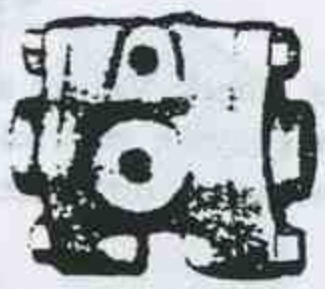
Orders should give PIECE NO. and NAME of part.

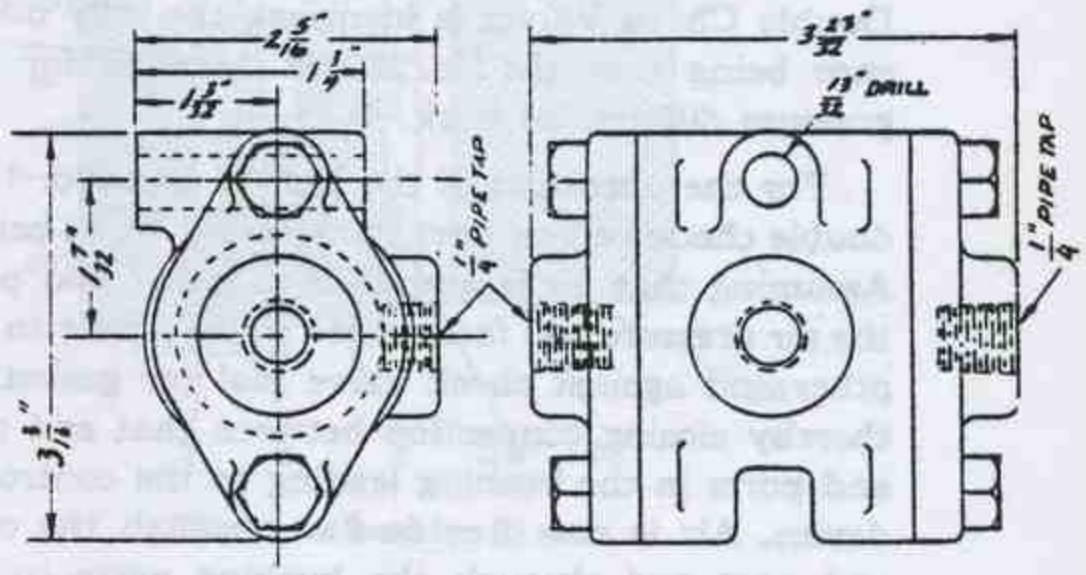
IDI 9368-31

No. 22-A Double Check Valve

For the operation of the No. 22-A double check valve, refer to the assembly view. Air is free to pass into the valve through the left-hand connection and through bushing ports into the radial chamber which is at all times in communication with a side connection leading to the controlled device.

With no air in the left-hand end of the valve, pressure acting on right-hand valve 4 will overcome the small force of right-hand spring 10 and force the valve from its seat. The pressure will then act on the large area of the right-hand end of valve 11 and force the shuttle assembly over to the left-hand end. Left-hand check valve 4 will seat, compressing its spring and allowing valve 11 to seat on left-hand seal 5, thus blanking the left-hand connection. Air from the right-hand connection is then free to pass through bushing ports into the radial chamber and through a side connection to the controlled device.

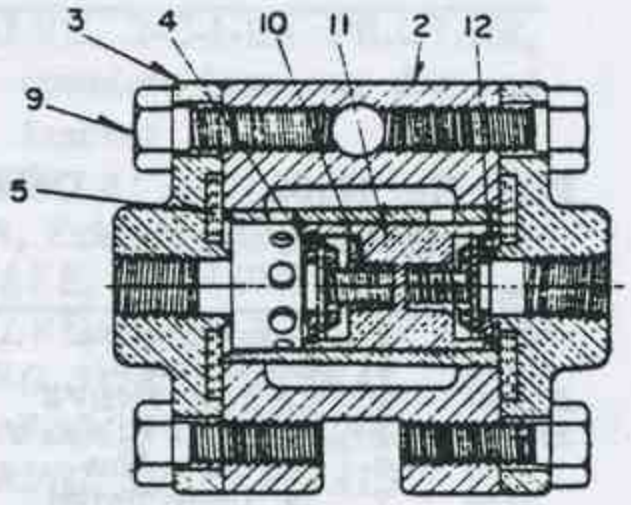




REPAIR PARTS LIST

Pc. No. 540107 No. 22-A Double Check Valve

Pc. No.	Ref. No.	
529004	2	Body
529011	3	Cover (2 Req'd)
529009	*4*	*CHECK VALVE (2 Req'd)*
529010	*5*	*COVER GASKET (2 Req'd)*
15784	9	Cover Cap Screw (4 Req'd)
9694	*10*	*CHECK VALVE SPRING (2 Req'd)*
540109	11	Valve Cage
540110	12	Retaining Ring



Approx. Net Weight 3 lbs.

NOTE. Parts set in *italic type* are recommended spares to be carried in stock at all times. Suggested quantities are: 100% for rubber parts, and 25% for all other parts recommended.

Prices will be quoted upon application.

Orders should give PIECE NO. and NAME of part.

ADJUSTMENT—No adjustment of Double Check Valves is required.

MAINTENANCE—Double Check Valves must be dismantled for cleaning and inspection. The parts may be washed in non-inflammable solvent and if the valve or valve seat gaskets are cracked, badly worn or have broken sealing beads, they must be replaced. No lubrication is required.

WESTINGHOUSE AIR BRAKE CO.
(INDUSTRIAL PRODUCTS DIVISION)
WILMERDING, PENNSYLVANIA

3M-3
Printed in U.S.A.
August, 1950

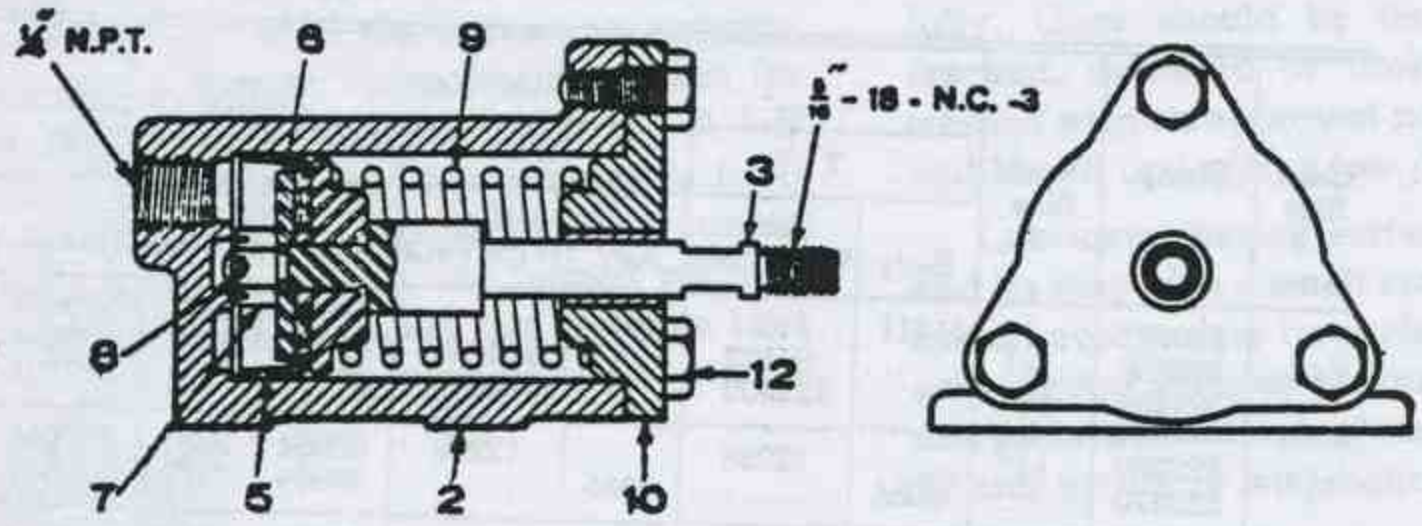
P.L. A-2373-9

WESTINGHOUSE AIR BRAKE COMPANY

(PART CATALOG SERIES "PNEU. CONT.")

PIECE LIST A-2373-9

1-1/2" x 1/2" SINGLE ACTING CYLINDER



Pc.No.	Ref.No.	
523159		1-1/2" x 1-1/2" Single Acting Cylinder, Complete
523160	2	Body
523161		Piston and Rod, Complete (Includes 3, 5, 6, 7 and 8)
523162	3	Piston and Rod
517810	5	Packing Cup
521568	6	Piston Follower
523166	7	1/4" Castle Nut
522955	8	1/16" x 3/4" Cotter
528692	9	Spring
523167	10	Cover
521656	12	1/4" x 5/8" Cover Cap Screw (3 req'd)

Prices will be quoted upon application.

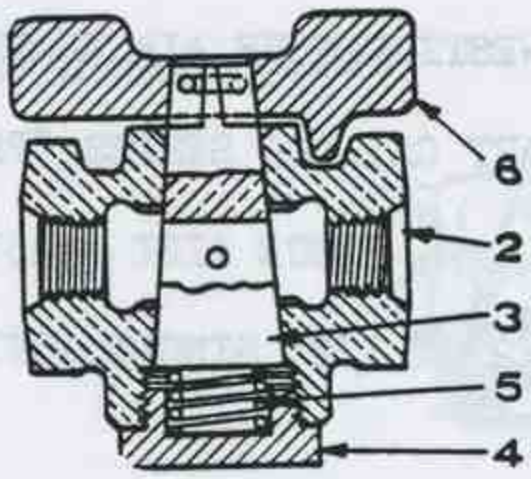
Orders should give PIECE NUMBER and NAME of part wanted.

3-10-47
P.F. 37.10
2-C-2
Printed in U.S.A.

ji

CUT-OUT COCKS

COCKS WITH "T" HANDLE



Cock Size	Comp.	Vent Size	Ref. No. 2 Body	Ref. No. 2 Body With Vent	Ref. No. 3 Key	Ref. No. 3 Key With Vent	Ref. No. 4 Cap	Ref. No. 5 *Spring	Ref. No. 6 Handle	Approx. Net Weight (Lbs.)
¼"	520647	.....	51311	.....	9056	.....	88064	2231	520654	1¼
	520850	⅛"	.....	84422	.....	512435	88064	2231	520654	
	‡522499	⅛"	.....	522500	.....	512435	88064	2231	522501	
⅜"	523369	⅛"	.....	12258	.....	12259	88064	2231	520654	1¼
	523370	.....	9055	.....	9056	.....	88064	2231	520654	
½"	526382	.....	2228	.....	2229	.....	88064	2231	526381	1½
	532944	⅛"	.....	43078	.....	43079	88064	2231	526381	
¾"	530793	.....	2235	.....	2236	.....	94297	2145	530792	2½

‡Includes seal wire 12½" long

*SPRING IDENTIFICATION

The following table is shown to enable railroad men, storekeepers and all Air Brake men to identify the various springs used in the Cocks cataloged herein. It is based on calculated figures and the actual spring will vary somewhat, due to small differences in wire diameter, coil diameter, number of turns, etc. This tabulation is intended for identification only and should not be used for any other purpose. It does not represent a specification for the springs mentioned.

SPRING IDENTIFICATION

Pc. No.	Approx. Out. Dia. "A"	Approx. Dia. Wire "B"	Approx. Free Height "C"	†Approx. No. Turns	Material	Name of Spring	Where Used
2098	11/64"	.1055"	1 7/32"	6	Steel	Key Spring	Double and 1¼" Cocks
2145	5/8"	.102"	11/64"	4½	Brass	Key Spring	¾" Cut-out Cocks
2231	5/8"	.0907"	17/32"	3½	Brass	Key Spring	¼", ⅜" and ½" Cocks
9529	1¼"	.162"	2"	8½	Brass	Key Spring	2" Cut-out Cock
11730	⅜"	.0475"	1 9/16"	13	Steel	Handle Spring	1" and 1¼" Cocks with Locking Handle
13109	11/64"	.055"	1 1/16"	9¾	Steel	Handle Spring	⅜", ½" and ¾" Cocks with Locking Handle
29615	11/64"	.129"	11/32"	4	Brass	Key Spring	¾" Cut-out Cock
66808	19/32"	.0475"	1 11/16"	10½	Steel	Handle Spring	Three Position B.P. Cut-out Cock
520304	11/64"	.113"	41/64"	3½	Steel	Key Spring	¾" Cut-out Cock
900613	27/32"	.1285"	1 7/64"	5¾	Brass	Key Spring	½"x¾" Double Cut-out Cock

†Number of turns of wire in each Spring, counted between extreme ends of wire

NOTE A—For Packaging, see page 15.

Prices will be quoted upon application

Orders should give PIECE NUMBER and NAME of part wanted

The Westinghouse Air Brake Company

"A-5-A" and "A-5-B" ROTAIR VALVES

Operation and Maintenance Instructions

The purpose of the A-5 type Rotair Valves is to perform as a selector, connecting a supply of air pressure to one or other of two alternative control stations in a pneumatic system.

Pneumatically, both A-5 type rotairs are the same, the difference is in the mounting arrangement. The A-5-A Rotair Valve has a bracket for mounting to a vertical support while the A-5-B Rotair Valve is designed for mounting on a horizontal panel. The rotair valves should be mounted in a vertical position, so that the lapped surfaces are horizontal. The pipe bracket has ¼" pipe taps to accommodate ⅜" O.D. copper tubing.

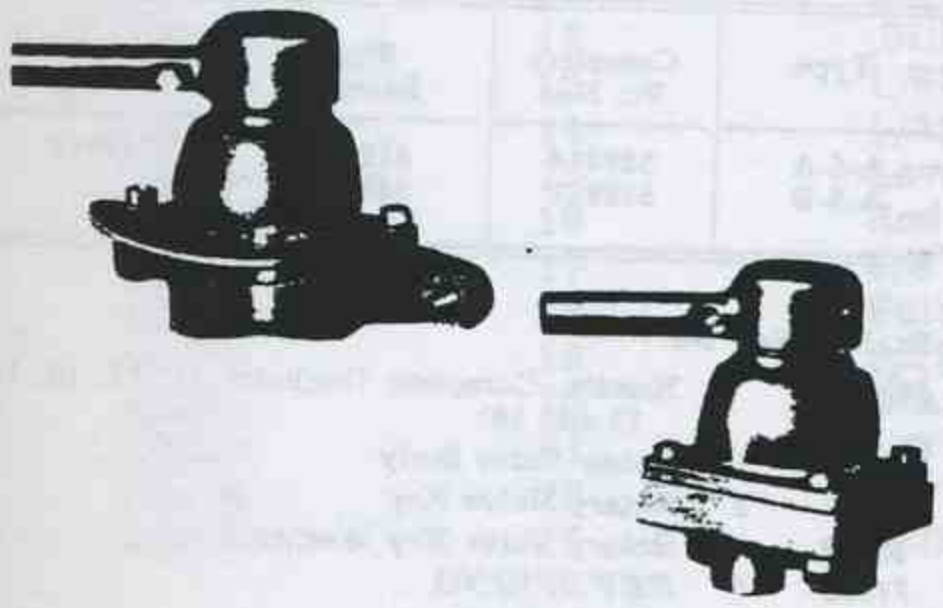


Fig. 1 A-5-A and A-5-B Rotair Valves

MAINTENANCE

The rotair valve should be dismantled periodically for inspection, cleaning and lubrication. Parts which are worn or defective should be replaced. Inspect gasket 8 and rubber packing ring 19 carefully, these should be replaced if found to be cracked, damaged or broken. All parts may be washed with an approved non-inflammable solvent, and blown dry with a low pressure air jet.

Lubricate mating surfaces of the rotary valve and its seat with a small amount of graphite grease spread evenly over its surfaces. Pack key washer 4 and friction surfaces of rotary valve key 3, body 2 and handle 11 with graphite grease. Oil handle latch 12 and spring 14 with light machine oil.

Avoid distorting parts. Assembly and disassembly should be easy. If force required seems excessive, investigate and correct cause before proceeding.

The air supply should be filtered, and filters kept clean, as grit and scale are injurious to lapped surfaces. In the event that these surfaces become damaged, the rotair valve should be returned to our factory for repairs. In an emergency the surfaces may be lapped by an experienced mechanic, using standard lapping techniques and materials.

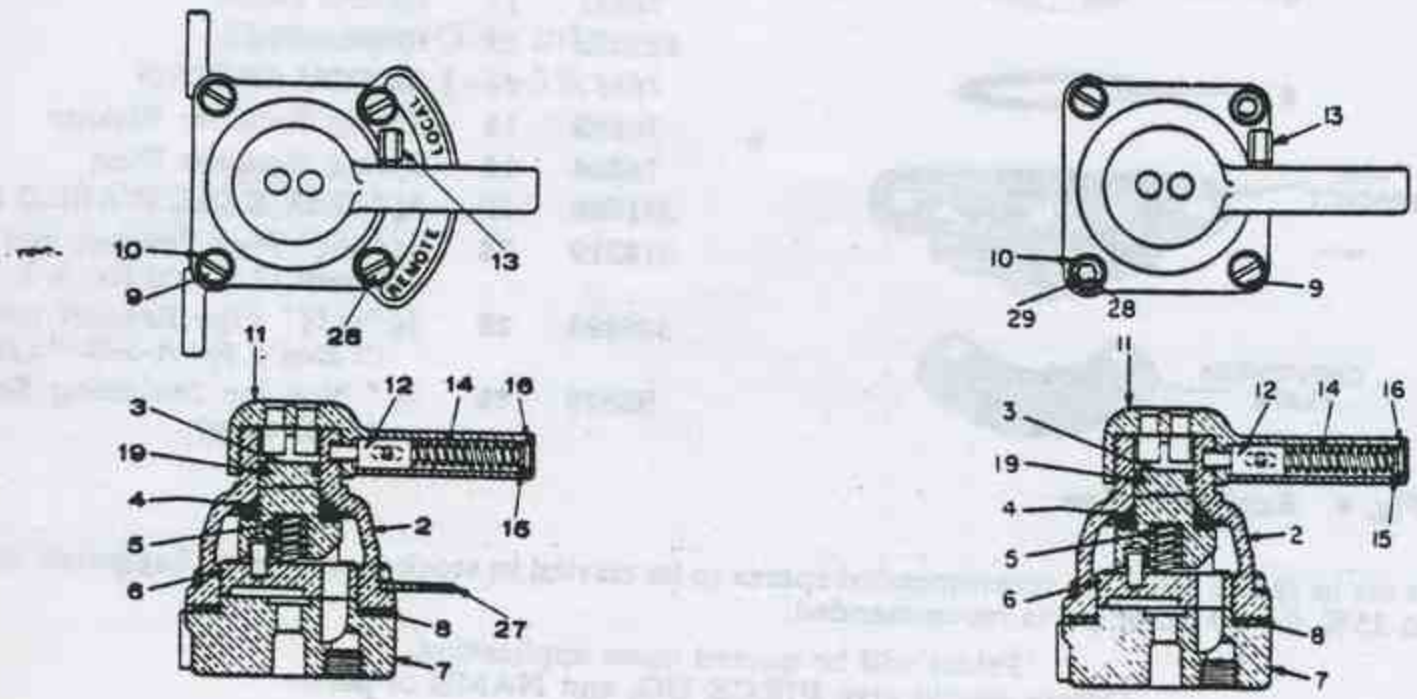
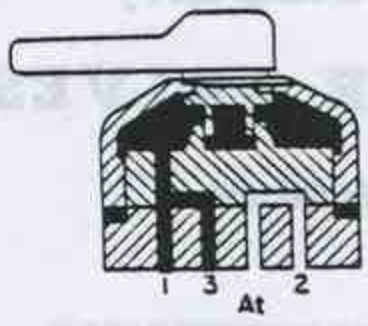


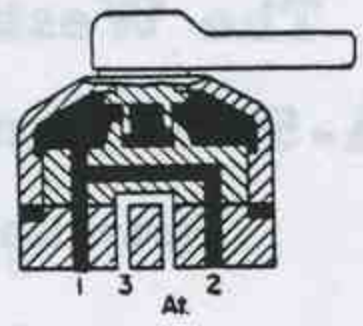
Fig. 2 A-5-A and A-5-B Rotair Valve Assemblies

OPERATION



Remote Position

Fig. 3 Diagrammatics



Local Position

In Remote position, supply air pressure from Port 1 is connected to the top of the rotary valve and through a cavity of the rotary valve to Port 3 and thence to the Remote Control Station, which is activated in this position.

In this same position Port 2 is connected to atmosphere through the Exhaust Port, thus inactivating the Local Control Station.

In Local position supply air pressure from Port 1 is connected to the top of the rotary valve and through a cavity of the rotary valve to Port 2 thence to the Local Control Station, which is activated in this position.

In this same position Port 3 is connected to atmosphere through the Exhaust Port, thus inactivating the Remote Control Station.

REPAIR PARTS LIST

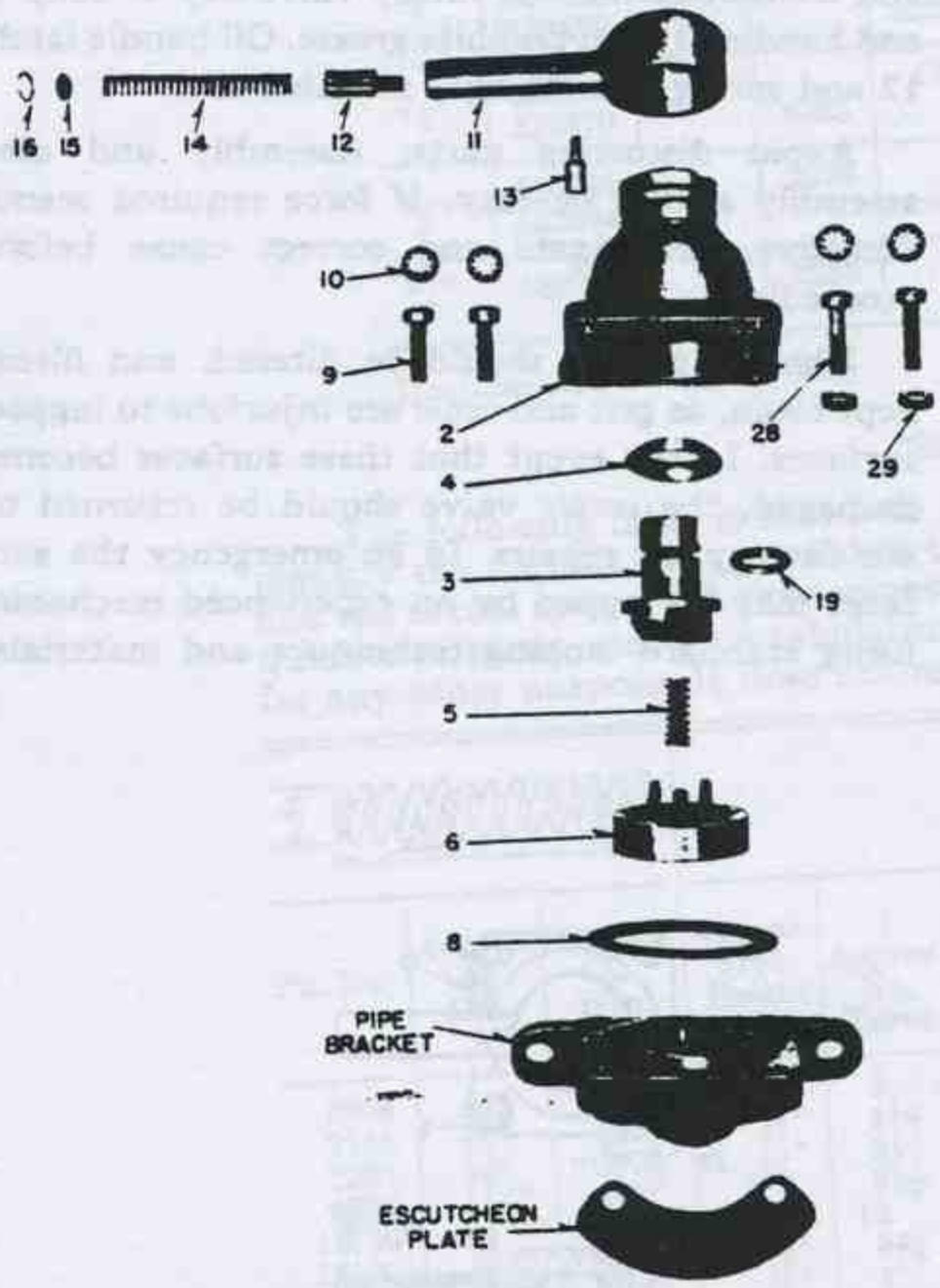


Fig. 4 Exploded View

Type	Complete Pc. No.	Pipe Bracket	Escutcheon Plate
A-5-A	529014	529918	529919
A-5-B	529921	533263	.....

Pc. No.	Ref. No.	
522627		Handle, Complete (Includes 11, 12, 13, 14, 15 and 16)
529917	2	Rotair Valve Body
520877	3	Rotary Valve Key
98669	4	Rotary Valve Key Washer
71060	*5*	*KEY SPRING*
520878	6	Rotary Valve
520880	*8*	*GASKET*
529936	9	¼"x¾" Pipe Bracket Screw (2 Req'd)
506591	10	¼" Lock Washer (4 Req'd)
76860	11	Handle Body
76861	12	Handle Latch
522623	13	Release Pin
76862	*14*	*LATCH SPRING*
76863	15	Spring Retainer Washer
76864	16	Spring Retainer Ring
531868	*19*	*¾" O.D. SEAL WABCO PACKING RING*
518319	28	¼"x⅞" Pipe Bracket and Escutcheon Plate Screw (2 Req'd for A-5-A only)
535895	28	¼"x1¼" Pipe Bracket and Mounting Screw (2 Req'd for A-5-B only)
93873	29	¼" Nut for Mounting Screws (2 Req'd for A-5-B only)

NOTE. Parts set in *italic type* are recommended spares to be carried in stock at all times. Suggested quantities are: 100% for rubber parts, and 25% for all other parts recommended.

Prices will be quoted upon application.
Orders should give PIECE NO. and NAME of part.

WESTINGHOUSE AIR BRAKE COMPANY

(Industrial Division)

WILMERDING, PENNSYLVANIA

2M-2
Printed in U.S.A.
June, 1949

P.L. A-2378-41

WESTINGHOUSE AIR BRAKE COMPANY
PIECE LIST A-2378-41

AA-1 ACTUATOR

Pc. No.	Ref. No.	
850650		AA-1 Actuator, Complete
850512	2	Actuator Body, with Adapter Bar
850485	4	Diaphragm Cover
850507	5	Diaphragm Spring
850482	6	Pusher Rod
539900	7	Diaphragm
850486	8	1/2'' x 1-3/4'' Sq. Head Bolt (4 Req'd)
850487	9	1/2'' Hex. Nut
850489	10	Adjuster
850488	11	1-1/4'' Adjuster Lock Nut
850479	12	.010'' Thick Shim (2 Req'd)
850480	13	1/64'' Thick Shim
850481	14	1/32'' Thick Shim
850490	15	Lever Arm Complete
850662	16	Rod End
850493	17	5/8'' Hex. Jam Nut
850513	18	Fulcrum Pin, Complete
534274	19	Spring Washer (2 Req'd)
850504	20	Bearing Bush (2 Req'd)
850484	21	3/8'' x 2-3/8'' Hex. Head Bolt
850505	22	3/8'' Hex. Nut
850506	23	3/32'' x 3/4'' Cotter (2 Req'd)

Prices should be quoted upon application

Orders should give PIECE NUMBER and NAME of part wanted.

Made by: GEJ:mim
1-3-52

WESTINGHOUSE AIR BRAKE COMPANY
Industrial Products Division
WILMERDING, PENNSYLVANIA

AA-1 ACTUATOR

The AA-1 Actuator is a positioning device wherein air pressure acting upon a diaphragm is balanced by spring force to position an actuating arm. The air pressure may be increased or decreased in very small increments in response to the handle movement of a remotely located Controlair. For every increment of pressure variation, the diaphragm and spring assembly will assume a corresponding position and will in turn position the actuating arm.

In Marine applications the Actuator is employed to accurately position an engine speed governor, fuel shaft or throttle.

The Actuator is of lightweight, essentially non-magnetic construction. Three 9/16 inch diameter holes are provided in the cover for mounting purposes. The Actuator may be mounted either vertically or horizontally. Care should be used in the application of this device to keep the friction load as low as possible, since high friction loading will interfere with the accuracy of positioning.

A single 1/4''-18 NPT port is provided in the top cover for control pipe connection. This permits the use of 3/8'' O.D. copper tubing between the remotely located Controlair and the Actuator.

The Actuator consists of a spring loaded diaphragm and pusher rod. The initial spring load is determined by shims inserted beneath the Actuator spring. An adjusting nut in the bottom serves as a guide for the pusher rod as well as a means of adjusting the travel of the actuating arm.

Friction in the actuating arm is minimized by the use of needle bearings in the pivot points.

The actuating arm is adjustable in length to suit the mounting arrangements and the travel required for the particular installation.

MAINTENANCE

The Actuator should be dismantled at regular intervals, inspected for wear, worn parts replaced, and all parts cleaned and lubricated as needed. Care must be exercised to avoid distortion of bolts, studs, nuts, pins, etc. as well as damage to diaphragms. It is possible to assemble or disassemble all parts readily. If the force required seems excessive, investigate immediately to determine the cause of the difficulty.

All parts should be cleaned with an approved non-inflammable solvent. Inspect diaphragms carefully while flexing back and forth, and replace if cracks, abrasions or bubbles indicating separation are found.

Before reassembly lubricate the pusher rod guide with graphite grease. The needle bearings of the actuating arm are provided with grease gun fittings and should be lubricated with a good grade of lubricating grease.

Piping should be maintained with a minimum of leakage. While the control devices will compensate for moderate pipe leakage, a loss of air causes unnecessary demand on the air supply. Care should be taken in piping installation to avoid pockets in which moisture might accumulate. If such condition is unavoidable, provision should be made to drain accumulated moisture daily.

WESTINGHOUSE AIR BRAKE COMPANY
(Part Catalog Series 'Pneu. Cont.')

PIECE LIST A-2384-20

DIRECTIONAL INTERLOCKS

Pc. No.	Ref. No.	
533195		Directional Interlock, Complete (for 8'' Nom., 7-1/2'' Min., 10'' Max. Shaft Dia.)
533292		Directional Interlock, Complete (for 16'' Nom., 15'' Min., 20'' Max. Shaft Dia.)
531795		Directional Interlock, Complete (for 28'' Nom., 20'' Min., 36'' Max. Shaft Dia.)
532879		Directional Interlock, Complete (for 45'' Nom., 36'' Min., 100'' Max. Shaft Dia.)
533320		Directional Interlock, Complete, less Shoe with lining
525335	2	Cylinder, Complete (includes two of 4 and 5)
513125	4	3/8'' x 2-1/2'' Valve Body Stud (2 Req'd)
523547	5	3/8'' Hex. Nut (2 Req'd)
528941		Piston, Complete (includes 6,7,8 and 9)
528942	6	Piston
519518	7	Piston Packing Cup
525339	8	Piston Follower
77958	9	Piston Nut
528943		Piston Rod, Complete (includes 10 and 11)
525341	10	Piston Rod
528944	11	Piston Rod Clevis
503307	12	Spring
525343	13	Spring Seat
504300	14	3/16'' x 7/8'' Spring Seat Pin
528945	15	Cylinder Cover
506591	17	1/4'' Lock Washer (4 Req'd)
3070	18	1/4'' x 3/4'' Cylinder Cover Cap Screw (4 Req'd)
533267	19	Shoe with Lining. Complete (includes 50 and four of 49) (for complete Pc. 533195)
533293	19	Shoe with Lining, Complete (includes 50 and four of 49) (for complete Pc. 533292)
532733	19	Shoe with Lining, Complete (includes 50 and four of 49) (for complete Pc. 531795)
532880	19	Shoe with Lining, Complete (includes 50 and four of 49) (for complete Pc. 532879)
525349	20	Link
525350	21	5/16'' x 1-1/8'' Double Cottered Pin
5735	22	1/16'' x 1/2'' Cotter Pin (8 Req'd)
525354	25	1/4'' x 1'' Double Cottered Pin
528951	26	Double Cam
525353	28	1/4'' x 3'' Double Cottered Pin (2 Req'd)

Pc. No.	Ref. No.	
525355	29	Cam Dog (2 Req'd)
525356	30	Cam Dog Spacer
526835	31	Filter (3 Req'd)
99458	34	Filter Gasket (3 Req'd)
525361		Valve Portion, Complete (includes 40 and two of 42, 43, 44, 45 and 46)
525357	40	Valve Body
521368	42	Valve (2 Req'd)
521369	43	Valve and Valve Lifter Spring (4 Req'd)
525363	44	Valve Cap Nut (2 Req'd)
528953	45	Valve Lifter (2 Req'd)
525362	46	Valve Lifter Cap Nut, Complete (includes 47 and 48) (2 Req'd)
523261	47	3/16" I.D. Wabco Seal Ring (2 Req'd)
526203	48	Seal Ring Retainer (2 Req'd)
	49	1/8" x 1/2" Fl. Hd. Copper Rivet (4 Req'd)
532732	50	Woven Lining

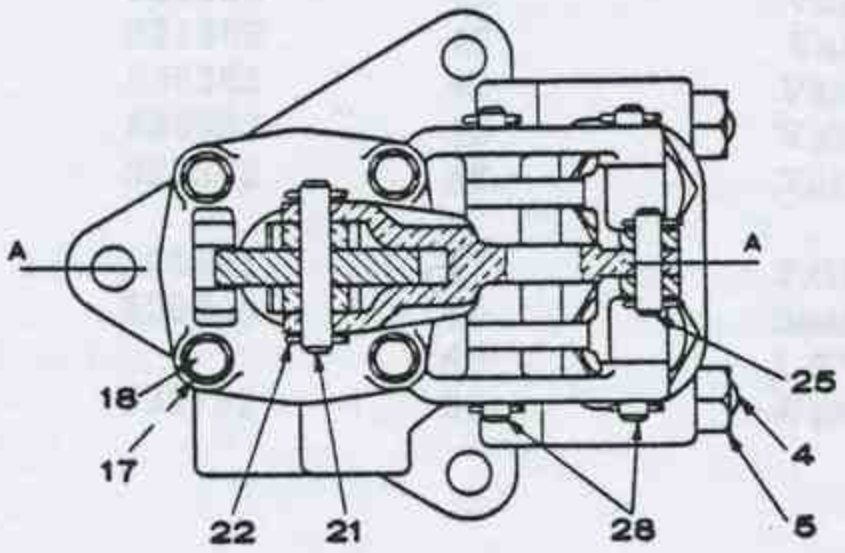
Prices will be quoted upon application

Orders should give PIECE NUMBER and NAME of part wanted

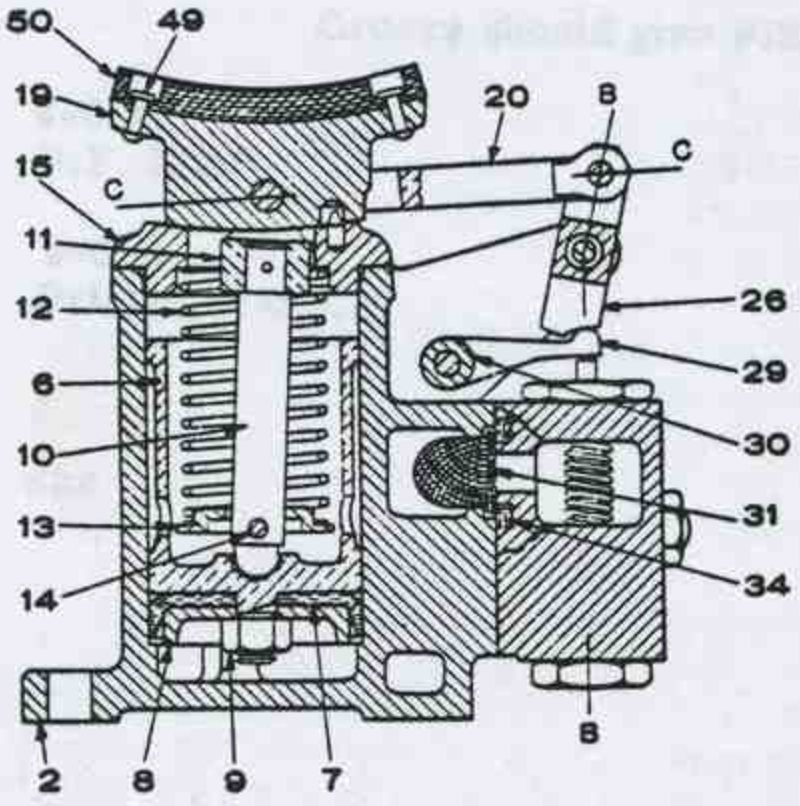
4-6-48
P.F. 37.10

2-C-1
Printed in U.S.A.

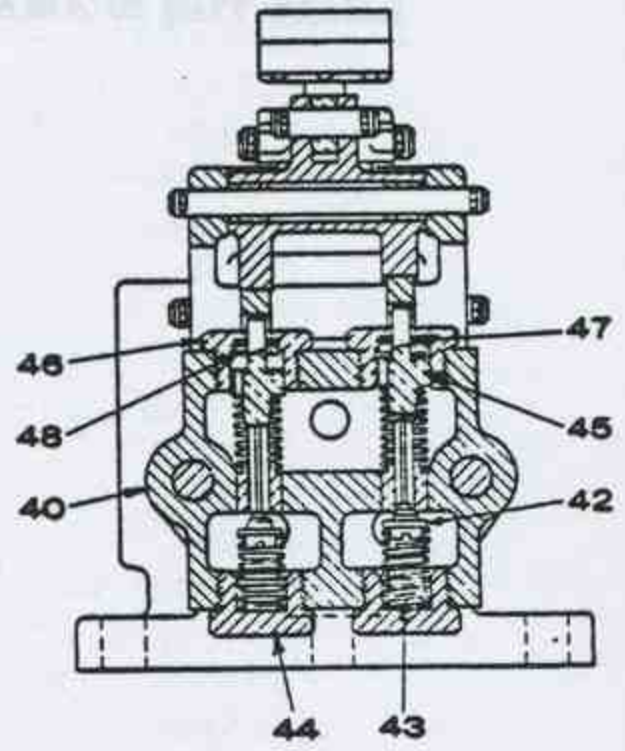
skr



Section C-C



Section A-A



Section B-B

(Cut No. 31872)

With the shaft turning Astern, let us suppose the Controlair handle is operated into Start Ahead position. This admits air to the Ahead pipe and port 1 of the Directional Interlock. Since Ahead valve 42 is held off its seat by cam 26 acting through cam dog 29 and valve lifter 45, and Astern valve 42 is held seated by its spring 43a, the air flows past the Ahead valve and out Port 13, charging the Fuel Cut-Off Cylinder and causing its piston to assume its extended position. The piston rod is arranged to exert force against an arm mounted on the fuel shaft, moving the shaft to 'Fuel Off' position.

Air is also admitted to the Start line, and by means of Port 7 to the cylinder of the Directional Interlock, causing piston 6 to move upward and force shoe 19 against the turning shaft, the position shown by the drawing. If the system includes a Cam Position Interlock, this action will not occur until the camshaft or other reversing means of the engine has been shifted to its Ahead position. At the same time that air from the Start line charges the Directional Interlock cylinder, it operates the Master Start Valve of the engine, causing high pressure starting air to be admitted to the engine cylinders. This acts as a brake against the Astern rotation of the engine, aiding in bringing the engine rapidly to a stop, and immediately initiating Ahead rotation. The first motion of the shaft in the Ahead direction carries friction shoe 19 to the right until piston rod clevis 11 stops against the right hand side of the cylinder cover. This action reverses the position of the valves, closing Ahead valve 42 and opening the Astern valve. Pressure in the Ahead line is thereby cut off from port 13, and the air in the Fuel Cut-Off Cylinder is released past Astern valve 42, through the Astern line and the open Astern exhaust valve of the Controlair to atmosphere. The piston of the Fuel Cut-Off Cylinder is retracted by its return spring, permitting the fuel shaft to assume whatever position is called for by the speed governor or fuel control, and causing fuel to be injected into the cylinders.

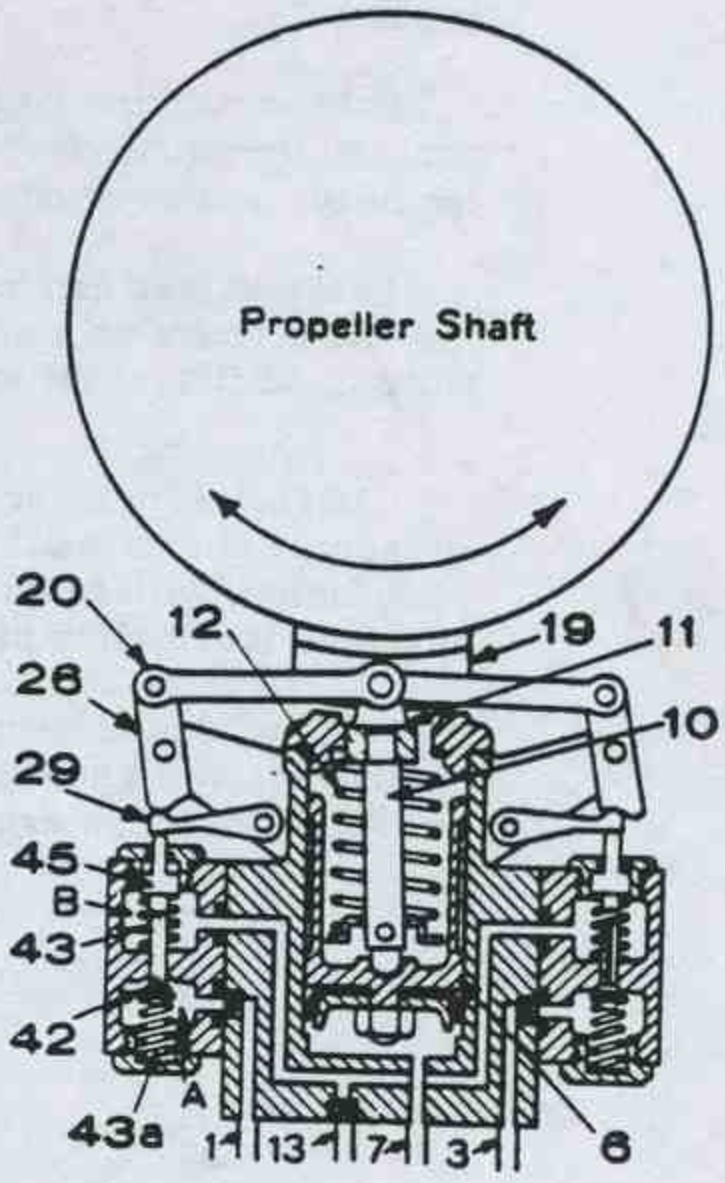


Fig. 2
Diagrammatic View

When the engine has begun to fire, air is released from the Start line either by returning the Controliar handle from the Start notch into the speed zone or by operation of the Automatic Starting Air Cut-Off feature. This also releases the air from the Directional Interlock cylinder, permitting spring 12 to force piston 6 downward, moving the friction shoe away from the rotating shaft. A pin in the cylinder cover engages a pocket in the underside of shoe 19, and the shoe assumes the position shown in figure 2, causing the device in effect to 'remember' the direction in which the shaft was turning when the interlock was last operated. When re-starting the engine in the same direction as last operated, the valve for that direction is held closed and air is not admitted to the Fuel Cut-Off Cylinder. In Astern position, the pin engages the outer edge of the shoe.

It will be understood that operation of the Interlockkwhen starting Astern after running Ahead is the exact reverse of that described above.

ADJUSTMENT

The Directional Interlock requires no adjustment.

MAINTENANCE

The Directional Interlock should be periodically dismantled for inspection, cleaning and lubrication, and parts replaced if worn or defective in any way. This should not be done on the installation, but at a suitable bench in a well-lighted location.

When dismantling the device, care must be exercised to avoid distortion of pins, studs, nuts, etc., as well as mutilation or damage to springs, gaskets, packing cups, valves and valve seats. It is possible to assemble or disassemble all parts of the device readily. If the force required seems excessive, investigate immediately to determine the cause of the difficulty.

All parts should be cleaned with an approved non-inflammable solvent. The three filter elements 31, Fig. 2, should be washed in solvent and blown off with a low-pressure air jet. In replacing the filters care should be taken to replace gaskets 34.

Rubber packing rings 47 should be carefully inspected and replaced if cracked or worn. Inspect packing cup 7 for cracks, abrasion, damage to sealing beads and wear out-of-round.

Leaky valves can be restored to their seats by rubbing in lightly with jeweler's rouge or a 50-50 mixture of 'Float' emery dust and powdered graphite in sufficient oil to make a semi-liquid paste.

Lubricate cylinder wall and flare of packing cup with a good grade of cup grease. Lubricate all pin joints and friction surfaces of moving parts, except shoe lining, with graphite grease. Oil all accessible pin joints daily with machine lubricating oil.

Piping should be maintained with a minimum of leakage. In piping installation, avoid pockets in which moisture may collect. If pockets are unavoidable, make provision to drain moisture daily.

1081

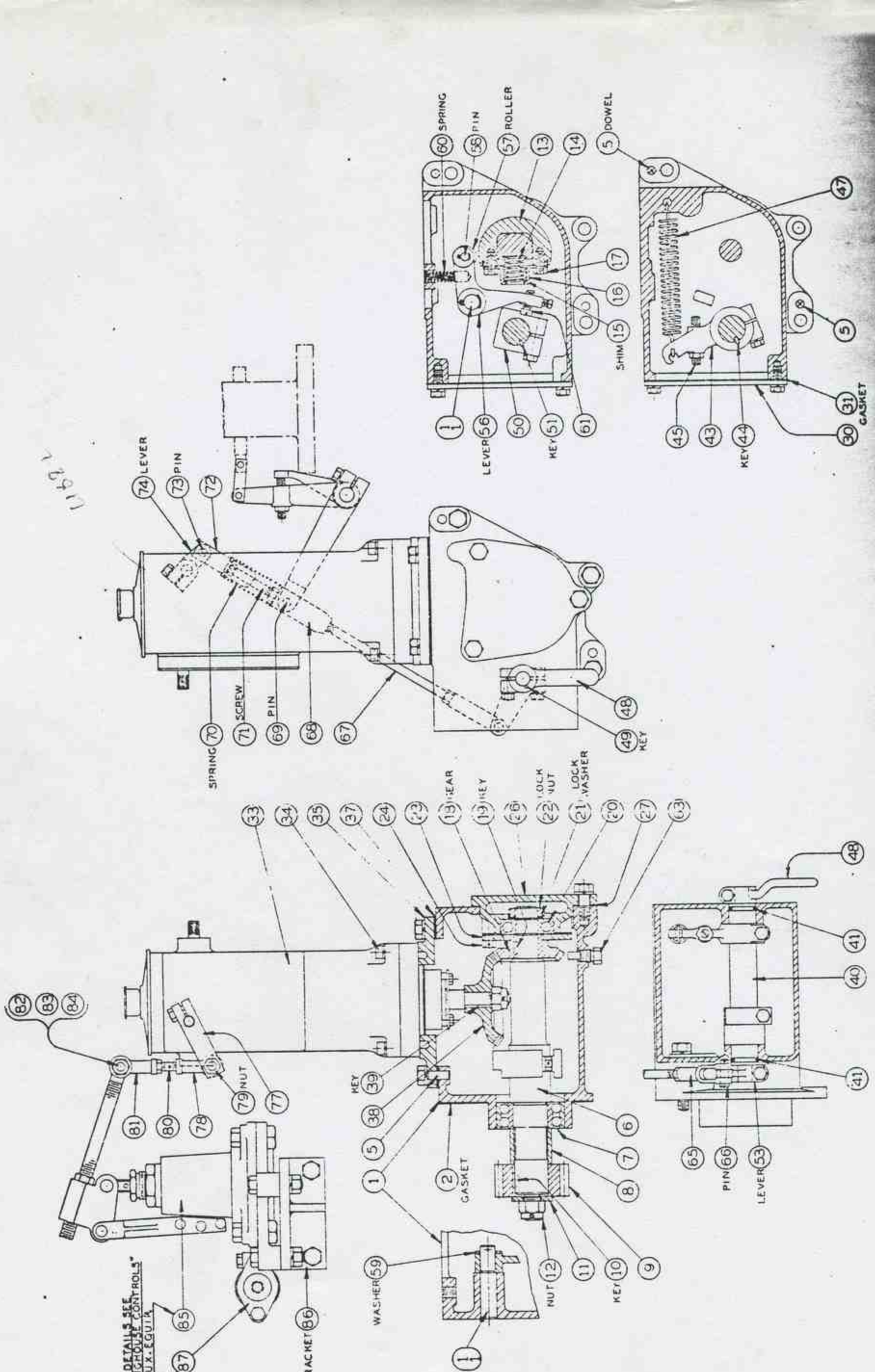


PLATE No.
3A4026

DO NOT ORDER PARTS BY REFER NUMBERS

rsede
-15-5.

119-85

C-9859
C-9845
C-9844

C-2406

COOPER ENERGY 714-891-3491
ATLAS 45MX

Supersedes Sheet Dated 10-19-51
-2-15-52 - Added Lines 47 to 49

CHANGES

CARL

BY ____ DATE ____

Same as Tue Jan ... S/n-50120

2L2540 SHEET 1 OF 2

ALWAYS GIVE PART NUMBER — PART NAME — ENGINE NUMBER
FOR STD HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4026

DRAG NO	PART NO		PART NAME
	1 3A3036-X	1	HOUSING ASSEMBLY VERTICAL & OVERSPEED GOV. DRIVE
	2 4B1090	1	GASKET - Assembly Vertical & Overspeed Governor Drive Housing
		3	CAPSCREW - 1/2"-13-NC x 1-1/4" Lg. - St.
		1	CAPSCREW - 1/2"-13 x 2-3/4" Lg. - St.
		4	LOCKWASHER - 1/2" SAE Reg. - St.
	5 T-270	4	PIN DOWEL
AB-1084 HK	6 4B1084 Yes	1 B2	SHAFT - Overspeed Governor Drive 250.00
109-850	7 BM-6378	1	MRC-5208K - Ball Bearing 36.70 055.80 109-850
	8 4A1146	1	SPACER - Governor Drive Shaft
	9 4B1080	1	GEAR - Governor Drive (INPUT)
	10	1	KEY - Woodruff #5
	11 3A2964	1	WASHER
	12	1	NUT - 3/4"-16 Light Thick Slotted
		1	COTTER PIN - 1/8" x 1-1/4" Long
	13 4A1144	1	WEIGHT - O.S. Gov. Control 110.00 DK
	14 3A2996	1	SPRING - O.S. Gov. Control
	15 3A3010	3	SHIMS - O.S. Gov. Spring
	16 4A1145	1	SPRING RETAINER - O.S. Gov.
	17 H-14259	2	CAPSCREW
		2Pc.	16 GAUGE - 4" Long - Wire
	18 4B1082	1	BEVEL PINION GEAR - Gov. Drive 23[illegible]
	19	1	KEY - Woodruff #5
C-9859	20 5709	1	BALL BEARING = 005-709. 23.-
C-9845	21 C-9845	1	LOCKWASHER - Ball Bearing
C-9844	22 C-9844	1	LOCKNUT - Ball Bearing
	23 3A2958	1	RETAINER - Gov. Dr. Ball Bearing
C-2406	24 C2406L-3/4	3	CAPSCREW
		1	LOCKWIRE - 16 Ga. x 12" Long
	26 3A2898	1	CAGE - Ball Bearing
	27 3A3007	1	GASKET - Ball Bearing Cage
		3	CAPSCREW - 1/2"-13 x 1" Lg. - St.
		3	LOCKWASHER - 1/2" SAE Reg. - St.
	30 3A2965	1	COVER - Gov. Housing
	31 3A2972	1	GASKET - Gov. Housing Cover
		5	CAPSCREW - 3/8"-16 x 3/4" Long
	33 4C1055	1	GOVERNOR WOODWARD UG-8 L
	35 3A2899	1	ADAPTOR - Governor to Housing
		4	CAPSCREW - 1/2"-13 x 1-1/4" Hex Head
		4	LOCKWASHER - 1/2"
HK-1	37 3A2998	3	SHIMS - Gov. Adapter to Housing (1/32
	37 3A2999	5	SHIMS - Gov. Adapter to Housing (.010
	37 3A3000	2	SHIMS - Gov. Adapter to Housing (.003
	34	4	CAPSCREW-3/8"-16 X2" Allen Socket Head Gov. to Adaptor
		4	LOCKWASHER - 3/8" - Gov. to Adaptor

----CONTINUED ON SHEET NO. 2----

NAME WOODWARD & OVERSPEED GOVERNOR

FOR TOTAL REQUIREMENTS PER ENGINE MULTIPLY NO. REQ'D ABOVE BY ____

ORIGINALLY ISSUED FOR 8 CYL. 9" X 10-1/2 DRM

PARTS LIST

2L2540 SHEET 1 OF 2

Supersedes Sheet Dated 10-19-51
-10/10/52-Part # on Line 27 was
R-3477

CHANGES

2L2540 SHEET 2 OF 2

ALWAYS GIVE PART NUMBER -- PART NAME -- ENGINE NUMBER
FOR STD. HARDWARE WITHOUT PART NUMBER GIVE DESCRIPTION AND SIZE

PLATE NO 3A4026

SHEET NO	ITEM NO	PART NO	QUANTITY	PART NAME
				----CONTINUED FROM SHEET NO. 1----
D	38	4B1081 →	1	GEAR - Governor Spindle
	39	H-7663	1	KEY - Governor to Gear
	40	4B1088	1	SHAFT - Overspeed Gov. Throw-Out
	41		2	"O" RING - (Parker #5427-19)
	43	4B1083	1	ARM - O. S. Throw-Out - Spring
	44		1	KEY - #5 Woodruff
			1	CAPSCREW - 3/8"-16 x 1-1/2" Hex Head
			1	WASHER - 3/8" Lock
	45		1	SETSCREW - Allen - 3/8"-16 x 2-1/4" Oval Pt.
			1	HALF NUT - 3/8"-16
	47	3A2992	1	SPRING
	48	4A1158	1	LEVER - Overspeed - Governor Reset
	49		1	KEY - #5 Woodruff
			1	SCREW - 5/16"-18 x 1" Hex Head Cap
	50	3A2937	1	LATCH - O. S. Gov. Trip
	51		1	KEY - #5 Woodruff - Latch to Shaft
			1	CAPSCREW - 3/8"-16 x 1-1/2" Hex Head
	53	4A1157	1	LEVER - Overspeed Throw-Out
			1	KEY - #5 Woodruff
			1	CAPSCREW - 3/8"-16 x 1" Lg. - Hex Head
	56	3A2947	1	PIVOT ARM - O. S. Gov. Trip
	57	3A2983	1	ROLLER - O. S. Gov. Trip Arm
	58	T-1384	1	PIN - O. S. Gov. Trip Roller
			2	COTTER PIN - 1/8" x 3/4"
	59	3A2985	1	WASHER
			1	COTTER PIN - 1/8" x 1-1/4"
	60	3A2995	1	SPRING - O. S. Gov. Trip Lever
	61	3A2984	1	SCREW - O. S. Gov. Trip Lever
			1	SETSCREW - 5/16"-18 x 3/4" Sq. Hd. -Cup Pt.
	63	4A1170	1	TUBE - Gear - Gov. Drive

NAME WOODWARD & OVERSPEED GOVERNOR

ORIGINALLY ISSUED FOR 8 CYL. 9 X 10-1/2 DRM

FOR TOTAL REQUIREMENTS PER ENGINE REFER TO NO. REQ'D

2L2540 SHEET 2 OF 2