

TECHNICAL MANUAL

**OPERATOR'S AND ORGANIZATIONAL
MAINTENANCE MANUAL
(INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)**

DIVING EQUIPMENT SET

SCUBA DIVING SUPPORT, TYPE A

NSN	ITEM	MFR'S PART NO.
4220-01-023-0246	Diving Equipment Set	DS-7
4310-01-223-6337	Compressor, Diesel Driven	C3-7D

Distribution Restricted in Accordance with DOD Directive 5200.20

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14 APRIL 1986**

CHANGE

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Operator's and Organizational Maintenance Manual
(Including Repair Parts and Special Tools List)

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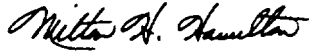
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Operator's And Organizational Maintenance Manual
(Including Repair Parts and Special Tools List)

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DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 15 September 1986

Operator's and Organizational Maintenance Manual
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To be distributed in accordance with DA Form 12-21A, Requirements for FSC Group 4220 Marine Lifesaving and Diving Equipment.

WARNING

THE FOLLOWING WARNINGS, ALTHOUGH NUMEROUS, SHOULD BE STRICTLY ADHERED TO FOR SAFE OPERATION OF THE EQUIPMENT.

When compressor unit(s) are operating, the operator(s) and other personnel in the area should wear sound attenuators. The area must be posted as a noise hazard.

Shut down the compressor if 3260 psi pressure in the final stage is exceeded. Refer to the trouble shooting Table 4-1. Do not operate the compressor until the problem has been identified and corrected.

Do not fill any cylinder if the cylinder inspection date has expired, i.e., five years.

Charge cylinders at a slow rate to prevent excessive heat buildup.

Never perform maintenance or repairs on a cylinder valve while the cylinder is charged.

Handle cylinders carefully. Avoid having the cylinders slip or drop. Do not lift or carry cylinders by the manifold.

Store cylinders in an upright position in a cool, shady place to prevent overheating.

Secure cylinders properly. This includes blocking and strapping them. The enormous potential energy of a fully charged SCUBA cylinder necessitates that special stowage maintenance and handling precautions be observed.

Internal inspections, hydrostatic tests, and repair work on cylinders should be accomplished only by those trained to do so.

Have cylinders inspected for interior deterioration annually.

Inspect cylinders externally before and after each use for signs of deterioration, corrosion, dents, cracks, or other damage. Never use a dented, welded or scarred cylinder.

Never fill a cylinder designated for another gas or which was previously filled with another gas. Never fill an oxygen tank. Danger of explosion exists.

The filler adapter and recharge connection should be thoroughly inspected prior to servicing and any trace of oil, grease, or foreign material carefully removed. Use only those adapters and connections supplied and designed for this equipment. Secure the dust cap between the handle-screw and the adapter seat when the filling adapter is not in use.

Never open filling valve when under pressure and not connected, as highly compressed air emerging can cause serious accidents.

Check air tightness of compressor from time to time by brushing all fittings and couplings with soapy water to detect air bubbles, indicating an air leak. Repair all air leaks.

Filling hose must always be in satisfactory condition and threads undamaged. Discard worn or damaged hose.

Permit only qualified personnel to use this equipment. Complete familiarity is a basic prerequisite to safe operation techniques. The operator must always be in attendance when equipment is in use.

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, U.S. Army Troop Support Command, ATTN: AMSTR-MMTS, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798.

A reply will be furnished directly to you.

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CHAPTER 1 INTRODUCTION AND DESCRIPTION

Section I GENERAL INFORMATION

1-1. GENERAL. This technical manual contains descriptive data, operating instructions, setup and storage procedures, maintenance instructions and an illustrated parts list for a Diving Equipment Set. The set is manufactured by Fluid Concepts, Inc., Ocala, Florida, USA. The manufacturer's part number for the Diving Equipment Set is DS-7.

NOTE

All dimensional values in this manual are given in both the English System and the SI System. The SI System values are listed in parentheses beside the English System Value.

Example: 25½ in. (648 mm)

1-2. PURPOSE. The purpose of the Diving Equipment Set (Fig. 1-1) is to provide purified, high pressure, compressed air for charging self-contained, underwater, breathing apparatus (SCUBA), diver tank block (2, Fig. 1-1). Also included with the set are a gas detector kit (3, Fig. 1-1), carbon dioxide test tubes (4, Fig. 1-1), carbon monoxide test tubes (5, Fig. 1-1), an air purifier chamber (6, Fig. 1-1), fill hose and manifold (7, Fig. 1-1), and a gage (8, Fig. 1-1). The air compressor unit (1, Fig. 1-1),

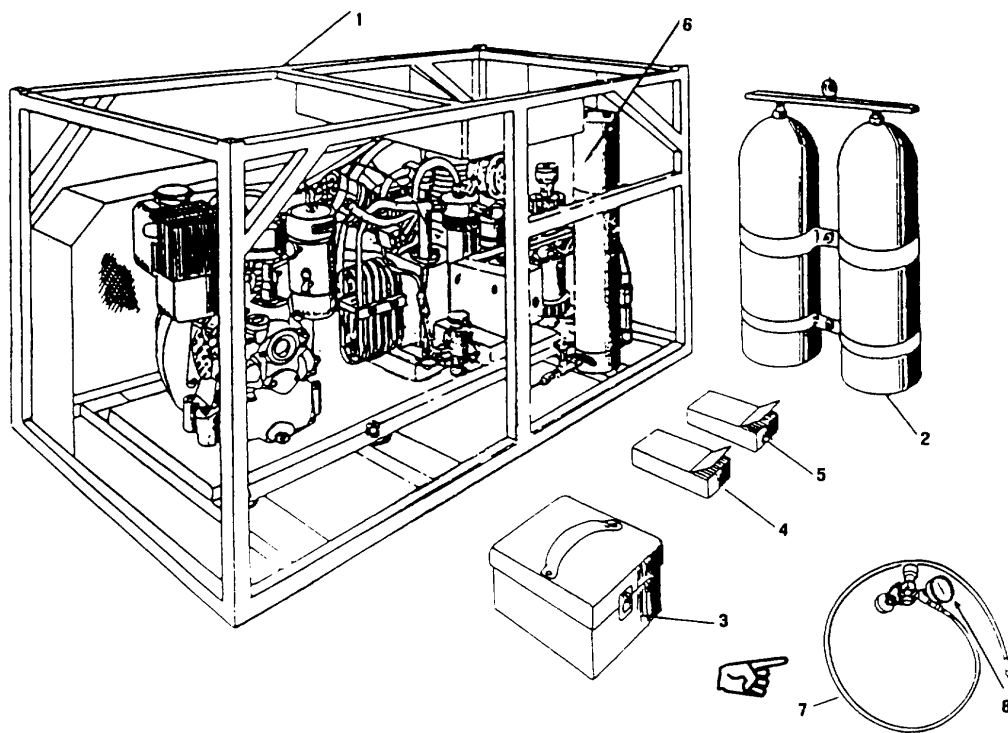


Figure 1-1. Diving Equipment Set, Scuba, Diving Support, Type A

- | | | | |
|----|---------------------------|----|----------------------------|
| 1. | Air Compressor Unit | 5. | Carbon Monoxide Test Tubes |
| 2. | Diver Tank Block | 6. | Purifier Chamber |
| 3. | Gas Detection Kit | 7. | Fill Hose and Manifold |
| 4. | Carbon Dioxide Test Tubes | 8. | Gage |

raises atmospheric air to a pressure of about 3200 PSIG. The compressed air is purified by the purification chamber and is then used to fill the SCUBA diver tank block. The gas detector kit is used in conjunction with the carbon dioxide and carbon monoxide test tubes to detect the presence of these contaminants in the compressed and purified air.

1-3 RELATED PUBLICATIONS. For further information concerning components used in this equipment but which are beyond the scope of this manual, the following publications are recommended:

a. Engine Service and Repair Instructions. Briggs and Stratton Corp. Manual Part No. 271461, covering Engine Model 18A430.

b. Detector Tube Handbook. Available from National Draeger Inc., Park View Drive, Pittsburgh, Pa. 15205. Special List 2340E, 4th edition.

Section II GENERAL DESCRIPTION

1-4. AIR COMPRESSOR UNIT. The air compressor is a portable, three stage, three cylinder, reciprocating, air cooled machine which is capable of supplying purified breathing air to fill air bottles. The compressor is driven by an air cooled, single cylinder, manually started diesel engine. A conventional V-belt drive is used to connect the diesel engine to the compressor block. The maximum brake horsepower of the engine is 6.2 BHP at 3600 RPM. A welded construction tubular steel frame provides appropriate mounting points for the instruments, purification chamber and all major components. A resilient mounting system is used to minimize transmission of engine vibration into other components. The compressor and purification chambers are interconnected. A fill hose and manifold (Fig. 1-2) with fill adapter (Fig. 3-5) must be used to connect the discharge of the air purifier chamber to the diver tank block.

1-5. DIVER TANK BLOCK. The diver tank block consists of two aluminum tanks joined together by a manifold, and fitted on a double tank harness for diver convenience and maneuverability. The two-cylinder air manifold is basically an on-off valve that controls the air supply of the two cylinders. The manifold is rated 3000 psi and is equipped with an air reserve valve that will shut off automatically at approximately 500 psi. The reserve supply can then be activated by means of a reserve valve knob, or rod connected to the knob. Charging of the cylinders is by means of a filler hose connected from the compressor to the center yoke of the manifold.

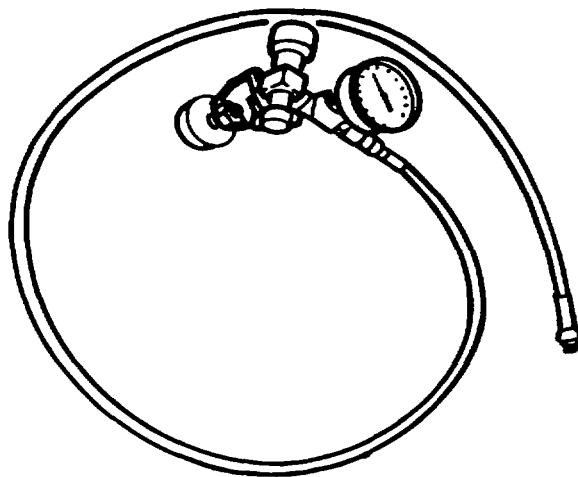


Figure 1-2. Fill Hose and Manifold

1-6. DETECTOR KIT AND TEST TUBES. The detector kit is an instrument which, when used with an appropriate test tube, will indicate the quantity of certain contaminants in the surrounding air being drawn into the air compressor. The detector kit is a field use instrument as opposed to a laboratory test instrument. The accuracy of the detector is consistent with usual field instruments. When used with the appropriate test tube, the detector will provide the user with a quantitative measure of the amount of carbon dioxide or carbon monoxide in the air around the intake of the air compressor. The gas detector kit consists of two major elements. They are: a calibrated air pump which will pump a known volume of air with each stroke and a set of test tubes containing a chemical reagent which will change color in the presence of the specified gas being evaluated. The change in color of the chemical reagent in the test tube is then compared to a color chart to determine the gas concentration level in the air being tested. The values determined by the gas detector kit may then be compared to minimum air purity values shown in Table 1-1 for acceptability.

Table 1-1. AIR PURITY STANDARDS

Oxygen	20 to 22% by volume
Maximum Carbon Dioxide	0.100% by volume (1000 ppm)
Maximum Carbon Monoxide	0.002% by volume (20 ppm)
Total Hydrocarbons, other than Methane	0.0025% by volume (25 ppm)
Maximum Total Oxidants	0.000005% by volume (0.05 ppm)
Dust and Water	Lack of any residue on membrane after passing 5000 cc of air through filter
Particulates and Oil Mist	5 mg/m ³ maximum
Odor or Taste	Not objectionable

Section III DETAILED DESCRIPTION

1-7. AIR COMPRESSOR UNIT. The significant features, items and controls which affect the operation and maintenance of the air compressor unit are shown in Figure 1-3 (unless otherwise noted) and are described as follows. The technical principles of operation of the compressor are listed in Section III.

a. Engine Fuel Tank. The engine fuel tank (1) has a capacity of approximately 4 quarts (4 liters). This is sufficient fuel for about 3/2 hours of operation at full load.

b. Engine Fuel Filter. The engine fuel filter (Inline type) is located in fuel line, between fuel pump and fuel tank. The filter is intended to prevent dirt and other debris from entering the fuel pump and fuel system.

c. Engine Oil Fill Cap. The engine oil fill cap (3) provides an access point to add engine lubricating oil during an oil change and to maintain proper oil level during engine operation.

d. Engine Oil Dipstick. The engine oil dipstick (4) is used to determine the level of lubricating oil in the engine crankcase.

e. Engine Oil Drain Plug. The engine oil drain plug (5) provides a discharge point for draining engine lubricating oil during an oil change and other maintenance operations.

f. Engine Inlet Air Filter. The engine inlet air filter (6) prevents airborne dirt and solid contaminants from entering and damaging the engine's internal components.

g. Engine Cold Start Primer. The engine cold start primer (7), when activated, provides additional fuel to assist in cold weather starting of the engine.

h. Engine Automatic Compression Release. The engine automatic compression release (8) has three positions; "start", "run", and "neutral". When rotated to the "neutral" position, the engine compression is released and the engine may be cranked an indefinite number of turns without encountering compression.

This position is used for cold weather starting. When rotated to the "start" position, the engine compression will be relieved for approximately 8 crankshaft revolutions. This is done to enable the operator to manually crank the engine up to starting speed. The release control will automatically return to "run" position from "start" position.

<p>CAUTION</p>

This device must never be used to stop the engine. Severe engine damage may result from such use.

i. Engine Starting Crank. The engine starting crank (9) engages the end of the camshaft drive. When rotated in the proper direction, the engine crankshaft will rotate at two times the starting crank speed. This will generate adequate "flywheel effect" to permit starting of the engine. The starting crank is used in conjunction with the automatic compression release and, when required, the cold start primer.

j. Engine Speed Control Lever. The engine speed control lever (10) is used to raise and lower the governed speed of the engine and to stop the engine.

k. Compressor Prefilter and Inlet Hose. The compressor prefilter and air inlet hose (11) provides a means of separating the air compressor from the point from which the air being compressed is actually taken. This insures that the cleanest possible air is being compressed.

l. Compressor Air Inlet Filter. The compressor air inlet filter (12) prevents airborne dirt and other solid contaminants from entering and damaging the compressor's internal components.

m. Compressor Interstage Separation. The compressor interstage separation (13) is located in the compressed air path downstream of the second to third stage intercooler. The oil and water vapor condensed from the compressed air by the intercooler are removed from the air by a combination of centrifugal force, air baffles and a sintered metallic filter element.

n. Compressor Final Separator. The compressor final separator (14) is located in the compressed air path downstream of the third stage aftercooler. The oil and water vapor condensed from the compressed air are removed from the air by the means of the air passing through two separate tubes of different lengths within final separator. This insures that adequately precleaned air is delivered to the purification chamber.

n. Check Valve. The check valve (13, Fig. 3-1) is located downstream from the compressor final separator. This check valve works in conjunction with the pressure maintaining valve in maintaining required pressure in the air purification chamber during operation and when compressor is not in use.

o. Air Purification Chamber. The air purification chamber (15) is located immediately downstream of the final separator. The precleaned air passes through a combination of chemicals intended to remove any remaining oil, water vapor and other contaminants. This insures that the resulting air is clean, dry, and free of odor and taste. The purifier chamber is furnished with a replaceable purification filter cartridge which is intended for regular replacement.

p. Separator/Purifier Drain Valves. The separator drain valves (16) and (23) and purifier drain valve (17) are used to vent accumulated oil and moisture from the separators and purifier chamber. They are also used to relieve pressure in the separators and purifier chamber for servicing and to reduce compressor starting load.

q. Compressor Pressure Maintaining Valve. The compressor pressure maintaining valve (18) is located downstream of the purification chamber and upstream of the fill valve, hose and manifold. The function of this

Legend for Figure 1-3

- | | | | |
|-----|----------------------------------|-----|----------------------------------|
| 1. | Engine Fuel Tank | 12. | Compressor Air Inlet Filter |
| 2. | Engine Fuel Tank Cap | 13. | Compressor Interstage Separator |
| 3. | Engine Oil Fill Cap | 14. | Compressor Final Separator |
| 4. | Engine Oil Dipstick | 15. | Air Purification Chamber |
| 5. | Engine Oil Drain Plug | 16. | Separator Drain Valve |
| 6. | Engine Inlet Air Filter | 17. | Purifier Drain Valve |
| 7. | Engine Cold Start Primer | 18. | Pressure Maintaining Valve |
| 8. | Engine Auto. Compression Release | 19. | Compressor Oil Fill Plug |
| 9. | Engine Starting Crank | 20. | Compressor Oil Drain Plug |
| 10. | Engine Speed Control Lever | 21. | Compressor Pressure Gauges |
| 11. | Compressor Inlet Hose | 22. | Fill Hose & Manifold Drain Valve |
| 23. | Compressor Final Separator | | |

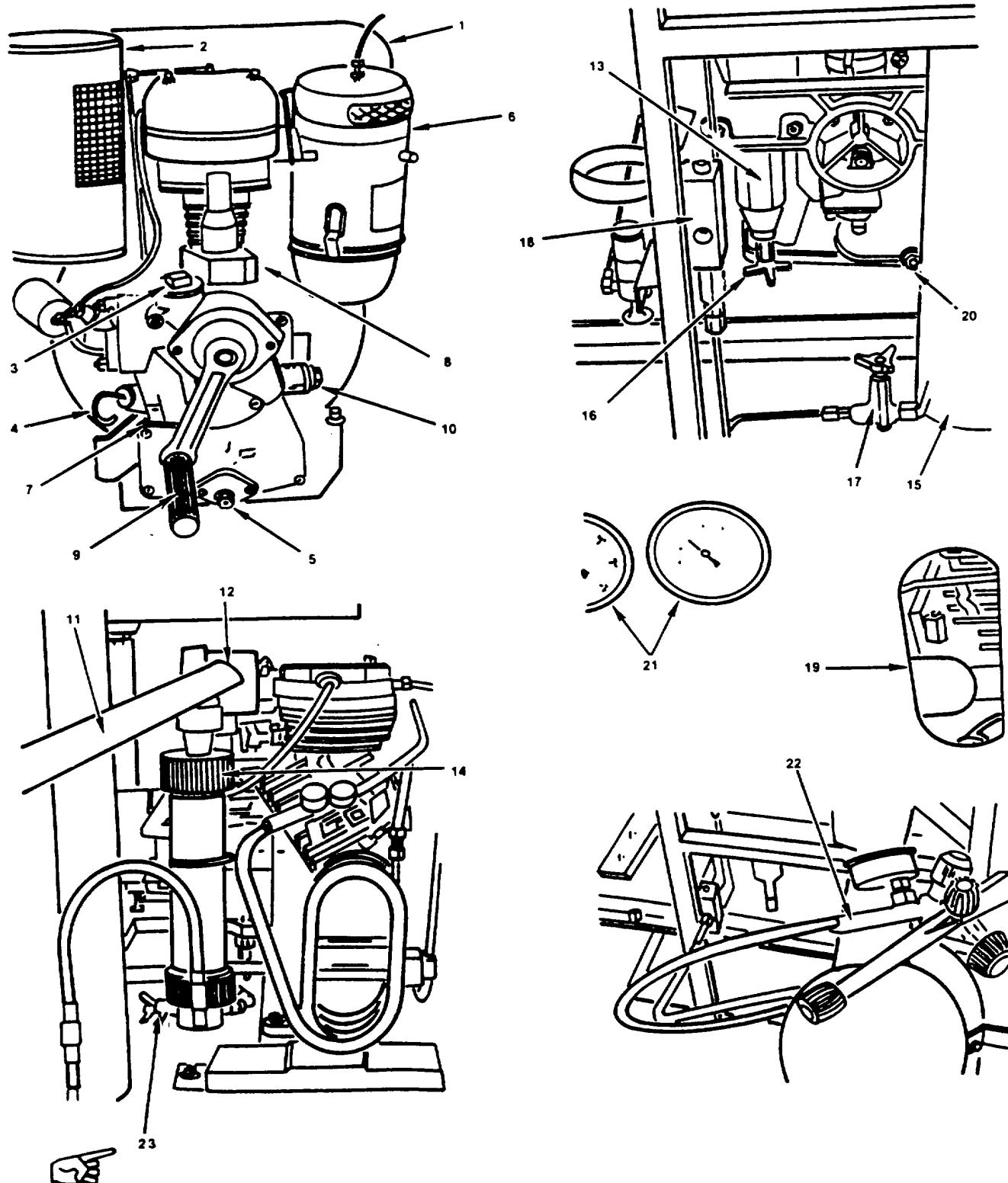


Figure 1-3. Air Compressor Unit.
Identification of Controls and Components

valve is to prevent air from passing through the purifier chamber at any pressure below 2000 PSIG. This will insure that the compressed air remains in contact with the purifier chemicals for long enough time to provide maximum purification and peak purifier efficiency.

r. Compressor Oil Fill Plug. The compressor oil fill plug (19), which includes the oil level dipstick, is used at a location to both check the compressor oil level and add oil to the compressor crankcase.

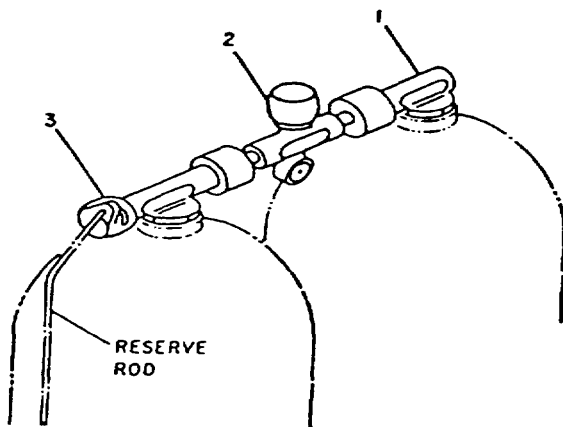
s. Compressor Oil Drain Plug. The compressor oil drain plug (20) provides a discharge point for draining compressor lubricating oil during an oil change and other maintenance operations.

t. Compressor Gauges. The compressor gauges (21) are used to give a continuous indication of the compressor final stage discharge pressure and the pressure entering the fill manifold hose.

u. Fill Hose and Manifold. The fill hose and manifold (22) is used to connect the air discharge from the pressure maintaining valve to the diver tank block.

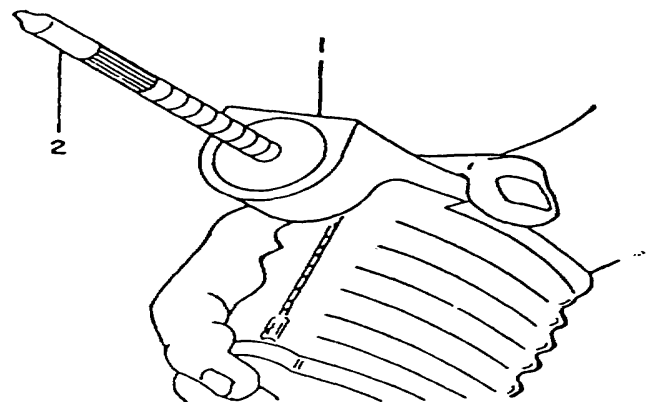
1-8. DIVER TANK BLOCK. As stated previously, the tank block consists of twin 80.0 Std. cu. ft. Cylinders joined by a double constant reserve valve. This double "J" valve (Figure 14) consists of an elbow assembly (1) that connects cylinder number 1 to the on-off valve (2). The air reserve valve (3) has the dual function of an elbow and a reserve valve. It connects cylinder number 2 to the shutoff valve (2) through the reserve mechanism and a operates as follows: during the start of a dive, the reserve valve is in the "up" position. When the pressure in cylinder number 2 falls to approximately 500 psi, this valve will automatically close and create the air breathing reserve in cylinder number 2. When the reserve valve knob is turned "down" (opened), the air reserve will become activated and be available via the on-off shutoff valve (2).

1-9. DETECTOR KIT. As stated previously, the pump and test tube (Figure 1-5) constitute a gas detector measuring instrument. The pump (1) is a bellows type device which is operated by hand and supplies 100 cc with each stroke. With the proper test tube (2) inserted in the pump head, and the pump operated, a gas sample will be sucked in via the tube. Depending on the number of pump strokes used and the composition of the test tube, a measurement can then be made for the gas being tested. Simply read the length of discoloration on the scale of the tube. The numerical value read off is a measure of the concentration of the gas (e.g., in ppm.) which can then be compared to Table 1-1 to check that it falls within the limits of breathing air acceptability. Ordinarily, the air should be tested at two locations, entering the prefilter and discharge from the purifier chamber. In the first



1. Elbow Assembly for Cylinder No. 1
2. Tank(s) Shutoff Valve
3. Reserve Valve and Elbow for Cylinder No. 2

Figure 1-4. Diver Tank Block Manifold



1. Pump
2. Test Tube

Figure 1-5. Detector Kit

case, the air surrounding the prefilter is sampled. In the second case, a quantity of air may be collected into a plastic bag from the fill hose and manifold. This air is then drawn into the test tube and the resultant color change compared to the appropriate color charts to determine the breathing air quality.

1-10. COMPRESSED AIR PURITY. The standards given in Table 1-1 are considered safe for human consumption and for use in divers breathing apparatus.

Section IV LEADING PARTICULAR

Table 1-2. COMPRESSOR

No. of Cylinders	3	
No. of Stages	3	
	<u>Cylinder Bore</u>	<u>Working Pressure</u>
1st Stage	3.465" (88 mm)	60-80 PSIG (4-5.5 BAR)
2nd Stage	1.417" (36 mm)	50-600 PSIG (34.5-41.0 BAR)
3rd Stage	0.551" (14 mm)	3200 PSIG (220 BAR)
Stroke	1.575" (40 mm)	
Speed	1300 RPM (max)	
Delivery Rate	5 SCFM (min)	
Minimum Ambient Temp.	-250 F (-32° C)	
Maximum Ambient Temp.	1100 F (430 C)	
Discharge Air Temp.	1350 F (571 C) (max)	
Maximum Allowable Compressor Inclination	150 in any direction	
Dimensions Length	42 (1066.8 mm)	
	Width	18" (457.2 mm)
	Height	24" (609.6 mm)
	Weight	275 lbs (125 KG)

Table 1-3. DIVER TANK BLOCK

No. of Cylinders	2
Tank Material	Aluminum
Tank Capacity	80 SCF @ 3000 PSIG, 70°F
Reserve Tank Capacity	500 PSIG

Table 1-4. DETECTOR KIT

Consists of:

Bellows Pump
 Protective Bag
 Carrying Case
 Special Screwdriver
 Special Spanner
 Spare Parts Boxes
 Carrying Strap
 Break-off Husk

	Part No.	Measuring Range	No. of Pump Strokes	TLV*
Carbon Dioxide	CH30801	0.01 to 0.3% by volume	10	5000 ppm
Test Tube (Color change to violet)				
Carbon Monoxide	CH25601	5 to 150 ppm 100 to 700 ppm	10 2	50 ppm
Test Tube (Color change to brown- green)				

*Threshold Limit Value. Refer to publication Par. 1-3.

Table 1-5. DIESEL ENGINE

No. of Cylinders	1
Bore	3.23" (82 mm)
Stroke	2.17" (55 mm)
Displacement	17.7 cu. in. (290 cc)
Horsepower	6.2 max @ 3600 RPM (4.5 KW)
Torque (Ft. Lbs.)	10.8 max @ 2500 RPM (14.7 NM)
Intake valve gap	.004" (0.1 mm)
Exhaust valve gap	.004" (0.1 mm)

CHAPTER 2 PREPARATION FOR USE

Section I GENERAL INFORMATION

2-1. GENERAL. The Diving Equipment Set is shipped fully assembled with the drive belt loosened. To prepare the equipment for use, carefully unpack all components and perform the following inspections and servicing.

- a.** Remove all packing material.
- b.** Check all components against the packing list and Figure D-1. Report any damaged or missing items to the proper authority.
- c.** Install new purifier cartridge in accordance with the instructions in paragraph 4-4.
- d.** Adjust drive belt tension in accordance with the instructions in paragraph 4-4.
- e.** Service engine oil bath air cleaner in accordance with the instructions in paragraph 4-4.
- f.** Check the oil level in the compressor crankcase with the combination oil fill plug and dipstick (19, Fig. 1-3). Wipe off the dipstick with a clean lint free cloth and reinsert the dipstick to determine the oil level. Dipstick must be screwed all the way down when checking oil. The crankcase oil level should be between the upper and lower marks on the dipstick. If the oil level is below the lower dipstick mark, add oil to raise the oil level to the upper dipstick mark. Oil must conform to the requirements shown in table 2-1.



Oil level must not be higher than the upper dipstick mark.
Compressor damage can occur if the oil level is too high.

Table 2-1. COMPRESSOR OIL

<u>Weather Condition</u>	<u>Specification</u>
Normal Weather	MIL-L-17331 (2190-TEP)
Cold Weather	MIL-H-17672 (2135-TH)

For normal weather operation, use oil conforming to Specification MIL-L-17331 (2190-TEP). For cold weather operation, use oil conforming to Specification MIL-H-17672 (2135-TH).

g. Check the oil level in the engine crankcase with the engine oil dipstick (4, Fig. 1-3). Wipe off the dipstick with a clean lint free cloth and reinsert the dipstick to determine the oil level. The crankcase oil level should be up to the upper dipstick mark. If the oil level is low, add oil to bring the level up to the upper dipstick mark. Oil must conform to the requirements shown in Table 2-2. When checking engine oil level push dipstick in until cap bottoms on tube.

Table 2-2. DIESEL ENGINE OIL VISCOSITY

<u>Season</u>	<u>Viscosity</u>
Summer Temperature Above 50°F (10°C)	SAE 30
Winter Temperature from 5°F (-15°C) to 50°F (10°C)	SAE 20
Arctic Temperature Below 5°F (-15°C)	SAE 5W

SAE 01W-30 or 10W-40 may be used as an acceptable alternate under all temperature conditions.

SAE 10W-30 or 10W-40 must be used during operation in extreme heat, dusty, or sandy areas.

Engine oil must conform to Specification MIL-L2104 and be marked "For API Service CC," or "For API Service CD."

NOTE

Pour slowly, crankcase capacity is about 1 qt. (1.0 liter).

h. Fill the engine Fuel Tank (1, Fig. 1-3) with clean, fresh diesel fuel, *type #2*, or 2D. Do not mix oil with diesel fuel. Do not use gasoline, fuel additives or other starting fluids in fuel tank. Do not overfill or spill. If fuel is spilled, wipe up immediately.

WARNING

Diesel fuel is highly flammable. Do not store or use diesel fuel near open flame or extreme heat emitting devices such as heaters, welders, torches, lanterns, etc. Use diesel fuel only in a well ventilated area. Do not fill tank with engine running.

i. Check that a clean filter element is installed in the compressor air intake filter (12, Fig. 1-3). Check that the prefilter and inlet hose (11, Fig. 1-3) is properly installed.

j. Check that all drain valves (16 & 17, Fig. 1-3) operate freely and that all safety valves are installed and are secure.

Section II COMPRESSOR LOCATION

2-2. GENERAL. To avoid contaminants that are sometimes found in free air, it is essential that the air compressor intake is not exposed to the contaminating effects of internal combustion engine exhaust, ship engine or ventilator exhaust, unventilated rooms or ships compartments, areas of high dust levels, or areas where excessive moisture is present. It is also not advisable to fill SCUBA tanks when an air pollution alert is in effect. The method of avoiding contamination is given below.

2-3. OUTDOOR LOCATION.

a. Position compressor unit so that exhaust fumes from the engine are blown away from the unit.

b. Connect black plastic hose of pre-filter (supplied with each compressor unit) to the compressor air intake filter (11, Figure 1-3). Locate pre-filter as shown in Figure 2-1

- c. Reposition unit accordingly as the wind changes direction.
- d. Be certain that no exhaust from running vehicles are in the vicinity of the unit.
- e. Check ambient air for carbon monoxide and carbon dioxide contamination with the Detector Set. Compare the results with Table 1-1. Change the operation site if these levels are excessive.

WARNING

The location of the compressor intake with respect to possible sources of contamination is fully as important as any single factor in assuring satisfactory air quality. The compressor unit should not be operated near exhausts of internal combustion engines, sewer manholes, sandblasting, painting, electric arcs, or sources of smoke.

- f. The compressor unit, since it is diesel powered, must be located outdoors, never indoors.
- g. Place compressor unit on level surface. Refer to Table 1-2 for maximum permissible inclination.

Section III PREPARATION FOR STORAGE

2-4. SHORT TERM STORAGE. Short term storage of the compressor unit, storage of about 6 months or less, may be accomplished by performing the following steps.

WARNING

All work performed on the compressor unit must be accomplished only while the unit is depressurized.

- a. Run the compressor unit at operating pressure (open drain valve 13, Fig. D-2) to maintain 3000 PSI on final pressure gauge (19, Fig. D-2) and temperature for approximately 10 minutes. All other valves should be closed.

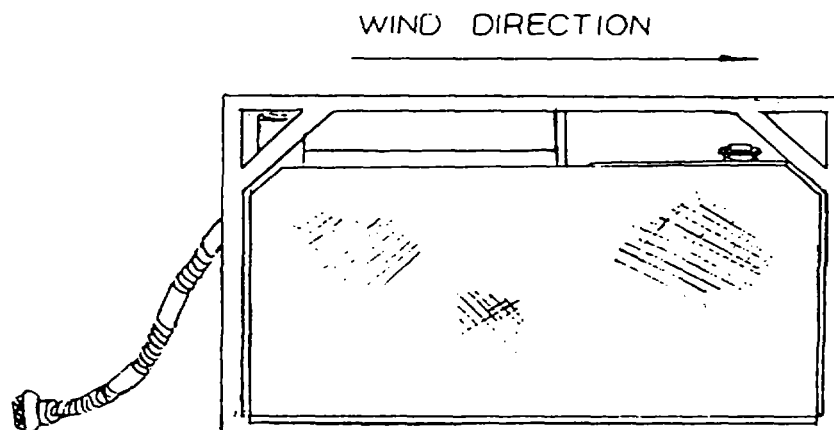


Figure 2-1. Orientation of Compressor Unit with Respect to Wind and Air Intake Hose

b. Check the unit for leaks at all pipe connections, filter, purifier, separator and valves. Tighten couplings and connections as required.

c. After 10 minutes of operation, open the fill valve and allow the compressed air to escape to the atmosphere. The compressor will then be maintained at about 2000 PSIG (138 BAR) by the pressure maintaining valve.

d. Shut down the unit after five more minutes of operation and drain off the filter, purifier and separator by opening their drain valves. Close the valves after compressor has been reduced to zero pressure.

e. Remove top plug (1, Fig. D-13) from purifier chamber. Remove chamber (2, Fig. D-13) from bottom plug (3, Fig. D-13). Coat threads and "O" ring seals with a thin coat of silicone grease. Install a new purifier cartridge (7, Fig. D-13) in accordance with paragraph 4-4. Reinstall chamber and top plug.

f. Service engine oil bath air cleaner (6, Fig. 1-3) in accordance with paragraph 4-5.

g. Install new compressor inlet air cleaner element (5, Fig. D-10) in accordance with paragraph 4-4.

h. Remove prefilter hose (15, Fig. D-2). Seal opening in air filter housing with tape, MIL-T-22085.

i. Drain fuel from fuel tank. Spray interior of tank with a small quantity of preservation oil P-10 grade 30.

j. Change engine oil in accordance with paragraph 4-5.

k. Change compressor oil in accordance with paragraph 4-4.

l. Loosen drive belt tension in accordance with paragraph 4-4.

m. Clean dirt and debris from engine cooling fins in accordance with paragraph 4-20.

n. Store in a dry, dust-free room and cover with a plastic film that does not "sweat". Remove cover from time to time and clean off the unit.

2-5. LONG TERM STORAGE. Long term storage of the compressor unit, storage without time limit, may be accomplished only by means of the following special instructions.

a. Run the compressor at operating pressure (open drain valve (13, Fig. D-2) to maintain 3000 PSI on final pressure gauge (19, Fig. D-2)) and temperature for approximately 10 minutes. All other valves should be closed.

b. Check the unit for leaks at all pipe connections, filter purifier, separator and valves. Tighten couplings and connections as required.

c. After 10 minutes of operation, open the fill valve and allow the compressed air to escape to the atmosphere. The compressor will then be maintained at about 2000 PSIG (138 BAR) by the pressure maintaining valve.

d. Shut down the unit after five more minutes of operation and drain off the filter, purifier and separator by opening their condensate valves. Close the valves after compressor has been reduced to zero pressure.

e. While still warm, drain compressor crankcase and refill with the proper lubricating oil as specified in Table 2-1.

f. While still warm, drain engine crankcase and refill with preservative P-10, grade 10.

g. Start compressor unit and run under load for about 5 minutes to circulate the proper lubricating oil.

h. Spray about one fluid ounce of preservative P-9 into the engine air inlet.

i. Shut down the compressor unit.

- j.* Loosen drive belts in accordance with paragraph 4-4.
- k.* Apply primer TT-P-664 to the groove surfaces of both the engine and compressor sheaves.

NOTE

Do not rotate either engine or compressor after the primer has been applied.

- l.* Remove top plug (1, Fig. D-13) from purifier chamber. Remove chamber from bottom plug. Coat threads and "O" ring seals with a thin coat of silicone grease. Install a new purifier cartridge (7, Fig. D-13) in accordance with paragraph 4-4. Reinstall chamber and top plug.
- m.* Install new compressor inlet air cleaner element (5, Fig. D-10) in accordance with paragraph 4-4.
- n.* Remove prefilter hose (12, Fig. D-2) seal opening in air filter housing with tape, MIL-T-22085.
- o.* Service engine inlet air cleaner (6, Fig. 1-3) in accordance with paragraph 4-5. Refill with preservative P-1, grade 10 in lieu of engine oil.
- p.* Seal engine air cleaner inlet with tape, MIL-T-22085.
- q.* Drain all fuel from engine fuel tank (1, Fig. 4-7). Spray interior of fuel tank with 2 to 3 fluid ounces of preservative P-10, grade 30.
- r.* Clean dirt and debris from engine cooling fins in accordance with paragraph 4-20.
- s.* Apply preservative P-9 to the exterior surfaces of the engine exhaust manifold, pipe and muffler.
- t.* Tag engine with a red tag stating "Caution: Crankcase filled with preservative P-10. Drain and refill with proper lubricating oil prior to use".
- u.* Store in a dry, dust-free room and cover with a plastic film that does not "sweat". Remove cover from time to time and clean off the unit.

2-6. RESUMPTION OF OPERATION AFTER LONG-TERM STORAGE. Once a compressor has been prepared for long term storage, the following service must be performed prior to placing the unit back into service.

- a.* Remove all dust caps and plugs.
- b.* Drain oil from compressor crankcase. Refill with proper lubricating oil as specified in Table 2-1.
- c.* Drain preservative from engine crankcase. Refill with proper lubricating oil as specified in Table 2-2.
- d.* Fill engine fuel tank with fuel. Ref. Par. 2-1h.
- e.* Drain preservative from engine inlet air cleaner. Fill with proper lubricating oil. Ref. Par. 2-1.
- f.* Install new purifier cartridge in accordance with paragraph 4-4.
- g.* Operate compressor for five minutes with filling valve open.
- h.* Check return oil flow and vent the oil pump if necessary, Par. 4-25q(4).
- i.* Close filling valve after five minutes of operation and run compressor until final pressure is achieved, as indicated by the final safety valve blowing off.

j. Check air tightness of complete unit by brushing all fittings and couplings with soapy water to detect escaping air, i.e., bubbles. Tighten all connections and couplings at leaks and recheck.

k. Shut off compressor and open all three condensate drain valves. Close drain valves. Unit is now ready for operation.

2-7. PREPARATION FOR SHIPMENT.

a. Boxed or Crated Shipment.

- (1) Prepare the unit for storage in accordance with paragraph 2-4 or 2-5 as applicable.
- (2) Box or crate the complete unit in accordance with the applicable Technical Orders, 00 85 Series.

b. Uncrated Shipment. The Compressor may be shipped by securing the unit directly to the load surface of a vehicle such as a truck. The unit should be lifted and tied down in accordance with Figure 2-2. The approximate center of gravity of the unit is shown in Figure 2-3.

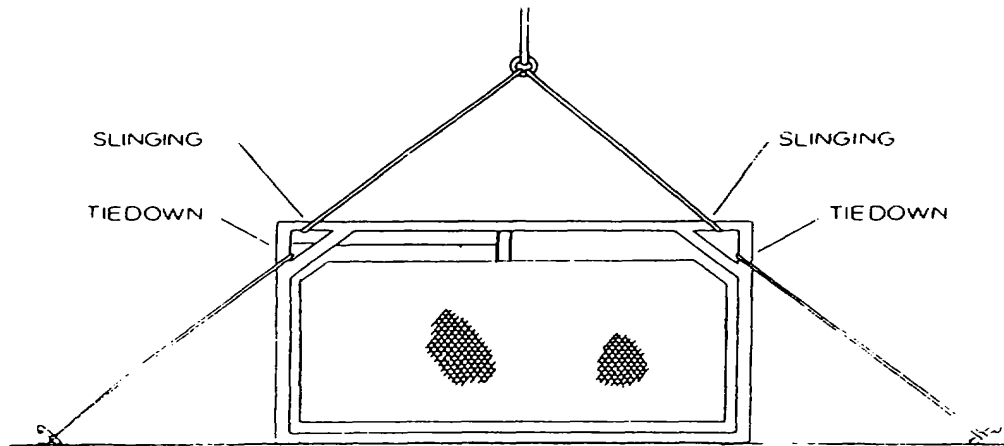


Figure 2-2. Compressor Unit Sling and Tie Down Arrangement

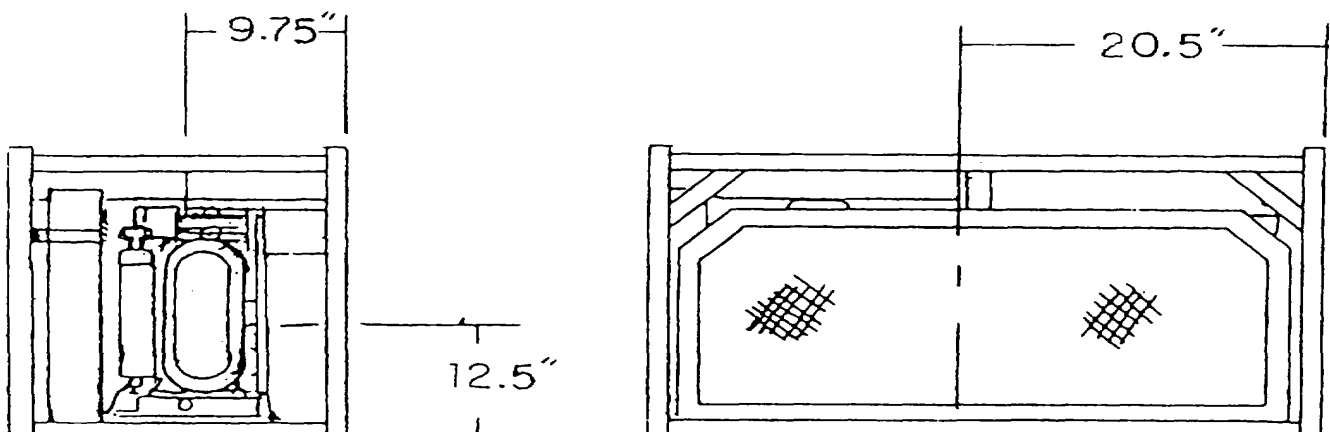


Figure 2-3. Compressor Unit Center of Gravity

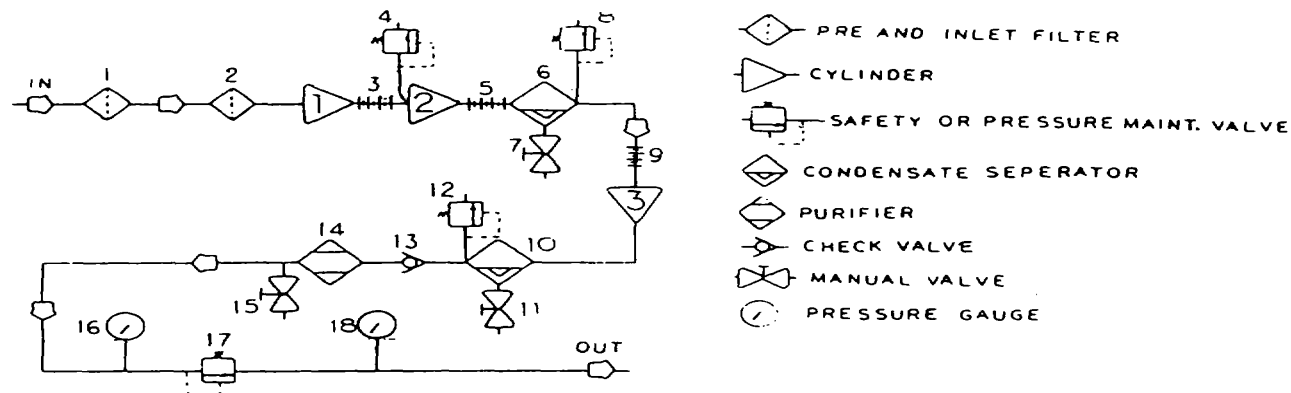
CHAPTER 3 OPERATION

Section I GENERAL INFORMATION

3-1. GENERAL. This section describes the basic principles of operation of the air compressor unit and various methods by which the unit and operating personnel are protected against excessive pressures, contaminated air, etc. This is followed by a step-by-step procedure for all modes of operation and the safety precautions to be followed to assure safe and trouble-free operation.

Section II. PRINCIPLES OF OPERATION

3-2. COMPRESSOR AIR FLOW. Air is taken into the first stage of the compressor by way of the prefilter (1, Fig. 3-1) and the inlet air filter (2, Fig. 3-1). The movement of the piston within the first stage cylinder compresses the incoming air to about 70 PSIG (4.8 BAR). The air leaving the first stage is substantially cooled by the first to second stage intercooler (3, Fig. 3-1). Both the first stage cylinder and the first to second stage intercooler are protected from damaging overpressure by the first stage safety valve (4, Fig. 3-1). The compressed air entering the second stage is compressed to a pressure of about 550 PSIG (38 BAR). The air leaving the second stage is cooled by the second to third stage intercooler (5, Fig. 3-1). The cooled compressed air enters the interstage separator (6, Fig. 3-1). Inside the interstage separator, a sintered metal filter removes any solid contaminants from the air. A series of air directing vanes and baffles cause the air flowing through the separator to spin. The resulting centrifugal force causes the water vapor and oil vapor which was condensed by the intercooler to collect on the inside surface of the separator housing and flow down into the sump area at the bottom of the separator. The accumulated condensate may then be drained by means of the separator drain



- | | |
|---|--|
| 1. Prefilter | 10. Final Separator |
| 2. Inlet Air Filter | 11. Separator Drain Valve |
| 3. Intercooler, 1st-2nd Stage | 12. Safety Valve, 3rd Stage, 3260 PSIG (225 BAR) |
| 4. Safety valve, 1st Stage, 116 PSIG (8 BAR) | 13. Check Valve |
| 5. Intercooler, 2nd -3rd Stage | 14. Purifier Chamber |
| 6. Interstage Separator | 15. Purifier Drain Valve |
| 7. Separator Drain Valve | 16. Discharge Pressure Gauge |
| 8. Safety Valve, 2nd Stage, 725 PSIG (50 BAR) | 17. Pressure Maintaining Valve |
| 9. Aftercooler | 18. Fill Pressure Gauge |

Figure 3-1. Compressor Air Flow Diagram

valve (7, Fig. 3-1). The second stage cylinder, second to third stage intercooler and the interstage separator are all protected from overpressure by the second stage safety valve (8, Fig. 3-1). The compressed air entering the third stage is compressed to a pressure of about 3260 PSIG (225 BAR). The high pressure air leaving the third stage is cooled to within about 250 F (140 C) of ambient temperature by the aftercooler (9, Fig. 3-1). It should be noted that the interstage coolers and the aftercooler are located directly in the air blast from the compressor cooling fan. The cooled compressed air from the aftercooler enters the final separator (10, Fig. 3-1). The final separator removes the condensed oil and water vapor by air passing through two separate tubes of different lengths within the separator. The accumulated condensate may be discharged by the separator drain valve (11, Fig. 3-1). The final safety valve (12, Fig. 3-1) protects the third stage, aftercooler and final separator from damaging over pressures. The compressed air leaving the final separator flows into the purifier chamber (14, Fig. 3-1) by way of a check valve (13, Fig. 3-1). The function of the check valve is to prevent a reverse flow of air from the purifier chamber back into the final separator whenever the condensate in the separator is drained. Such a reverse flow of air could damage the chemicals in the purifier chamber cartridge. Any accumulated moisture collecting in the purifier chamber may be drained by the purifier chamber drain valve (15, Fig. 3-1). This drain valve is also used to relieve any pressure within the purifier chamber so that the chamber may be opened for cartridge servicing. The pressure maintaining valve (17, Fig. 3-1) prevents passage of air through the chemicals in the purifier chamber until the pressure rises above about 2000 PSIG (135 BAR). This is done to insure the purifier operates at peak efficiency. The final pressure gauge (16, Fig. 3-1) and fill pressure gauge (18, Fig. 3-1) indicate the air pressure inside the purification chamber and the air pressure being delivered to the diver tank block respectively.

3-3. COMPRESSOR LUBRICATION SYSTEM. The compressor is equipped with a positive pressure lubricating oil system. The oil pump (1, Fig. 3-2) is driven by a cam which is bolted to the end of the crankshaft. The oil pump supplies oil to a pressure regulating valve (3, Fig. 32) which controls the oil pressure. The pressure regulating valve also controls the oil flow rate to the third stage cylinder. The surplus oil not required for the third stage is delivered to be base of the second stage cylinder to provide lubrication for the second stage and the crankshaft. The oil then drains back into the crankcase sump where it is picked up by the oil pump for recirculation. The first stage is lubricated by an oil vapor drawn from the crankcase into the intake of the first stage. This high pressure lubrication system insures adequate oil delivery to all wear points resulting in minimum wear and maximum service life.

NOTE

Use only those oils recommended in Table 2-1. These oils have been selected for maximum compatibility with this compressor.

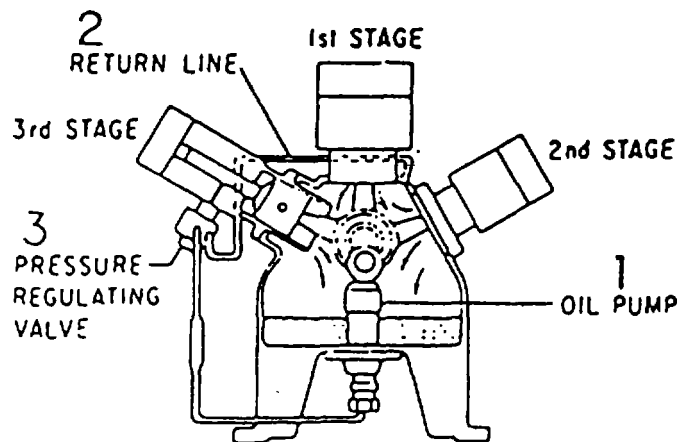


Figure 3-2. Compressor Lubricating Oil Flow Diagram

3-4. OPERATION.**WARNING**

The following warnings, although numerous, should be strictly adhered to for safe operation of the equipment.

When compressor unit(s) are operating, the operator(s) and other personnel in the area should wear sound attenuators. The area must be posted as a noise hazard.

Shut down the compressor if 3260 psi pressure in the final stage is exceeded. Refer to the Compressor Maintenance Schedule Table 4-1. Do not operate the compressor until the problem has been identified and corrected.

Do not fill any cylinder if the cylinder inspection date has expired, i.e., five years.

Charge cylinders at a slow rate to prevent excessive heat buildup. Never perform maintenance or repair on a cylinder valve when the cylinder is charged.

Handle cylinders carefully. Avoid having the cylinders slip or drop. Do not lift or carry cylinders by the manifold.

Store cylinders in an upright position in a cool, shady place to prevent overheating.

Secure cylinders properly. This includes blocking and strapping them. The enormous potential energy of a fully charged SCUBA cylinder necessitates that special stowage maintenance and handling precautions be observed.

Internal inspections, hydrostatic tests, and repair work on cylinders should be accomplished only by those trained to do so.

Have cylinders inspected for interior deterioration annually. Inspect cylinders externally before and after each use for signs of deterioration, corrosion, dents, cracks, or other damage. Never use a dented, welded or scarred cylinder.

Never fill a cylinder designated for another gas or which was previously filled with another gas. Never fill an oxygen tank. Danger of explosion exists.

The filter adapter and recharge connection should be thoroughly inspected prior to servicing and any trace of oil, grease, or foreign material carefully removed. Use only those adapters and connections supplied and designed for this equipment. Secure the dust cap between the handlescrew and the adapter seat when the filling adapter is not in use.

Never open filling valve when under pressure and not connected, as highly compressed air emerging can cause serious accidents.

Check air tightness of compressor from time to time by brushing all fittings and couplings with soapy water to detect air bubbles, indicating an air leak. Repair all air leaks.

Filling hose must always be in satisfactory condition and threads undamaged. Discard worn or damaged hose.

Permit only qualified personnel to use this equipment. Complete familiarity is a basic prerequisite to safe operation techniques. The operator must always be in attendance when equipment is in use.

3-5. COMPRESSOR UNIT

a. *Prior to Start Up*

- (1) Obtain appropriate Logbook and enter Date and Start Time.
- (2) Check belts for tightness. (Ref. para. 4-4f.)
- (3) Check compressor lubricating oil level. (Ref. para. 2-1f.)
- (4) Check engine lubricating oil level. (Ref. para. 2-1g.)

NOTE

For operation below 32° F (0° C), diesel fuel marked #1 or #1D will provide easier starting. Do not use #1 or #1D diesel fuel at temperature higher than 32° F (0° C).

- (5) Fill the engine fuel tank. (Ref. para. 2-lh.)
- (6) Check SCUBA fill hose (Fig. 1-2) and air intake hose (Fig. 2-1) for damage.

b. *Start Up*

- (1) Open separator drain valves (16, 23, Fig. 1-3) and close filling valve (Fig. 3-5).
- (2) Move speed control lever "UP" to fast position (1, Fig. 3-3).
- (3) Rotate automatic compression release (8, Fig. 1-3) clockwise two 'Clicks' to the start position (3, Fig. 3-3).

WARNING

Always keep hands, feet and clothing clear of moving parts of other rotating machinery.

Hand and thumb must be positioned as shown (4, Fig. 3-3) to prevent injury if kickback should occur.

- (4) For cold weather starts rotate compression release (8, Fig. 1-3) clockwise one "click", crank engine 30 turns and proceed with steps (3) through (7).

- (5) Pull cold start primer (2, Fig. 3-3).
- (6) Insert crank into starter crank guide, rotate clockwise to engage end of camshaft (4, Fig. 3-3).

NOTE

If compressor unit is equipped with cold start primer system, activate primer system by pushing knob as shown in Figure 3-4.

- (7) Rapidly crank engine until it starts.
- (8) If engine fails to start, repeat steps 3 through 7.
- (9) After engine starts, remove and store crank.
- (10) After engine speed stabilizes, close separator drain valves (16, 23, Fig. 1-3).

Change 3 3-4

WARNING

If pressure goes over 3260 PSIG, shut down compressor immediately.

NOTE

During initial start-up, a knocking sound will be generated by the floating piston in the third stage. This knocking sound will continue for several seconds until the air pressure in the third stage is high enough to hold the floating piston against the third stage guide piston. This knocking sound is completely normal and is not a cause for alarm.

(11) Let compressor build to maximum pressure of 3260 PSIG and listen for fourth stage safety valve to lift. Note blowoff pressure on pressure gauges (21, Fig. 1-3).

c. During Operation

- (1) Charge SCUBA cylinders (Ref. para. 3-6).
- (2) Bleed moisture separator drain valves (16, 23, Fig. 1-3) and purifier drain valve (17, Fig. 1-3) every 15 minutes while compressor is running.

d. Shut down

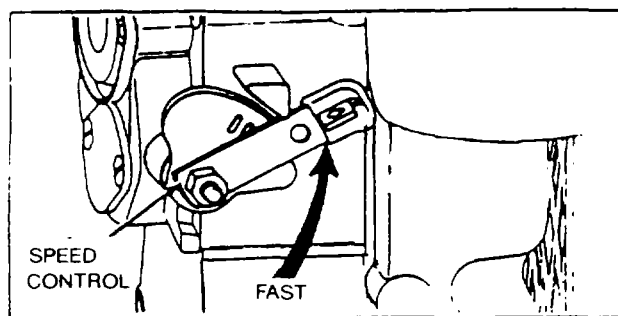
- (1) Open moisture separator drain valves (16, 23, Fig. 1-3) and filling valve (Fig. 3-5).

CAUTION

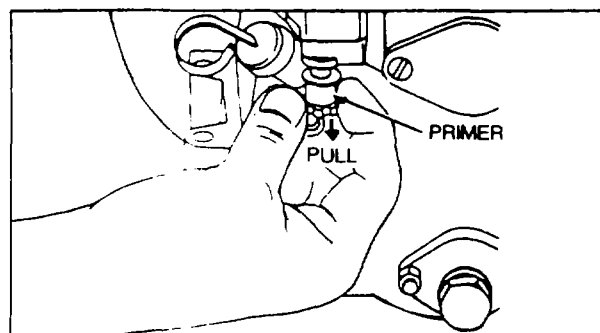
Do not open air purifier drain valve (17, Fig. 1-3).

- (2) Move speed control lever (1, Fig. 3-3) to half position and idle compressor for 3-5 minutes with no load.
- (3) Hold speed control lever down until engine stops (6, Fig. 3-3).
- (4) Make appropriate entries into equipment logbook for stop time and total hours.

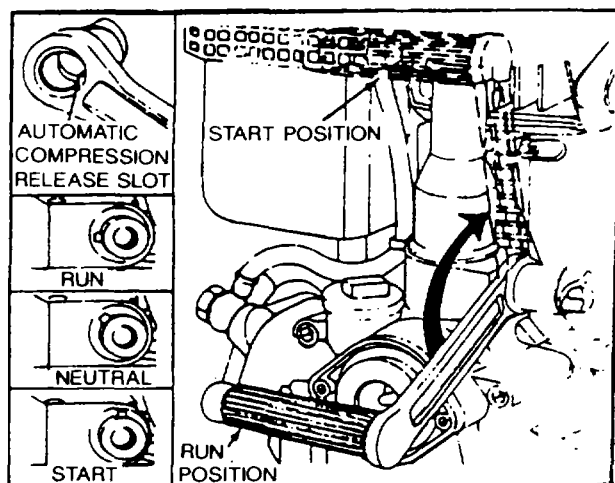
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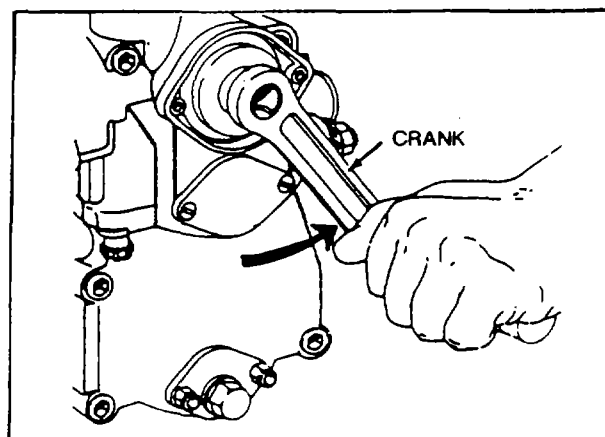
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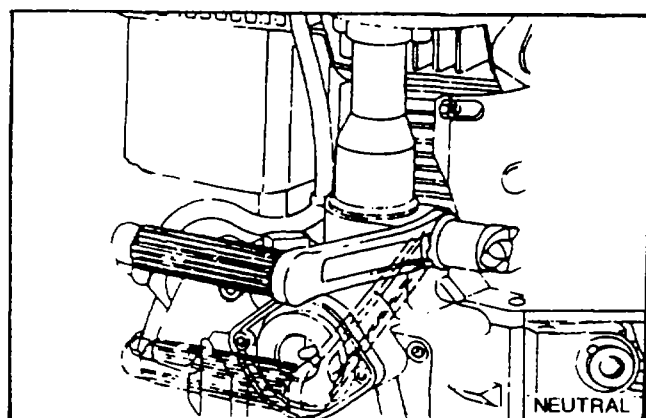
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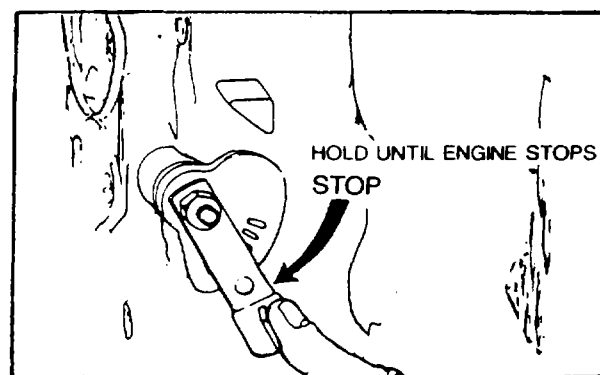
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4



5



6

- 1 Speed Control Lever
- 2 Cold Start Primer
- 3 Automatic Compression Release

- 4 Hand Position for Engine Cranking
- 5 Cold Weather Starting
- 6 Engine Shutdown

Figure 3-3. Diesel Engine Operation Details

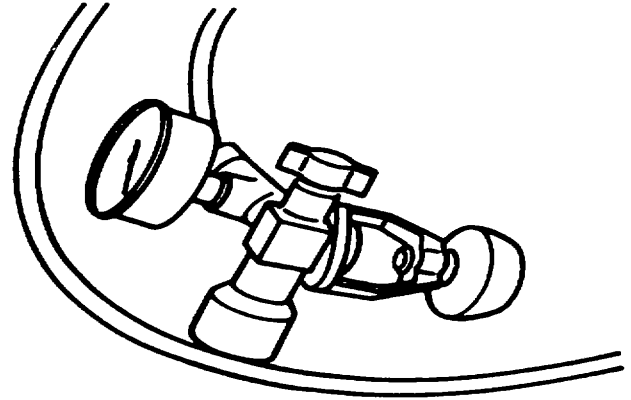
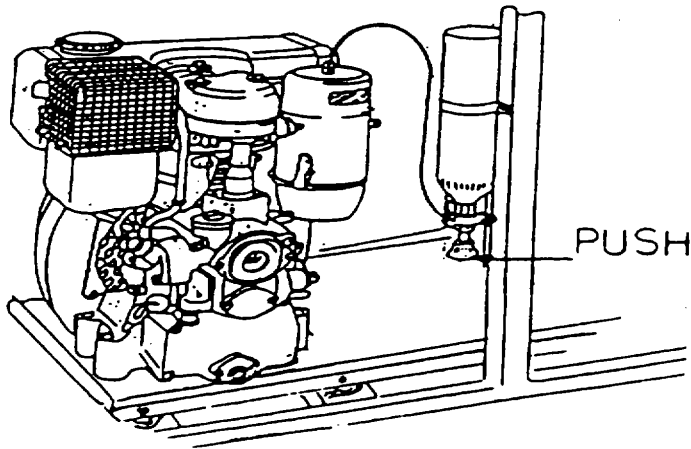


Figure 3-4.

Optional Diesel Engine Cold Start Primer System

Figure 3-5. Filler Adapter

3-6 SERVICING SCUBA CYLINDERS.

- a. Read and comply with the safety warnings (para. 3-4) prior to servicing.
- b. Check that the SCUBA cylinder shutoff valve (2, Fig. 1-4) is closed prior to servicing.

WARNING

SCUBA cylinders with valves that have been left open must not be charged without first being properly purged to avoid contamination.

- c. Connect charging hose to outlet of pressure maintaining valve (18, Fig. 1-3) Check filler adapter (Figure 3-5) for damage or contamination.
- d. Orient the filler adapter on the SCUBA cylinder manifold and screw down the handle-screw sufficiently to create a seal.
- e. Open the filling valve (Figure 3-5) and start the compressor (Par 3-5).
- f. Allow compressor to build up pressure.
- g. Place the reserve valve knob (3, Fig. 1-4) in the "down" position and open the SCUBA tank shutoff valve (2, Fig. 1-4).

Change 3 3-6

- h. Charge the SCUBA cylinders to the proper pressure as observed on the pressure gauge (Figure 3-5).

NOTE

Monitor the unit at all times during the filling procedure.

- i. Close the SCUBA shutoff valve (2, Fig. 1-4) and filling valve (Fig. 3-5).

NOTE

Before use, the reserve valve knob (3, Fig. 1-4) should be in the "up" position.

NOTE

During the filling procedure the SCUBA cylinders will warm up and then cool down after being detached from the compressor. The cylinders will then need topping-off to the required nominal filling pressure. However, this tedious procedure can be avoided by using a water tank for submerging the SCUBA cylinders while filling them.

3-7. DIVER TANK BLOCK This technical manual does not cover diving procedures or techniques. The appropriate publication covering diving operations and procedures is FM 20-11-1, Military Diving Manual, Volume One. It should be remembered, however, that upon starting a dive the reserve valve knob (3, Fig. 1-4) should be in the "up" position, and to release the reserve supply to the diver, the reserve rod must be actuated.

NOTE

Do not completely drain a cylinder tank of air. Residual pressure will prevent moisture from entering the tank.

3-8. DETECTOR KIT.

- a. Select the test tube of the gas to be measured. (Ref. Table 1-4).
- b. Break off both tips of the test tube and fit in on the gas detector pump (1, Fig. 1-5).
- c. Select the air to be tested, i.e., compressor air intake or compressor discharge air.
- d. Make the prescribed number of strokes (Table 1-4) and read the length of discoloration on the graduated tube scale.
- e. The numerical value read off is the measure of the concentration of gas (e.g., ppm) and should be compared to Table 1-1 for acceptability.

Change 3 3-7/(3-8 blank)

CHAPTER 4 MAINTENANCE, TROUBLESHOOTING AND REPAIR

Section I GENERAL INFORMATION

4-1. GENERAL. In order to be assured that the breathing air produced by this compressor is of acceptable quality for human consumption, the compressor and all elements of the overall system must be carefully maintained in strict compliance with the schedules and procedures contained in this manual. Keeping complete and accurate records of all maintenance performed and all repairs required can prevent serious injury to the operating personnel or to the diver using the air produced by the unit.

Section II PREVENTIVE MAINTENANCE

4-2. COMPRESSOR MAINTENANCE SCHEDULE. The maintenance requirements of the compressor are all related to either frequency of use or operating time. Table 4-1 lists the maintenance item, the frequency of maintenance and appropriate instructional reference paragraph.

Table 4-1. COMPRESSOR MAINTENANCE SCHEDULE

<u>Frequency of Maintenance</u>	<u>Maintenance Item</u>	<u>Ref. Par.</u>
Daily-Every 8 hours	Crankcase-Check Oil Level	2-1f
Daily	Fill Hose-Check for Wear and Damage	4-4b
Every 15 min.	Interstage Separator-Drain Condensate	4-4c
Every 40 hours/12 mos.	Interstage Separator-Remove, Disassemble, Clean, Lube, and Reassemble	
Every 15 min.	Final Separator-Drain Condensate	4-4c
Every 40 hours/12 mos.	Final Separator-Remove, Disassemble, Clean, Lube, and Reassemble	416d, 4-25r
Every 20 hours/6 mos.	Purifier Chamber-Replace Cartridge	4-4d
Every 40 hours/12 mos.	Purifier Chamber Assembly-Remove, Disassemble, Clean, Lube, and Reassemble	4-10, 4-14, 4-18, 4-23, 4-27
Every 15 min.	Purifier Chamber-Drain Condensate	4-4d
First 20 hours/	Crankcase-Change Oil	4-4c
Every 100 hours/6 mos.		
Every 20 hours	Inlet Air filter-Clean	4-4a
Every 10 hours	Inlet Air filter-Clean during operation in extreme heat, dusty, or sandy areas.	4-4a
Every 40 hours/12 mos.	Inlet Air Filter-Replace	4-4a
Every 40 hours	Inlet Air Filter-Replace during operation in extreme heat, dusty, or sandy areas.	4-4a
Every 100 hours/6 mos.	All Air Tubing-Check for Leaks and Damage	4-4h
Every 100 hours/6 mos.	Intercooler/Aftercooler-Check and Clean	4-4i
Every 20 hours/6 mos.	Compressor Drive Belt-Check for Wear/Adjustment	4-4f, 4-4g
Every 100 hours/6 mos.	Compressor Assembly-Check for Loose or Missing Hardware	4-4j
Every 200 hours/12 mos.	First Stage Valve-Service/Replace as required	4-4k
Every 200 hours/12 mos.	Second Stage Valve-Service/Replace as required	4-4l
Every 200 hours/12 mos.	Third Stage Valve-Service/Replace as required	4-4m
Every 40 hours/12 mos.	Pressure Maintaining Valve-Remove, Disassemble, Clean, Lube, and Reassemble	4-11, 4-15, 4-24
Every 12 mos.	Safety Valves-Test/Replace as required	
Every 40 hours/12 mos.	Directional Flow Check Valve-Remove, Disassemble, Clean, Lube, and Reassemble	

4-3. ENGINE MAINTENANCE SCHEDULE. Like the compressor, the maintenance schedule for the engine is based upon either frequency of use or on operating time. Table 4-2 lists the maintenance items, the frequency of maintenance and the appropriate instructional reference paragraph.

Table 4-2. ENGINE MAINTENANCE SCHEDULE

<u>Frequency of Maintenance</u>	<u>Maintenance Item</u>	<u>Ref. Par.</u>
Daily/Every 8 hours	Air Cleaner-Check Oil Level	4-5a
Daily/Every 8 hours	Crankcase-Check Oil Level	2-lg
First 20 hours/ Every 100 hours/6 mos.	Crankcase-Change Oil	4-5c
First 20 hours/ Every 250 hours/12 mos.	Crankcase-Clean Oil Screen	4-5d
First 20 hours/ Every 250 hours/12 mos.	Valves-Adjust	4-5e
Every 100 hours/6 mos.	Cooling System-Check & Clean	4-5g
Every 250 hours/12 mos.	Fuel Filter--Replace	4-5f
Every 100 hours/6 mos.	Air Cleaner-Change Oil	4-5b
Every 80 hours	Air Cleaner-Change Oil During operation in extreme heat, dusty, or sandy areas	4-5b

Section III MAINTENANCE INSTRUCTIONS

4-4. COMPRESSOR.

a. Inlet Air Filter. Service the air filter (1, Fig. D-10) as follows:

- (1) Unscrew cover and remove element (5, Fig. D-10).
- (2) Clean element with brush or low pressure air blowing from the inside out.
- (3) Turn element 90 degrees clockwise when reinstalling. Check O-rings for wear. Check that spring is seated properly. Screw cover onto air cleaner housing.

NOTE

Replace dirty element after it has been rotated three times (80 hours).

b. Fill Hose and Manifold. Inspect the fill hose and manifold (not included) (Fig. 1-2) as follows:

- (1) Inspect hose fittings for damaged threads, worn sealing surface and other flaws. Replace hose assembly if damaged.
- (2) Inspect fill valve, gauge, vent valve and filler adapter for damage, missing parts or wear. Replace if defective.
- (3) Inspect hose for kinks, splits or damage. Replace if defective.

c. Interstage and Final Separator Drains. Drain condensate from the interstage and final separators (10, Fig. D-11) and (15, Fig. D-12) as follows:

- (1) Slowly open drain valves (10, Fig. D-11) & (15, Fig. D-12) until condensate begins to flow.
- (2) Observe condensate flow from each drain valve.

(3) Close each drain valve after all condensate has been vented from each separator.

d. Purifier Chamber Cartridge Replacement. Replace the purifier cartridge (7, Fig. D-13) as follows:

- (1) Compressor must be shut down.
- (2) Slowly open purifier drain valve (17, Fig. 1-3) to relieve all pressure within the purifier chamber.

WARNING

Because of pressure monitoring valve (17, Fig. D-2) and check valve (18, Fig. D-2) purifier chamber may contain high pressure. Never attempt to service purifier chamber with pressure inside the system. Open drain valve and wait until all pressure has been vented. Pressure can be monitored by gauge (19, Fig. D-2).

Change 3 4-2.1/(4-2.2 blank)

- (3) Remove the top plug (1, Fig. D-13).
- (4) Unscrew purifier chamber (2, Fig. D-13) from bottom plug.
- (5) Remove and discard old purifier cartridge (7, Fig. D-13).
- (6) Inspect cartridge O-ring (6, Fig. D-13), chamber O-rings, and back-up rings (4 & 5, Fig. D-13) for damage, replace if necessary.

NOTE

Back-up ring is installed at the top of the "O"-ring groove with the flat face of the back-up ring against the top of the "O"-ring groove.

- (6.1) Using a clean, lint free cloth, wipe down the interior surfaces of the following: cylinder (2, Fig. D-13), top plug (1, Fig. D-13), and bottom plug (3, Fig. D-13).
- (7) Unwrap new purifier cartridge. Using a clean, lint free cloth, install the new purifier cartridge into the bottom plug. Make sure the cartridge seats down through "O"-ring (6, Fig. D-13).

CAUTION

Do not use any petroleum lubricants. Do not touch the surface of the cartridge with bare hands.

- (8) Apply a thin film of silicone grease to the "O"-rings, back-up rings, bottom and top plug threads.
- (9) Screw chamber back down on bottom plug until chamber comes down flush with bottom plug. Do not overtighten.
- (10) Insert the top plug (1, Fig. D-13) into the top of the purifier chamber (2, Fig. D-13). Screw the top plug down until the top of the plug is flush with the end of the purifier chamber. Do not overtighten.
- (11) Make appropriate entry into compressor log book.

e. Change Crankcase Oil. Change the lubricating oil in the compressor crankcase as follows:

- (1) The compressor should be run and shut down after normal operating temperature has been reached.
- (2) Position a drain pan under the compressor drain plug (20, Fig. 1-3).
- (3) Remove drain plug (20, Fig. 1-3). Allow old oil to drain from the crankcase into the pan.
- (4) Install drain plug (20, Fig. 1-3).
- (5) Fill crankcase with lubricating oil. Ref. Par. 2-1f Table 2-1.

NOTE

Change compressor oil after the first 20 hours of operation and every 100 hours, or 6 months, thereafter.

- f. **Compressor Drive Belt Inspection.** Inspect compressor drive belt (9, Fig. D-2) as follows:

WARNING

Do not operate compressor while inspecting, replacing or adjusting drive belt.

- (1) Visually inspect drive belt for fraying, wear, cracks, or other damage. Replace if defective. Ref. Par. 4-4.
- (2) Check drive belt tension by pushing down on the belt midway between the engine and compressor sheaves. The belt should deflect no more than about 1 1/2" (38 mm). Adjust as required. Ref. Par. 4-4.

- g. **Compressor Drive Belt Replacement.** Replace the compressor drive belt (9, Fig. D-2) as follows:

WARNING

Do not operate compressor while installing or adjusting drive belt. Serious injury or equipment damage may result.

- (1) Remove belt guard (21, Fig. D-2)
- (2) Loosen (4) compressor mounting nuts (45, Fig. D-2).
- (3) Slide compressor toward engine to release drive belt tension.
- (4) Remove drive belt (9, Fig. D-2) from compressor and engine drive sheaves.
- (5) Assemble new drive belt (9, Fig. D-2) over engine and compressor drive sheaves.
- (6) Pull compressor away from engine and tighten compressor mounting nuts while pulling compressor.
- (7) Use a straight edge against the engine and compressor sheaves (Fig. 4-1). Rotate the compressor about its vertical axis to align the sheaves. Secure the mounting nuts (45, Fig. D-2).
- (8) Replace belt guard (9, Fig. D-2).

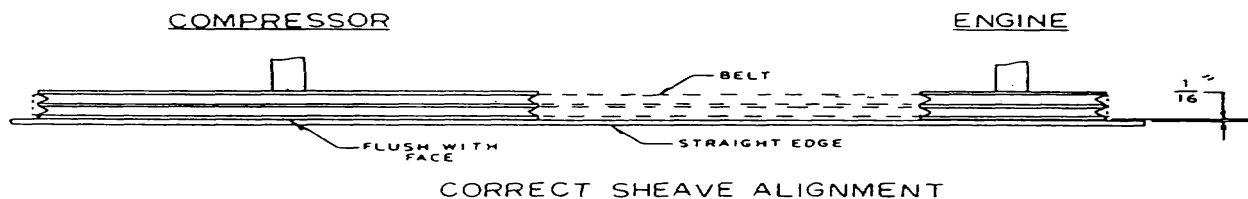


Figure 4-1. Compressor Unit Sheave Alignment

- h. **Air Tubing Inspection.** Inspect air tubing as follows:

- (1) Visually inspect all air tubing and fittings for damage. Replace damaged tubing or fittings.
- (2) Start compressor to pressurize all fittings. Inspect with soapy water solution to locate air leaks. Depressurize and repair all leaks.

- i. **Intercooler and Aftercooler Cleaning and Inspection.** Clean and inspect the intercoolers (13 and 20, Fig. D-8) and aftercooler (6, Fig. D-8) as follows:

- (1) Clean intercooler coils (13 and 20, Fig. D-8) using a soft brush or low pressure air.

- (2) Clean the aftercooler coil (6, Fig. D-8) using a soft brush or low pressure air.
- (3) Inspect all cooler coils for damage. Replace damaged coils.

j. Compressor Assembly Inspection. Inspect the complete compressor assembly (Fig. D-2) for loose, damaged or missing items. Repair or replace damaged or missing items.

k. First Stage Valve Replacement. Replace first stage valve assembly (Fig. D-5) as follows:

WARNING

Compressor piping may cause high pressure. Never attempt to service or repair any portion of the compressor until all pressure has been released to the atmosphere.

- (1) Remove inlet air filter assembly (1, Fig. D-10).
- (2) Disconnect discharge line (7, Fig. D-5).
- (3) Remove 3 bolts (9, Fig. D-5). Remove hex nut and washer (11 and 10, Fig. D-5). Remove valve head (1, Fig. D-5).
- (4) Remove first stage inlet and discharge valve assembly (5, Fig. D-5).
- (5) Clean valve in mineral spirits. Metallic components may also be cleaned in lacquer thinner.
- (6) Inspect valve (5, Fig. D-5) for wear and damage. The seating surface of each plate should be clean, bright and free of excessive wear. Damaged or worn valve must be replaced.

NOTE

Always replace complete valve assembly.

- (7) Check for free movement of valve reeds.
- (8) Place gasket (6, Fig. D-5) on first stage cylinder, place first stage inlet and outlet valve (5, Fig. D-5) on gasket, place gasket (4, Fig. D-5) on top of valve assembly.
- (9) Place valve head (12, Fig. D-5) over stud (8, Fig. D-5) on cylinder. Install washer (10, Fig. D-5) and screw Hex Nut down stud. Screw in three socket head bolts (9, Fig. D-5). Tighten Hex Nut and bolts to a torque of 18ft-lbf. (25 NM).
- (10) Connect discharge line (7, Fig. D-5). Tighten line nuts securely. Connect oil breather hose (13, Fig. D-5) to valve head.
- (11) Install inlet air filter (1, Fig. D-10).

l. Second Stage Valve Replacement. Replace second stage valve assembly as follows:

WARNING

Compressor piping may contain high pressure. Never attempt to service or repair any portion of the compressor until all pressure has been released to the atmosphere.

- (1) Remove safety valve (23, Fig. D-11) and gasket (24, Fig. D-11).

NOTE

Do not readjust safety valve.

NOTE

Do not overtighten vice. Valve head damage may occur.

- (7) Using valve tool (Fig. D-15) remove inlet valve assembly (4, Fig. D-6).
- (8) Clean all components in mineral spirits. Metallic components may also be cleaned in lacquer thinner. Remove all carbon deposits.
- (9) Inspect valve plates (7, Fig. D-6), valve seats (5, 23, Fig. D-6) and valve springs (8, 17, Fig. D-6) for wear and damage. Plates and seats should be free from pits, corrosion, carbon and excessive wear. Springs should be free from worn spots. Always replace valve plates and seats in assemblies.
- (10) Lapping of plate and seat surface is necessary even on new valve parts. Using a lapping compound, grit #2-A or equivalent. Lapping surface should have a smooth uniform surface free from scratches, pits, or indentations.
- (11) Replace gaskets (14, 5, Fig. D-6) and O-ring (10, Fig. D-6).
- (12) Assemble intake valve as shown (4, Fig. D-6)
- (13) Place valve head upside down in vice. Using valve tool, Fig. D-15), screw valve assembly into head being careful not to tighten down on valve plate (7, Fig. D-6). Tighten down tight with valve tool.
- (14) Center punch two places on edge of threads to secure inlet valve cover (16, Fig. D-6) in valve head.
- (15) Assemble outlet valve assembly as shown (3, Fig. D-6).
- (16) Install spring plate and O-ring (11, 10, Fig. D-6) on plug (12, Fig. D-6).
- (17) Install valve assembly (3, Fig. D-6) into plug (12, Fig. D-6).
- (18) Screw plug (12, Fig. D-6) and valve assembly (3, Fig. D-6) into valve head. Torque plug down to 18 ft lbs (25 NM).
- (19) Install stud (13, Fig. D-6) into plug (12, Fig. D-6) pull down (by hand) tight with allen wrench. Install gasket (14, Fig. D-6) on stud and screw acorn nut (15, Fig. D-6) down on gasket. Check for free movement of valve plates (7, Fig. D-6).
- (20) Align valve head on top of cylinder with inlet and outlet tubes. Install 6 socket head screws (18, Fig. D-6) and torque to 18 ft-lbs (25 NM).
- (21) Connect inlet and outlet lines and tighten securely.
- (22) Install gasket (24, Fig. D-11) and safety valve (23, Fig. D-11). Tighten securely.

NOTE

Do not readjust safety valve.

m. Third Stage Valve Replacement. Third stage valves are replaced as assemblies only.

WARNING

Compressor piping may contain high pressure. Never attempt to service or repair any portion of the compressor until all pressure has been released to the atmosphere.

- (1) Disconnect inlet and outlet lines. Do not disturb fittings (12, 10, Fig. D-7) in valve head.
- (2) Remove acorn nut (8, Fig. D-7) and gasket (7, Fig. D-7). Remove stud (6, Fig. D-7) from valve head. Remove 6 socket head screws (9, Fig. D-7) and lift valve head (2, Fig. D-7) off cylinder.
- (3) Separate valve head cover (5, Fig. D-7) from valve head (2, Fig. D-7). Place valve head on work bench with outlet valve (3, Fig. D-7) up. Remove outlet valve (3, Fig. D-7) and O-ring (4, Fig. 5-7) by placing two screw drivers into the groove of outlet valve body and push down on screw driver handles. Lift outlet valve (3, Fig. D-7) and O-ring (4, Fig. D-7) together.
- (4) Turn valve head (2, Fig. D-7) over and place in vice. Do not overtighten vice. Damage to valve head may occur. Using valve tool (Fig. D-15) unscrew inlet valve (1, Fig. D-7).
- (5) Inspect valve head for damage and carbon deposits. Replace or clean as necessary.
- (6) Using valve tool (Figure D-15) screw inlet valve (1, Fig. D-7) into valve head (2, Fig. D-7). Tighten down securely. Do not punch as in step 14 under second stage valve replacement.
- (7) Place O-ring (4, Fig. D-7) on outlet valve (3, Fig. D-7). Insert outlet valve (3, Fig. D-7) into valve head (2, Fig. D-7). Place valve head cover (5, Fig. D-7) on valve head (2, Fig. D-7).
- (8) Align assembled valve head on cylinder to inlet and outlet lines. Screw in 6 socket head screws (9, Fig. D-7) and torque to 18 ft-16f (25 NM).
- (9) Install stud (6, Fig. D-7) and tighten down securely using allen wrench. Place gasket (7, Fig. D-7) on stud (6, Fig. D-7). Screw acorn nut (8, Fig. D-7) down and tighten securely.
- (10) Connect inlet and outlet lines and tighten securely.

4-5. ENGINE

a. Check Air Cleaner Oil Level. Check oil level in engine air cleaner as follows:

- (1) Release cup retainer snaps (1, Fig. 4-2).
- (2) Remove cup and cup gasket (2 and 3, Fig. 4-2)
- (3) Verify that oil level in cup (2, Fig. 4-2) is up to "Full" as shown in Figure 4-3 Add SAE 30 oil conforming to MIL-L-2104 as required.
- (4) Inspect oil cup gasket (3, Fig. 4-2) for wear and damage. Replace worn or damaged gasket.
- (5) Install oil cup and cup gasket (2 and 3, Fig. 4-2) onto filter housing (7, Fig. 4-2). Secure with two snaps (1, Fig. 4-2).

b. Change Air Cleaner Oil. Change the oil in the air cleaner cup as follows:

- (1) Remove oil cup. (Ref. para 4-5a).
- (2) Drain oil from oil cup.
- (3) Remove filter elements and retainers (6, 4, and 5, Fig. 4-2).
- (4) Wash all parts in clean diesel fuel. Dry all parts thoroughly.
- (5) Wipe dirt from inside of housing (7, Fig. 4-2). Make sure no dirt is allowed to enter the engine inlet port.
- (6) Assemble filter elements and retainers as shown in Figure 4-2.
- (7) Fill oil cup with SAE 30 lubricating oil conforming to MIL-L-2104 as shown in Figure 4-3.
- (8) Install oil cup. (Ref. para 4-5a).

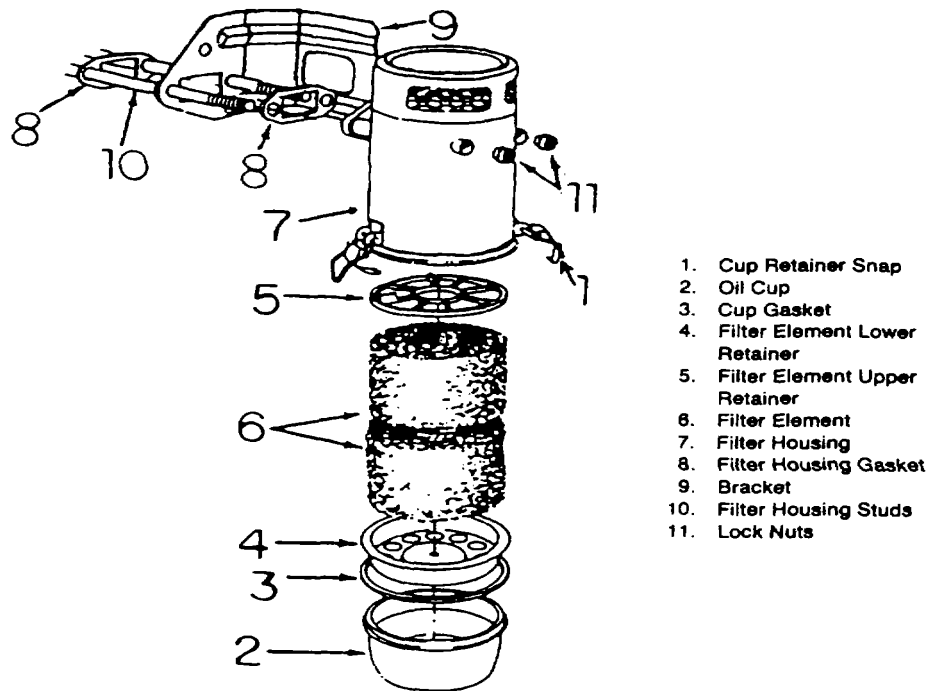


Figure 4-2. Engine Oil Bath Air Cleaner Assembly

c. Change Engine Crankcase Oil. Change the lubricating oil in the engine crankcase as follows:

- (1) The engine should be at normal operating temperature.
- (2) Position a drain pan under the engine oil drain plug (5, Fig. 1-3).
- (3) Remove oil drain plug (5, Fig. 1-3) as shown in Figure 4-4 Drain oil from engine crankcase.
- (4) Install oil drain plug (5, Fig. 1-3) as shown in Figure 4-4 Tighten plug securely.
- (5) Fill engine crankcase with lubricating oil. (Ref. para 2-1g) Table 2-2.

NOTE

Change engine oil after the first 20 hours of operation and every 100 hours/6 mos. thereafter.

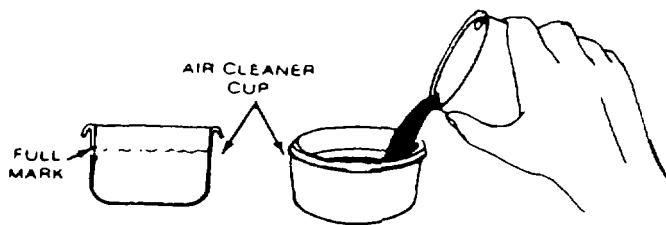


Figure 4-3.
Engine Oil Bath Air Cleaner Oil Level

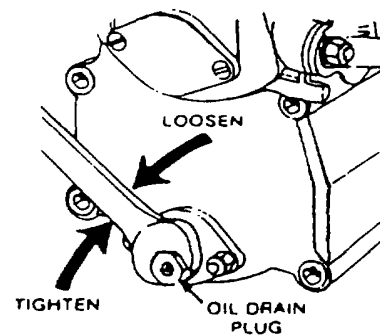


Figure 4-4.
Diesel Engine Oil Drain Plug Removal

d. Clean Engine Crankcase Oil Screen. Clean the engine crankcase oil screen as follows:

- (1) Drain engine oil. Ref. Para 4-5.
- (2) Remove two nuts (1, Fig. 4-5). Remove oil screen and gasket (4 and 5, Fig. 4-5) from engine crankcase.
- (3) Clean oil screen (4, Fig. 4-5) with fresh diesel fuel.
- (4) Flush engine crankcase with fresh diesel fuel. Then flush engine crankcase with fresh engine lubricating oil.
- (5) Inspect oil screen and gasket (4 and 5, Fig. 4-5) for damage. Replace damaged parts.
- (6) Install oil screen and gasket (4 and 5, Fig. 4-5) into engine crankcase. Secure with two nuts (1, Fig. 4-5).
- (7) Refill engine crankcase with lubricating oil. Ref. Para 4-5.

NOTE

Clean engine oil screen after the first 20 hours of operation and every 250 hours/12 mos. thereafter.

e. Adjust Engine Valves. Adjust the engine valves as follows:

- (1) Engine must be at room temperature. Allow the engine to cool at least 12 hours after operation before adjusting valves.
- (2) Make sure automatic compression release (8, Fig. 1-3) is in "RUN" position.
- (3) Remove two acorn nuts (1, Fig. 4-6). Remove valve cover and gasket (2 and 3, Fig. 4-6).
- (4) Rotate engine until the exhaust valve rocker arm (6, Fig. 4-6) is fully open.
- (5) Check clearance between intake valve stem and intake rocker arm (5, Fig. 4-6). Loosen locknut and adjust valve to rocker arm clearance as required to obtain .004" (.1mm) clearance.
- (6) Rotate engine until intake valve rocker arm (5, Fig. 4-6) is fully open.
- (7) Check clearance between exhaust valve stem and exhaust rocker arm (6, Fig. 4-6). Loosen locknut and adjust as required to obtain .004" (.1mm) clearance.
- (8) Clean valve cover (2, Fig. 4-6) in mineral spirits. Inspect valve cover and gasket (2 and 3, Fig. 4-6) for damage. Replace damaged parts.

Assemble valve cover and valve cover gasket (2 and 3, Fig. 4-6) to cylinder head. Secure with two acorn nuts (1, Fig. 4-6).

NOTE

Adjust engine valves after the first 20 hours of operation and every 250 hours/12 mos. thereafter.

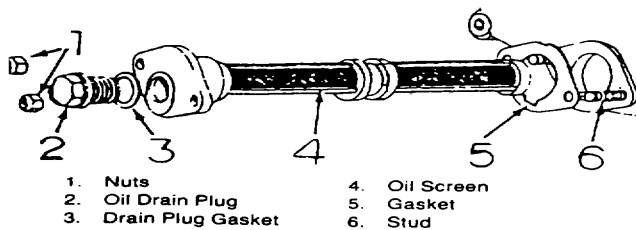


Figure 4-5. Diesel Engine Crankcase Oil Screen

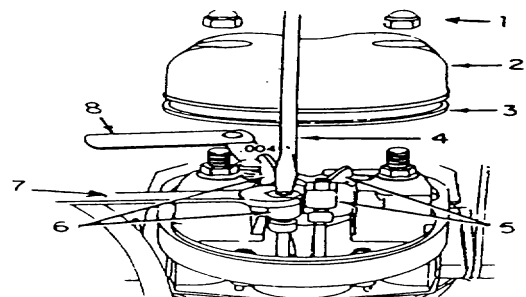


Figure 4-6. Diesel Engine Valve Adjustment

f. Replace Engine Fuel Filter. Replace the engine fuel filter element as follows:

- (1) Remove hollow screw (3, Fig. 4-7) from fuel line and fuel injection pump (1 and 2, Fig. 4-7).
- (2) Drain fuel from fuel tank (5, Fig. 4-7). Discard old fuel.
- (3) Remove fuel fill cap (4, Fig. 4-7).
- (4) Remove fuel filter element (6, Fig. 4-7) from fuel line. Discard fuel filter element.
- (5) Flush fuel tank and fuel line (5 and 1, Fig. 4-7) with clean diesel fuel.

NOTE

Make sure no dirt is allowed to enter fuel injection pump.

- (6) Install new fuel filter element (6, Fig. 4-7) in fuel line.
- (7) Reconnect fuel line (1, Fig. 4-7) to fuel injection pump (2, Fig. 4-7) using hollow bolt (3, Fig. 4-7).
- (8) Fill fuel tank with fresh diesel fuel. Ref. para 2-lh.
- (9) Install fuel fill cap (4, Fig. 4-7).

NOTE

Replace fuel filter element after 250 hours/12 mos. or more often under severe conditions.

g. Check and Clean Engine Cooling System. Check and clean the engine cooling system as follows:

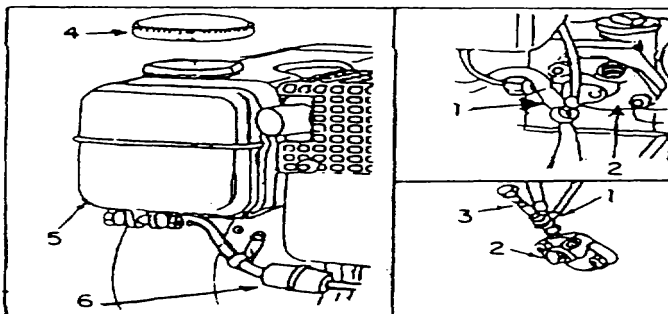
CAUTION

Do not operate engine with cooling shields and screens removed.

- (1) Remove cylinder shields (1, Fig. 4-8) as shown.
- (2) Remove flywheel screens (2, Fig. 4-8) as shown.
- (3) Inspect exposed cylinder cooling fins and flywheel fan for dirt and debris. Clean as required.
- (4) Install flywheel screens (1, Fig. 4-8) as shown.
- (5) Install cylinder shields (2, Fig. 4-8) as shown.

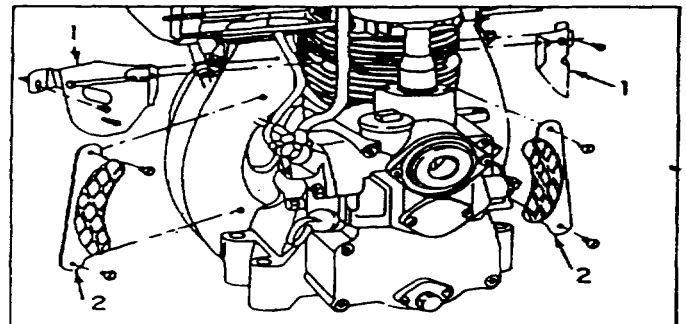
NOTE

Check and clean cooling system every 100 hours/6 mos. of operation or more often under severe conditions.



- | | | |
|------------------------|------------------|------------------------|
| 1. Fuel Line | 3. Hollow Bolt | 5. Fuel Tank |
| 2. Fuel Injection Pump | 4. Fuel Fill Cap | 6. Fuel Filter Element |

Figure 4-7. Diesel Engine Fuel Filter Replacement



- | |
|---------------------|
| 1. Cylinder Shields |
| 2. Flywheel Screen |

Figure 4-8. Diesel Engine Cooling System

Section IV TROUBLESHOOTING

4-6. COMPRESSOR. Identification of major symptoms, probable causes and recommendations for corrective action for the compressor are contained in Table 4-3.

Table 4-3. COMPRESSOR TROUBLESHOOTING

Symptom	Probable Cause	Correction
Compressor Noisy	Low Oil Level	Add Oil
	Loose Flywheel	Tighten Flywheel
	Worn Drive Belts	Replace Worn Belts
Compressor Runs Hot	Ambient Conditions too Hot	Move Compressor to Cooler Location
	Inlet or Discharge Valves Leaking	Clean and Inspect Valves-Replace Worn Parts
	Cooling Air Obstructed	Clean Obstruction
	Cooling Fins Clogged	Clean Cooling Fins
	Intercooler or After-cooler Tube Fins Dirty	Clean Intercooler & Aftercooler Tubes
	Drive Belt Slipping	Adjust Drive Belt
	Inlet Air Cleaner Clogged	Clean or Replace Air Cleaner Element
Compressor Pressure too Low	Air Leaks At Lines and Fittings	Tighten Loose Connection
	Worn Pistons/Piston Rings	Replace Worn Parts
	Air Leaks in Intercooler or Aftercooler Tubes	Replace Defective Coolers
	Condensate Drain Valves or Fittings Leaking	Tighten Valves-Replace Defective Parts
	Safety Valves Opening too Soon	Replace Defective Safety Valves

Table 4-3. COMPRESSOR TROUBLESHOOTING (con't)

Symptom	Probable Cause	Correction
Compressor Output Volume Low	Inlet Air Cleaner Clogged Cleaner Element	Clean or Replace Air
	Air Leaks at Fittings	Tighten Leaking Fittings
	Safety Valves Opening Too Soon	Replace Defective Safety Valves
	Worn Pistons/Piston Rings	Replace Worn Parts
	Drive Belt Slipping	Adjust/Replace Drive Belt
	Engine Speed Too Low	Adjust Engine Speed
	Leaking Condensate Drain Valves	Tighten or Replace Defective Valves
Compressor Vibrates	Mounting Bolts Loose	Tighten Loose Fasteners
	Drive Sheaves Out of Alignment	Realign Drive Sheaves Readjust Belts
Safety Valves Open	Interstage Pressure Too High	Check/Replace Valves
	Obstruction in System	Check and Correct Obstruction
Air Has Oil Taste	Purifier Cartridge Saturated	Replace Purifier Cartridge
	Incorrect Oil	Change to Correct Oil-Clean Valves
Abnormal Belt Wear	Drive Sheaves Out of Alignment	Align Drive Sheaves
	Drive Belts Too Loose or Too Tight	Adjust Drive Belts
	Oil or Grease on Belts	Clean or Replace Drive Belts

NOTE

This table is not intended to cover every possible symptom, but is rather a list of the more frequent problems and some of their causes.

4-7. ENGINE. Identification of major symptoms, probable causes and recommendations for corrective action for the engine are contained in Table 4-4.

Table 4-4. ENGINE TROUBLESHOOTING

Symptom	Probable Cause	Correction
Engine Does Not Start	Fuel Tank Empty or Filled with Improper Fuel Throttle Lever at Stop Engine Primer Button Not Pulled Fuel Filter or Lines Clogged Air in Fuel System Low Compression	Fill Tank with Diesel Fuel Place Throttle Lever at Maximum When Starting Engage Primer Button Replace Filter Element, Clean Lines Bleed Fuel Lines Check Piston Rings; Check Valve Condition and Clearance; Check Head Gasket Condition; Check Rod Bearing Wear-Overhaul if Necessary
Engine Does Not Start	Faulty Fuel Injection Engine Oil Too Viscous (Heavy) Improper Governor Clearance	Check Feed Rate of Pump; Adjust or Replace as Necessary-Replace Injector Use Oil of the Proper Viscosity for Climate Conditions Adjust Governor Clearance
Engine Starts, Then Stops	Fuel Primer Button Not Pulled Down Starting Load Too Great	Pull Down Button Reduce Engine Load
Engine Stalls When Warm	Fuel Too Hot	Eliminate Cause for Excess Heat in Fuel
Engine Runs Unevenly; Low Output	Fuel Supply Too Low Filter Clogged Not Enough Fresh Air Air in Fuel System Fuel Line(s) Leaking Improper Valve Clearance	Replace Fuel Filter Element; Check Contents of Tank Provide Engine Enclosure with Adequate Openings for Fresh Air Bleed Fuel Lines Check and Tighten Adjust Valves

Table 4-4. ENGINE TROUBLESHOOTING (con't)

Symptom	Probable Cause	Correction
Engine Runs Unevenly; Low Output	Improper Injection Timing or Worn Injection Pump Poor Quality or Improper Fuel Sticking Governor	Check Fuel Pump Timing; Adjust or Repair as Necessary Replace Contents of Tank with Fresh Diesel Fuel Clean and Adjust Governor and Change Lube Oil
Engine Races Exhaust Emits Excessive Smoke:	Governor Damaged or Improperly Adjusted	Adjust or Replace Governor
A. Blue Smoke	Engine Oil Level too High Poor Compression Due to Seized or Broken Piston Rings, Worn Valves or Guides	Drain Off and Recheck Oil Level; Check to Make Sure Engine is Not Tilted from its Normal Angle of Operation Replace Broken Piston Ring, Valves or Guides
B. Black Smoke Engine Runs too Hot	Engine Overloaded Primer Button Does Not Disengage Since Engine Does Not Reach its Rated Speed Engine Compartment too Hot Oil Level Too High Injection Nozzle Defective Feed Rate of Injection Pump Erratic	Reduce Engine Load Reduce Load on Engine; Move Throttle Lever into Idling Position. Then Slowly Back to Full Load Provide More Fresh Air Circulation to Engine Clean Air Intake Screens and Cylinder Shields Drain Excess Engine Oil; Check Engine Angle Replace Nozzle Adjust or Repair Injection Pump
Excessive Oil Consumption	High Oil Temperature Breather Inoperative Oil too Thin	Reduce Single Load; Provide More Cooling Air Clean or Replace Breather Replace with Oil of Proper Viscosity for Climate Conditions

Table 4-4. ENGINE TROUBLESHOOTING (con't)

Symptom	Probable Cause	Correction
Excessive Oil Consumption	Piston Rings Worn or Sticking, Cylinder Wall(s) Scuffed or Scratched	Inspect and Free Rings or Overhaul Engine
	Oil Leaking	Inspect and Tighten Fittings as Needed
Unusual Engine Knocks and Noises	Loose Mounting Bolts	Inspect and Tighten Any Loose Bolts
	Engine Overload	Reduce Engine Load
	Loose Flywheel	Tighten Flywheel Mounting Bolts
	Damaged Gear Teeth	Replace Any Gear with Broken Teeth; Also Examine Gear it Engages for Damage
	Incorrect Timing	Correct Injection Pump Timing

NOTE

This table is not intended to cover every possible symptom, but is rather a list of the more frequent problems and some of their causes.

Section V
REMOVAL OF MAJOR ASSEMBLIES

4-8. COMPRESSOR. The compressor may be removed from the frame as follows:

WARNING

Compressor piping may contain high pressure. Never attempt to service or repair any portion of the compressor until all pressure has been released to the atmosphere.

- a. Remove drive belt. (Ref. para 4-4g).
- b. Disconnect gauge lines (40, Fig. 4-2).
- c. Remove gauge panel (22, Fig. D-2).
- d. Disconnect discharge hose (30, Fig. D-2) at the final separator (Fig. D-12).
- e. Remove 4 bolts, 4 nuts, 4 lock washers and 12 flatwashers (45, 46, 47, 48, Fig. D-2).
- f. Move compressor assembly (1, Fig. D-2) straight out through beltguard side of the frame and place on a flat, level surface.

4-9. ENGINE. The engine may be removed from the frame as follows:

- a. Remove drive belt. (Ref. para 4-4g).
- b. Disconnect cold weather start primer tube (42, Fig. D-2) at top of engine inlet air cleaner.
- c. Remove 4 bolts, 4 nuts, 4 lock washers and 8 flat washers (49, 50, 51, 52, Fig. D-2).
- d. Slide engine through end of frame and place on a flat, level surface.

4-10. PURIFIER CHAMBER. The purifier chamber may be removed from the frame as follows:

WARNING

Compressor piping may contain high pressure. Never attempt to service or repair any portion of the compressor until all pressure has been released to the atmosphere.

- a. Disconnect discharge hose (30, Fig. D-2) at the purifier chamber.
- b. Remove discharge tube (41, Fig. D-2).
- c. Remove 2 bolts, 2 flat and 2 lock washers from bottom plug (3 Fig. D-13).
- d. Remove purifier clamp (24, Fig. D-2).
- e. Remove purifier chamber (5, Fig. D-2) from frame.

4-11. PRESSURE MAINTAINING VALVE. The pressure maintaining valve may be removed from the frame as follows:

WARNING

Compressor piping may contain high pressure. Never attempt to service or repair any portion of the compressor until all pressure has been released to the atmosphere.

- a. Remove discharge tube (41, Fig. D-2).
- b. Remove gauge tubes (40, Fig. D-2)
- c. Remove 2 screws, 2 flat and 2 lock washers (53, 55, 54, Fig. D-2).
- d. Remove pressure maintaining valve (17, Fig. D-2) from frame.

Section VI INSTALLATION OF MAJOR ASSEMBLIES

4-12. COMPRESSOR. The compressor may be installed into the frame as follows:

- a. Position the compressor (1, Fig. D-2) through the frame opening. Align the mounting holes in the compressor with the corresponding holes in the compressor support (23, Fig. D-2). Secure the compressor to the compressor support with 4 bolts, 4 nuts, 12 flat washers and 8 lock washers (48, 45, 47, 46, Fig. D-2).
- b. Connect discharge hose (30, Fig. D-2) to the final separator (Fig. D-12). Tighten tube nut securely.
- c. Install gauge panel (22, Fig. D-2).
- d. Connect gauge lines.
- e. Install drive belt and belt guard. (Ref. para 4-4g.)
- f. Start compressor and check for air leaks. Ref. para 3-5b and 4-4h.

4-13. ENGINE. The engine may be installed into the frame as follows:

- a. Position the engine (2, Fig. D-2) through the frame opening. Align the mounting holes in the engine base with the corresponding holes in the engine support (23, Fig. D-2). Secure the engine to the supports with 4 bolts and 4 nuts, 4 lock washers and 8 flat washers (52, 49, 50, 51, Fig. D-2).
- b. Connect optional primer tube (42, Fig. D-2) at the top of the engine air cleaner.
- c. Install drive belt. (Ref. para 4-4g.)
- d. Start engine and check for proper operation. (Ref. para 3-5b and 4-4h.)

4-14. PURIFIER CHAMBER. The purifier chamber may be installed into the frame as follows:

- a. Position purifier chamber (5, Fig. D-2) against frame.
- b. Loose assemble clamp and 2 bolts with washers (24, 56, 57, 58, Fig. D-2).
- c. Secure purifier chamber to bottom plate of frame with 2 bolts, 2 flat washers and 2 lock washers 59, 60, 61, Fig. D-2).
- d. Secure 2 bolts, washers and clamp (24, 56, 57, 58, Fig. D-2).
- e. Connect discharge tube (41, Fig. D-2). Tighten tube nuts securely.
- f. Connect discharge hose (30, Fig. D-2). Tighten tube nuts securely.
- g. Install new purifier cartridge. (Ref. para 4-4d.)
- h. Start compressor and check for leaks. (Ref. para 3-5b and 4-4h.)

4-15. PRESSURE MAINTAINING VALVE. The pressure maintaining valve may be installed into the frame as follows:

- a. Position pressure maintaining valve (17, Fig. D-2) against frame bracket (26, Fig. D-2). Align holes in valve with holes in bracket. Secure pressure maintaining valve to frame bracket with 2 screws, 2 flat washers and 2 lock washers (62, 64, 63, Fig. D-2).
- b. Connect discharge tube (41, Fig. D-2). Tighten tube nuts securely.
- c. Connect gauge tubes (40, Fig. D-2). Tighten tube nuts securely.
- d. Start compressor and check for leaks. (Ref. para 3-5b and 4-4h.)

Section VII. DISASSEMBLY OF MAJOR ASSEMBLIES

4-16. COMPRESSOR. The compressor may be disassembled as follows:

WARNING

Compressor piping may contain high pressure. Do not attempt to service or repair any portion of the compressor until all pressure has been released to the atmosphere.

- a. Drain compressor. (Ref. para 4-4e.)
- b. Remove compressor from frame. (Ref. para 4-8.)
- c. Remove second stage separator (28, Fig. D-11).
 - (1) Disconnect discharge tube (29, Fig. D-11) at separator and at third stage valve head (10, Fig. D-7). Remove discharge tube.

- (2) Disconnect separator inlet tube (22, Fig. D-11) at separator. Remove inlet tube.
- (3) Remove bolt, nuts, washers and strap (11, 1, 30, 2 and 3, Fig. D-11). Remove second stage separator from compressor.
- d. Remove final separator (Fig. D-12).
 - (1) Disconnect separator inlet line (4, Fig. D-12) at separator.
 - (2) Remove separator U Bolt, nuts and washers. Remove final separator from compressor.
- e. Remove oil pump (2, Fig. D-9).
 - (1) Disconnect oil pump discharge pipe (3, Fig. D-9) at the oil pump and at the oil pressure regulator (6, Fig. D-9). Remove the oil pump discharge pipe.
 - (2) Remove 3 bolts and washers (4 and 5, Fig. D-9). Remove oil pump and gasket (2 and 1, Fig. D-9) from crankcase.
- f. Remove fan (3, Fig. D-8).
 - (1) Remove 4 bolts and washers (1 and 2, Fig. D-8). Remove fan from fan hub (5, Fig. D-8).
 - (2) Remove pinch bolt and washer (4 and 2, Fig. D-8). Remove fan hub (5, Fig. D-8) from crankshaft (9, Fig. D-4).
- g. Remove first to second stage intercooler coil (18, 19, and 20, Fig. D-8).
 - (1) Disconnect intercooler coil (18, 19, and 20, Fig. D-8) at first stage valve head (7, Fig. D-5) and at second stage valve head (19, Fig. D-6).
 - (2) Remove 2 bolts and washers from cooler bracket (8, Fig. D-8).
- h. Remove second to third stage intercooler coil (13, Fig. D-8).
 - (1) Disconnect second stage intercooler coil (13, Fig. D-8) at the second stage valve head (19, Fig. D-6).
 - (2) Remove 2 bolts and washers from cooler support bracket (8, Fig. D-8).
- i. Remove aftercooler (6, Fig. D-8).
 - (1) Remove 1 bolt and washer (16 and 15, Fig. D-8) from cooler clamp (14, Fig. D-8).
 - (2) Remove 2 bolts (7, Fig. D-8) from cooler bracket (8, Fig. D-8). Remove aftercooler.
- j. Remove first stage cylinder (20, Fig. D-4).
 - (1) Remove first stage valve head. (Ref. para 4-4k.)
 - (2) Remove 4 nuts and washers (21 and 22, Fig. D-4).
 - (3) Remove first stage cylinder and gasket (20 and 23, Fig. D-4) from crankcase.
- k. Remove first piston and piston rings (25 and 26, Fig. D-4).
 - (1) Remove 2 circlips (24, Fig. D-4).
 - (2) Push wrist pin (27, Fig. D-4) out of piston (25, Fig. D-4). Remove piston from connecting rod (28, Fig. D-4).
 - (3) Remove piston rings (26, Fig. D-4) from piston (25, Fig. D-4). Note location and orientation of piston rings for later reassembly.
- l. Remove second stage cylinder (37, Fig. D-4).
 - (1) Remove second stage valve head. (Ref. para 4-41.)
 - (2) Remove 4 nuts and washers (21 and 22, Fig. D-4).
 - (3) Remove second stage cylinder and gasket (37 and 38, Fig. D-4) from crankcase.

- m. Remove second stage piston and piston rings (39 and 40, Fig. D-4).
 - (1) Remove two circlips (42, Fig. D-4).
 - (2) Push wrist pin (41, Fig. D-4) out of piston (39, Fig. D-4). Remove piston from connecting rod (43, Fig. D-4).
 - (3) Remove piston rings (40, Fig. D-4) from piston (39, Fig. D-4). Note location and orientation of piston ring for later reassembly.
- n. Remove oil pressure regulator (6, Fig. D-9).
 - (1) Remove two socket head bolts (10, Fig. D-9). Remove oil pressure regulator and O-ring (6 and 12, Fig. D-9) from the third stage cylinder.
- o. Remove third stage piston and sleeve (45, Fig. D-4).
 - (1) Remove third stage valve head. Ref. para 4-4m.
 - (2) Remove third stage cooling ring (44, Fig. D-4). Remove third stage piston and sleeve (45, Fig. D-4) from third stage cylinder (47, Fig. D-4).
- p. Remove third stage upper cylinder and lower cylinder (47 and 60, Fig. D-4).
 - (1) Remove four nuts and washers (21 and 22, Fig. D-4).
 - (2) Remove third stage cylinder, O-ring, lower cylinder and gasket (47, 59, 60 and 48, Fig. D-4) from crankcase.
- q. Remove third stage guide piston (49, Fig. D-4).
 - (1) Remove two snaps (52, Fig. D-4).
 - (2) Push wrist pin (51, Fig. 1) out of guide piston (49, Fig. D-4). Remove guide piston from connecting rod (50, Fig. D-4).
- r. Remove oil pump drive cam (11, Fig. D-4).
 - (1) Remove three socket head bolts (16, Fig. D-4) from filter mounting (15, Fig. D-4). Remove filter mounting (15, Fig. D-4).
 - (2) Remove two bolts and one tab washer (13 and 12, Fig. D-4). Remove oil pump drive cam (11, Fig. D-4) from crankshaft (9, Fig. D-4).
- s. Remove crankshaft end housing (5, Fig. D-4).
 - (1) Remove six Hex head bolts and washers (1 and 2, Fig. D-4).
 - (2) Remove crankshaft end housing; crankshaft, connecting rods and bearings from crankcase.
- t. Remove connecting rods (28, 43, and 50, Fig. D-4).
 - (1) Remove bearing (10, Fig. D-4) from end of crankshaft (9, Fig. D-4).
 - (2) Remove pinch bolt, nut and washer from counterweight (62, Fig. D-4). Remove counterweight (62, Fig. D-4) from crankshaft.
 - (3) Before removing connecting rods, mark rods for sequence and orientation on crankshaft. Remove connecting rods (28, 43, 50, Fig. D-4).

4-17. ENGINE. Disassembly of the engine is covered in Appendix A.

4-18. PURIFIER CHAMBER. The purifier chamber may be disassembled as follows:

- a. Remove purifier chamber from frame (Ref. para 4-10.)
- b. Remove top plug (1, Fig. D-13) from purifier chamber cylinder (2, Fig. D-13).
- c. Remove bottom plug (3, Fig. D-13) from purifier chamber cylinder (2, Fig. D-13).
- d. Remove O-rings and back up rings (4 and 5, Fig. D-13) from top and bottom plugs (1 and 3, Fig. D-13).

4-19. DELETED.

Section VIII. CLEANING AND INSPECTION

4-20. Clean all parts in fresh mineral spirits. Metallic parts may also be cleaned in lacquer thinner. Purifier chamber must have a final cleaning of soap and clean water followed by a thorough rinse in clean water.

4-21. COMPRESSOR. After cleaning, inspect all parts for excessive wear and damage. Inspect all threaded parts for thread wear and damage. Inspect all machined surfaces for scratches, score marks, cracks or other defects that would make the part unuseable. The following piston to cylinder wall clearances are applicable:

First Stage:	.006" (.152mm) -.007" (.178mm) nominal 0.11" (.279mm) maximum
Second Stage	.005" (.127mm) -.006" (.152mm) nominal .009" (.229mm) maximum
Third Stage	.0003" (.0076mm) nominal
Piston:	.001" (.025mm) maximum
Third Stage	.003" (.076mm) -.004" (.102mm) nominal
Crosshead:	.006" (.152mm) maximum
Piston Ring end gap as measured at the bottom of the cylinder is as follows:	
First Stage:	.028" (.70mm)
Second Stage:	.014" (.35mm)
Third Stage:	No Piston Rings

4-22 ENGINE. Refer to Appendix A.

4-23 PURIFIER CHAMBER. After cleaning inspect O-rings for wear and damage Inspect all threaded parts for wear and damaged threads.

4-24 PRESSURE MAINTAINING VALVE. After cleaning, inspect all threaded parts for wear and damaged threads. Inspect tube fittings for damage.

SECTION IX REASSEMBLY OF MAJOR ASSEMBLIES

4-25 COMPRESSOR. The Compressor may be reassembled as follows. Particular note should be made to the relationship of components as they were disassembled. Apply a light film of lubricating oil to all moving parts during assembly. When reinstalling pipes and lines, when possible, loose assemble all fittings prior to tightening. To install crankshaft bearing, heat bearing on a hot plate to a temperature of about 250 F (121 C) and slide onto crankshaft. Allow bearing to cool, then press bearing into housings.

- a** Assemble crankshaft and crankcase end housing (9 and 5, Fig. D-4).
 - (1) Install crankshaft bearing (7, Fig. D-4) onto crankshaft (9 Fig. D-4).
 - (2) Install new crankshaft seal (4, Fig. D-4) into crankcase housing (5, Fig. D-4). Lubricate seal with crankcase oil.
 - (3) Install crankshaft and bearing (9 and 7, Fig. D-4) into crankcase end housing (5, Fig. D-4).
 - (4) Install shaft key (8, Fig. D-4) into crankshaft (9, Fig. D-4).
- b.** Install connecting rods (28, 43 and 50, Fig. D-4) and connecting rod spacers (29, Fig. D-4).
 - (1) Lubricate crankshaft and connecting rods (9, 28, 43 and 50, Fig. D-4).
 - (2) Install connecting rods onto crankshaft in the same order in which they were removed. (Third stage first; first stage second; second stage last).

- (3) Install counterweight onto crankshaft (62, 9, Fig. D-4). Secure counterweight with one pinch bolt, nut and washer. (Tighten to 18 ft-lbF., (25NM))

NOTE

Check connecting rod total side clearance. Clearance should be .015" (.38mm) to .035" (.89mm).

- (4) Install crankshaft bearing (10, Fig. D-4) onto crankshaft (9, Fig. D-4).
- c.** Install crank assembly into crankcase (17, Fig. D-4).
- (1) Assemble O-ring (6, Fig. D-4) onto crankcase end housing (5, Fig. D-4).
 - (2) Assemble crankcase end housing, crankshaft and connecting rods into crankcase. Make sure crankcase bearing enters crankcase properly. Make sure connecting rods come out of proper cylinder holes.
 - (3) Align holes in crankcase end housing with tapped holes in crankcase. Secure crankcase end housing to crankcase with 6 socket head bolts and washers (1 and 2), Fig. D-4). Tighten bolts in a "star" pattern to a torque of 18 ft-16f. (25NM).
- d.** Install oil pump drive cam (11, Fig. D-4).
- (1) Position oil pump drive cam (11, Fig. D-4) over end of crankshaft (9, Fig. D-4). Align bolt holes in cam with tapped holes in crankshaft. Secure oil pump drive cam with 2 bolts and 1 tab washer (13, and 12, Fig. D-4).
 - (2) Install O-ring on filter mount (14 and 15, Fig. D-4). Position filter mount over opening in crankcase. Align bolt holes in filter mount over tapped holes in crankcase. Secure filter mount with socket head bolts (16, Fig. D-4).
- e.** Install third stage guide piston (49, Fig. D-4).
- (1) Lubricate guide piston (49, Fig. D-4) and connecting rod (50, Fig. D-4).
 - (2) Install one snap (52, Fig. D-4) into guide piston.
 - (3) Install wristpin (51, Fig. D-4) into piston. Push wristpin only part way through guide piston.
 - (4) Position guide piston over connecting rod. Align wristpin with connecting rod bearing. Push wristpin through bearing.
 - (5) Install second snap (52, Fig. D-4).
- f.** Install third stage lower cylinder and upper cylinder (60 and 47, Fig. D-4).
- (1) Rotate crankshaft so that third stage guide piston (49, Fig. D-4) is at its top position.
 - (2) Position gasket (48, Fig. D-4) over studs (61, Fig. D-4) in crankcase.
 - (3) Position lower cylinder (60, Fig. D-4) over guide piston, align stud holes in cylinder with studs and seat cylinder onto crankcase.
 - (4) Install O-ring (59, Fig. D-4) into groove in third stage upper cylinder (47, Fig. D-4).
 - (5) Position third stage upper cylinder over studs as shown in Figure D-4. Secure upper and lower cylinders to crankcase with 4 nuts and washers. Tighten nuts to a torque of 18 lb/ft. (25NM).
- g.** Install third stage piston and sleeve (45, Fig. D-4).
- (1) Lubricate outer surface of sleeve (45, Fig. D-4).
 - (2) Press third stage piston and sleeve into third stage cylinder (47, Fig. D-4). Make sure shoulder at top of sleeve seats against top of cylinder.
 - (3) Install third stage cooling ring (44, Fig. D-4) over and around top shoulder of third stage piston and sleeve (45, Fig. D-4).

NOTE

Always install third stage piston sleeve as a factory matched set. O-rings (46, Fig. D-4) are supplied with factory set.

(4) Install third stage valve head. Ref. para. 4-4m.

h. Install oil pressure regulator (6, Fig. D-9).

- (1) Install O-ring (12, Fig. D-9) into O-ring groove in third stage upper cylinder as shown in Figure D-9.
- (2) Position oil pressure regulator (6, Fig. D-9) over oil pressure regulator mounting surface on third stage cylinder (47, Fig. D-4). Align bolt holes in regulator with bolt holes in cylinder. Secure oil pressure regulator to cylinder with 2 socket head bolts (10, Fig. D-9).

NOTE

Orient regulator to cylinder as shown in Figure D-9.

i. Install second stage piston and piston rings (39 and 40, Fig. D-4).

- (1) Install piston rings (40, Fig. D-4) into grooves in piston (39, Fig. D-4) as shown in Figure 4-9.

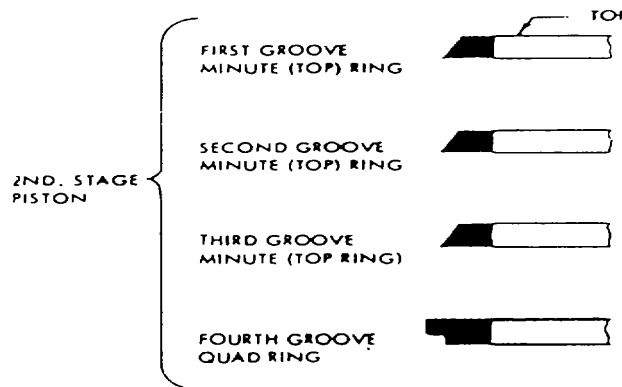


Figure 4-9. Compressor Second Stage Piston Ring Installation.

NOTE

Always install piston rings with the "top" mark toward the top or head of the piston.

- (2) Lubricate connecting rod, piston and wristpin (43, 39 and 41, Fig. D-4).
- (3) Install one circlip (42, Fig. D-4) into groove in piston (39, Fig. D-4).
- (4) Align wristpin bore of piston (39, Fig. D-4) with bearing in connecting rod (43, Fig. D-4). Install wristpin and circlip (41, and 42, Fig. D4).

j. Install second stage cylinder (37, Fig. D-4).

- (1) Install second stage cylinder gasket (38, Fig. D-4) over second stage cylinder studs (30, Fig. D-4).
- (2) Lubricate bore of second stage cylinder (37, Fig. D-4).
- (3) Position second stage cylinder (37, Fig. D-4) over top of second stage piston (39, Fig. D-4). Squeeze piston rings (40, Fig. D-9) with one hand while pressing cylinder over piston with other hand. The bottom of the cylinder bore is chamfered to assist in ring installation.
- (4) Seat second stage cylinder (37, Fig. D-4) over second stage studs (30, Fig. D-4). Secure second stage cylinder to crankcase with 4 nuts and washers (21, and 22, Fig. D-4). Tighten nuts to a torque of 181b/ft. (25NM).

- (5) Rotate crankshaft until second stage piston is at top dead center. Piston should be flush with top of cylinder. If not, adjustment has to be made with gaskets under cylinder.
- (6) Install second stage valve head. (Ref. para 4-41)
- k. Install first stage piston and piston rings (25, and 26, Fig. D-4).
 - (1) Install piston rings (26, Fig. D-4) into ring grooves in piston (25, Fig. D-4) as shown in Figure 4-10.

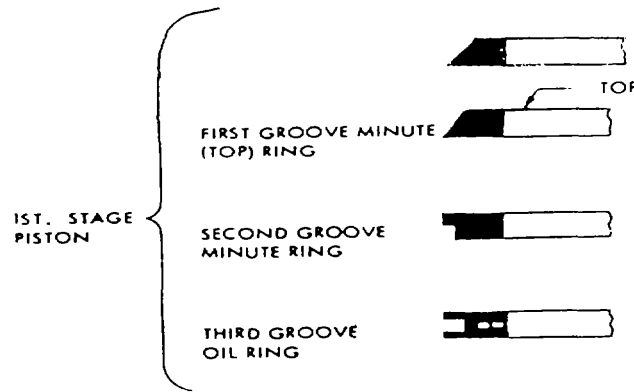


Figure 4-10. Compressor First Stage Piston Ring Installation.

NOTE

Always install piston rings with the "top" mark toward the top or head of the piston.

- (2) Lubricate the connecting rod, piston and wristpin (28, 25 and 27, Fig. D-4).
- (3) Install one circlip (24, Fig. D-4) into groove in piston. (25, Fig. D-4).
- (4) Position piston (25, Fig. D-4) over connecting rod (28, Fig. D-4).
- (5) Align wristpin bore of piston (25, Fig. D-4) with bearing in connecting rod (28, Fig. D-4). Install wristpin and circlip (24 and 27, Fig. D-4).
- l. Install first stage cylinder (20, Fig. D-4).
 - (1) Install first stage cylinder gasket (23, Fig. D-4) over first stage cylinder studs (30, Fig. D-4).
 - (2) Lubricate bore of first stage cylinder (20, Fig. D-4).
 - (3) Position first stage cylinder (20, Fig. D-4) over top of first stage stage piston (25, Fig. D-4). Squeeze piston rings (26, Fig. D-4) with one hand while pressing cylinder over piston with other hand. The bottom of the cylinder bore is chamfered to assist in ring installation.
 - (4) Seat first stage cylinder (20, Fig. D-4) over first stage studs (30, Fig. D-4). Secure first stage cylinder to crankcase with 4 nuts and washers (21 and 22, Fig. D-4). Tighten nuts to a torque of 18 lb/ft. (25NM).
 - (5) Rotate crankshaft until first stage piston is at top dead center. Piston should be flush with top of cylinder. If not, adjustment has to be made with gaskets under cylinder.
 - (6) Install first stage valve head. (Ref. para 4-4K).
- m. Install aftercooler (6, Fig. D-8).
 - (1) Loose assemble cooler pipe clamp (14, Fig. D-8) with 1 bolt and washer (16, and 15, Fig. D-8) into cooler bracket (8, Fig. D-8).

- (2) Loose assemble inlet end of aftercooler (6, Fig. D-8) to discharge fitting of third stage valve head (12, Fig. D-7).
 - (3) Install 2 bolts (7 Fig. D-8) through cooler clamps (11 and 17, Fig. D-8), into cooler bracket (8, Fig. D-8).
 - (4) Secure bolts (16, Fig. D-8) and washers (15, Fig. D-8) and tube nut at third stage valve head.
- n.** Install second to third stage intercooler (22, Fig. D-8).
- (1) Secure intercooler and intermediate piece (12, Fig. D-8) to cooler bracket (3, Fig. D-4) with 2 bolts, washers, and nuts.
 - (2) Loose assemble second to third stage intercooler (13, Fig. D-8) at second stage valve head (20, Fig. D-6).
 - (3) Secure intercooler tube nut at second stage valve head.
- o.** Install first to second stage intercooler (21, Fig. D-8).
- (1) Secure the intercooler and intermediate piece (12, Fig. D-8) to the cooler bracket with 2 bolts, nuts, and washers.
 - (2) Loose assemble first to second stage intercooler (18, 19, 20, Fig. D-8) at the first stage valve head (7, Fig. D-5) and at the second stage valve head (19, Fig. D-6).
 - (3) Secure intercooler coil tube nuts at the first stage valve head (7, Fig. D-5) and at the second stage valve head (19, Fig. D-6).
- p.** Install flywheel/fan and hub (3 and 5, Fig. D-8).
- (1) Align keyway in flywheel hub (5, Fig. D-8) with key (8, Fig. D-4). Install hub onto crankshaft (9, Fig. D-4).
 - (2) Secure hub with 1 bolt and washer (4 and 2, Fig. D-8).
 - (3) Align bolt holes in flywheel/fan (3, Fig. D-8) with holes in hub (5, Fig. D-8). Secure flywheel/fan to hub with 4 bolts and washers (1 and 2, Fig. D-8).
- q.** Install oil pump (2, Fig. D-9).
- (1) Position oil pump gasket (1, Fig. D-9) over body of oil pump (2, Fig. D-9).
 - (2) Insert oil pump and gasket (2 and 1, Fig. D-9) into crankcase as shown in Figure D-9. Secure oil pump with 3 socket head screws and washers (4 and 5, Fig. D-9).
 - (3) Loose assemble oil discharge pipe (3, Fig. D-9) at the oil pump (2, Fig. D-9) and at the oil pressure regulator (6, Fig. D-9).
 - (4) Secure oil discharge pipe nuts.
- NOTE**
- To bleed air from the oil pump, loosen pipe nut at the oil pressure regulator and operate compressor until oil flows from the pipe nut. Then secure pipe nut at oil pressure regulator.
- r.** Install final separator (Fig. D-12).
- (1) Attach final separator (Fig. D-12) to compressor filter mount (15, Fig. D-4) with U bolt, nuts and washers.
 - (2) Connect separator inlet line (6, Fig. D-8) and outlet line (4, Fig. D-12) of separator. Tighten line nuts securely.
- s.** Install second stage separator (28, Fig. D-11).
- (1) Attach second stage separator (28, Fig. D-11) to compressor filter mount (15, Fig. D-4) with 2 bolts, 2 nuts, 4 washers and 1 strap (11, 30, 1, 2, and 3, Fig. D-11).
 - (2) Connect separator inlet line (13, Fig. D-8) at separator. Tighten line nuts securely.

- (3) Connect separator discharge line (29, Fig. D-11) at separator and at third stage valve head (10, Fig. D-7). Tighten line nuts securely.

t. Install compressor into frame. (Ref. para 4-12.)

u. Fill compressor with oil. (Ref. para 4-4.)

v. Start compressor. (Ref. para 3-5.) Bleed air from oil pump. Ref. para 4-25). Check all fittings for leaks. Repair as required.

4-26. ENGINE. Reassembly of the engine is covered in Appendix A.

4-27. PURIFIER CHAMBER. The purifier chamber may be reassembled as follows:

a. Install O-rings (4 and 5, Fig. D-13) into grooves in top and bottom plugs (1 and 3, Fig. D-13). Install cartridge O-ring (6, Fig. D-13) into groove in bottom plug (3, Fig. D-13).

NOTE

Back-up ring is installed at the end of the O-ring groove nearest plug threads and with the flat face against the face of the O-ring groove.

b. Apply a thin film of silicone grease to the O-rings, backup rings and plug threads.

c. Install purifier cartridge. Ref. para 4-4.

d. Slip chamber (2, Fig. D-13) down over cartridge (7, Fig. D-13), screw chamber down on bottom plug (3, Fig. D-13) until chamber comes down flush with bottom plug. Do not overtighten.

e. Install top plug. Ref. para. 44.

4-28. TORQUE LIMITS. Unless otherwise specified, the following torque limits shall apply.

<u>Bolt Size</u>	<u>Torque</u>
6 mm	7 ft-lbf (10 NM)
8 mm	18 ft-lbf (25 NM)
10 mm	32 ft-lbf (44 NM)
1/4"-20	6-9 ft-lbf (8-13 NM)
1/4"-28	6-9 ft-lbf (8-13 NM)
5/16"-18	12-15 ft-lbf (17-21 NM)
5/16"-24	15-18 ft-lbf (21-25 NM)
3/8"-16	23-28 ft-lbf (32-39 NM)
3/8"-24	30-35 ft-lbf (42-49 NM)

4-29. SPECIAL TOOLS. A valve tool for removing second and third stage inlet valves (4, Fig. D-6) and (1, Fig. D-7) is provided with this compressor unit. Valve tool part number is 4555.

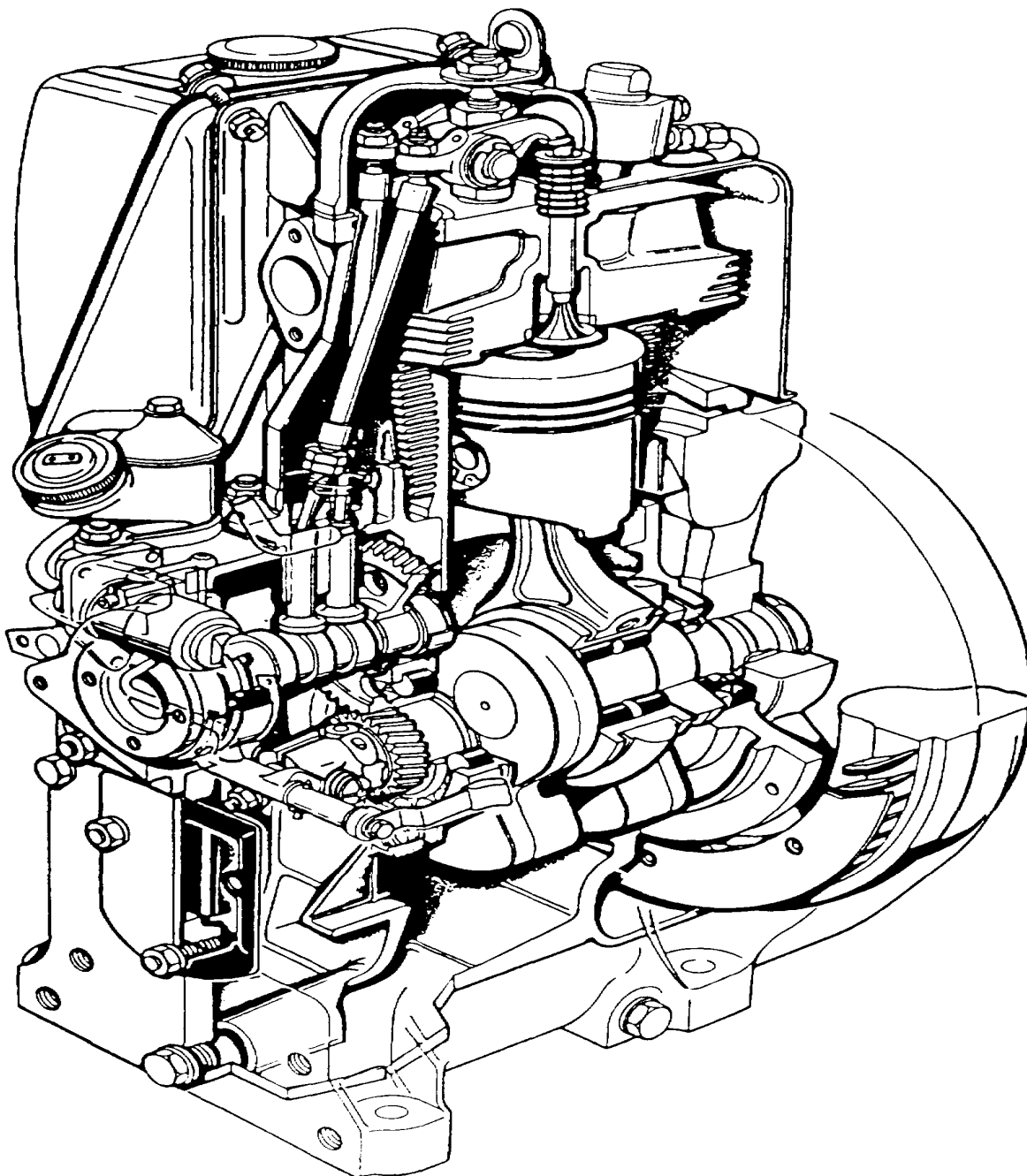
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APPENDIX A
DIESEL ENGINE REPAIR MANUAL ILLUSTRATED PARTS LIST

A-1. FOREWORD.

Before attempting an engine overhaul or a tune-up, it is necessary that your shop be equipped with proper tools, equipment and mechanics who are thoroughly familiar with Briggs & Stratton engine design and construction. With your shop thus equipped, this book will serve as a guide in performing the various steps necessary to do a complete and satisfactory job.

In order to keep all tables as simple as possible, only the basic engine models are listed unless there is a difference between them and special models.



Section I GENERAL INFORMATION

A-2. DIESEL 4 CYCLE OPERATION

Farymann engines, like their larger brothers in automotive, agricultural and industrial equipment, are 4 cycle diesels. These four cycles, or strokes, are intake, compression, power and exhaust.

a. The intake stroke begins with the piston moving down, creating a vacuum which draws air through the open intake valve into the space above the piston.

b. With both valves closed, the piston rises, compressing the air into the very small space remaining between the piston top and cylinder head and causing a tremendous rise in air temperature.

c. The fuel injector now sprays a fine mist of diesel fuel directly into this space, where the high temperature of the compressed air causes it to ignite and drive the piston downward.

d. After the piston has reached the limit of its downward travel, momentum causes it to begin moving upward once again. At this point, the exhaust valve opens and the piston forces out all of the burnt gases, completing one cycle.

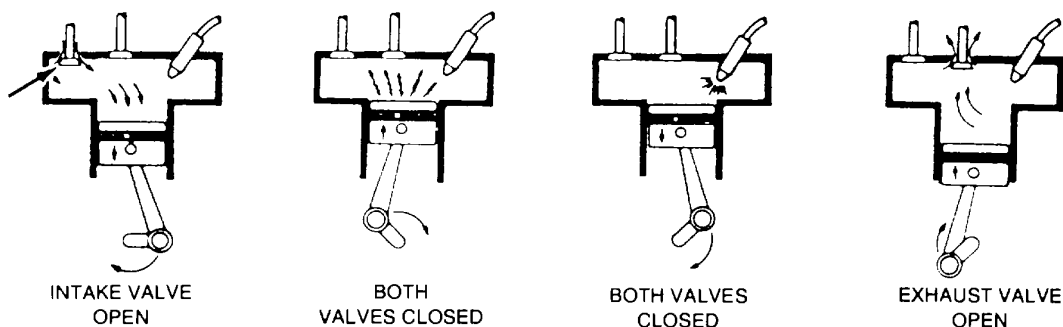


Table A-1. PREVENTIVE MAINTENANCE

Daily:	Check engine oil level . Oilbath aircleaner - check oil level, if atmosphere is dusty, clean daily. Drytype aircleaner - under (lusty conditions check daily, renew paper cartridge if necessary)
After 20 hours:	Change oil and check valve clearance on all new or rebuilt engines. Check all nuts and bolts for tightness (for tightening torques see chart page 3).
Every 100 hours:	Change oil Check V-belt tension (generator, waterpumps etc.) Oilbath aircleaner -- clean thoroughly (earlier when necessary) Drytype airfilter - renew paper cartridge if necessary Check valve clearance (engine cold). Check all fuel lines for leakages Under dusty conditions: clean cooling air intake, blower in flywheel and cooling fins on cylinder and cylinder head
Every 300 hours:	Change oil Renew oil filter (2-cylinder engines only) Clean oil strainer Flush crankcase (if sludge is present) Check decompression device
Every 500 hours:	Check and clean crankcase breather Clean fuel tank Fuel filter - check and renew cartridge if necessary

Section II TROUBLESHOOTING

FAULT	POSSIBLE CAUSE	REMEDY
Engine Does Not Start	Starter Does Not Turn	Charge Battery; Tighten Terminals; Replace Starter
	Fuel Tank Empty or Filled with Improper Fuel	Fill Tank with Diesel Fuel
	Throttle Lever at Stop	Place Throttle Lever at Maximum When Starting
	Engine, Primer Button Not Pulled	Engage Primer Button
	Fuel Filter or Lines Clogged	Replace Filter Element, Clean Lines
	Air in Fuel System	Bleed Fuel Lines
	Low Compression	Check Piston Rings; Check Valve Condition and Clearance; Check Head Gasket Condition, Check Rod Bearing Wear - Overhaul if Necessary
	Faulty Fuel Injection Pump or Fuel Injector(s)	Check Feed Rate of Pump; Adjust or Replace as Necessary - Replace Injector
	Engine Oil Too Viscous (Heavy)	Use Oil of the Proper Viscosity for Climate Conditions
Engine Starts, Then Stops	Improper Governor Clearance	Adjust Governor Clearance
	Fuel Primer Button Not Pulled Down	Pull Down Button
Engine Stalls When Warm	Starting Load Too Great	Reduce Engine Load
	Fuel Too Hot	Eliminate Cause for Excess Heat In Fuel
Engine Runs Unevenly; Low Output	Fuel Supply Too Low; Filter Clogged	Replace Fuel Filter Element; Check Contents of Tank
	Not Enough Fresh Air	Provide Engine Enclosure with Adequate Openings for Fresh Air
	Air in Fuel System	Bleed Fuel Lines
	Fuel Line(s) Leaking	Check and Tighten
	Improper Valve Clearance	Adjust Valves
	Improper Injection Timing or Worn Injection Pump	Check Fuel Pump Timing; Adjust or Repair as Necessary
	Air in Fuel System	Bleed System
	Poor Quality or Improper Fuel	Replace Contents of Tank with Fresh Diesel Fuel
	Sticking Governor	Clean and Adjust Governor and Change Lube Oil

TROUBLESHOOTING (Continued)

FAULT	POSSIBLE CAUSE	REMEDY
Engine Races	Governor Damaged or Improperly Adjusted	Adjust or Replace Governor
Exhaust Emits Excessive Smoke:		
A. Blue Smoke	Engine Oil Level Too High	Drain Off and Recheck Oil Level, Check to Make Sure Engine is Not Tilted from Its Normal Angle of Operation
	Poor Compression Due to Seized or Broken Piston Rings, Worn Valves or Guides	
B. Black Smoke	Engine Overloaded	Reduce Engine Load
	Primer Button Does Not Disengage Since Engine Does Not Reach Its Rated Speed	Reduce Load on Engine; Move Throttle Lever Into Idling Position, Then Slowly Back to Full Load
Engine Runs Too Hot	Engine Compartment Too Hot	Provide More Fresh Air Circulation to Engine; Clean Air Intake Screens and Cylinder Shields
	Oil Level Too High	Drain Excess Engine Oil; Check Engine Angle
	Injection Nozzle Defective	Replace Nozzle
	Feed Rate of Injection Pump Erratic	Adjust or Repair Injection Pump
Excessive Oil Consumption	High Oil Temperature	Reduce Single Load, Provide More Cooling Air
	Breather Inoperative	Clean or Replace Breather
	Oil Too Thin	Replace with Oil of Proper Viscosity for Climate Conditions
	Piston Rings Worn or Sticking; Cylinder Wall(s) Scuffed or Scratched	Inspect and Free Rings or Overhaul Engine
	Oil Leaking	Inspect and Tighten Fittings as Needed
Unusual Engine Knocks and Noises	Loosen Mounting Bolts	Inspect and Tighten Any Loose Bolts
	Engine Overloaded	Reduce Engine Load
	Loose Flywheel	Tighten Flywheel Mtg. Bolts
	Damaged Gear Teeth	Replace Any Gear with Broken Teeth, Also Examine Gear It Engages for Damage
	Incorrect Timing	Correct Injection Pump Timing

Section III 15A430/18A430 DISASSEMBLY/ASSEMBLY

A-3. ENGINE DISASSEMBLY - MODELS 15A430 AND 18A430

a. Air Cleaner. Using 13mm socket, remove the two air cleaner locknuts. Pull off the air cleaner and gasket.

b. Muffler. Again using the 13mm socket, remove the two hex nuts on the outside of the muffler screen. With a 100mm socket, take off the hex nut and lockwasher on the opposite side of the muffler screen. Pull off the screen, muffler and muffler gasket.

c. Fuel Tank. Place a clamp on the fuel supply line coming from the fuel tank to the fuel injection pump. Next, remove the banjo bolts from the top of the field injector and from the fuel injection pump. Replace the banjo bolts and their four copper washers both to avoid losing them and to keep dirt from entering the pump and injector. Next, remove the lock nut holding the fuel supply line clipped to the crankcase.

Finally, loosen the fuel tank straps using an adjustable mm socket and slide them off the ends of the tank. The fuel tank and line may now be removed. (Figure A-1)

d. Fuel tank support brackets. Pull off both the fuel tank support brackets as well as the intake and exhaust manifold gaskets. (Figure A-2)

e. Air Deflectors. Using a 4mm allen socket, remove the two allen head screws and lockwashers holding the air deflector shields on top of the crankcase. (Figure A-3)

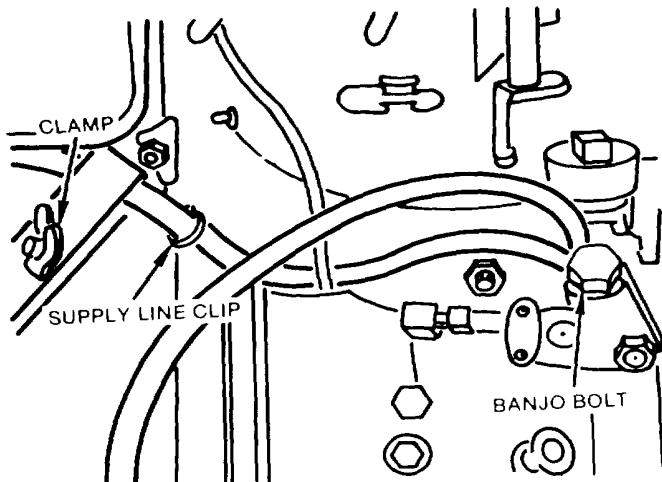


Figure A-1. Fuel Tank and Lines

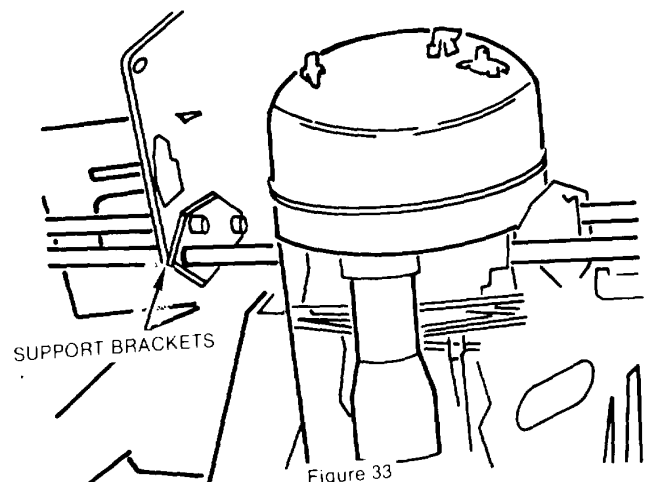


Figure A-2. Fuel Tank Support Brackets

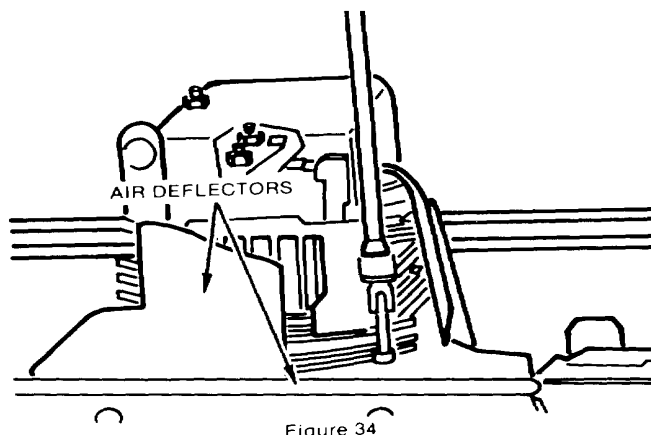


Figure A-3. Air Deflectors

15A430/18A430 DISASSEMBLY/ASSEMBLY

f. Valve Cover. Remove the valve cover and cover gasket by removing the two acorn nuts on top of the valve cover with a 13mm socket. If necessary, tap lightly on the side of the valve cover with a soft faced hammer to loosen it. (Figure A-4).

g. High Pressure Fuel Line. Loosen the high pressure fuel line by holding a 14mm wrench on the delivery valve holder while loosening the fuel line fitting with a 17mm flare nut wrench. (Figure A-5)

- (1) Loosen the fuel line nut at the fuel injector with a standard 17mm open end wrench. Remove the fuel line. (Figure A-6)

h. Fuel Injector. Using a 10mm socket, remove the tow hex head screws and their lockwashers from the injector clamp. Lift off the injector clamp and **carefully** pull out the fuel injector assembly. Note that there is an asbestos washer between the injector and cylinder head which must also be removed through the injector opening. (Figure A-7)

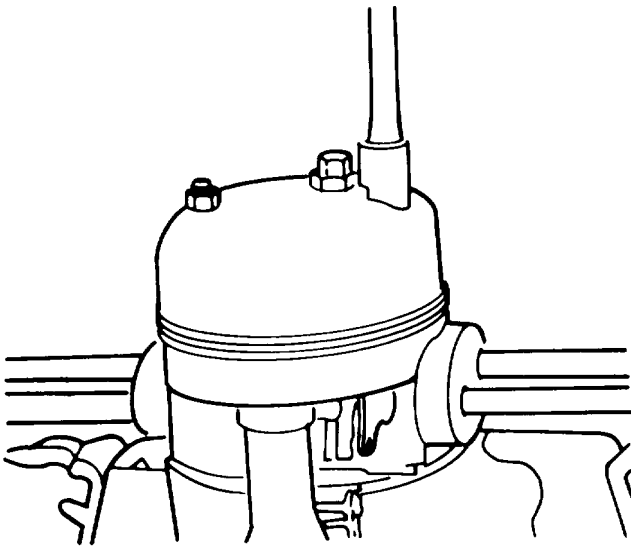


Figure A-4. Valve Cover

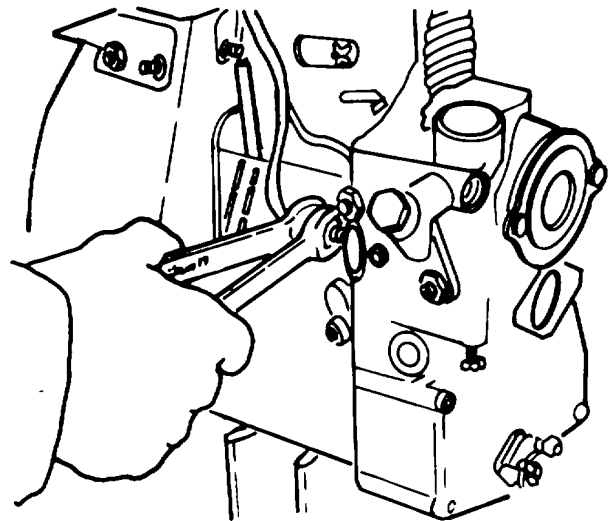


Figure A-5. High Pressure Fuel Line

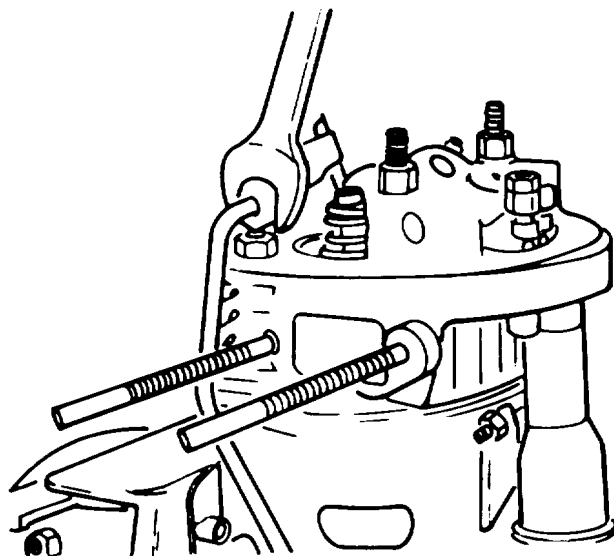


Figure A-6. Fuel Line Nut

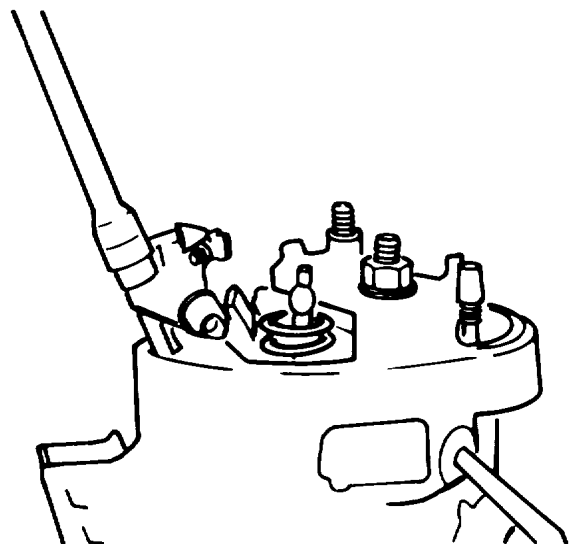


Figure A-7. Fuel Injector

15A430/18A430 DISASSEMBLY/ASSEMBLY

i. **Cylinder Head.** With an 8mm nut driver, remove the push rod tube retaining spring. (Figure A-8)

- (1) Remove the bolt holding the two cylinder head shields together using a screwdriver and needle nose pliers. (Figure A-9)
- (2) Beginning with the two injector side nuts, loosen the 4 cylinder head nuts with a 13mm deep well socket. (Figure A-10.)
- (3) Knock out the rocker arm shaft with a drift pin and hammer. Pull out the rocker arms and push rods. (Figure A-11.)

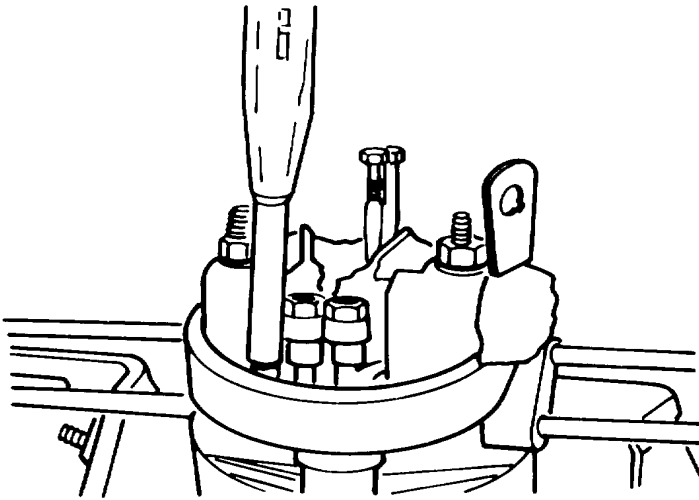


Figure A-8. Cylinder Head

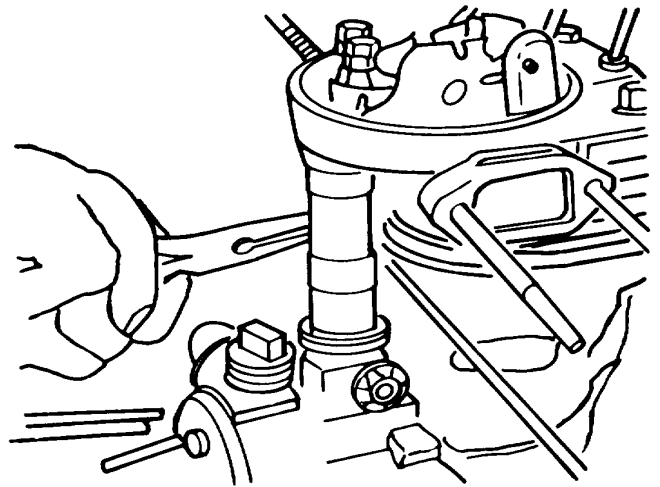


Figure A-9. Bolt Holding Two Cylinder Head

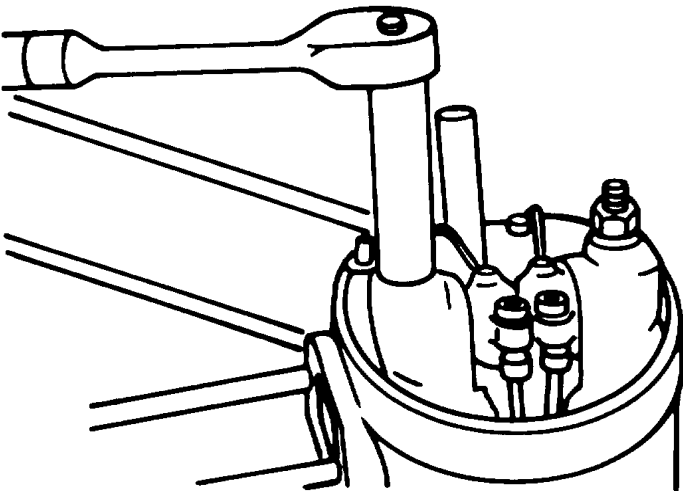


Figure A- 10. Two Injector Side Nuts

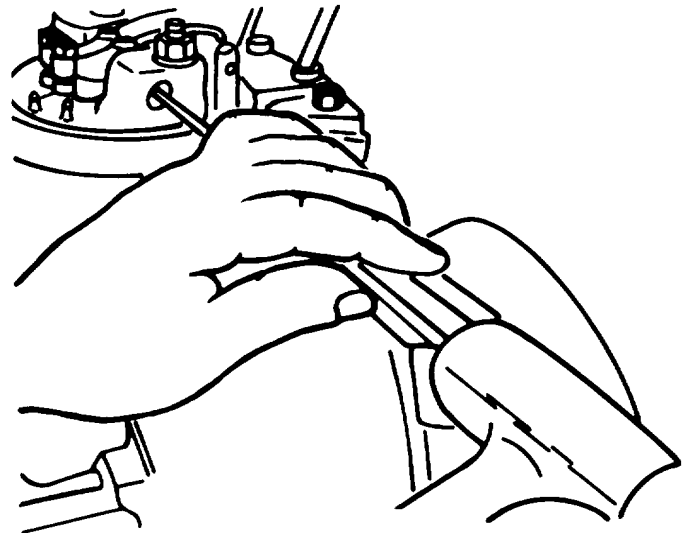


Figure A-11. Rocker Arm Shaft

15A430/18A430 DISASSEMBLY/ASSEMBLY

(4) Remove the cylinder head nuts and pull off the cylinder head. (Figure A-12.)

j. Cylinder Shield. Completely remove the cylinder shield from the cylinder head using a 4mm allen wrench. (Figure A-13.)

k. Compression Release. After removing its screws with a 4mm allen wrench, pull the compression release out of the gearcase. (Figure A-14.)

l. Cylinder. Rotate the flywheel until the piston reaches the bottom of its stroke. Carefully slide the cylinder up off the studs. (Figure A-15.)

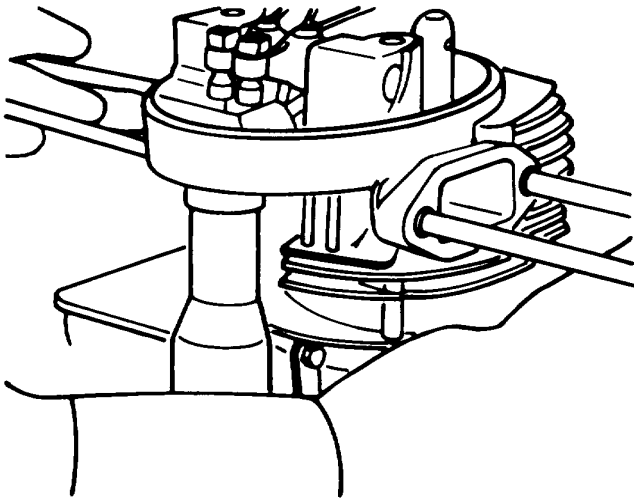


Figure A-12. Removal of Cylinder Head Nuts

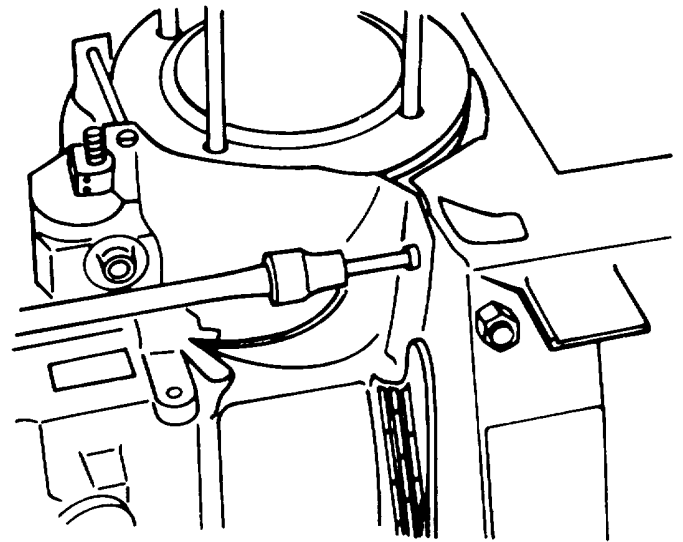


Figure A-13. Cylinder Shield

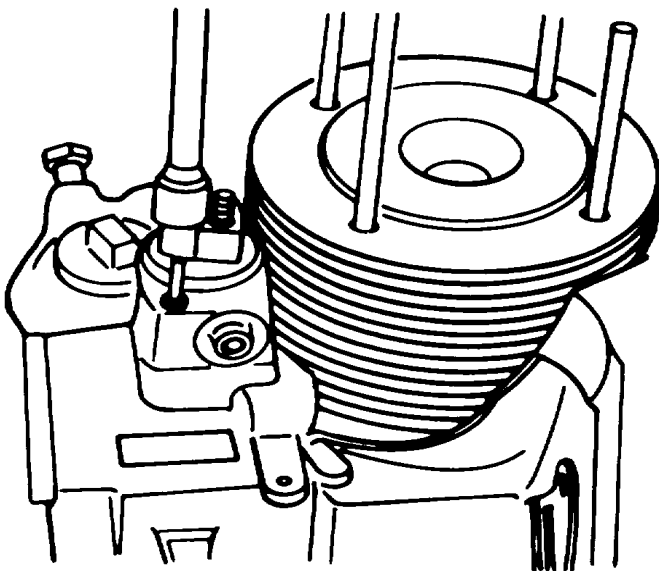


Figure A-14. Compression Release

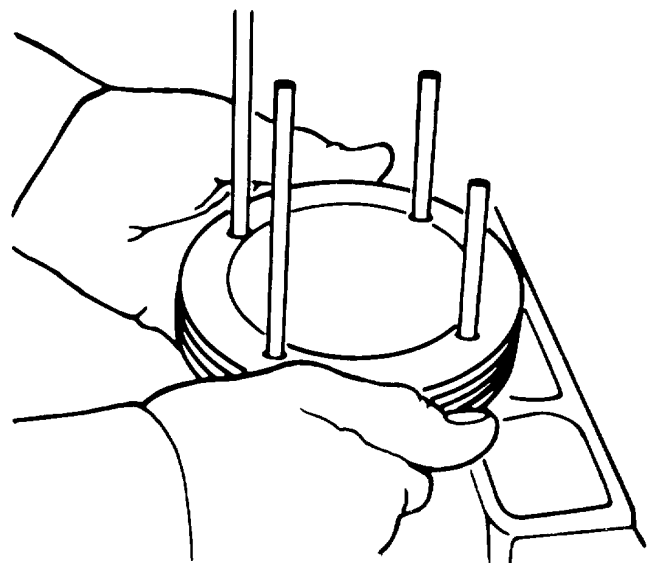


Figure A-15. Cylinder

15A430/18A430 DISASSEMBLY/ASSEMBLY

m. Piston. Slowly rotate the flywheel until the piston reaches the top of its stroke. With a needle nose pliers, remove the piston pin retainer on the governor side of the engine. (Figure A-16.)

- (1) Pull out the piston pin. If the pin does not come out easily, insert a hook (such as a bent coathanger) through the center of the pin and pull while gently rocking the piston. (Figure A-17.)

n. Oil Filter Screen. Before removing the connecting rod, drain the engine oil. Remove the oil filter screen assembly,. (Figure A-18.)

o. Connecting Rod. Turn the engine onto its flywheel side. Remove the crankcase inspection cover by removing the six allen screws with a 4mm allen wrench. If these screws are very tight, tapping on them with a hammer and drift pin or flat-faced punch may help loosen them. (Figure A-19).

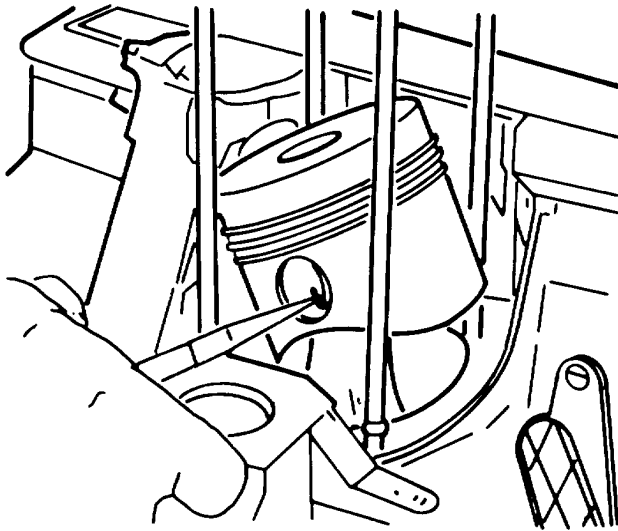


Figure A-16. Piston

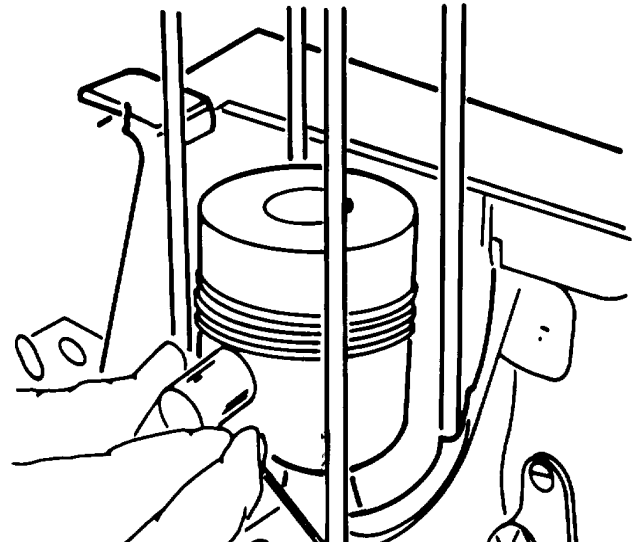


Figure A-17. Piston Pin

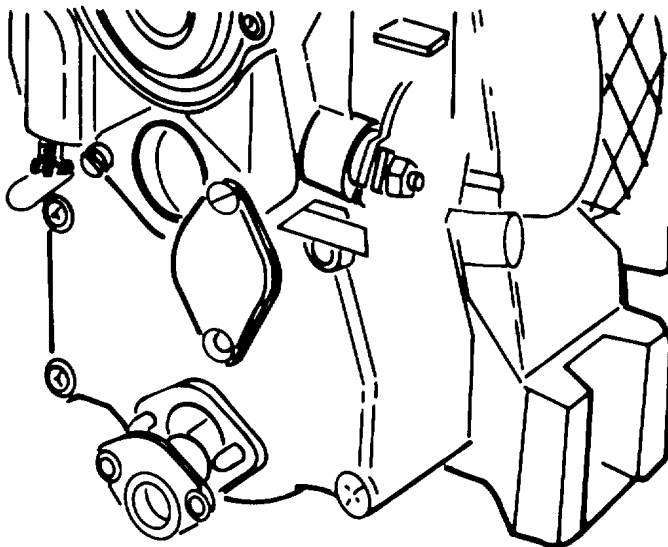


Figure A-18. Oil Filter Screen

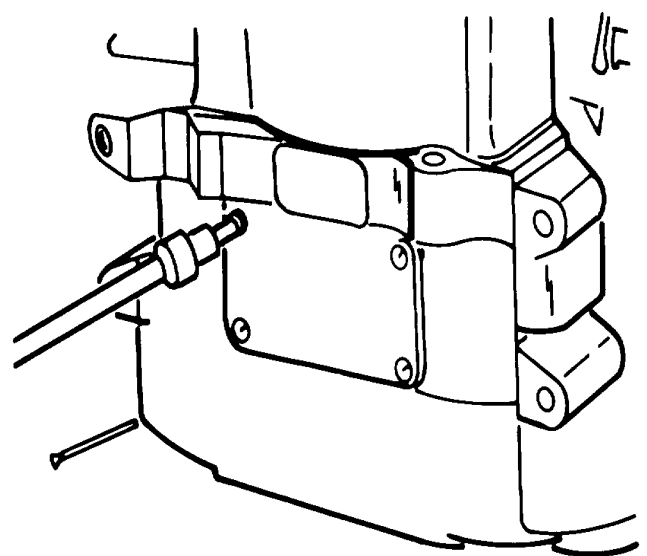


Figure A-19. Connecting Rod

15A430/18A430 DISASSEMBLY/ASSEMBLY

- (1) Using a 13mm socket, remove the two connecting rod hex nuts. Tap on the connecting rod cap with a hammer handle, if necessary, to loosen and remove it. Pull and remove it. Pull out the connecting rod. (Figure A-20.)

p. Injection Pump. With the 13mm socket, remove both the injection pump hex nuts. Pull the injection pump from the gear cover. Leaving the injection pump gasket and shims on the gear cover, reinstall the hex nuts and lockwasher on their studs. (Figure A-21.)

q. Crank Handle Guide. Remove the two crank handle guide screws with a 5mm allen head wrench. Pull off the guide, o-ring and o-ring retainer. (Figure A-22.)

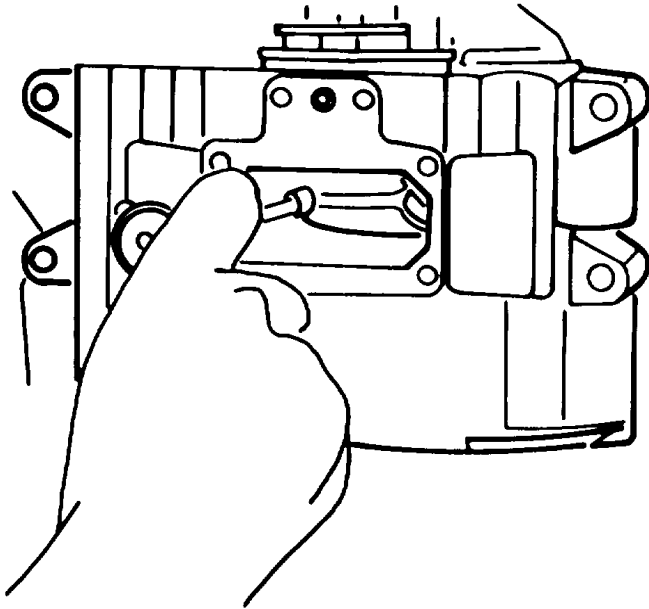


Figure A-20. Rod Hex Nuts

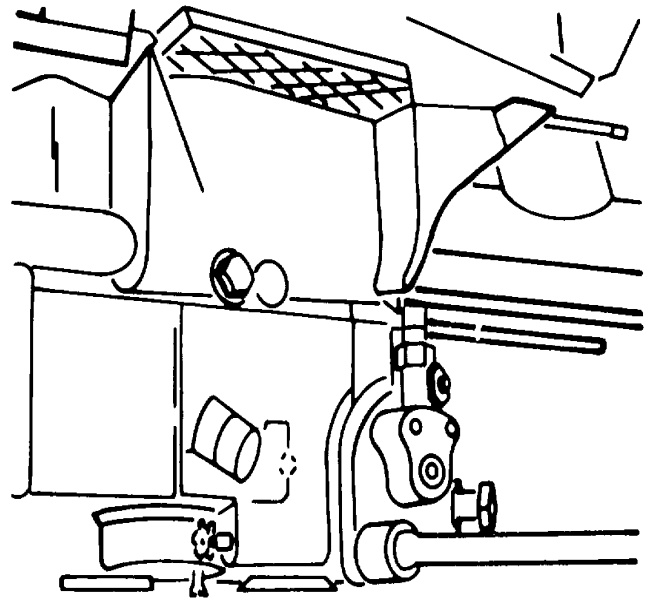


Figure A-21. Injection Pump

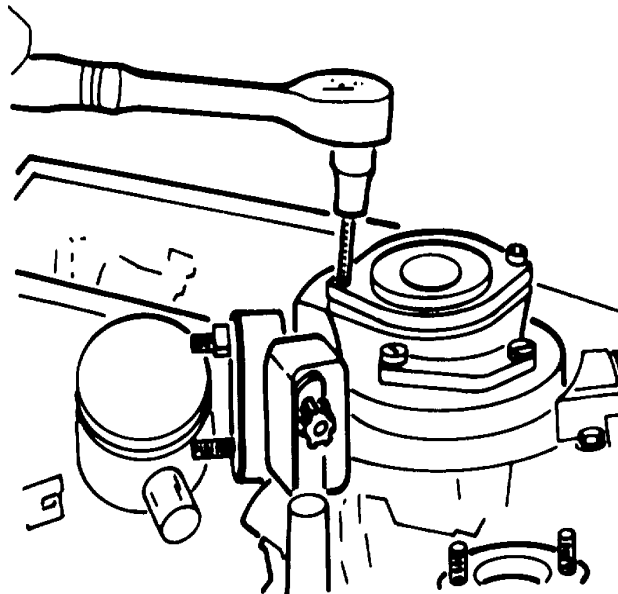


Figure A-22. Crank Handle Guide

15A430/18A430 DISASSEMBLY/ASSEMBLY

r. Gear Cover. Using a 6mm **pilot** allen socket, remove the six gear cover screws. Remove the gear cover. If necessary, tap on the gear cover with a soft faced hammer to loosen it. If, when removing the cover it should catch on the governor beneath, turning the flywheel slightly will free it. (Figure A-23.)

s. Camshaft. Remove the snap ring holding the cam shaft in the gear cover. Press out the camshaft using the special tool or a socket of the proper diameter. (Figure A-24.)

t. Governor. First remove the air screen from the right side of the engine. Place a piece of wood through the air screen opening and the flywheel to prevent the flywheel from turning.

Next, pull out the governor pin. Using a 14mm socket and a breaker bar, remove the governor by loosening its screw in a **clockwise** direction (the governor has a left hand thread). Spread the governor weights enough to ensure that the socket will completely seat on the governor. (Figure A-25.)

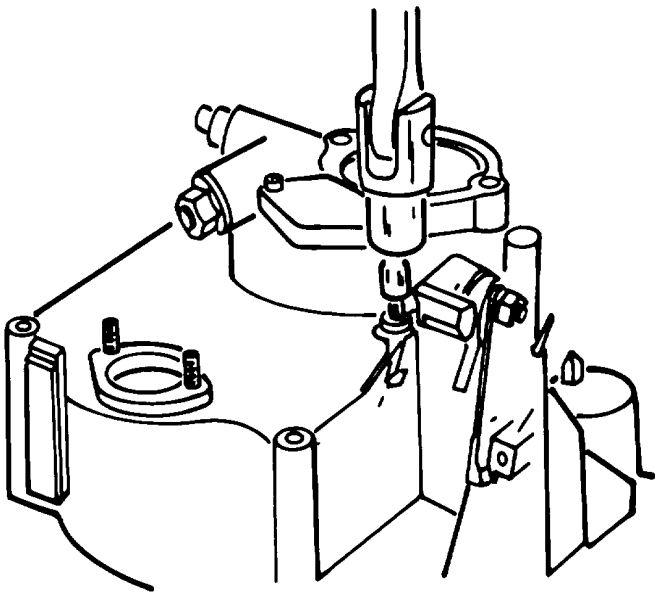


Figure A-23. Gear Cover

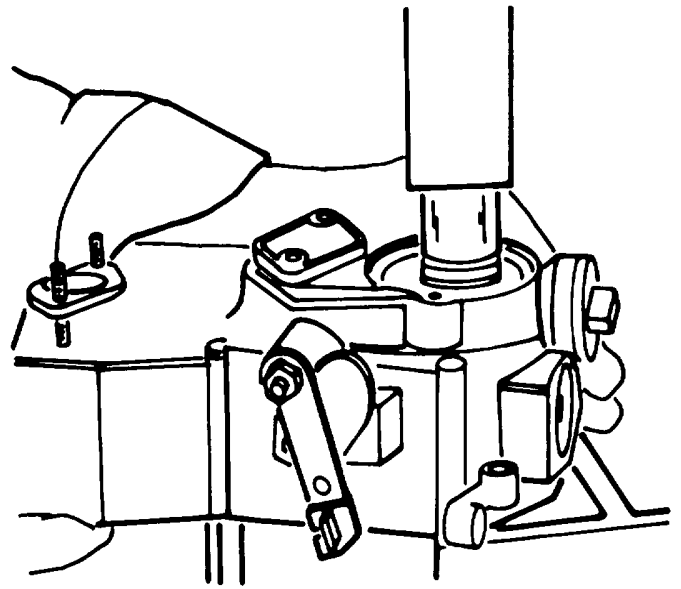


Figure A-24. Camshaft

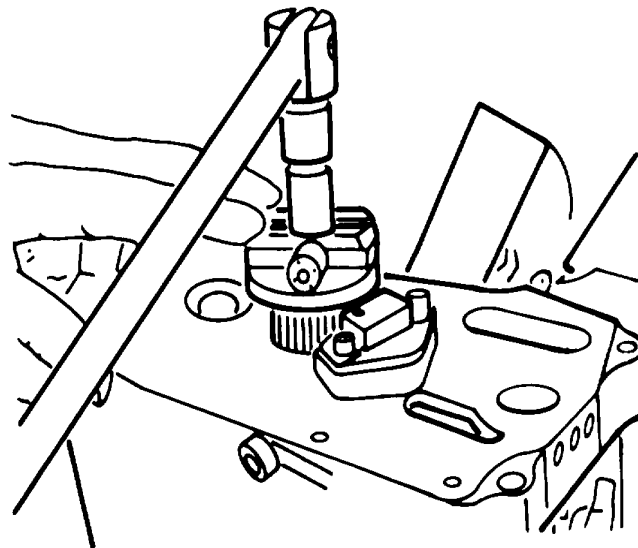


Figure A-25. Governor

15A430/18A430 DISASSEMBLY/ASSEMBLY

u. Oil Pump. Remove the oil pump by removing the two oil pump screws with a 5mm allen head wrench (Figure A-26.)

v. Flywheel. Using a 36mm socket on the special flywheel nut tool, loosen the flywheel nut. (Figure A-27.)

- (1) Leave the nut on the shaft. Install the flywheel puller and screw it down until the flywheel breaks loose from the crankshaft taper. Remove the flywheel nut and flywheel. (Figure A-28.)

w. Main Bearing Support. Remove the four main bearing support nuts with a 8mm socket. (Note that these nuts have a thread pitch unlike other 8mm nuts used in the engine.) Next, install two remover screws into the support and screw them in until the support breaks loose from the crankcase. (Figure A-29.)

- (1) Pull off the support, belleville washers, oil seal, o-ring retailer and o-ring.

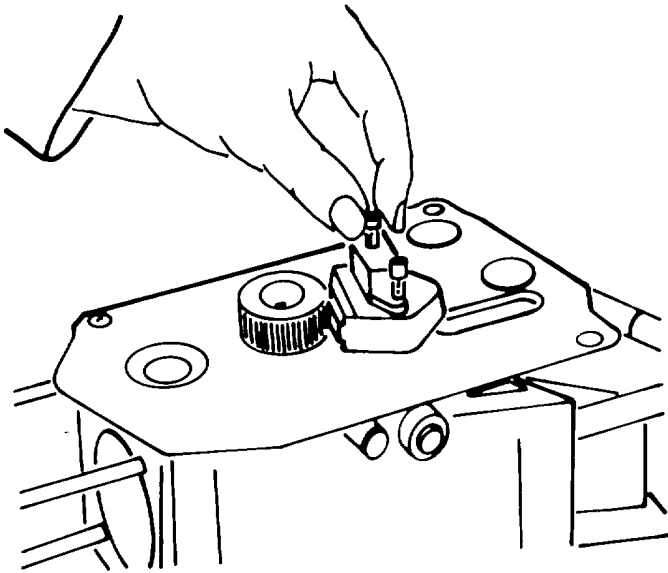


Figure A-26. Oil Pump

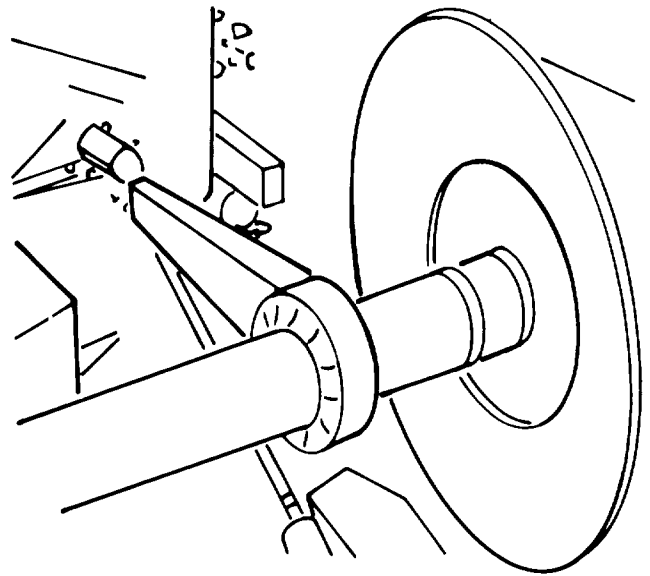


Figure A-27. Flywheel

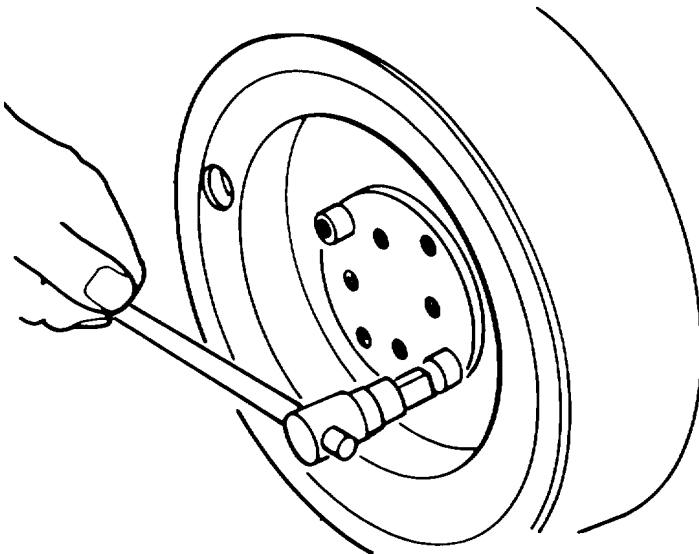


Figure A-28. Removal of Flywheel Nut and Flywheel

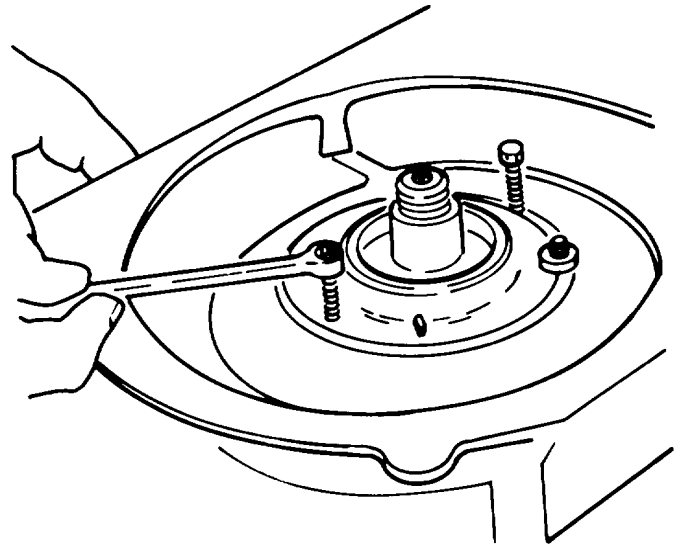


Figure A-29. Main Bearing Support

15A430/18A430 DISASSEMBLY/ASSEMBLY

x. **Crankshaft.** Pull out the crankshaft from the crankcase, being careful not to drag the crankshaft gear on the crankcase main bearing. (Figure A-30.)

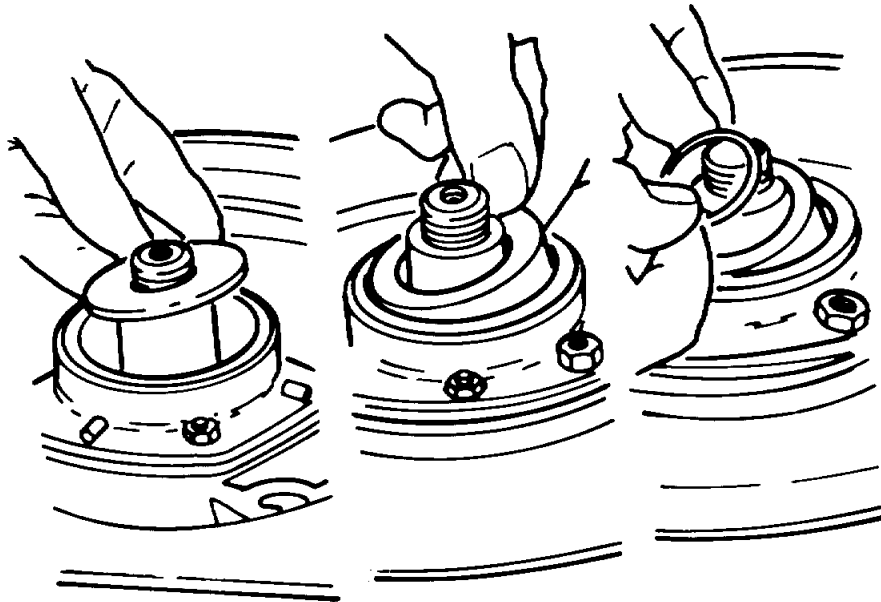


Figure A-30. Crankshaft

A-4. ENGINE REASSEMBLY

a. **Crankshaft.** Wipe a little oil on the surface of the governor side main bearing. Carefully, slide the crankshaft into the housing. (Figure A-31.)

b. **Main Bearing Carrier.** Replace the main bearing carrier being certain to use a new gasket. Tap lightly with a soft faced hammer to seat the carrier. Using a 8mm wrench, torque down all four support capscrews. Replace the main bearing washer and o-ring, followed by the o-ring retainer. Face the beveled surface of the retainer towards the o-ring. (Figure A-32.)

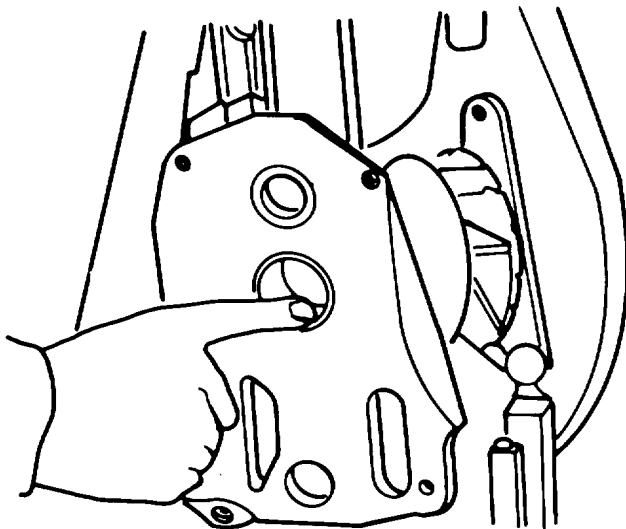


Figure A-31. Crankshaft

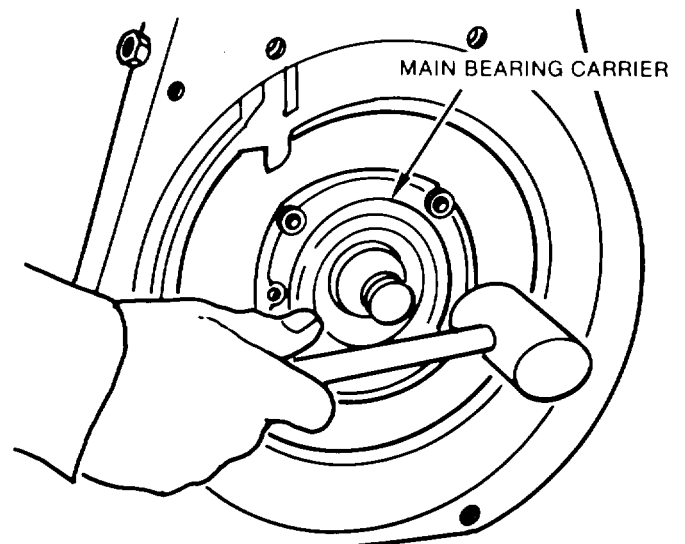


Figure A-32. Main Bearing Carrier

15A430/18A430 DISASSEMBLY/ASSEMBLY

- (1) Replace the two belleville washers so that their outer edges, are touching. (Figure A-33.)

c. Flywheel. Make sure the crankshaft taper is free of oil and grease. Insert the flywheel key and slide the flywheel onto the crankshaft taper. Reinstall the flywheel retaining nut. With the striker bar and a mallet, securely tighten the retaining nut. (Figure A-34.)

It is extremely important that the flywheel seats securely on the crankshaft taper. To see if the flywheel is properly seated, first loosen the retaining nut. Using a wooden mallet or hammer handle, strike the outer face of the flywheel at 90° intervals (3:00, 6:00, 9:00, 12:00). If the flywheel comes loose, remove it and check once more for oil, grease or dirt. Clean the taper surfaces thoroughly and reinstall the flywheel. Repeat the test once more. If the flywheel breaks loose again, the flywheel or crankshaft tapers may be damaged or defective.

d. Oil Pump. Reinstall the oil pump. Note that there are two long screws and one short screw. The two longer screws pass through the bracket on the pump face. Be careful not to distort this bracket when torquing these three screws to engine specifications. (Figure A-35.)

e. Connecting Rod. Note the painted marks on one side of the connecting rod. When installed, this side should face the injection pump. Also be sure that the stamped match marks on the connecting rod and cap are aligned on the same side of the rod. (Figure A-36.)

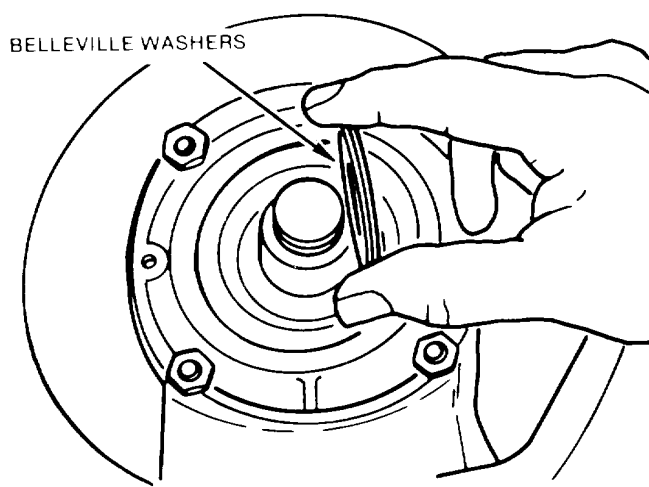


Figure A-33. Belleville Washers

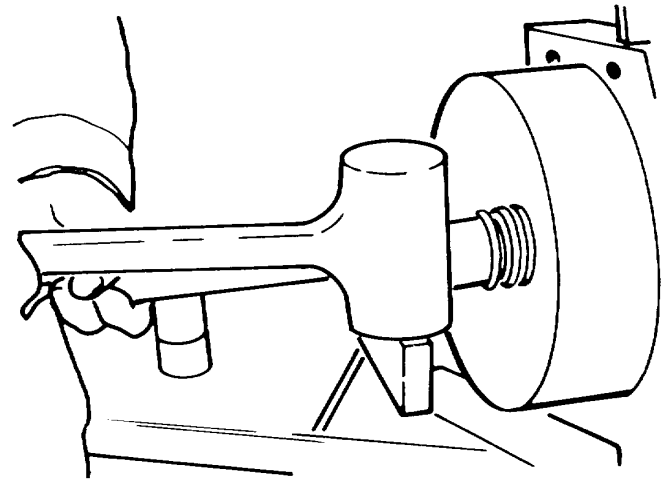


Figure A-34. Flywheel

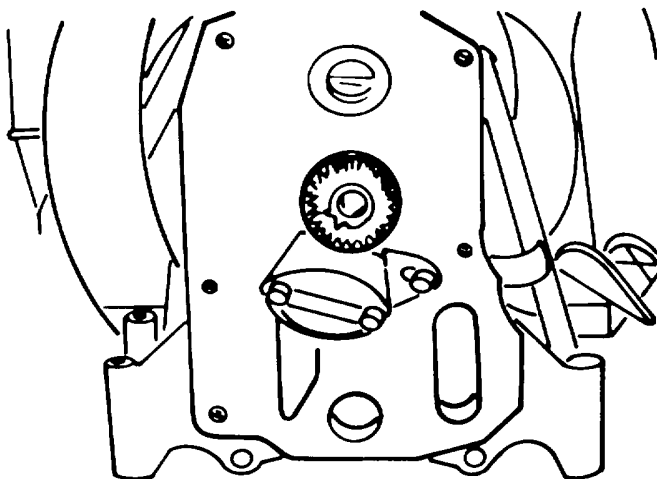


Figure A-35. Oil Pump

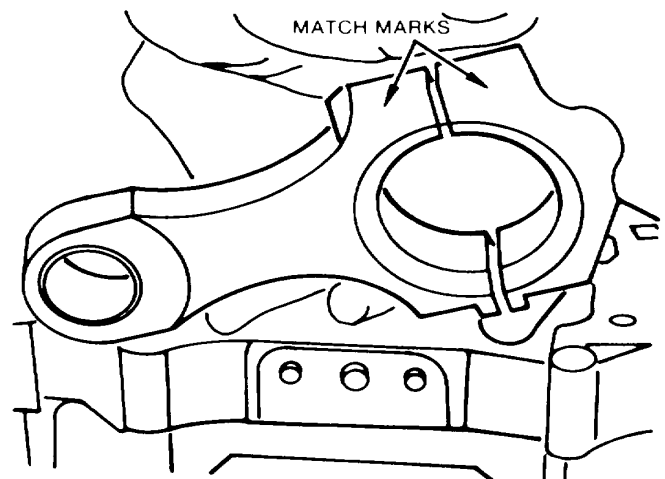


Figure A-36. Connecting Rod

15A430/18A430 DISASSEMBLY/ASSEMBLY

- (1) Install connecting rod into the crankcase until it seats on the crankshaft. Insert the connecting rod cap through the inspection cover. Torque the connecting rod nuts to 22ft. lbs. Use new nuts whenever the connecting rod cap is removed. (Figure A-37.)
- (2) With a 4mm allen head wrench, reinstall the crankcase inspection cover. (Figure A-38).

f. Camshaft. Using the driver supplied in the special tools set, press the camshaft bearing into the gear cover.

Now press the camshaft into the camshaft bearing; again, use the appropriate special tool. Turn the gear cover over and check the camshaft bearing. It should be completely seated against the gear cover bearing flange. (Figure A-39.)

- (1) Replace the nylon o-ring retainer on the end of the camshaft bearing so that its shoulder faces out. Press the o-ring into the retainer. Next, using a snap ring pliers, replace the bearing retaining ring in the gear cover. (Figure A-40.)

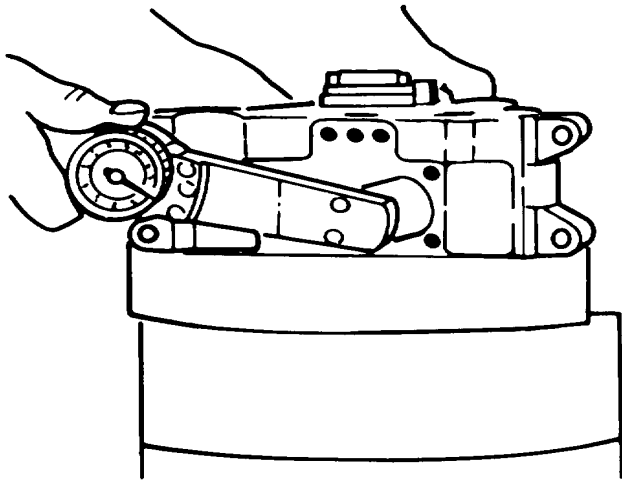


Figure A-37. Installation of Connecting Rod

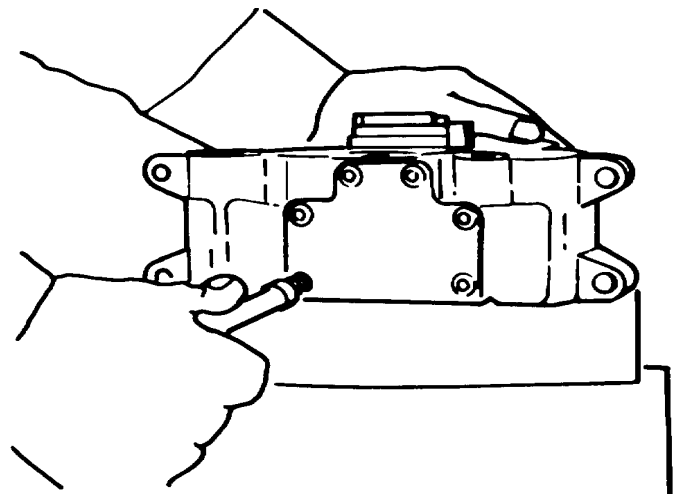


Figure A-38. Reassembly of Crankcase Cover

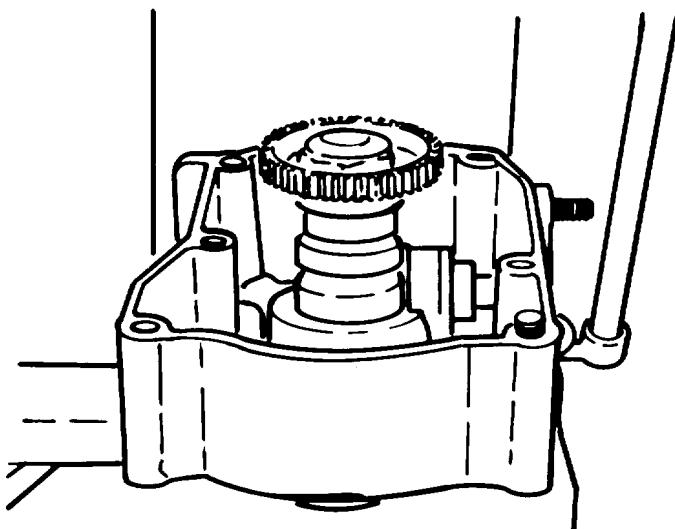


Figure A-39. Camshaft

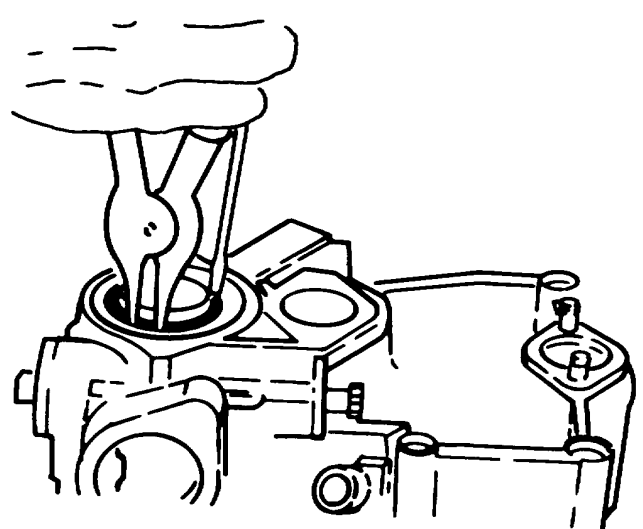


Figure A-40. Replacing nylon o-ring

15A430/18A430 DISASSEMBLY/ASSEMBLY

- (2) Finally, replace the oil seal and crank handle guide. Do not push the guide straight onto the gear cover. Instead, while holding the camshaft gear with one hand, use a light twisting motion until the guide seats itself. Tighten the two guide screws with a 6mm allen head wrench. (Figure A-41.)

g. Piston. Fit the piston ring compressor to the piston. Lay the cylinder down on the bench so the bottom of the cylinder is facing up. Install the piston from the bottom of the cylinder. Never tap on the top of the piston. Do not push the piston in so far that the piston pin bore is covered. (Figure A-42.)

- (1) Slide the piston and cylinder over the studs, making sure the crescent shaped grooves in the cylinder fins face the governor side of the engine. Align the piston and connecting rod bores. Push the wrist pin into the piston and through the connecting rod. Replace the wrist pin retaining ring using a snap ring pliers.
- (2) Slide the cylinder down until it seats firmly on the engine block. On 18A430 engines only, install a new copper cylinder head gasket. Slide the cylinder head down onto the cylinder. Replace the flat washers and flange nuts on the studs. (Figure A-43.)

h. Governor. Make sure the governor threads are free of oil and grease. Apply a couple of drops of Lock-Tite to the threads. Screw the governor on hand tight in a counterclockwise direction (left-hand thread). Torque the

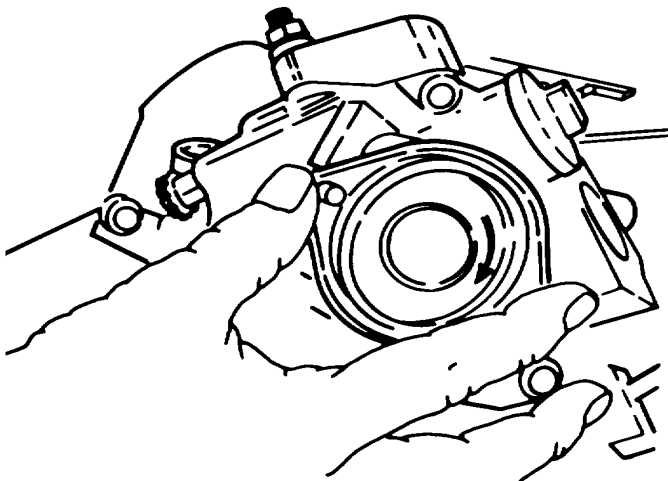


Figure A-41. Replacing Oil Seal and Crank Handle Guide

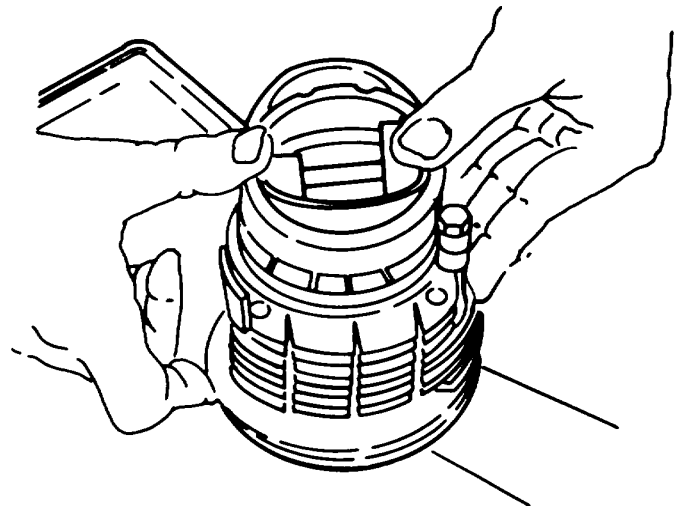


Figure A-42. Piston

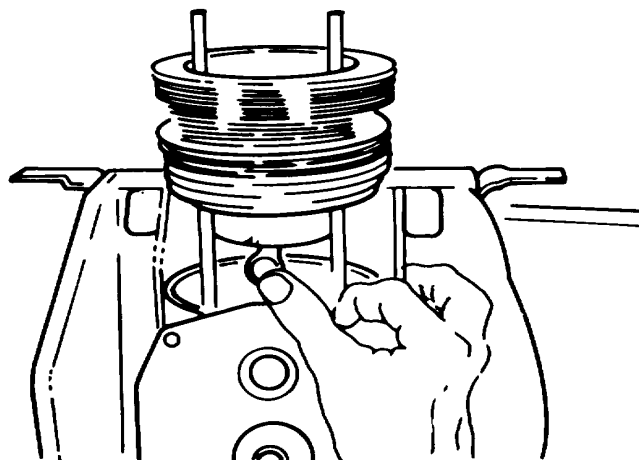


Figure A-43. Piston and Cylinder

15A430/18A430 DISASSEMBLY/ASSEMBLY

governor according to engine specifications. The weights must be spread apart slightly so that the socket will completely cover the governor screw head: Install the governor pin. NOTE: Before torquing the governor, place a block of wood through the crankcase and flywheel to keep the flywheel from turning. (Figure A-44.)

i. Governor Control. Install a new o-ring on the speed control shaft. Place the speed control lever ratcheting pin in its hole in the gear cover. Lay the governor lever in the housing and slide the control shaft through the governor arm about 3, into the housing. Twist the lever downward towards the working surface until the slotted end of the speed control shaft lines up with the hook on the governor return spring. Make sure the spring is completely seated in the slotted end of the shaft. (Figure A-45.)

- (1) After turning the speed control lever with its end points upward, push the control shaft into the housing until the control shaft's retaining ring groove is visible. Push on the retaining ring with your thumb on screw-driver handle. Hook the large end of the outside return spring across the boss of the pin. (Figure A-46.)

NOTE

There are three closely spaced notches on the speed control lever racket plate. Usually the spring should be placed in the middle notch. However, if there is not enough spring tension to return the lever from its engine stop position to its idle position, place the spring in the uppermost of the three notches.

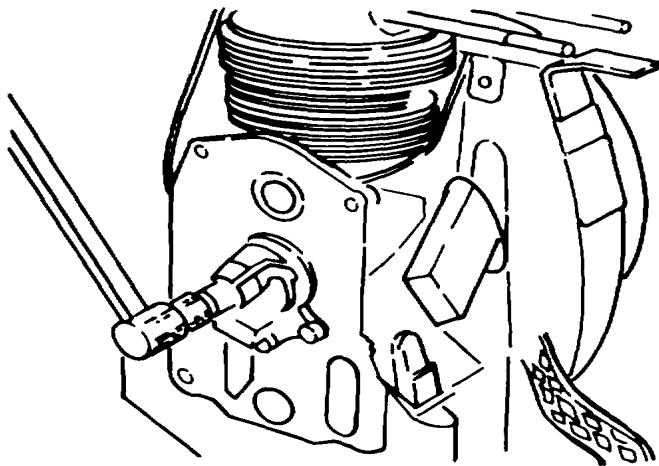


Figure A-44. Governor

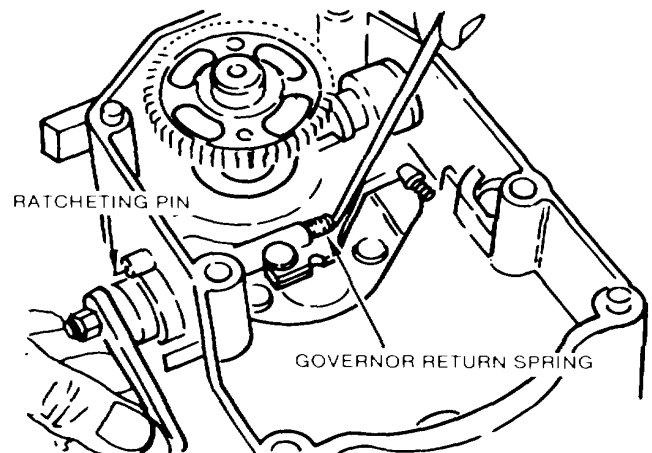


Figure A-45. Governor Control

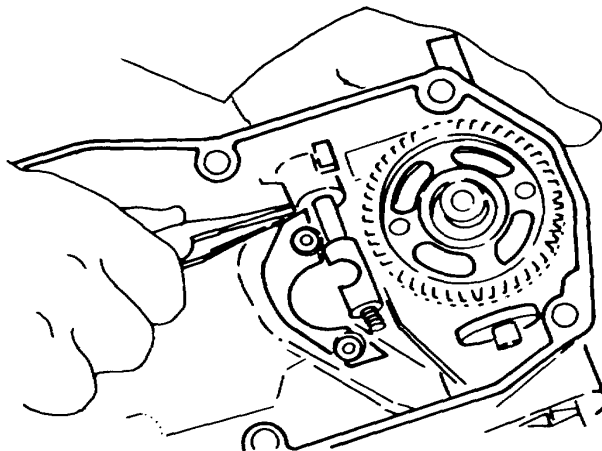


Figure A-46. Speed Control Lever

15A430/18A430 DISASSEMBLY/ASSEMBLY

j. Gear Cover. To install the gear cover, first bring the crankshaft to TDC1 (top dead center). This is done by aligning the flywheel timing mark with the TDC mark stamped on the crankcase at the 12 o'clock position. (Figure A-47.)

- (1) Next, line up the timing mark on the cam gear with the mark on the gear cover. This mark is visible on the inside ridge of the compression release mounting flange.
- (2) Install the gear cover (remember to replace the gaskets) onto the crankcase being careful not to move the cam gear. After the cover is installed, check the timing by aligning the cam gear with the timing mark on the gear cover and checking the timing mark on the flywheel. If the crankcase and flywheel timing marks are within 1/4" of lining up, the timing is correct. (Figure A-48).
- (3) Occasionally, however, the governor will tighten onto the crankshaft in a position that makes it difficult to install the gear cover. If this happens, use the following procedure to install the cover.
 - a** Turn the flywheel until its timing mark aligns with the threaded hole in the crankcase at approximately the 1 o'clock position. (Figure A-49.)

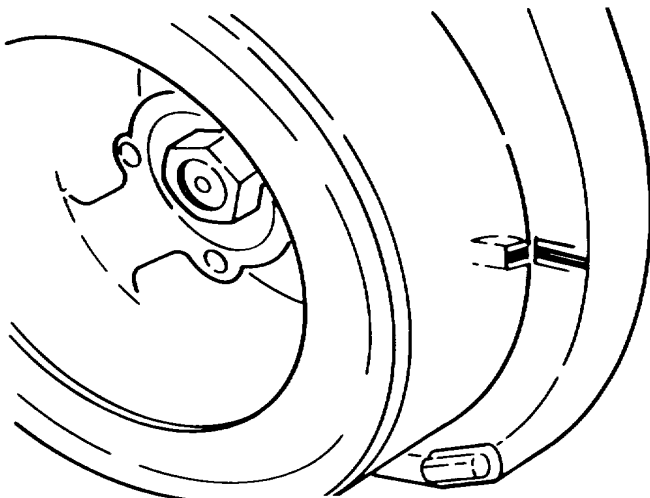


Figure A-47. Gear Cover

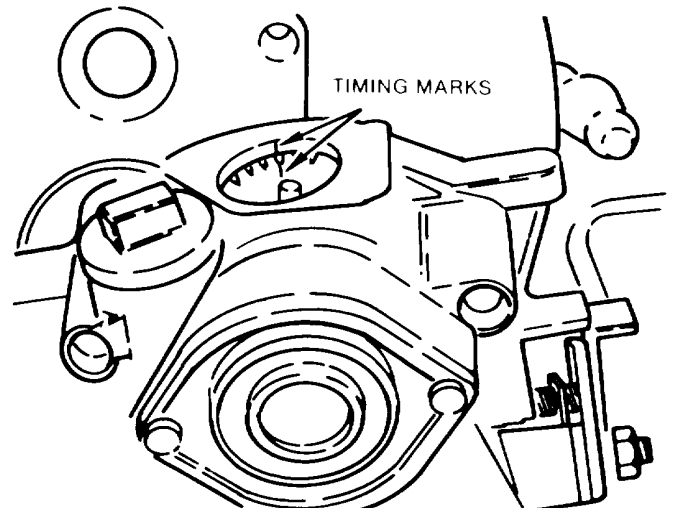


Figure A-48. Timing Marks

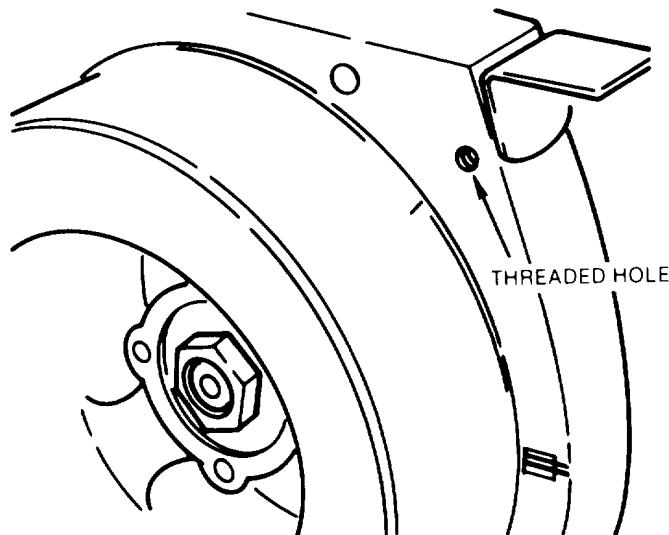


Figure A-49. Threaded Hole

15A430/18A430 DISASSEMBLY/ASSEMBLY

- b Move the timing mark on the cam gear exactly 3 teeth to the left. (Figure A-50).
- c Install the cover. Align the cam gear and gear cover timing marks. Now check the flywheel and crankcase timing marks. The timing is acceptable if they are within 1/4" of each other.

When installing the gear cover screws, note that the two top and bottom left screws are longer than the other three. Be certain to use a 6mm **pilot** allen head socket when tightening the gear cover screws. (Figure A-51.)

k. Oil Screen Assembly. Reinstall the oil screen assembly using an adjustable mm wrench. Install the oil drain plug using new copper washer. (Figure A-52).

l. Cylinder Shield, Air Guides. Install both halves of the cylinder shield. Do not, at this time, install the single bolt which connects the shield halves. Install the two air guide plates on the top of the crankcase. (Figure A-53.)

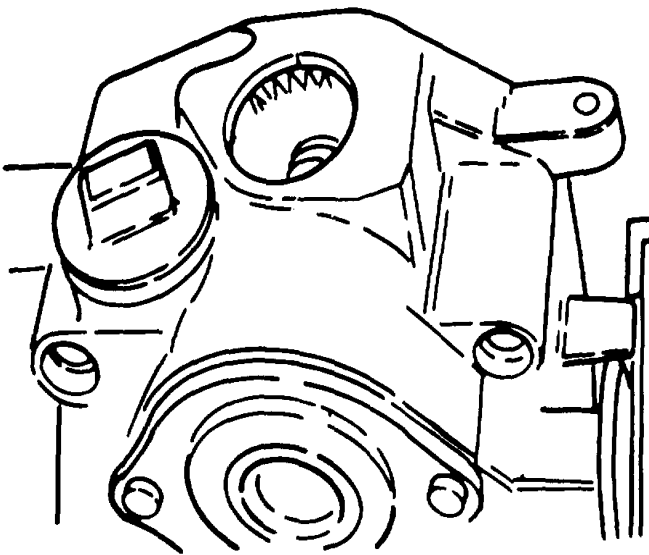


Figure A-50. Moving the Timing Mark

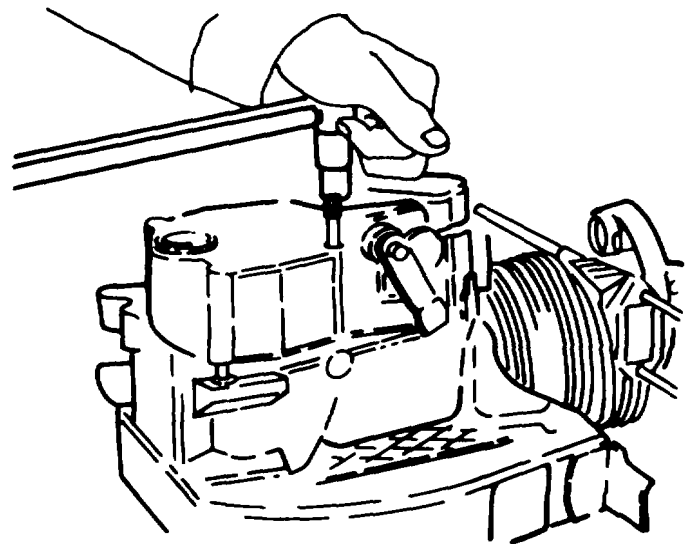


Figure A-51. Installing Cover

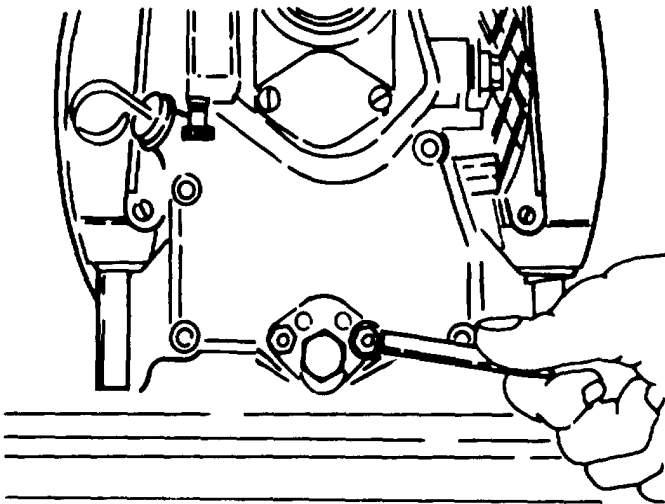


Figure A-52. Oil Screen Assembly

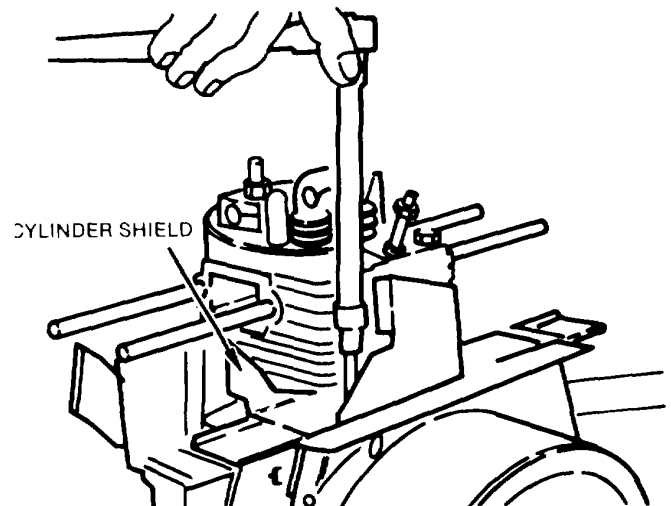


Figure A-53. Cylinder Shield, Air Guides

15A430/18A430 DISASSEMBLY/ASSEMBLY

m. Fuel Injector. Replace the asbestos washer located in the cylinder head on the seating surface for the fuel injector holder. **Never** place a new gasket on top of the old. Install the fuel injector and injector clamp. Torque the two injector clamp nuts to engine specification. (Figure A-54.)

n. Injection Pump. Place the speed control lever in an approximately horizontal position. Set the injection pump rack to the midpoint of its travel. These steps will insure that the injector rack pin mates properly with the governor arm. Do not move the speed control lever before tightening down the injection pump. Install the same number and types of shims and gasket as were on the engine when disassembled. (See Fuel/Governing System for complete injection timing information.) (Figure A-55.)

o. High Pressure Fuel Line. Replace the pressure fuel line between the fuel injection pump and fuel injector. Tighten the tube nut at the fuel injector using a 17mm open end wrench; tighten the two nuts at the injection pump using a 17mm **flare nut** wrench and a 14mm open end wrench. (Figure A-56.)

p. Push Rods. Push Rod Tube and Compression Release. Install the compression release and a new gasket with a 4mm allen head.

Slide the push rod tube up into its hold in the cylinder head. Remember to install a new push rod tube o-ring on the top of the compression release and the top of the push rod tube. (Figure A-57.)

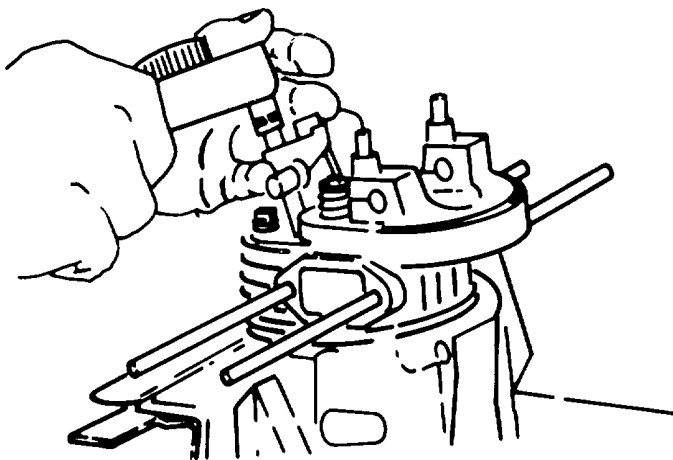


Figure A-54. Fuel Injector

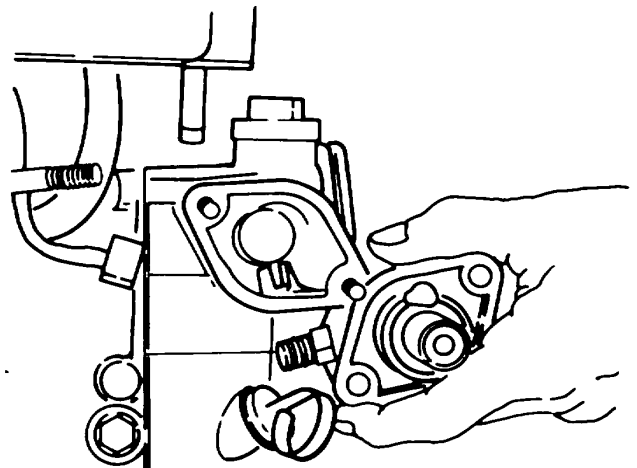


Figure A-55. Injection Pump

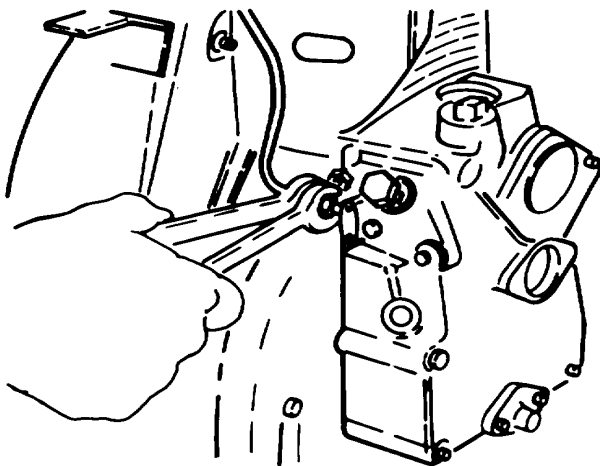


Figure A-56 High Pressure Fuel Line

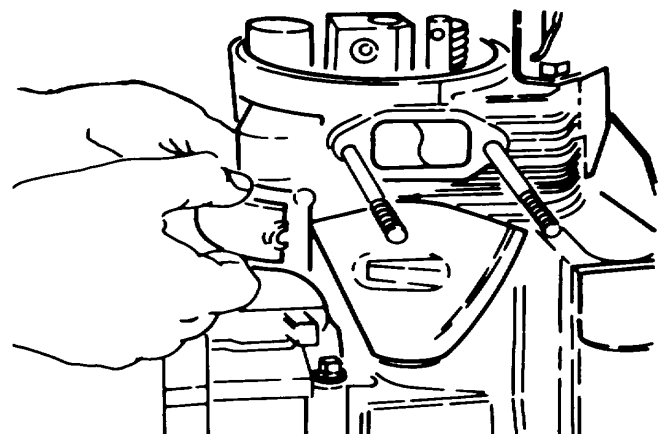


Figure A-57. Push Rods. Push Rod Tube and Compression Release

15A430/18A430 DISASSEMBLY/ASSEMBLY

- (1) Slide the push rod tube down onto the compression release. Install the push rod tube retaining spring in the top of the cylinder head exactly as shown. (Figure A-58.)
- (2) Insert the push rods through the push rod tube into the top of the compression release. Both push rods are alike. The opening in the compression release closest to the engines center is for the intake push rod. This rod should go to the rocker arm on the air cleaner (intake) side of the engine. Install the cylinder shield bolt and tighten using a screwdriver and needlenose pliers. (Figure A-59.)

q. Rocker Arms. Run the flywheel counterclockwise until the compression stroke is reached. Install the rocker arms by placing them into the cylinder head and tapping in the rocker arm shaft. Place each rocker arm over the proper push rod as explained in step p. Oil the rocker arm shaft before installing.

- (1) Torque the cylinder head, using a 13mm deep well socket, to the torque specified. After torquing, tighten down the nuts holding the push rod tube retaining spring and adjust the valves. (Figure A-60.).

r. Valve Adjustment. Be certain that the compression release mechanism is at the 9 o'clock position.

- (1) This is the run position; the valves are not put into the compression release mode. Turn the flywheel counterclockwise until one valve is open as wide as possible. With a 11mm open end wrench, loosen the

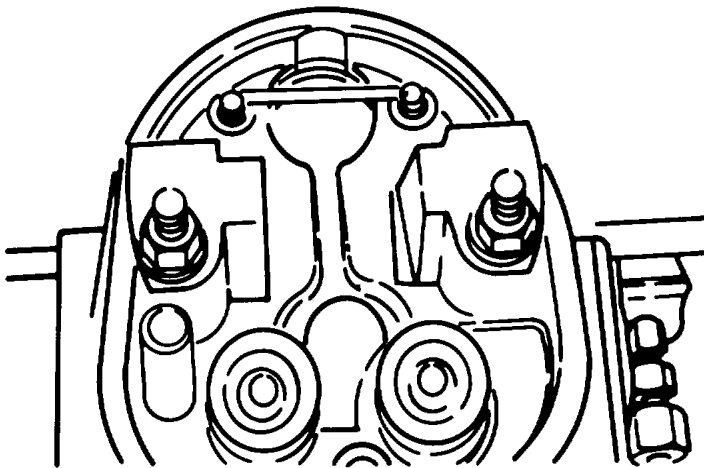


Figure A-58. Push Rod Tube

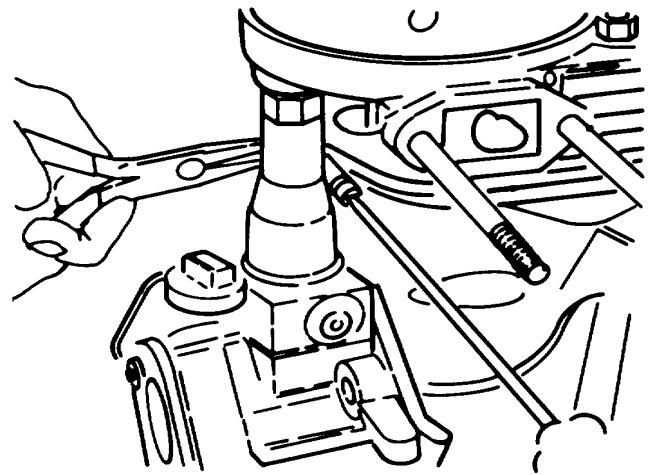


Figure A-59. Plush Rod

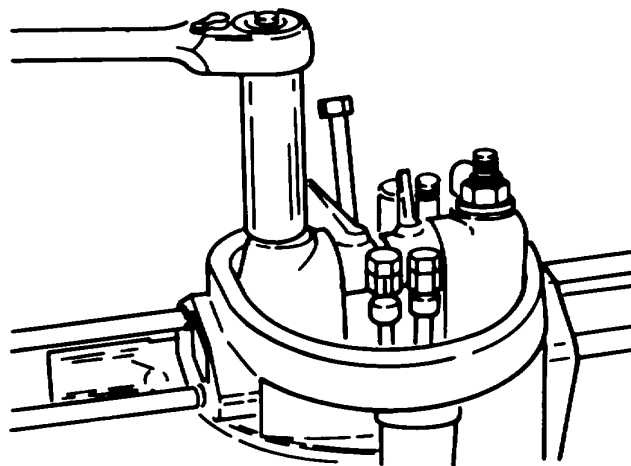


Figure A-60. Rocker Arms

15A1430/18A430 DISASSEMBLY/ASSEMBLY

valve adjusting locknut on the closed valve. Insert a .1mm (.004") feeler gage between the valve and the rocker arm and adjust the clearance until a slight drag is felt on the gage when removed. Tighten the lock nut and recheck. Repeat this procedure for the other valve. (Figure A-61)

s. Valve Cover. Install the valve cover gasket and valve cover, making certain the gasket is properly seated on the cylinder head. Torque the two crown nuts with a 13mm socket. Note: *Install new o-rings on the valve cover studs before installing the cover.* (figure A-62)

t. Replace the two brackets. Use new gaskets on both sides of these brackets. Note that the exhaust gaskets and air cleaner gaskets are different. (Figure A-63)

u. Air Cleaner. Using a 13mm wrench on the two self locking nuts, install the air cleaner.

v. Fuel Tank. Place the fuel tank on the fuel tank support brackets. Slide both tank straps over the tank and brackets. Do not forget to reinstall both tank seam protectors. Tighten the straps (Figure A-64)

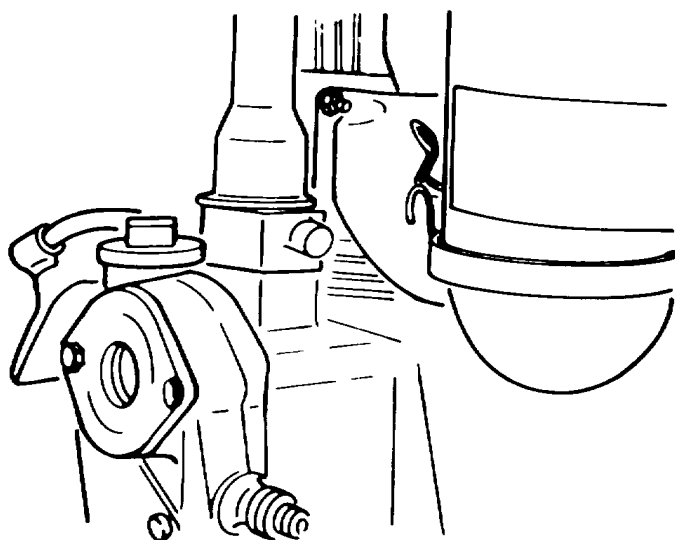


Figure A-61. Valve Adjustment

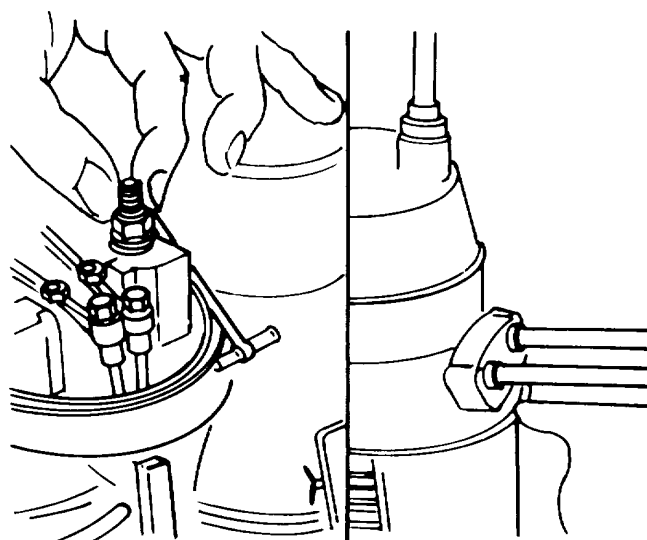


Figure A-62. Valve Cover

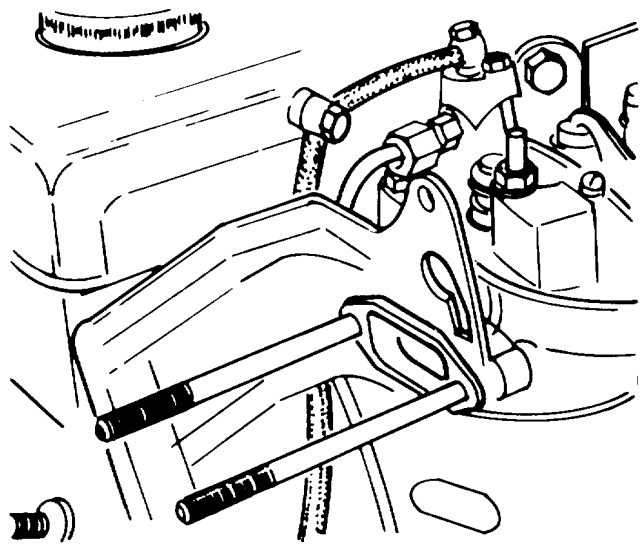


Figure A-63. Replacing Two Brackets

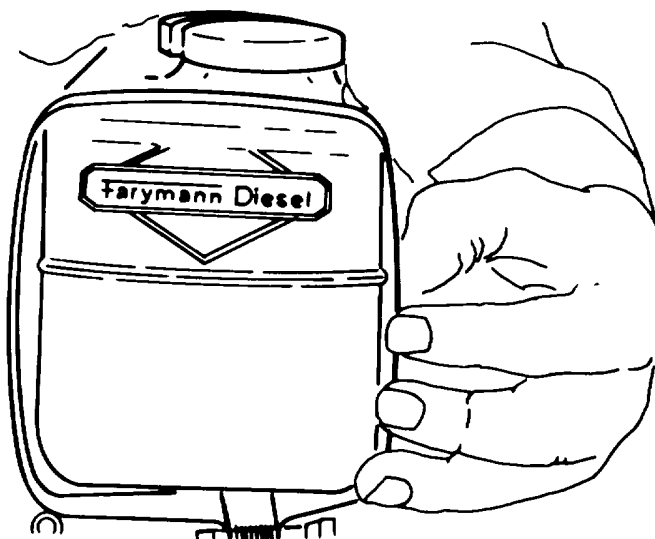


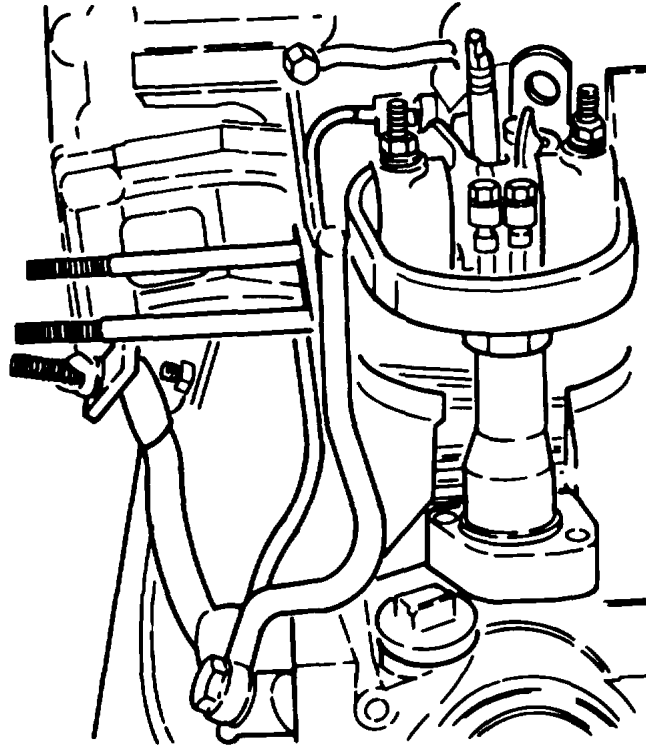
Figure A-64. Fuel Tank

15A430/18A430 DISASSEMBLY/ASSEMBLY

w. Fuel Leak-Off and Supply Line. Install the banjo bolts on the fuel leak-off/supply line at the fuel tank and fuel injector. Remember to replace both copper washers on each banjo bolt. Route the fuel line as shown. (Figure A-65)

x. Muffler. Install the muffler and muffler screen using a 14mm wrench. Remember to install the two flat washers on the outside of the muffler guard. The nut opposite these two requires a 10mm socket.

y. Governor Adjustment. If the governor was removed or taken apart during engine disassembly, adjust the governor now. Refer to the Fuel/Governing System section for instructions.



*Figure A-65. Fuel Leak-off
and Supply Line*

Section IV FUEL SYSTEM/GOVERNOR

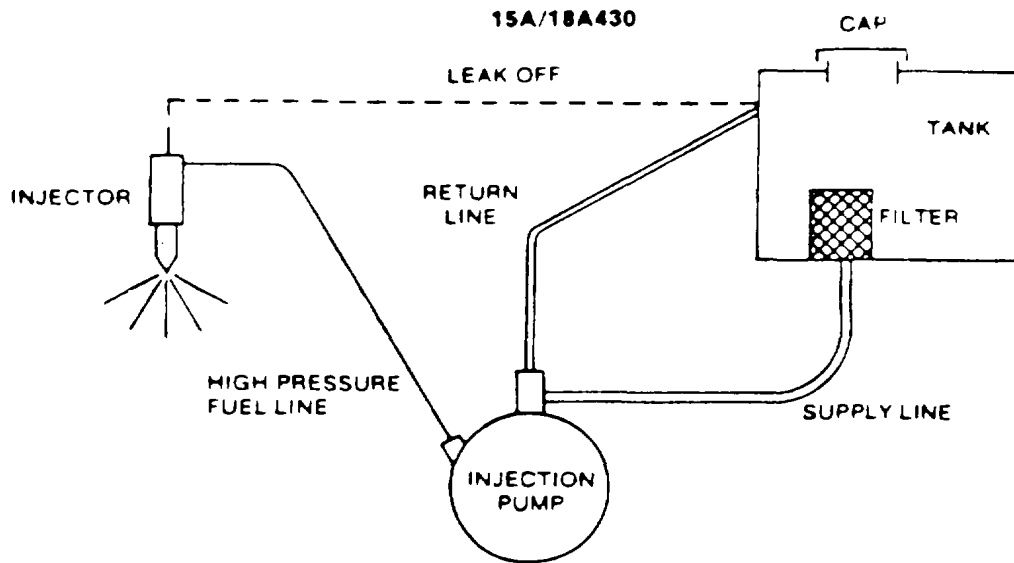


Figure A-66. Gravity Feed - Automatic Bleed

A-5. FUEL PRIMER DEVICE.

a. Model 18A430 has a primer knob built into the crankcase below the injection pump. It operates much like the lever already described, except it must be pulled downward to prime the engine. On all models, the speed control must be full open before the primer device will engage. Model 15A430 has no priming device. (Figure A-67.)

b. V-twin engines feature a fuel primer push button built into the injection pump; again, it works much like the others.

A-6. FUEL SYSTEM. Checking timing.

- a.** Add one quart diesel fuel to engine.
- b.** Set speed control lever to mid-range. Primer control (extra fuel button) not pulled.
- c.** Locate and mark the timing marks on flywheel and engine housing.

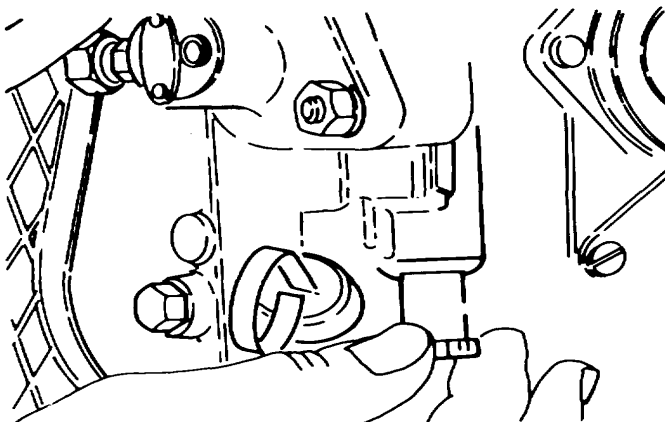


Figure A-67. Fuel Primer Device

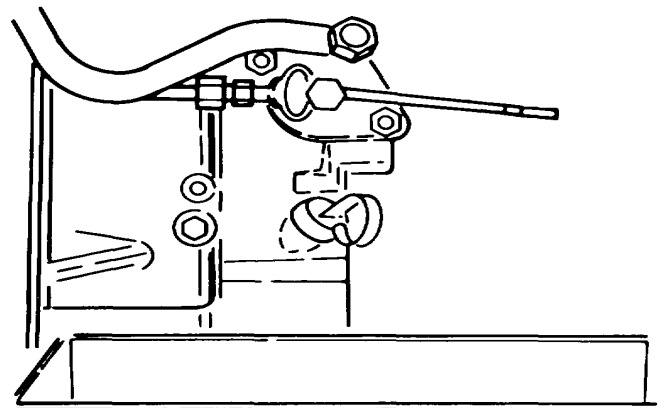


Figure A-68. Fuel System

FUEL SYSTEM/GOVERNOR

- d.** Clamp off fuel supply line from tank to injection pump.
- e.** Remove Allen plug and from injection pump with 5mm Allen wrench.
- f.** Install drip pipe, copper washers and banjo bolt into injection pump with 14mm wrench.
- g.** Open fuel line to allow fuel to flow to injection pump.
- h.** Set compression release pin to neutral position. This is the first "click" of the compression release, usually 10 o'clock.
- i.** Rotate flywheel counter clockwise until fuel flows freely from drip pipe.
- j.** Continue turning flywheel counter clockwise until fuel stops dripping. Slowly continue to rotate flywheel counter clockwise. When the fuel starts to drip from the fuel pipe, STOP. Hold the flywheel in that position and check the timing marks on flywheel and engine housing.

NOTE

Summary explanation of fuel flow during timing. Check while turning flywheel counter clockwise.

- (1) Fuel will flow freely.
- (2) Fuel will drip from pipe.
- (3) Fuel flow will stop.
- (4) Fuel will again start to drip. At this point you hold the flywheel on this position and check the timing.

k. Using a metric rule, measure the distance between the two marks. Check the timing chart for the correct RPM and the (mm) distance before top-dead-center.

l. See timing change procedure for complete instructions. Add or remove shims as needed to obtain proper timing.

m. Reinstall injection pump to engine and check for proper timing. Note: As a general rule-of thumb, to change from 3600 RPM to 3000 RPM, add one shim .2mm (approx. .008) to the existing shims behind the injection pump. Adding .2mm shim behind the pump will retard the timing. To increase timing one would remove shims from the engine.

A-7. ENGINE SPEED GOVERNING SYSTEM. The governor uses centrifugal force to limit engine speed. As engine speed increases, the two governor flyweights are forced further and further apart. This pushes the governor pin outward against the tappet bolt surface, causing the governor lever to push the pump rack towards its idling position. Unopposed, this would simply return the engine to an idle. However, when the throttle lever is moved, the part or full throttle, the throttle shaft extension screw moves away from the governor lever extension. This allows the spring on the inside end of the throttle shaft to constantly pull the pump rack towards its full open position. The point at which these two forces balance determines maximum engine speed at any throttle setting. It's now easy to see how the governor maintains engine speed under changing loads. When a load is applied or increased, the engine slows and the flyweights move closer together. This permits the governor lever to move the pump rack towards the full open position until again stopped by the governor pin.
(Figure A-69.)

A-8. GOVERNOR ADJUSTMENT. Open governor inspection cover using a screwdriver, remove one screw from the governor inspection cover and slide the plate away. Put the speed control lever in the top speed position. With a small screwdriver, pry away the locking tab from the governor lock nut. Loosen the lock nut with a 10mm open end wrench. Turn the flywheel until the governor weights are split at the vertical position. With a standard screwdriver, spread the weights as far as they will go. With the governor weights spread to the maximum, using a small screwdriver, screw in the adjusting screw until it just contacts the governor pin. Release the screwdriver from the weights, and screw the adjusting screw an additional 1/2 turn. Keeping the screwdriver into the slot, tighten up the lock nut. Then bend the locking tab over the lock nut. Reinstall the cover.

FUEL SYSTEM/GOVERNOR

A-9. SPEED ADJUSTMENT.

a. Maximum governor speed is set at the factory and normally requires no adjustment. Figure A-70 shows a typical governor with low, midrange and full load springs. Refer to the service parts book for alternative springs and other governor parts when special governor characteristics are required.

b. If new components are fitted, the governor speed should be set on a test bench so that engine rpm may be observed.

CAUTION

Careless adjustment or spring selection may cause the engine to race, resulting serious engine damage.

c. Engine speed adjustment is possible in a range of about 100 rpm by altering the tension of the governor springs through a few turns of the cross slotted nuts. Tighten them to increase engine speed; loosen to reduce speed.

d. For larger variations in engine speed, change the governor springs. To change them with disassembling the engine, remove the oval cover located behind the throttle lever. *NOTE: On Models 15A430 and 18A430, the injection pump must be removed before the governor springs can be adjusted. The springs may be adjusted or removed through the injection pump opening.*

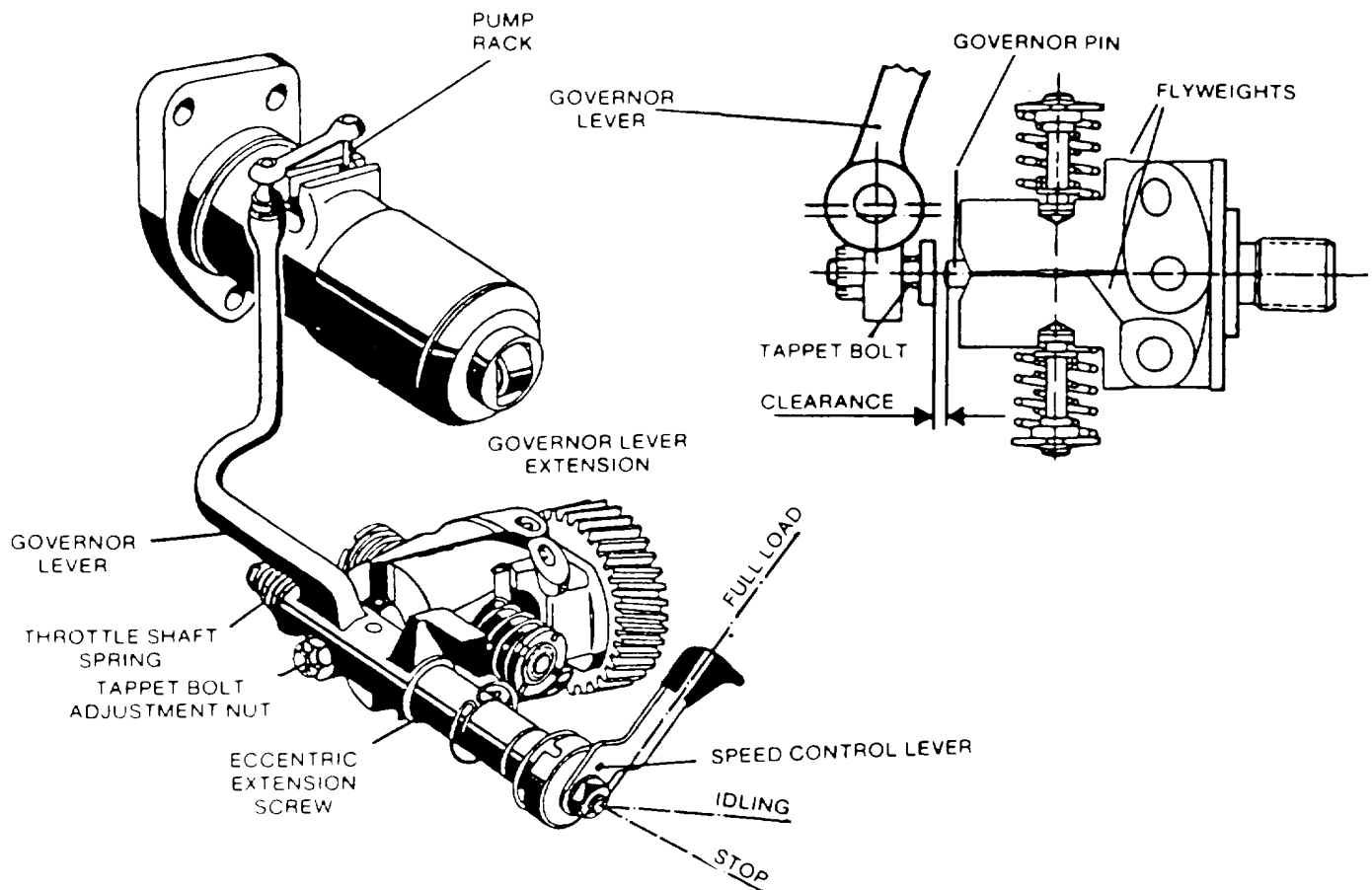


Figure A-69. Engine Speed Governing System

FUEL SYSTEM/GOVERNOR

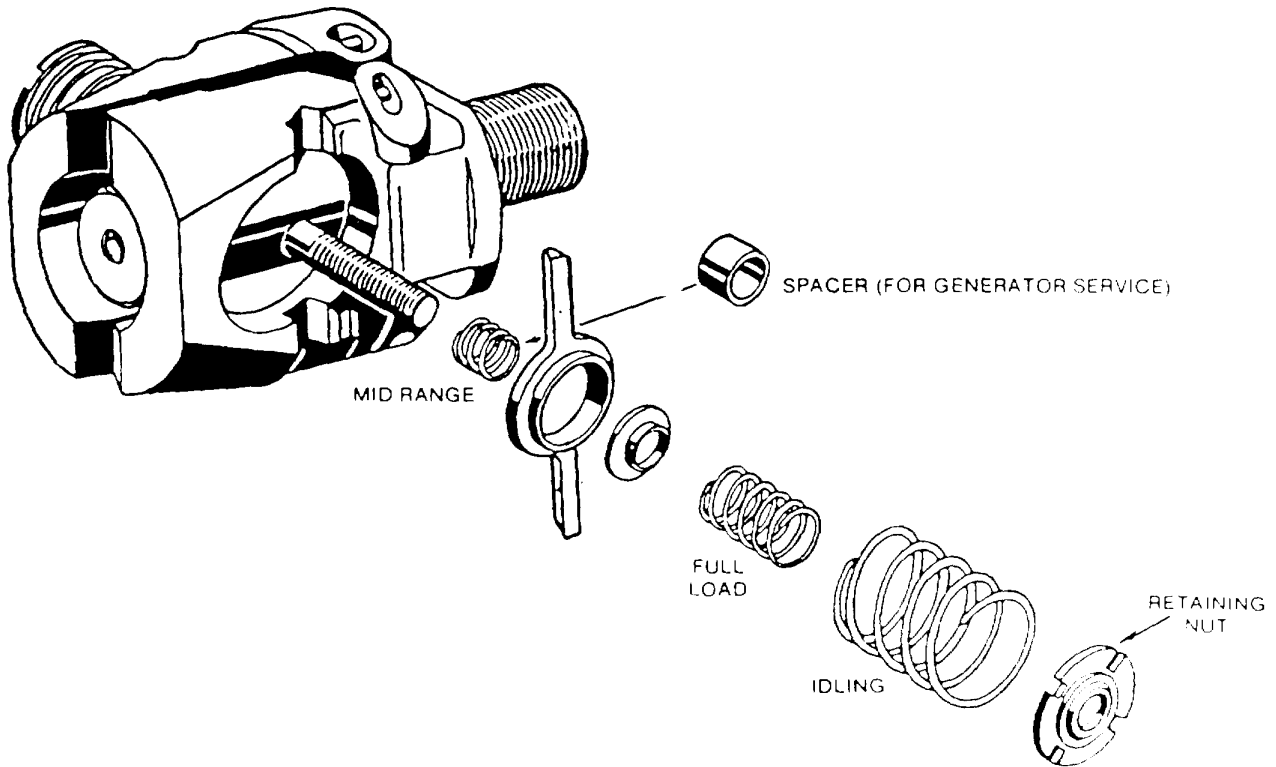


Figure A-70. Speed Adjustment

e. Rotate the flywheel until one of the cross slotted nuts is visible in the opening. After carefully removing the nut, remove the full load spring and fit its replacement. Replace and retighten the cross slotted nut. Turn the flywheel until the other nut is visible and repeat the above procedure. NOTE: Cross slotted nuts use a plastic locking device and require no lockwashers or other fasteners. However, **always** fit **new** cross slotted nuts any time the springs are exchanged. Finally, check your adjustment with a tachometer. Figure A-70.

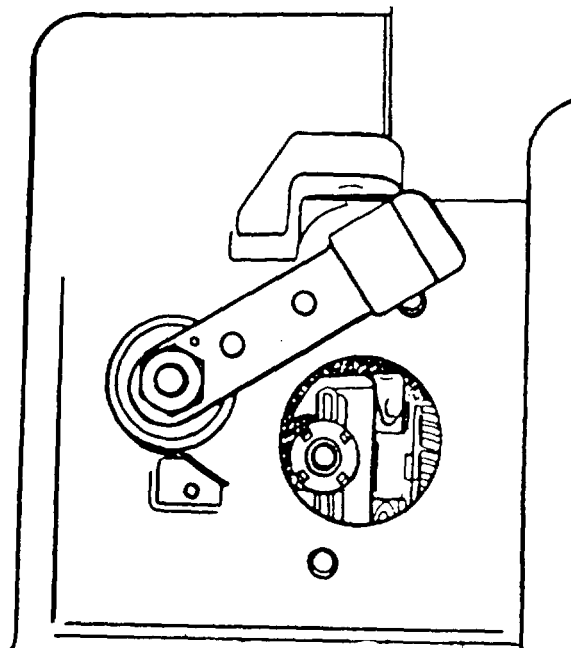


Figure A-71. Flywheel Adjustment

FUEL SYSTEM/GOVERNOR

A-10. **IDLE SPEED ADJUSTMENT.** An eccentric notch in the head of the ratched plate screw allows the snap pin to fit properly in a notch at idling speed. This adjustment is not possible on models 15A430/18A430. Figure A-72.

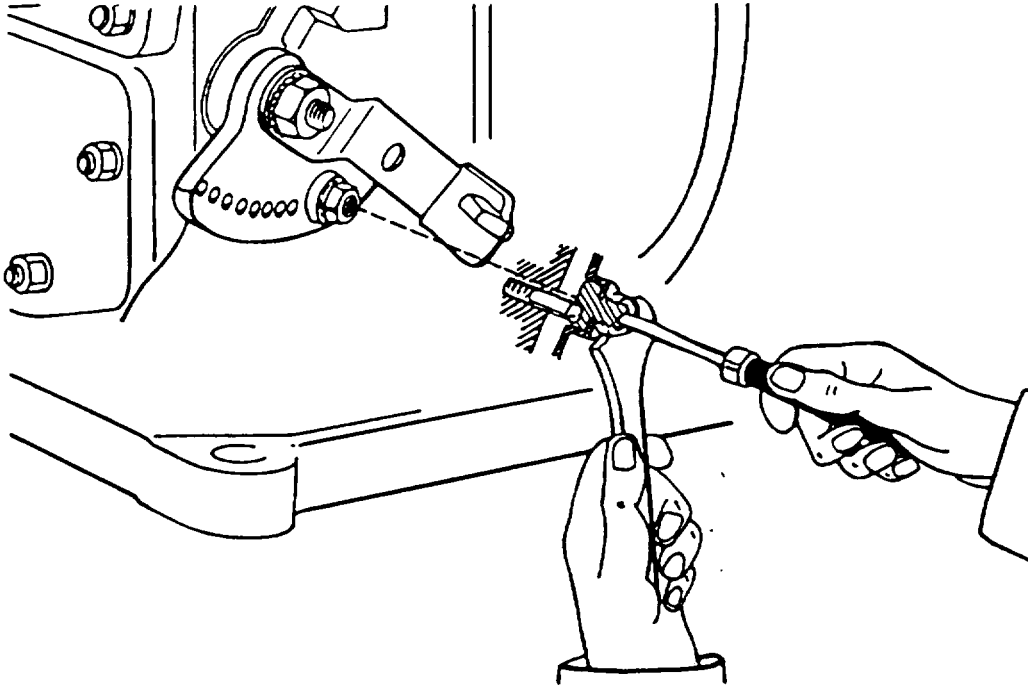


Figure A-72. Idle Speed Adjustment

Section V

LUBRICATION/COOLING SYSTEM

A-11. **LUBRICATION SYSTEM OPERATION (2 CYLINDER ENGINE).** Engine oil is drawn through the oil strainer (1) by the oil pump (2) and pushed upwards towards the spin-on oil filter (3). The filtered oil flows through the filter adapter connector (4) into the crankcase oil duct (5). Oil flows up the crankcase oil duct and around the relief valve (6), leaving the crankcase at banjo connector (7) to pass through the external oil cooler (not shown). If the oil cooler becomes clogged, relief valve (6) will open, discharging the oil directly into oil duct (10) and towards spray tube (12). If the cooler is clear, oil re-enters the engine through banjo union (8), passes through the relief valve, through oil duct (10) and lubricates the crankshaft main bearing. A smaller quantity of oil goes from the relief valve (6) into two spray tubes (12) which lubricate the valve gear. Oil drains through return passages to the oil pan, completing the lubrication circuit.

If oil pressure becomes too high, however, main relief valve (13) discharges the oil directly back into the oil pan through passage (14). Oil pressure switch (9) opens the main relief valve when it senses high oil pressure. Figure A-73.

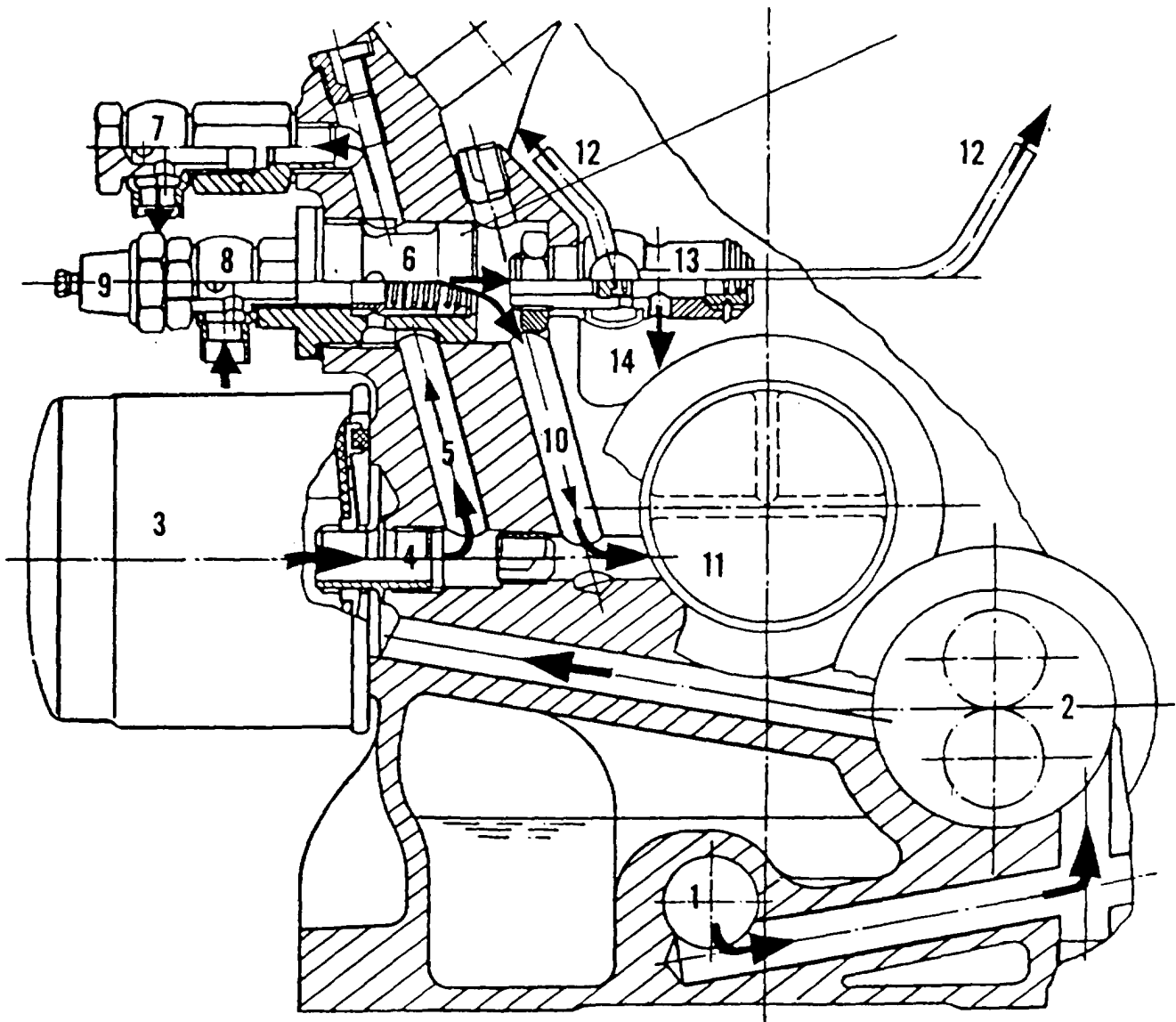


Figure A-73. Lubrication System Operation (2 Cylinder Engine)

LUBRICATION/COOLING SYSTEM

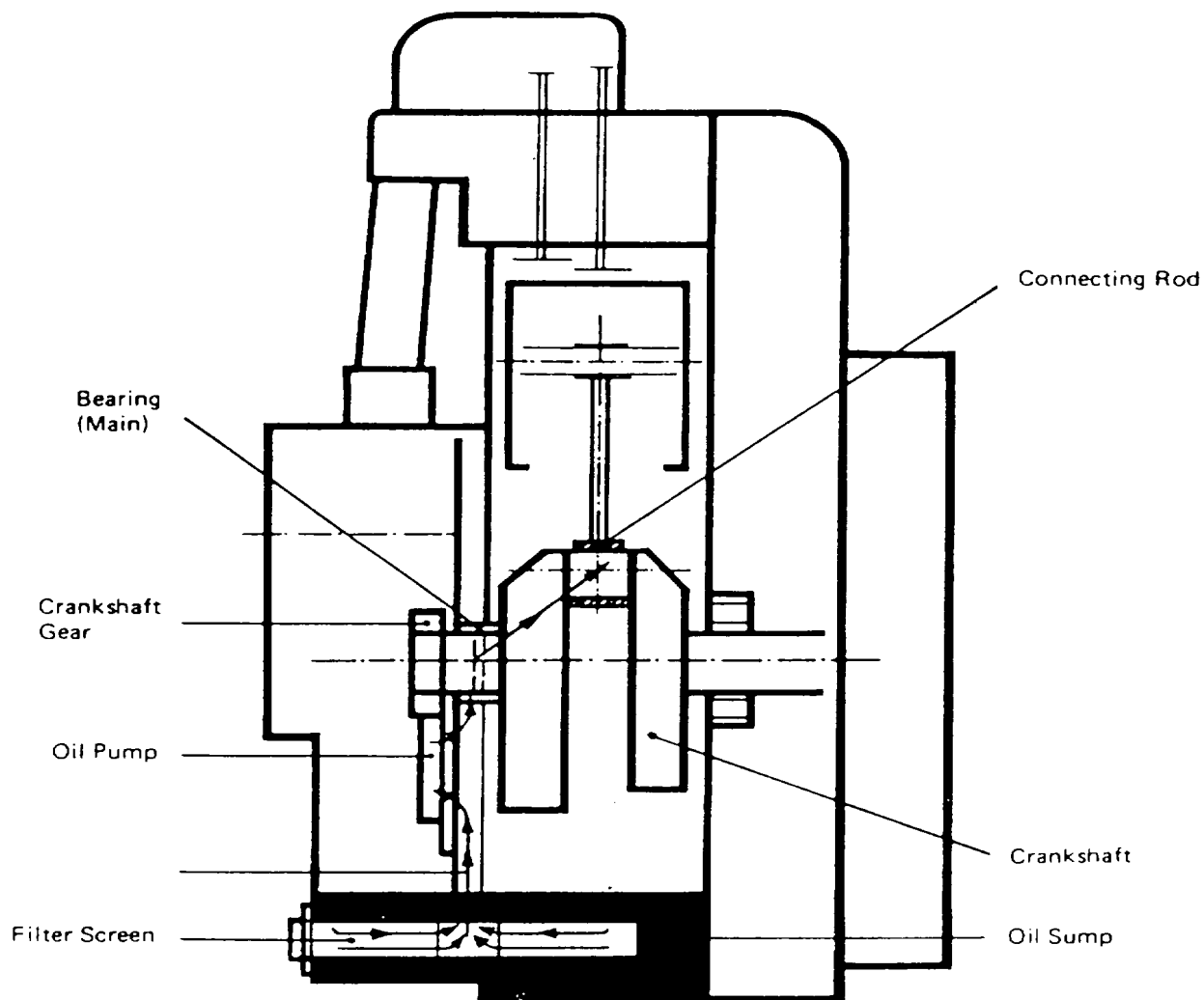


Figure A-74. 15A430/18A430 Lubrication System

A-12. **OIL PRESSURE TESTING.** Remove the oil pressure gauge plug (found on side of crankcase on 15A430/18A430: at oil cooler on 2 cylinder engines) and install an oil pressure gauge. On models 15A430 and 18A430, the oil pressure at idle should be at least 12 psi (.8 BAR) while the pressure at full engine speed should not exceed 60 psi (4.0 BAR). V-Twin engine oil pressure should fall between 45 psi (3.0 BAR) and 150 psi (10.0 BAR). Models 25A430, 36A430 and 36E435 are splash lubricated - no oil pressure check is necessary.

A-13. **LUBRICATION SYSTEM MAINTENANCE.** All Farymann engines require heavy-duty lubricating oils of at least CC and preferably CD (quality (API Service Classification). The following chart indicates the temperature range of popular oil viscosities. See General Information -- Maintenance for oil change intervals.
Figure A-75.

A-14. **COOLING SYSTEM OPERATION.** A flywheel fan provides flow of air ducted to cool all parts of the cylinder and cylinder head, which are heavily finned for heat dissipation.

Although uncomplicated and effective, this cooling system will not perform properly if:

- a. The engine is operated in an enclosed space without provision for the intake of cool air.

- b.* Any of the baffles or ducts are removed, the flywheel fan is damaged, or cooling fins clogged with debris.

A-15. **COOLING SYSTEM MAINTENANCE.** No routine cooling system maintenance is necessary. Periodically however, check to make sure the flywheel fan is in good condition, the finned areas of the cylinder and head are clean and the intake screens clear of obstructions.

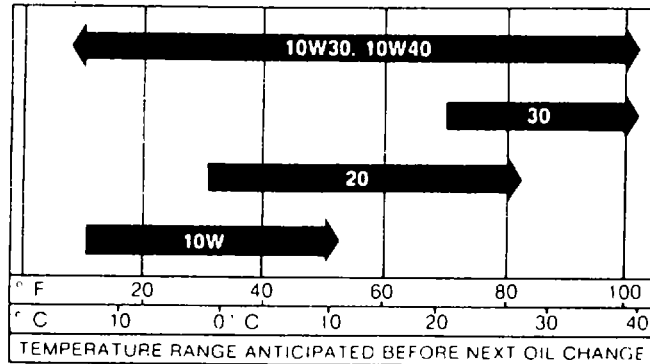


Figure A-75. Lubrication System Maintenance

Section VI REPAIR GUIDELINES AND SPECIFICATIONS

A-16. REBUILDING GUIDELINES.

a. Crankshaft and Connecting Rod Bearings: Should the crankshaft bearing journals show evidence of wear or damage, regrinding to .25 or .5 mm undersize may restore bearing surfaces. Roller main bearings must be pulled out and replaced with new parts. Models 25A430, 36A430 and 36E430 have roller bearings on the connecting rod journal end; these are not replaceable.

b. Installing a New Crankshaft or Fly wheel: Before installing a new crankshaft or flywheel, the crankshaft taper must be ground into the tapered bore of the flywheel. Apply grinding compound to the crankshaft taper. Slide the crankshaft into the flywheel bore. Rotate the crankshaft in the flywheel bore until a good finish is obtained. Thoroughly wash away all grinding compound with diesel fuel or gasoline. (Figure A-76).

c. Camshafts: These must be replaced when wear or damage appears on the cam faces.

d. Roller Bearings: Replace whenever wear or damage is evident.

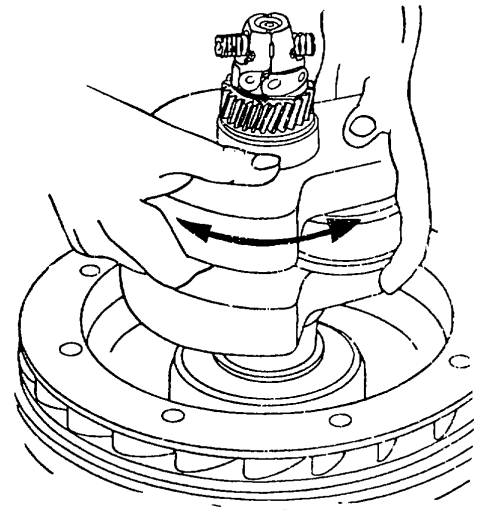


Figure A-76. Installation of New Crankshaft or Flywheel

LUBRICATION/COOLING SYSTEM

e. Piston and Cylinder: Examine these carefully whenever there is a noticeable drop in output or high oil consumption. Replace them if ridges or deep scratches are visible or if they were worn beyond specification. Piston Rings can be measured for wear by checking their end gap. Measure end gap with the piston ring inserted 1" into the cylinder.

f. Valve Seats: All valve seats are cut at 45° angle. They should be free of noticeable wear or pitting. If damaged, they may be either resurfaced or replaced. Use the valve cutter provided in the special tools set to resurface the valves. Do not remove material unnecessarily. If the seats are cut too deep, hard starting and poor engine efficiency will result. If the distance between the valve head and cylinder head face exceeds the limits shown below, the valve seat must be replaced. Figure A-77.

Table A-2. MODEL AND END GAP

Model	End Gap
15A430/18A430	.2mm- .8mm
25A430	.3mm-1.0mm
36A430/36E435	.4mm-1.0mm
71A437	.4mm-1.0mm
95A437	.5mm-1.5mm

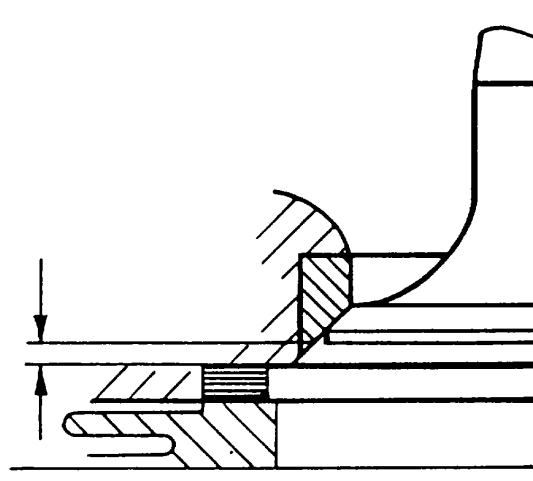


Figure A-77. Clearance Valve Head to Cylinder Face

Table A-3. INTAKE AND EXHAUST VALVE

Engine Model No.	Intake Valve mm	Exhaust Valve mm
15A430/18A430	.0-0.1	.0-.1
25A430	1.1-1.2	.4-.5
36A430/36E435	1.1	1.4
A12, A14, A16	0.9	0.7
A22, A24, A26		
71A437/95A437	1.0-1.1	1.0-1.1

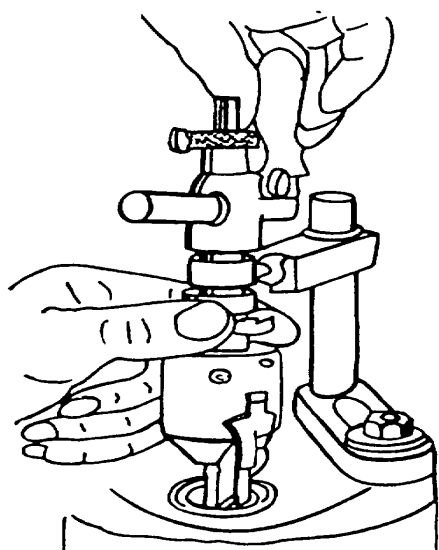


Figure A-78. Installation of New Inserts

To replace the seat, grind or cut (using the valve seat cutter) out the seat until only a small, easily removable rim remains. Remove the inserts. Figure A-78.

To install new inserts, heat the cylinder head to 80°-90°C (175°-195°F). Quickly press in the new inserts.

g. Testing a Rebuilt Engine. An engine which has been fitted with new bearings, cylinder and piston or valves should be run-in at low speed for ½ hour or more before any load is applied to the engine. Run for 2 hours more at operating speed under a light load.

This will establish polished bearing surfaces and proper clearance between moving parts, adding years to the life of the engine.

REPAIR GUIDELINES AND SPECIFICATIONS

*FT. LB.
NM

Table A-4. TORQUE SPECIFICATION

Location of Fasteners To Be Torqued		15A430 18A430	25A430	36A430 36E435	71A437	95A437
Cylinder Head Nuts		22 ft. lbs	33	40	43	47
		30 nm	45	54	58	65
Rocker Arm Bracket		---	58	58	58	58
		---	80	80	80	80
Connecting Rod Nuts		22	47	47	47	58
		30	65	65	65	80
		30	65	65	65	80
		22	22	22	22	22
Main Bearing Carrier		22	22	22	22	22
		30	30	30	30	30
Injection Pump		22	14	1822	14	18-22
		30	19	25-30	19	25-30
Delivery Valve		25-29	25-29	25-29	25-29	25-29
		34-39	34-39	34-39	34-39	34-39
Pressure Fuel Line		132-180 in lbs.	14-22	14-22	14-22	14-22
		14.9-20.4	19-30	19-30	19-30	19-30
Nozzle Into Holder		18-22	22	29	22	29
		24-29	30	40	30	40
Injector Hold Down Clamp		42-50 in lbs.	22	22	22	22
		56	30	30	30	30
Flywheel Nut		USE IMPACT WRENCH				
Gear Cover Bolts		15	---	---	---	---
		20	---	---	---	---
ValveCover Governor		75-85 in lbs.	90 in lbs.	90 in lbs.	90 in lbs.	
		8.4-9.6	10	10	10	10
		25	---	---	---	---
		34	---	---	--	---
Stub Shaft		35	35	35	35	35
		48	48	48	48	48
	10mm	35	35	35	35	35
		48	48	48	48	48
Flywheel Housing		90 in lbs.	90 in lbs.	90 in lbs.	90 in lbs.	90 in lbs.
	6mm	9.5	9	.5	9.5	9.5

*Unless Otherwise
Indicated

REPAIR GUIDELINES AND SPECIFICATIONS

Table A-5. CRANKSHAFT BEARING SPECIFICATIONS NEW - REBUILD STAGE 1 AND 2

Model	Crankshaft			Crankcase		
	Governor Side Main Bearing					
	Grinding Measures (mm)			Int. Dia. of Bearing in Case (mm)		
	New	Rep. Stage 1	Rep. Stage 2	New	Rep. Stage 1	Rep. Stage 2
					Undersize 0.25mm	Undersize 0.5mm
15A430	40.030	39.780	39.530	40.080	39.830	39.580
18A430	40.020	39.770	39.520	40.070	39.820	39.570
25A430	---	---	---	---	---	---
36A430/ 36E435	---	---	---	---	---	---
Also A14-A24						
					Undersize 0.5	Undersize 1.0
71A437	65.015	64.515	64.015	65.065	64.565	64.065
	64.985	64.485	63.985	65.055	64.555	64.055
					Undersize 0.5	Undersize 0.1
95A437	80.015	79.515	79.015	80.065	79.565	79.065
	79.985	79.485	78.955	80.055	79.555	79.055

Please proceed with the next rebuild stage when:
the bearing pin is 0.06mm and more out of round
the bearing clearance is 0.08mm and more with 15A430, 18A430
the bearing clearance is 0.10mm and more with 71A437, 95A437

Table A-6. FUEL INJECTION TIMING - MILLIMETERS BTDC (± 2 mm)

Model #	mm Flywheel Dia.	Governor Maximum R.P.M.							
		1500	1800	2000	2500	2800	3000	3300	3600
15A430	258	-	18	18	21	21	21	27	27
18A430									
25A430	310	15	20	25	30	35	40	-	-
36A430	310	10	15	22	30	33	37	-	-
36E435	310	10	14	20	25	27	30	-	-
71A437	306	21	21	23	27	-	-	-	-
95A437	352	25	29	31	38	-	-	-	-

REPAIR GUIDELINES AND SPECIFICATIONS

Table A-7. CONNECTING ROD BEARING - NEW, REBUILD STAGE 1 AND 2

Model	Crankshaft			Connecting Rod Bearing			Bearing Play
	Grinding Measures for Con. Rod Bearing Journal			Plain Bearing			
	New	Rebuild 1	Rebuild 2	New	Rebuild 1	Rebuild 2	
					Undersize 0.25	Undersize 0.5	
15A430	40.030mm	39.780	39.530	40.070	39.820	39.570	0.03-0.05
18A430	40.020	39.770	39.520	40.060	39.810	39.560	
25A430	---	---	---	---	---	---	
36A430							
Also							
A74-A24					Undersize 0.5	Undersize 1.0	
71A437	65.015	64.515	64.015	65.045	64.545	64.045	0.03-0.05
	64.985	64.485	63.985	65.035	64.535	64.035	
					Undersize 0.5	Undersize 1.0	
95A437	75.015	74.515	74.015	75.045	74.545	74.045	0.03-0.05
	74.985	74.485	73.985	75.035	74.535	74.035	

Table A-8. VALVE TIMING

Model	Intake Opens mm BTDC	Exhaust Closes mm ATOC
15A430	20-25	15-20
18A430	20-25	15-20
25A430	30-35	25-30
36A430	35-40	25-30
36E435		
71A437	95	70
95A437	110	95

REPAIR GUIDELINES AND SPECIFICATIONS

Table A-9.

CLEARANCE BETWEEN PISTON AND CYLINDER HEAD
Piston Top Outside Cylinder And/Or
Piston Top Inside Cylinder

Model	Top of Piston Outside Cylinder	Top of Piston Inside Cylinder	Clearance
15A430 No Cylinder Head Gasket	---	0.475-0.8	0.475-0.8
18A430	0.650-0.975	-	0.475-0.85
25A430	0.7-1.0	-	0.4-0.8
36A430			
36E435	0.8-1.05	-	0.35-0.7
36E435			
A14-A24	0.7-0.9	-	0.5-0.8
71A437	0.775-1.05	-	0.35-0.725
95A437	0.775-1.075	-	0.325-0.725

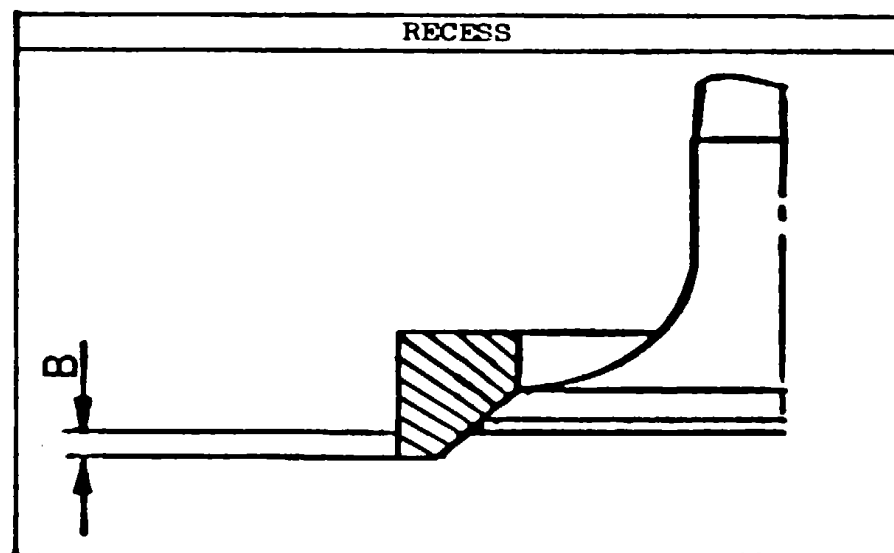
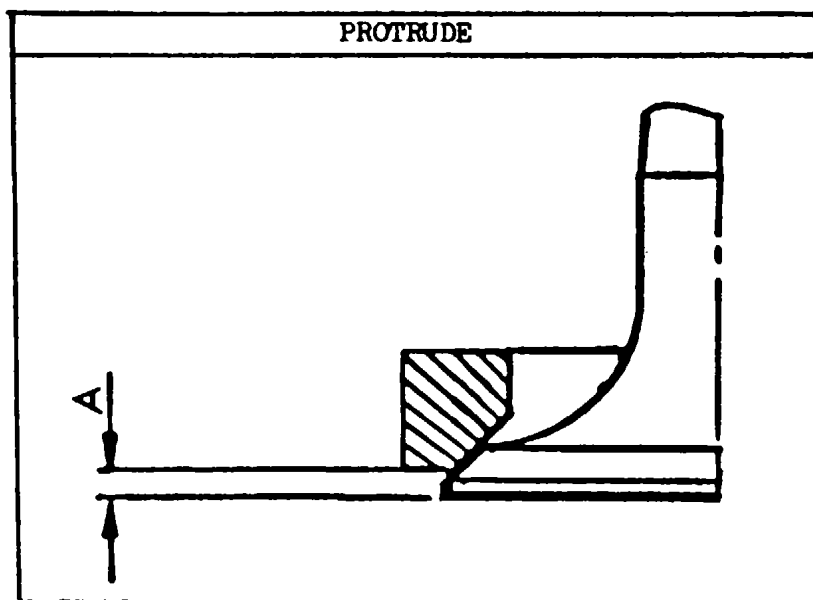
Table A-10.

CYLINDER BORE TOLERANCES (mm)

Model Up to and including	Smallest Diameter Top	Largest Diameter Top
1800 rpm	74.86	74.88
(Tapered Cylinder)	Bottom	Bottom
15A430	75.01	75.03
Over 1800 rpm	Top	Top
	74.91	74.93
	Bottom	Bottom
	75.01	75.03
Up to and including 1800 rpm	Top	Top
	81.88	81.90
18A430	Bottom	Bottom
(Tapered Cylinder)	82.01	82.03
Over 1800 rpm	Top	Top
	81.94	81.96
	Bottom	Bottom
	82.01	82.03
25A430	80.02	80.04
36A430		
36E435	95.04	95.06
71A437		
A14-A24	98.03	98.05
95A437	105.00	105.02

Table. A-11. SEATED VALVE DIMENSION

B & S Model	15A	15B	18A	36A	36E		41A		41E	25A	71A	95A
Farymann Model	K54	K55	K64	A10	A20	A12	A14	A22	A24	L14	R10	S10
Intake Valve:												
(A) Protrude				1-1-.5 mm								
(B) Recess		0-0.5 mm				1.0-1.5mm				1.1-1.6 mm	1.0-1.5 mm	1.0-1.5 mm
Exhaust Valve:												
(A) Protrude				1.4-1.0 mm								
(B) Recess		0-.0.5 mm				.6-1.1 mm				.6-1.1 mm	1.0-1.5 mm	1.0-1.5mm



REPAIR GUIDELINES AND SPECIFICATIONS

Table A-12.
TORQUE SPECIFICATIONS

15A 18A

DESCRIPTION	NM	FT. LB.	IN. LB.	MKP
CYLINDER HEAD	34-39	25.3-28.8	--	3.5-4.0
CONNECTING ROD	30	22	--	3.0
MAIN BEARING CARRIER	30-34	22-25	--	3.0-3.4
INJECTION PUMP	20	-	175	2.0
DELIVERY VALVE HOLDER	34-35	25-33	-	3.44.5
HIGH PRESSURE FITTINGS	15-20	--	132-176	1.52.0
NOZZLE NUT	25-30	--	221-265	2.53.0
INJECTOR CLAMP NUTS	5-6	--	43-52	.5-.6
GOVERNOR	35-40	25-29	--	3.0-4.0
CYLINDER STUDS	3949	29-36	--	4.0-4.9
GEAR COVER CASE	18-20	--	159-176	1.8-2.0
FLYWHEEL	IMPACT			

REPAIR GUIDELINES AND SPECIFICATIONS

Table A-13. NEWTON METRES TO POUND INCHES-FORCES

N•m	lb. in.	N•m	lb. in.	N•m	lb. in.	N•m	lb. in.	N•m	lb. in.
.2	1.7702	4.2	37.1747	8.2	72.5792	12.2	107.9837	16.2	143.3882
.4	3.5404	4.4	38.9449	8.4	74.3494	12.4	109.7539	16.4	145.1584
.6	5.3107	4.6	40.7152	8.6	76.1197	12.6	111.5242	16.6	146.9287
.8	7.0809	4.8	42.4854	8.8	77.8899	12.8	113.2944	16.8	148.6989
1	8.8511	5	44.2556	9	79.6601	13	115.0646	17	150.4691
1.2	10.6213	5.2	46.0258	9.2	81.4303	13.2	116.8348	17.2	152.2393
1.4	12.3916	5.4	47.7961	9.4	83.2006	13.4	118.6051	17.4	154.0096
1.6	14.1618	5.6	49.5663	9.6	84.9708	13.6	120.3753	17.6	155.7798
1.8	15.9320	5.8	51.3365	9.8	86.7410	13.8	122.1455	17.8	157.5500
2	17.7022	6	53.1067	10	88.5112	14	123.9157	18	159.3202
2.2	19.4725	6.2	54.8770	10.2	90.2815	14.2	125.6860	18.5	163.7458
2.4	21.2427	6.4	56.6472	10.4	92.0517	14.4	127.4562	19	168.1714
2.6	23.0129	6.6	58.4174	10.6	93.8219	14.6	129.2264	19.5	172.5970
2.8	24.7831	6.8	60.1876	10.8	95.5921	14.8	130.9966	20	177.0225
3	26.5534	7	61.9579	11	97.3624	15	132.7669	20.5	181.4480
3.2	28.3236	7.2	63.7281	11.2	99.1326	15.2	134.5371	21	185.8736
3.4	30.0938	7.4	65.4983	11.4	100.9028	15.4	136.3073	22	194.7247
3.6	31.8640	7.6	67.2685	11.6	102.6730	15.6	138.0775	23	203.5759
3.8	33.6342	7.8	69.0388	11.8	104.4433	15.8	139.8478	24	212.4270
4	35.4045	8	70.8090	12	106.2135	16	141.6180	25	221.2781

Table A-14. POUND INCHES-FORCE TO NEWTON METRES

lb. in.	N•m	lb. in.	N•m	lb. in.	N•m	lb. in.	N•m	lb. in.	N•m
2	.2260	42	4.7453	82	9.2646	122	13.7839	162	18.3032
4	.4519	44	4.9713	84	9.4906	124	14.0099	164	18.5292
6	.6779	46	5.1972	86	9.7165	126	14.2359	166	18.7552
8	.9039	48	5.4232	88	9.9425	128	14.4618	168	18.9811
10	1.1298	50	5.6492	90	10.1685	130	14.6878	170	19.2071
12	1.3558	52	5.8751	92	10.3944	132	14.9138	172	19.4331
14	1.5818	54	6.1011	94	10.6204	134	15.1397	174	19.6590
16	1.8077	56	6.3270	96	10.8464	136	15.3657	176	19.8850
18	2.0337	58	6.5530	98	11.0723	138	15.5917	178	20.1110
20	2.2597	60	6.7790	100	11.2983	140	15.8176	180	20.3369
22	2.4856	62	7.0049	102	11.5243	142	16.0436	182	20.5629
24	2.7116	64	7.2309	104	11.7502	144	16.2696	184	20.7889
26	2.9376	66	7.4569	106	11.9762	146	16.4955	186	21.0148
28	3.1635	68	7.6828	108	12.2022	148	16.7215	188	21.2408
30	3.3895	70	7.9088	110	12.4281	150	16.9475	190	21.4668
32	3.6155	72	8.1348	112	12.6541	152	17.1734	192	21.6927
34	3.8414	74	8.3607	114	12.8801	154	17.3994	194	21.9187
36	4.0674	76	8.5867	116	13.1060	156	17.6253	196	22.1447
38	4.2934	78	8.8127	118	13.3320	158	17.8513	198	22.3706
40	4.5193	80	9.0386	120	13.5580	160	18.0773	200	22.5966

N•m	lb. ft.	N•m	lb. ft.	N•m	lb. ft.	N•m	lb. ft.	N•m	lb. ft.
1	.7376	21	15.9888	41	30.2400	61	44.9913	81	59.7425
2	1.4751	22	16.2264	42	30.9776	62	45.7289	82	60.4801
3	2.2127	23	16.9639	43	31.7152	63	46.4664	83	61.2177
4	2.9502	24	17.7015	44	32.4527	64	47.2040	84	61.9552
5	3.6878	25	18.4391	45	33.1903	65	47.9415	85	62.6928
6	4.4254	26	19.1766	46	33.9279	66	48.6791	86	63.4303
7	5.1629	27	19.9142	47	34.6654	67	49.4167	87	64.1679
8	5.9005	28	20.6517	48	35.4030	68	50.1542	88	64.9054
9	6.6381	29	21.3893	49	36.1405	69	50.8918	89	65.6430
10	7.3756	30	22.1269	50	36.8781	70	51.6293	90	66.3806
11	8.1132	31	22.8644	51	37.6157	71	52.3669	91	67.1181
12	8.8507	32	23.6020	52	38.3532	72	53.1045	92	67.8557
13	9.5883	33	24.3395	53	39.0908	73	53.8420	93	68.5933
14	10.3259	34	25.0771	54	39.8284	74	54.5796	94	69.3308
15	11.0634	35	25.8147	55	40.5659	75	55.3172	95	70.0684
16	11.8010	36	26.5522	56	41.3035	76	56.0547	96	70.8060
17	12.5386	37	27.2898	57	42.0410	77	56.7923	97	71.5435
18	13.2761	38	28.0274	58	42.7786	78	57.5298	98	72.2811
19	14.0137	39	28.7649	59	43.5162	79	58.2674	99	73.0187
20	14.7512	40	29.5025	60	44.2537	80	59.0050	100	73.7562

lb. ft.	N•m	lb. ft.	N•m	lb. ft.	N•m	lb. ft.	N•m	lb. ft.	N•m
1	1.3558	21	28.4722	41	55.5885	61	82.7049	81	109.8212
2	2.7116	22	29.3290	42	56.9444	62	84.0607	82	111.1770
3	4.0675	23	31.1838	43	58.3002	63	85.4165	83	112.5328
4	5.4233	24	32.5396	44	59.6560	64	86.7723	84	113.8888
5	6.7791	25	33.8954	45	61.0118	65	88.1281	85	115.2446
6	8.1349	26	35.2513	46	62.3676	66	89.4840	86	116.6004
7	9.4907	27	36.6071	47	63.7234	67	90.8398	87	117.9562
8	10.8465	28	37.9629	48	65.0793	68	92.1956	88	119.3120
9	12.2024	29	39.3187	49	66.4351	69	93.5514	89	120.6678
10	13.5582	30	40.6745	50	67.7909	70	94.9073	90	122.0236
11	14.9140	31	42.0304	51	69.1467	71	96.2631	91	123.3794
12	16.2698	32	43.3862	52	70.5025	72	97.6189	92	124.7352
13	17.6256	33	44.7420	53	71.8583	73	98.9747	93	126.0910
14	18.9815	34	46.0978	54	73.2142	74	100.3316	94	127.4468
15	20.3373	35	47.4536	55	74.5700	75	101.6882	95	128.8026
16	21.6931	36	48.8094	56	75.9258	76	103.0442	96	130.1586
17	23.0489	37	50.1653	57	77.2816	77	104.3980	97	131.5144
18	24.4047	38	51.5211	58	78.6374	78	105.7538	98	132.8702
19	25.7605	39	52.8769	59	79.9933	79	107.1196	99	134.2260
20	27.1164	40	54.2327	60	81.3491	80	108.4654	100	135.5820

N•m	lb. ft.	N•m	lb. ft.	N•m	lb. ft.	N•m	lb. ft.	N•m	lb. ft.
100	73.7562	300	221.2686	500	368.7810	700	516.2935	900	663.8059
110	81.1818	310	228.6443	510	376.1567	710	523.6691	910	671.1815
120	88.5075	320	236.0199	520	383.5323	720	531.0447	920	678.5571
130	95.8331	330	243.3955	530	390.9079	730	538.4203	930	685.9328
140	103.2587	340	250.7711	540	398.2835	740	545.7959	940	693.3084
150	110.6343	350	258.1467	550	405.6592	750	553.1716	950	700.6840
160	118.0099	360	265.5223	560	413.0348	760	560.5472	960	708.0596
170	125.3856	370	272.8980	570	420.4104	770	567.9228	970	715.4352
180	132.7612	380	280.2736	580	427.7860	780	575.2984	980	722.8108
190	140.1368	390	287.6492	590	435.1616	790	582.6741	990	730.1865
200	147.5124	400	295.0248	600	442.5372	800	590.0497	1000	737.5621
210	154.8880	410	302.4005	610	449.9129	810	597.4253	1050	774.4402
220	162.2637	420	309.7761	620	457.2885	820	604.8009	1100	811.3183
230	169.6393	430	317.1517	630	464.6641	830	612.1765	1150	848.1964
240	177.0149	440	324.5273	640	472.0397	840	619.5522	1200	885.0745
250	184.3906	450	331.9029	650	479.4154	850	626.9278	1250	921.9526
260	191.7661	460	339.2786	660	486.7910	860	634.3034	1300	958.8307
270	199.1418	470	346.6542	670	494.1667	870	641.6790	1350	995.7088
280	206.5174	480	354.0298	680	501.5422	880	649.0546	1400	1032.5869
290	213.8930	490	361.4054	690	508.9178	890	656.4302	1500	1106.3431

lb. ft.	N•m	lb. ft.	N•m	lb. ft.	N•m	lb. ft.	N•m	lb. ft.	N•m
100	135.5818	300	406.7454	500	677.9090	700	949.0726	900	1220.2362
110	149.1400	310	420.3036	510	691.4672	710	962.6308	910	1233.7943
120	162.6982	320	433.8618	520	705.0254	720	976.1900	920	1247.3525
130	176.2563	330	447.4199	530	718.5835	730	989.7471	930	1260.9107
140	189.8145	340	460.9781	540	732.1417	740	1003.3053	940	1274.4689
150	203.3727	350	474.5363	550	745.6999	750	1016.8635	950	1288.0271
160	216.9309	360	488.0945	560	759.2581	760	1030.4216	960	1301.5852
170	230.4891	370	501.6527	570	772.8163	770	1043.9798	970	1315.1434
180	244.0472	380	515.2108	580	786.3744	780	1057.5380	980	1328.7016
190	257.6054	390	528.7690	590	799.9326	790	1071.0962	990	1342.2598
200	271.1636	400	542.3272	600	813.4908	800	1084.6544	1000	1355.8180
210	284.7218	410	555.8854	610	827.0490	810	1098.2125	1050	1423.6089
220	298.2800	420	569.4436	620	840.6072	820	1111.7707	1100	1491.3998
230	311.8381	430	583.0019	630	854.1653	830	1125.3289	1150	1559.1907
240	325.3963	440	596.5599	640	867.7235	840	1138.8871	1200	1626.9816
250	338.9545	450	610.1181	650	881.2817	850	1152.4453	1250	1694.7725
260	352.5127	460	623.6763	660	894.8399	860	1166.0034	1300	1762.5634
270	366.0709	470	637.2345	670	908.3981	870	1179.5616	1350	1830.3543
280	379.6290	480	650.7926	680	921.9562	880	1193.1198	1400	1898.1452
290	393.1872	490	664.3508	690	935.5144	890	1206.6780	1500	2033.7270

REPAIR GUIDELINES AND SPECIFICATIONS

Table A-15. DECIMAL INCHES TO MM

in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
.01	.254	.21	5.334	.41	10.414	.61	15.494	.81	20.574
.02	.508	.22	5.588	.42	10.668	.62	15.748	.82	20.828
.03	.762	.23	5.842	.43	10.922	.63	16.002	.83	21.062
.04	1.016	.24	6.096	.44	11.176	.64	16.256	.84	21.336
.05	1.270	.25	6.350	.45	11.430	.65	16.510	.85	21.590
.06	1.524	.26	6.604	.46	11.684	.66	16.764	.86	21.844
.07	1.778	.27	6.858	.47	11.938	.67	17.018	.87	22.098
.08	2.032	.28	7.112	.48	12.192	.68	17.272	.88	22.352
.09	2.286	.29	7.366	.49	12.446	.69	17.526	.89	22.606
.10	2.540	.30	7.620	.50	12.700	.70	17.780	.90	22.860
.11	2.794	.31	7.874	.51	12.954	.71	18.034	.91	23.114
.12	3.048	.32	8.128	.52	13.208	.72	18.288	.92	23.368
.13	3.302	.33	8.382	.53	13.462	.73	18.542	.93	23.622
.14	3.556	.34	8.636	.54	13.716	.74	18.796	.94	23.876
.15	3.810	.35	8.890	.55	13.970	.75	19.050	.95	24.130
.16	4.064	.36	9.144	.56	14.224	.76	19.304	.96	24.384
.17	4.318	.37	9.398	.57	14.478	.77	19.558	.97	24.638
.18	4.572	.38	9.652	.58	14.732	.78	19.812	.98	24.892
.19	4.826	.39	9.906	.59	14.986	.79	20.066	.99	25.146
.20	5.080	.40	10.160	.60	15.240	.80	20.320	1.00	25.400

Table A-16. FRACTIONAL INCHES TO MM

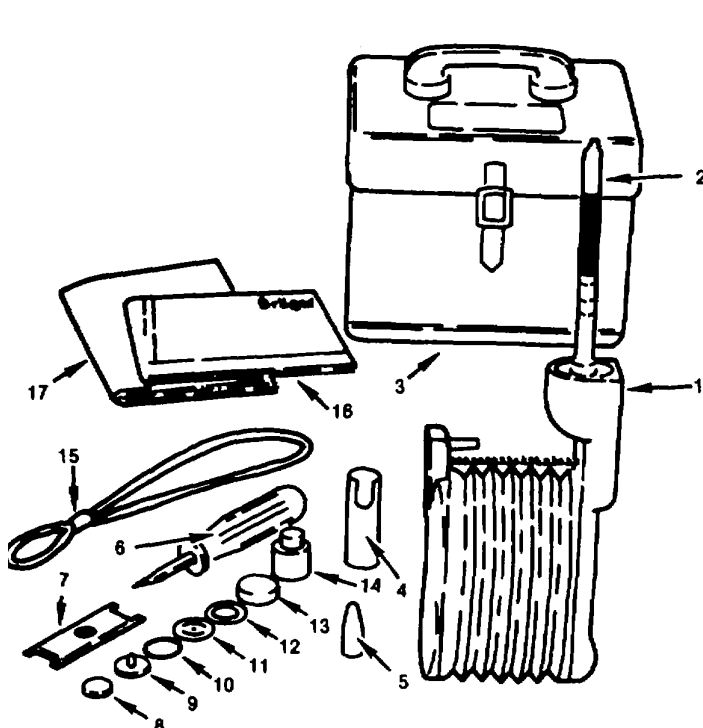
Inches			Inches		
Frac.	Dec	mm	Frac.	Dec	mm
1/64	.015625	.3969	33/64	.515625	13.0969
1/32	.031250	.7938	17/32	.531250	13.4988
3/64	.046875	1.1906	35/64	.546875	13.8906
1/16	.062500	1.5875	9/16	.562500	14.2875
5/64	.078125	1.9844	37/64	.578125	14.6844
3/32	.093750	2.3812	19/32	.593750	15.0812
7/64	.109375	2.7781	39/64	.609375	15.4781
1/8	.125000	3.1750	5/8	.625000	15.8750
9/64	.140625	3.5719	41/64	.640625	16.2719
5/32	.156250	3.9688	21/32	.656250	16.6688
11/64	.171875	4.3656	43/64	.671875	17.0656
3/16	.187500	4.7625	11/16	.687500	17.4625
13/64	.203125	5.1594	45/64	.703125	17.8594
7/32	.218750	5.5562	23/32	.718750	18.2562
15/64	.234375	5.9531	47/64	.734375	18.6531
1/4	.250000	6.3500	3/4	.750000	19.0500
17/64	.265625	6.7469	49/64	.765625	19.4469
9/32	.281250	7.1438	25/32	.781250	19.8437
19/64	.296875	7.5406	51/64	.796875	20.2406
5/16	.312500	7.9375	13/16	.812500	20.6375
21/64	.328125	8.3344	53/64	.828125	21.0344
11/32	.343750	8.7312	27/32	.843750	21.4312
23/64	.359375	9.1281	55/64	.859375	21.8281
3/8	.375000	9.5250	7/8	.875000	22.2250
25/64	.390625	9.9219	57/64	.890625	22.6219
13/32	.406250	10.3188	29/32	.906250	23.0188
27/64	.421875	10.7156	59/64	.921875	23.4156
7/16	.437500	11.1125	15/16	.937500	23.8125
29/64	.453125	11.5094	61/64	.953125	24.2094
15/32	.468750	11.9062	31/32	.968750	24.6062
31/64	.484375	12.3031	63/64	.984375	25.0031
1/2	.500000	12.7000	1	1.000000	25.4000

Table A-17. MM TO DECIMAL INCHES

mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
.01	.00039	.21	.00827	.41	.01614	.61	.02402	.81	.03189
.02	.00079	.22	.00866	.42	.01654	.62	.02441	.82	.03228
.03	.00118	.23	.00906	.43	.01693	.63	.02480	.83	.03268
.04	.00157	.24	.00945	.44	.01732	.64	.02520	.84	.03307
.05	.00197	.25	.00984	.45	.01772	.65	.02559	.85	.03346
.06	.00236	.26	.01024	.46	.01811	.66	.02598	.86	.03386
.07	.00276	.27	.01063	.47	.01850	.67	.02638	.87	.03425
.08	.00315	.28	.01102	.48	.01890	.68	.02677	.88	.03465
.09	.00354	.29	.01142	.49	.01929	.69	.02717	.89	.03504
.10	.00394	.30	.01181	.50	.01969	.70	.02756	.90	.03543
.11	.00433	.31	.01220	.51	.02008	.71	.02795	.91	.03583
.12	.00472	.32	.01260	.52	.02047	.72	.02835	.92	.03622
.13	.00512	.33	.01299	.53	.02087	.73	.02874	.93	.03661
.14	.00551	.34	.01339	.54	.02126	.74	.02913	.94	.03701
.15	.00591	.35	.01378	.55	.02165	.75	.02953	.95	.03740
.16	.00630	.36	.01417	.56	.02205	.76	.02992	.96	.03780
.17	.00669	.37	.01457	.57	.02244	.77	.03032	.97	.03819
.18	.00709	.38	.01496	.58	.02283	.78	.03071	.98	.03858
.19	.00748	.39	.01535	.59	.02323	.79	.03110	.99	.03898
.20	.00787	.40	.01575	.60	.02362	.80	.03150	1.00	.03937

mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
1	.03937	21	.82677	41	1.61417	61	2.40167	81	3.18897
2	.07874	22	.86614	42	1.65354	62	2.44094	82	3.22884
3	.11811	23	.90551	43	1.69291	63	2.48031	83	3.26771
4	.15748	24	.94488	44	1.73228	64	2.51968	84	3.30708
5	.19685	25	.98425	45	1.77165	65	2.55905	85	3.34645
6	.23622	26	1.02362	46	1.81102	66	2.59842	86	3.38582
7	.27559	27	1.06299	47	1.85039	67	2.63779	87	3.42519
8	.31496	28	1.10236	48	1.88976	68	2.67716	88	3.46456
9	.35433	29	1.14173	49	1.92913	69	2.71653	89	3.50393
10	.39370	30	1.18110	50	1.96850	70	2.75590	90	3.54330
11	.43307	31	1.22047	51	2.00787	71	2.79527	91	3.58267
12	.47244	32	1.25984	52	2.04724	72	2.83464	92	3.62204
13	.51181	33	1.29921	53	2.08661	73	2.87401	93	3.66141
14	.55118	34	1.33858	54	2.12598	74	2.91338	94	3.70078
15	.59055	35	1.37795	55	2.16535	75	2.95275	95	3.74015
16	.62992	36	1.41732	56	2.20472	76	2.99212	96	3.77952
17	.66929	37	1.45669	57	2.24409	77	3.03149	97	3.81889
18	.70866	38	1.49606	58	2.28346	78	3.07086	98	3.85826
19	.74803	39	1.53543	59	2.32283	79	3.11023	99	3.89763
20	.78740	40	1.57480	60	2.36220	80	3.14960	100	3.93700

APPENDIX B MULTI-GAS DETECTOR SET



1. Gas detector pump Model 31
2. DRAGER Tubes*
3. Carrying case
4. Break off husk
5. Rubber cap
6. Screwdriver
7. Special spanner
8. Filter sieve
9. Valve disc
10. Washer
11. Gasket
12. Rubber ring
13. Valve seat
14. Rubber bung
15. Carrying strap
16. Instructions for Use
17. Detector Tube Handbook

*The DRAGER Tubes are not supplied with the instrument, but must be ordered separately as a function of the gas type. See Prospectus 2341 e and Table 2340e).

Figure B-1. Multi Gas Detector

Section I

B-1. SUMMARY OF OPERATING INSTRUCTIONS.

- a. Check the pump for leaks before each series of measurements.
- b. Break off both tips of the DRAGER Tube in the break-off eyelet (Fig. B-3) or in the break-off husk (Fig. B-4).
- c. Tightly insert the DRAGER Tube in the pump head with the arrow pointing towards the pump (Fig. B-5).
- d. Hold the pump as shown in Fig. B-6.
- e. Fully compress the bellows (Fig. B-7).
- f. Straighten the fingers. The suction process takes place automatically and is completed when the limit chain is taut (Fig. B-9).
- g. Repeat the suction process as often as specified in the Tube Operating Instructions.
- h. Evaluate the indication as described in the Tube Operating Instructions.



Figure B-2.
Carrying Strap.

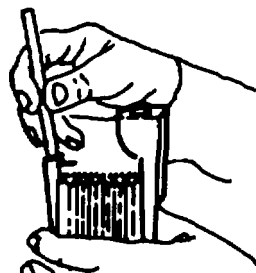


Figure B-3.
Breaking-Off Eyelet

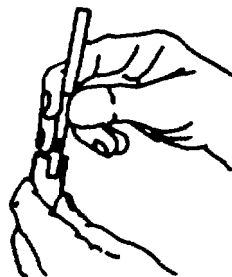


Figure B-4.
Breaking-Off Husk

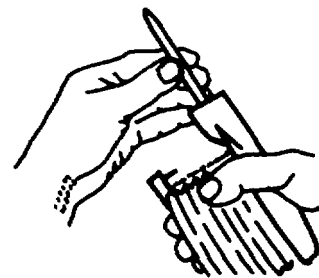


Figure B-5.
Inserting Tube in Pump Head

Section II

B-2. DESCRIPTION OF THE INSTRUMENT.

The two essential components of the DRAGER Multi Gas Detector are the gas detector pump (also called the bellows pump) and DRAGER Tubes chosen as a function of the measurement to be carried out. The pump and Tube together form a complete unit. **All the information given in DRAGER publication on the reliability of the indications as valid only when a DRAGER bellows pump is used in conjunction with DRAGER Tubes.**

The DRAGER Multi Gas Detector Model 21/31 (Fig. B-1) consists of a carrying case containing the bellows pump Model 31, a carrying strap, a break-off husk, tools and spare parts for maintenance of the pump, the Instructions for Use, the Detector Tube Handbook and a supply of rubber caps for sealing used detector tubes. The case also has space for a supply of detector tubes and various accessories.

The bellows pump simultaneously sucks in and measures the gas volume. It has been designed for maximum simplicity and accuracy. The pump can easily be operated with one hand and sucks in 100 cm³ per stroke.

The pump can be carried around the wrist by means of a carrying strap (Fig. B-2).

Section III

B-3. USE OF THE INSTRUMENT.

a. Breaking-off the tips of the Tube. Break off both tips of the DRAGER Tube in the break-off eyelet (Fig. B-3). The break off husk (Fig. B-4) can also be used for this purpose. This ensures that glass splinters do not fall onto the floor.

b. Inserting the DRAGER Tube in the Pump. Insert the opened DRAGER Tube in the pump head so that the arrow points towards the pump. The Tube must fit firmly and tightly in the pump head stopper so that no by-pass air can be sucked in (Fig. B-5).

c. Sucking-in the Gas Sample. Hold the pump in the hand with the pump between the thumb and the base of the index finger and the fingers resting on the front plate. (Fig. B-6).

Compress the bellows completely (Fig. B-7) and then release it (Fig. B-9). When the bellows is compressed, the air in it escapes through the outlet valve and not through the Tube, since the Tube has a much higher resistance than the outlet valve. The pump suction operation commences when the fingers are relaxed. The compression springs inside the bellows, which are placed under stress when the bellows is compressed, extend and the outlet valve is closed through the vacuum created in the bellows. The air flows through the DRAGER Tube into the bellows while the latter returns to its original volume (Fig. B-4). The volume of air sucked-in by the DRAGER Tube is defined by the dimensions and stroke of the bellows. It amounts to 100 cm³ per stroke. The end of the suction movement is reached when the limit chain is completely taut. Since the suction of the pump is caused only by the relaxation of the springs, any subjective influence is excluded.

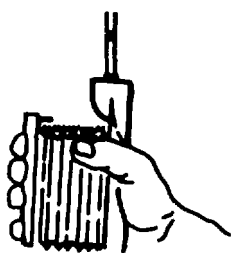


Figure B-6.
Pump

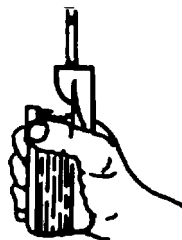


Figure B-7.
Compressing Bellows

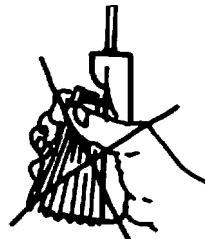


Figure B-8. Compressing
Bellows Incorrectly

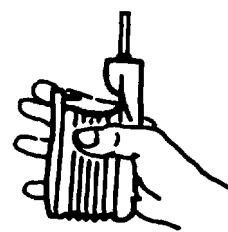


Figure B-9. Tauting
of Limit Chain

Consequently, the rate of flow of the air in the DRAGER tube which is decisive for the accuracy of measurement, is determined exclusively by the spring force of the pump and the resistance of the tube filling, which is fixed during manufacture. To check that testing takes place correctly, see also the section on Opening time in the Tube Operation Instructions.

When testing, make the number of pump strokes specified in the Operating Instructions for the Tube concerned.

Section IV

B-4. MAINTENANCE OF THE BELLOWS PUMP.

a. Leak Testing. It is wise to check the pump for leaks every time it is used. To do this, seal the pump with an unopened DRAGER Tube and completely compress the bellows. The pump is sufficiently air-tight if the bellows has not expanded again completely after 10 minutes, i.e. the limit chain is not taut. It will then deliver the volume required.

b. Eliminating Leaks. Any leaks can usually be eliminated by cleaning the valve. To do this, remove the front plate (Fig. B-10) and unscrew the valve using the special spanner (Fig. B-11). Raise the valve disc to prevent it from being damaged by the spanner. Clean the valve by blowing it through with air or by rinsing it with water. Dry after cleaning.

If the rubber of the valve disc is sticky, brittle, hard or cracked, it must be replaced. Remove the pin from the valve seat stem and push in the pin of the new valve disc until the disc lies flat against the valve seat (Fig. B-12). It is best to moisten the pin a little first. When fitting the cover plate, ensure that the limit chain is not twisted and that the fixing hook lies in the longitudinal direction of the pump, so that it fits satisfactorily in the slot of the cover plate.

c. Cleaning of the metal screen. After prolonged use of the bellows pump, the wire mesh sieve under the rubber bung in the pump head may become blocked. The sieve must, therefore, be cleaned from time to time, about every four weeks when the pump is used frequently. Loosen the two-hole nut with the special spanner and remove the rubber bung. Take out the sieve and clean it with a brush under running water. When re-inserting the two-hole nut, tighten it only until the rubber bung is just under stress and the DRAGER Tube can be inserted easily, but tightly.

d. Flushing the Pump with Air. During testing, certain tube types give off vapours which pass into the interior of the bellows pump (e.g., sulphuric acid mist). To prevent corrosion, flush out the pump with air by making a few strokes without a detector tube every time it has been used.

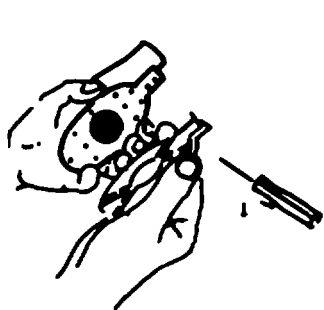


Figure B-10.
Front Plate

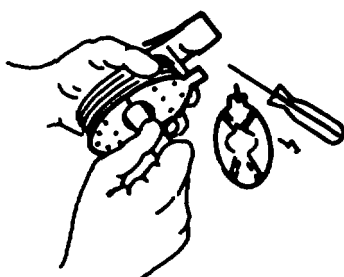


Figure B-11.
Special Spanner

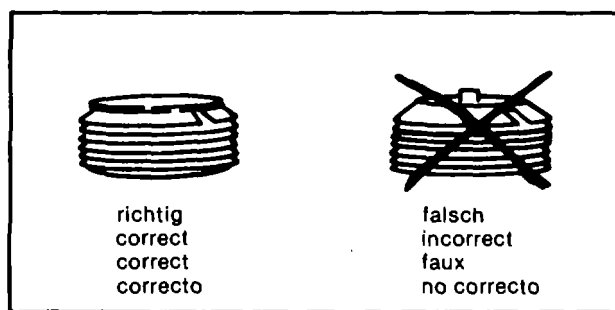


Figure B-12.
Disc

Section V

B-5. ACCESSORIES FOR THE MULTI GAS DETECTOR.

a. Stroke Counter. The stroke counter automatically counts the strokes made with the pump (counting range 0 to 19). It is pushed onto the pump head.

b. Extension Hose for Inaccessible Points of Measurement. For inaccessible points of measurement, we recommend the use of the extension hose. One end of the extension hose is equipped with a device permitting easy connection of the hose to the bellows pump. The dimensions of the tube holder at the other end of the hose are chosen in such a way that the DRAGER Tubes can be inserted in a gas tight manner. The extension hose is 3 m long and is made from a synthetic rubber which is resistant to petrol.

Since the DRAGER Tube fits into the tube holder at the intake opening of the hose, the volume of the intake line need not be taken into consideration in the measurement. Testing and evaluation of the result are carried out just as described for the detector tube concerned.

c. Motor Vehicle Exhaust Gas Probe for the Multi Gas Detector. A probe, which is inserted in the exhaust pipe, is available for investigation of the exhaust gases of internal combustion engines. Its design is such that the gas sample is sucked in at a temperature which is acceptable for the DRAGER Tube.

For further details, see Instructions for Use 2341.1e.

d. Hot Air Probe for the Multi Gas Detector for Sampling Hot Flue Gases. For example, for the determination of the CO or CO₂ content of the flue gases of oil furnaces. The efficiency of the furnace can be calculated from the CO₂ content, measured with the DRAGER CO₂ 1% Tube and the tube gas temperature. See also Instructions for Use 2341.2e.

e. Supplementary Parts for the Respiratory CO Test. Determination of the CO content in the expired air has proved to be a valuable supplement to measurement of carbon monoxide at the workplace. The test subject is asked to inflate fully a 1-litre measuring bag by exhaling through a resistance tube into the bag. The expired air sample is investigated by means of the bellows pump and the DRAGER Respiratory CO₂ a Tube. The tube indication is a direct measure of the CO content.

B-5. FOR DRAGER TUBES, see the Detector Tube Handbook (Special Print 2340 e) and the Instructions for Use of the detector tubes used.

B-6. DRAGER QUANTIMETER MODEL 1. DRAGERWERK supply the DRAGER Quantimeter Model 1-Automatic Gas Detector for prolonged measurements with DRAGER Tubes e.g. in the emission concentration range.

This instrument works like the bellows pump, but the suction strokes are made automatically. A counter enables the number of strokes required to be set before testing. Built-in rechargeable batteries act as energy source. Mains floating battery operation is possible using the corresponding charging instrument.

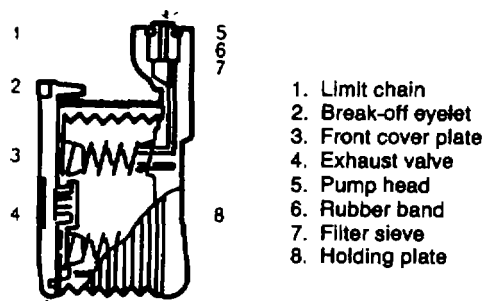


Figure B-13.

APPENDIX C MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

C-1. GENERAL.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. The Maintenance Allocation Chart (MAC) in section II designates overall authority and responsibility for the performance of maintenance functions on the identified item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance levels.

c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

C-2. MAINTENANCE FUNCTIONS.

a. *Inspect.* To determine the serviceability of an item by comparing its physical, mechanical, and or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

b. *Test.* To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. *Service.* Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. *Adjust.* To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. *Aline.* To adjust specified variable elements of an item to bring about optimum or desired performance.

f. *Calibrate.* To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. *Remove/Install.* To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. *Replace.* To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and is shown as the 3d position code of the SMR code.

i. *Repair.* The application of maintenance services, including fault location/troubleshooting, removal/installation, and disassembly/assembly procedures, and maintenance actions to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. *Overhaul.* That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications.

(i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

C-3. EXPLANATION OF COLUMNS IN THE MAC, SECTION II

a. Column 1, Group Number. Column 1 lists functional group code numbers the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00".

b. Column 2, Component/Assembly. Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Function. Column 3 lists the functions to be performed on the item listed in Column 2. (For detailed explanation of these functions, see paragraph C-2).

d. Column 4, Maintenance Level. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the level of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance levels, appropriate work time figures will be shown for each level. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance levels are as follows:

C	Operator or crew
O	Unit Maintenance
F	Intermediate Direct Support Maintenance
H	Intermediate General Support Maintenance
L	Specialized Repair Activity (SRA)
D	Depot maintenance

e. Column 5, Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

f. Column 6, Remarks. This column shall, when applicable, contain a letter code in alphabetic order, which shall be keyed to the remarks contained in Section IV.

C-4. EXPLANATION OF COLUMNS IN TOOL AND TEST EQUIPMENT REQUIREMENTS, SECTION III

a. Column 1, Reference Code. The tool and test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

- b. Column 2, Maintenance Category.** The lowest category of maintenance authorized to use the tool or test equipment.
- c. Column 3, Nomenclature.** Name or identification of the tool or test equipment.
- d. Column 4, National Stock Number.** The National stock number of the tool or test equipment.
- e. Column 5, Tool Number.** The manufacturer's part number.

C-5. EXPLANATION OF COLUMNS IN REMARKS, SECTION IV

- a. Column 1, Reference Code.** The code recorded in column 6, Section II.
- b. Column 2, Remarks.** This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

NOMENCLATURE OF END ITEMS

(1)	(2)	(3)	(4)					(5)	(6)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIPMENT	REMARKS
			UNIT		INTERMEDIATE		DEPOT		
			C	O	F	H	D		
01	Compressor Assy w/ Gasoline Engine	Inspect Test Service Replace Overhaul		0.1 0.5 0.5 2.5				32	A,B C
0101	Pulley	Service Align Replace		0.1 0.2 0.3					D
0102	V-Belt	Inspect Adjust Replace		0.1 0.1 0.1					E
0103	Frame Shock Mounts	Inspect Replace		0.1 0.5					
	Brackets, Guard & Mount Plates	Inspect Service		0.1 0.1					
0104	High Temperature Switch	Replace		0.2					
0105	Hourmeter	Replace		0.2					
02	Intake Filter System								
0201	Filter Assy, Intake	Inspect Service Replace		0.1 0.1 0.2					F G H I
0202	Hose Assy, Intake Filter	Service Replace		0.1 0.1					
03	Filter Set, 3200 PSI								
0301	Filler Hose Assy	Inspect Repair		0.1 0.1					
0302	Filler Valve Assy	Inspect Replace		0.1 0.1					
0303	Purifier Assy	Inspect Service Replace Repair		0.1 0.3 0.3 0.5				J	
0304	Separator Assy	Inspect Service Replace Repair		0.1 0.2 0.3 0.5					
0305	Safety Valve	Inspect Replace		0.1 0.1				K	
04	Interfilter System	Inspect Service		0.1 0.2				L	
0401	Safety Valves	Repair Replace		0.5 0.3				M	

Section II. MAINTENANCE ALLOCATION CHART

NOMENCLATURE OF END ITEMS

(1)	(2)	(3)	(4)					(5)	(6)
GROUP NUMBER	COMPONENT ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE LEVEL					TOOLS AND EQUIPMENT	REMARKS
			UNIT		INTERMEDIATE	DEPOT			
			C	O	F	H	D		
01	Compressor Assy w/ Gasoline Engine	Inspect Test Service Replace Overhaul		0.1 0.5 0.5 2.5				32	A,B C
0101	Pulley	Service Align Replace		0.1 0.2 0.3					D
0102	V-Belt	Inspect Adjust Replace		0.1 0.1 0.1					E
0103	Frame Shock Mounts								
		Inspect Replace		0.1 0.5					
	Brackets, Guard & Mount Plates	Inspect Service		0.1 0.1					
0104	High Temperature Switch	Replace		0.2					
0105	Hourmeter	Replace		0.2					
02	Intake Filter System								
0201	Filter Assy, Intake	Inspect Service Replace		0.1 0.1 0.2					F G H I
0202	Hose Assy, Intake Filter	Service Replace		0.1 0.1					
03	Filter Set, 3200 PSI								
0301	Filler Hose Assy	Inspect Repair		0.1 0.1					
0302	Filler Valve Assy	Inspect Replace		0.1 0.1					
0303	Purifier Assy	Inspect Service Replace Repair		0.1 0.3 0.3 0.5					J
0304	Separator Assy	Inspect Service Replace Repair		0.1 0.2 0.3 0.5					
0305	Safety Valve	Inspect Replace		0.1 0.1					K
04	Interfilter System	Inspect Service		0.1 0.2					L
		Repair		0.5					
0401	Safety Valves	Replace		0.3					M

Section II. MAINTENANCE ALLOCATION CHART

NOMENCLATURE OF END ITEMS

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			UNIT		INTERMEDIATE		DEPOT		
			C	O	F	H	D		
05	Intercoolers and Fan System	Inspect		0.1					
		Repair		1.5					
0501		Wheel, Fan	Service		0.1				
0502		Aftercooler	Replace		1.0				
0503		Intercooler Assy 2nd Stage	Replace		1.5				
0504		Intercooler Assy 1st Stage	Replace		1.5				
06		Lubrication System	Inspect		0.5				
			Repair		1.2				
0601		Oil Pump	Replace		1.5				
0602		Check Valve (Press Regulator)	Inspect		0.1				
		Adjust		0.1					
		Replace		0.3					
		Repair		0.6					
07	Valve Head Assy 1st Stage	Inspect		0.1					O
		Service		1.0					P
		Replace		0.8					
		Repair		1.5					Q
08	Valve Head Assy 2nd Stage	Inspect		0.1					R
		Service		1.0					S
		Replace		0.8					
		Repair		1.5					T
09	Valve Head Assy 3rd Stage	Inspect		0.1					U
		Service		1.0					V
		Replace		0.8					
		Repair		1.5					W
10	Crankcase Assy	Inspect		0.8					
		Service		0.3					X
		Repair		4.5					
1001		Pistons, Conn Rods	Inspect		0.5				
		Replace		3.5					
	Piston Rings	Replace		2.5					Y
1002	Cylinder Assy	Inspect		0.5					
		Replace		1.5					
		Repair		2.0					
1003		Dearator Tube, & Filter Element	Inspect		0.4				
		Service		0.5					
		Replace		0.4					
1004	Oil Dipstick & O'Ring	Inspect		0.1					
		Replace		0.1					
1005	Crankshaft Assy & Bearings	Inspect	0.8	Z					
		Replace	5.0						

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR AN/GRC-240				
(1) REFERENCE CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NATIONAL STOCK NUMBER	(5) TOOL NUMBER
		No special tools are required for the air compressor Mako Model KA 51GF		

**SECTION IV.
MAINTENANCE ALLOCATION CHART**

REFERENCE CODE	REMARKS
A	Test for Air Purity Standards listed in the Operation & Maintenance Manual and FM 20-11-1.
B	Conduct leakage test in accordance with instructions in manual.
C	Consists of cleaning and replenishing fuel & oil.
D	The compressor assembly will be returned to the contractor for overhaul.
E	Adjust belt tension in accordance with instructions in manual.
F	After 25 hours operation clean air intake filter. See Manual.
G	Replace any part of assy.
H	Clean filter in accordance with manual. Replace any part.
J	Change cartridge after 30 tank fillings.
K	Safety Valves are sealed at factory. No repairs are authorized.
L	Clean filter element according to instructions in manual.
M	Same as K above.
N	Adjust according to instructions in manual.
O	After 30 minutes operation check for overheating. Valve head should be handwarm.
P	Clean in accordance with instructions in manual.
Q	Replace valve plates and seats in pairs. When plates have excessive wear replace entire valve.
R	Same as O above.
S	Same as P above.
T	Same as Q above.
U	Same as O above.
V	Same as P above.
W	The third stage intake valve and pressure delivery valve must be replaced as a complete assembly.
X	Make oil changes in accordance with instructions in manual.

**SECTION IV.
MAINTENANCE ALLOCATION CHART**

REFERENCE CODE	REMARKS
Y	When replacing piston rings note correct sequence shown in the manual.
Z	The crankshaft and bearing must be replaced at the contractors plant.
AA	Clean combustion chamber. See manual.
BB	Clean and set spark plug gap at .030".

C-9/(C-10 blank)

APPENDIX D

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Section I INTRODUCTION

D-1. SCOPE.

This manual list spares and repair parts required for performance of organizational maintenance of Diving Equipment Set, SCUBA Diving Support, Type A.

D-2. GENERAL

This Repair Parts List is divided as follows:

a. Section II. Repair Parts List. A list of spares and repair parts authorized for use in the performance of maintenance. The list also includes parts which must be removed for replacement of the authorized parts.

b. Section III. National Stock Number and Part Number Index. A list, in National Item Identification Number (NIIN) sequence, at all National Stock Numbers (NSN) appearing in the listing, followed by a list in alphanumeric sequence, of all part numbers appearing in the listing. National Stock Numbers, and part numbers are cross-referenced to each Illustration figure and Item Number appearance.

D-3. EXPLANATION OF COLUMNS.

a. Figure and Item Number Column. Indicates the figure number of the Illustration on which the item is shown. Item Number used to identify item called out in the Illustration.

b. Part Number Column. The Part Number assigned for a part installed in a delivered product.

c. FSCM Column. Federal Supply Code for Manufacturers.

d. Description Column. Indicates the item name and if required a minimum description to identify the item.

e. Item of Supply Part Number Column. The part number that is stocked, stored and issued by the Government.

f. National Stock Number Column. Indicates the NSN assigned to the item and which will be used for requisitioning purposes.

g. Quantity Column. Indicates the quantity of the item used in the illustration figure.

D-4. SPECIAL INFORMATION.

Federal Supply Code for manufacture (FSCM). The FSCM is a 5digit numeric code listed in SB 70842 which is used to identify the manufacturer, distributor, or Government agency.

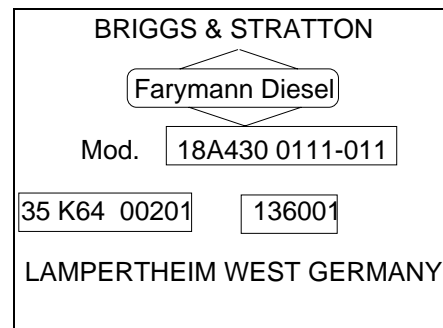
**FARYMANN DIESEL
ILLUSTRATED PARTS LIST**

**Model Series
18A430
TYPE NUMBER
0111-01**

**TO FIND
THE CORRECT NUMBER OF THE PART YOU NEED:
FOLLOW THE INSTRUCTIONS BELOW**

- A. Refer to the Engine Identification Numbers stamped on the metal identification tag. The identification numbers read as follows:

18A430	—	Engine Model
0111-01	—	Engine Type
35	—	Production Year
		351981
		34—1980
		33—1979, etc.
K64	—	Basic Farymann Design Series
0020	—	Serial Number
3600	—	RPM



- B. Refer to Illustrated Parts section and compare the old part with illustration. The number on the illustration is the Reference Number. Assemblies include all parts shown in frames. All parts shown in assembly frames on which individual reference numbers are given can be purchased separately.
- C. After the Reference Number has been identified, refer to that Table's Parts List, where Reference and Master Part Number are listed. THE MASTER PART IS USED IN ALL CASES EXCEPT WHERE STATED UNDER "NOTE".
- D. If a "Note" appears below the Master Part Number, this means that other parts could be used. An explanation will accompany the note.
- E. For Type Numbers other than those covered by this book, please refer to the factory if you are unable to identify the part by comparison.
- F. Quantity of each part is printed after the part number. This quantity refers to the number of parts in that particular table only.

Section II PARTS LIST

D-5. GENERAL.

D-6. This parts list and Appendix A illustrate the parts for the Model DS-7 Diving Equipment Set, manufactured by Fluid Concepts, Inc., Ocala, Florida. The equipment is divided into major components, assemblies and sub assemblies. Information is listed in columns under the following headings.

a. Fig. & Index No. The number of the figure in which an item appears and the index number assigned to a specific item shown in the figure.

b. Part Number. A number assigned to an item for the purpose of identification. This may be a number assigned by a vendor or the prime contractor, Fluid Concepts, Inc. (FCI).

c. Description. A description of the item called out and, where applicable, a vendor code (in parentheses) following the description. For the name and address of the vendor, refer to the List of Vendors' Codes following this subparagraph. Items having a Fluid Concepts Inc. part number will not have a vendor code.

List of Vendors' Codes

Code	Vendor's Name and Address	Code	Vendor's Name and Address
8V006	Fluid Concepts Inc. 2550 N.W. 42 Street Ocala, FL. 32675	08645	Briggs and Stratton Milwaukee, WI. 53201
5H413	K.B.I. Diesel Start 900 Pingree Road Algonquin, IL. 60102	45681	Parker Hannifin 17325 Euclid Avenue Cleveland, OH. 44112
9N865	National Draeger Inc. Parkway View Drive Pittsburgh, PA. 15205	57328	Bauer Compressors Inc. 1328 Azalea Garden Road Norfolk, VA. 23502
GIC	General Instrument Corporation 3811 University Blvd., West #26 Jacksonville, FL. 32217	71198	Browning Belting & Supply Co. 801 Jackson Avenue East Knoxville, TN. 37917
04147	Gill Spark Arrestor-Mufflers Erickson Products Co. Koch Road Corte Madera, CA. 94925	76005	Lord Mfg. 1635 W. 12 Street Erie, PA 16512
		94120	U.S. Divers Co. 3323 West Warner Avenue Santa Ana, CA. 92702

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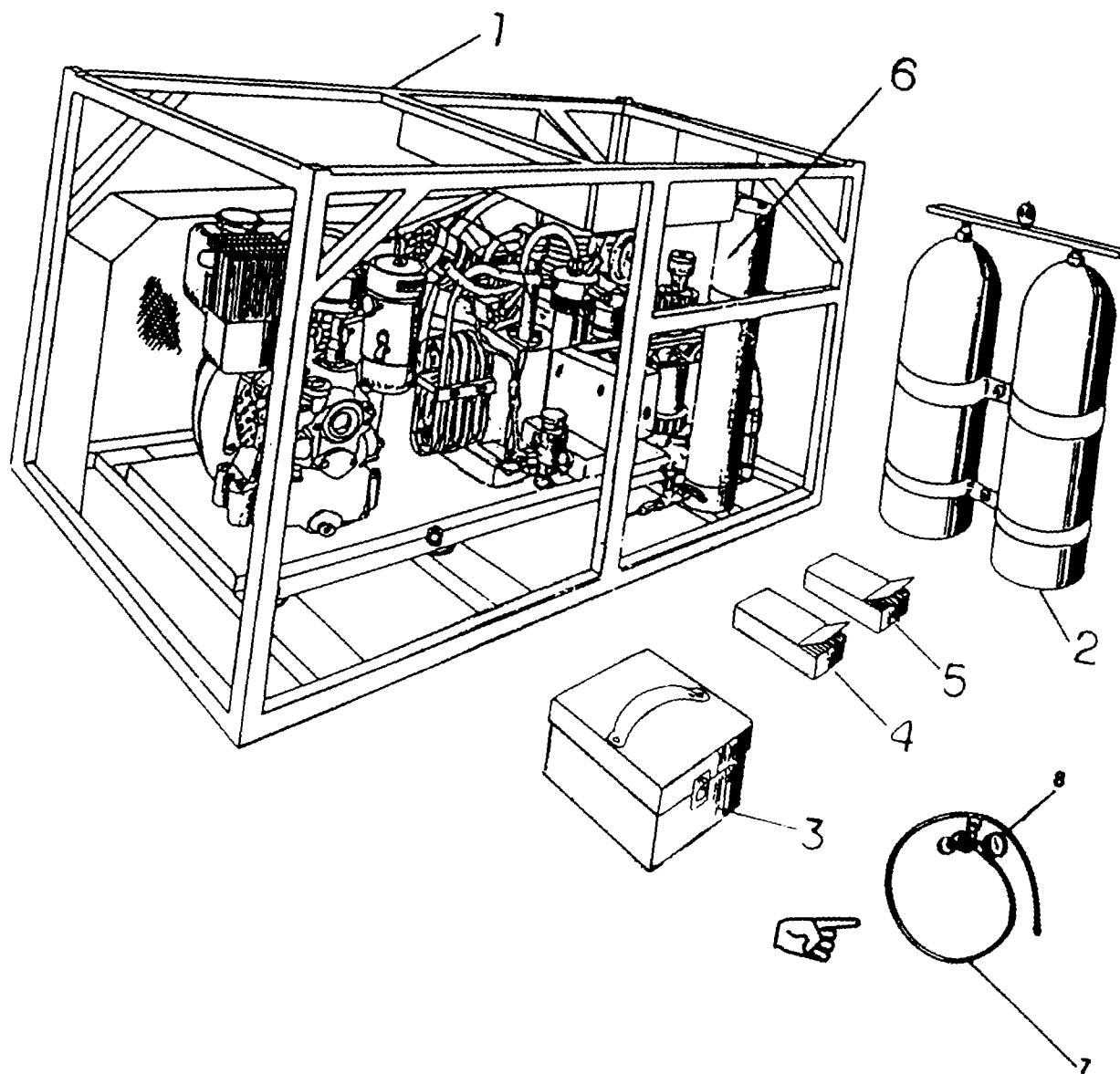


Figure D-1. Diving Equipment Set, Scuba
Diving Support, Type A

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PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-1	DS-7	8V006	DIVING EQUIPMENT SET, SCUBA Diving Support, Type A			SET
1	C3-7D	8V006	.COMPRESSOR, AIR, 5 SCRM, 3200 psi, diesel engine driven (See Fig. 0-2)			1
2	0757-80	94120	.TANK BLOCK, DIVER			4
	0743-03	94120	CYLINDER, AIR 2475 Operating pressure, 80 cu. ft			2
	0743-05	94120	.ROD, Reserve			1
	0834-00	94120	..HARNESS Double tank HARNESS, Double tank			1
	2800-00	94120	..MANIFOLD, Air, 2cylinder with air reserve (See Fig. D-14)			1
3	CH304	9N865	.DETECTOR KIT, Gas purity, hand-held, w/case (Ref. App. B)			1
4	CH30801	9N865	.TUBE, Test, carbon dioxide, 10 per box			3BX
5	CH25601	9N865	.TUBE, Test, carbon monoxide, 10 per box			3BX
6	C30-014	8V006	.PURIFIER (See Fig. 0-13)			1
7	HP778-12	14819	FILL HOSE AND MANIFOLD ASSY			1
8	J4882	14819	GAGE			1

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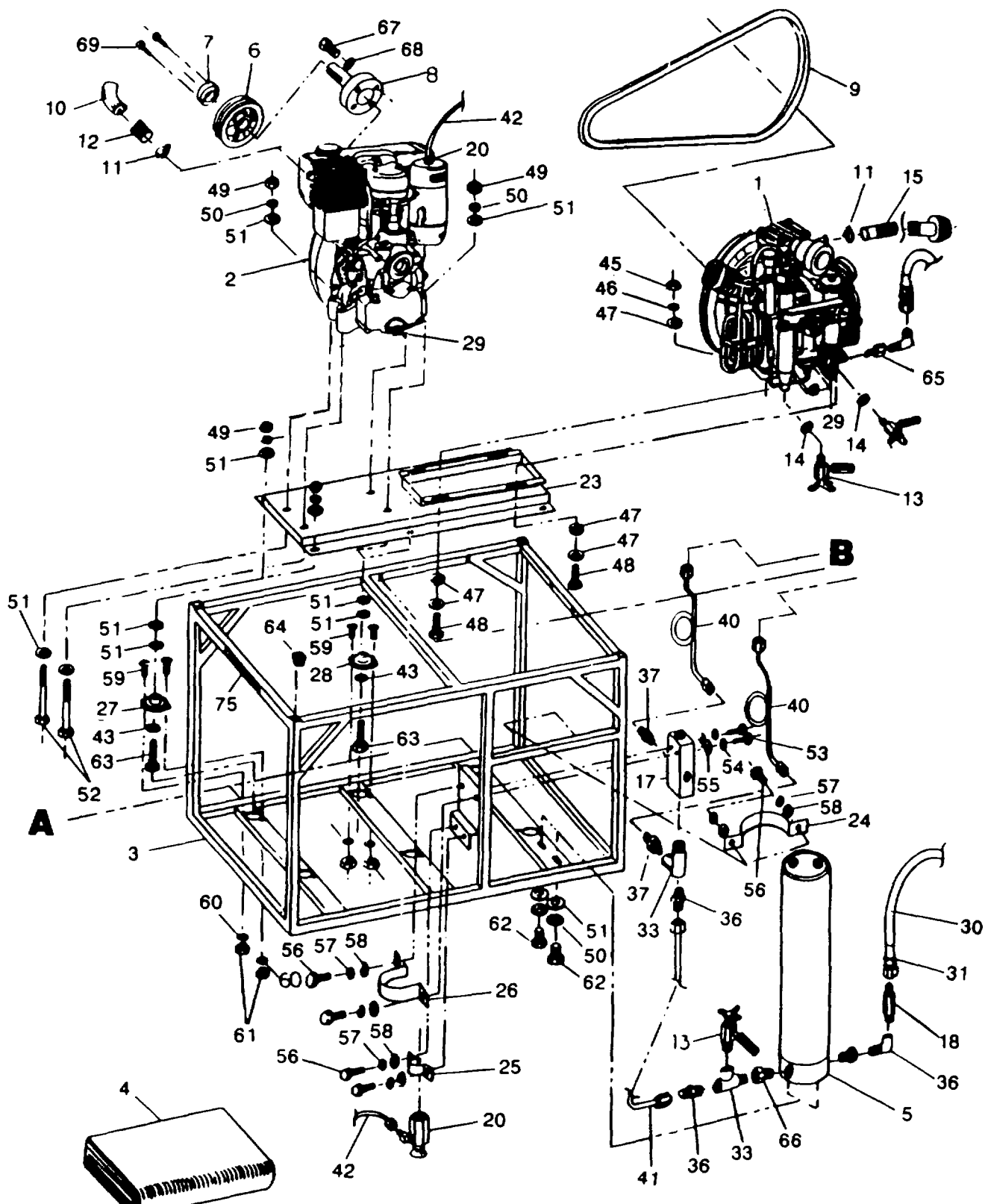


Figure D-2. Air Compressor, Diesel Engine Driven (Sheet 1 of 2)

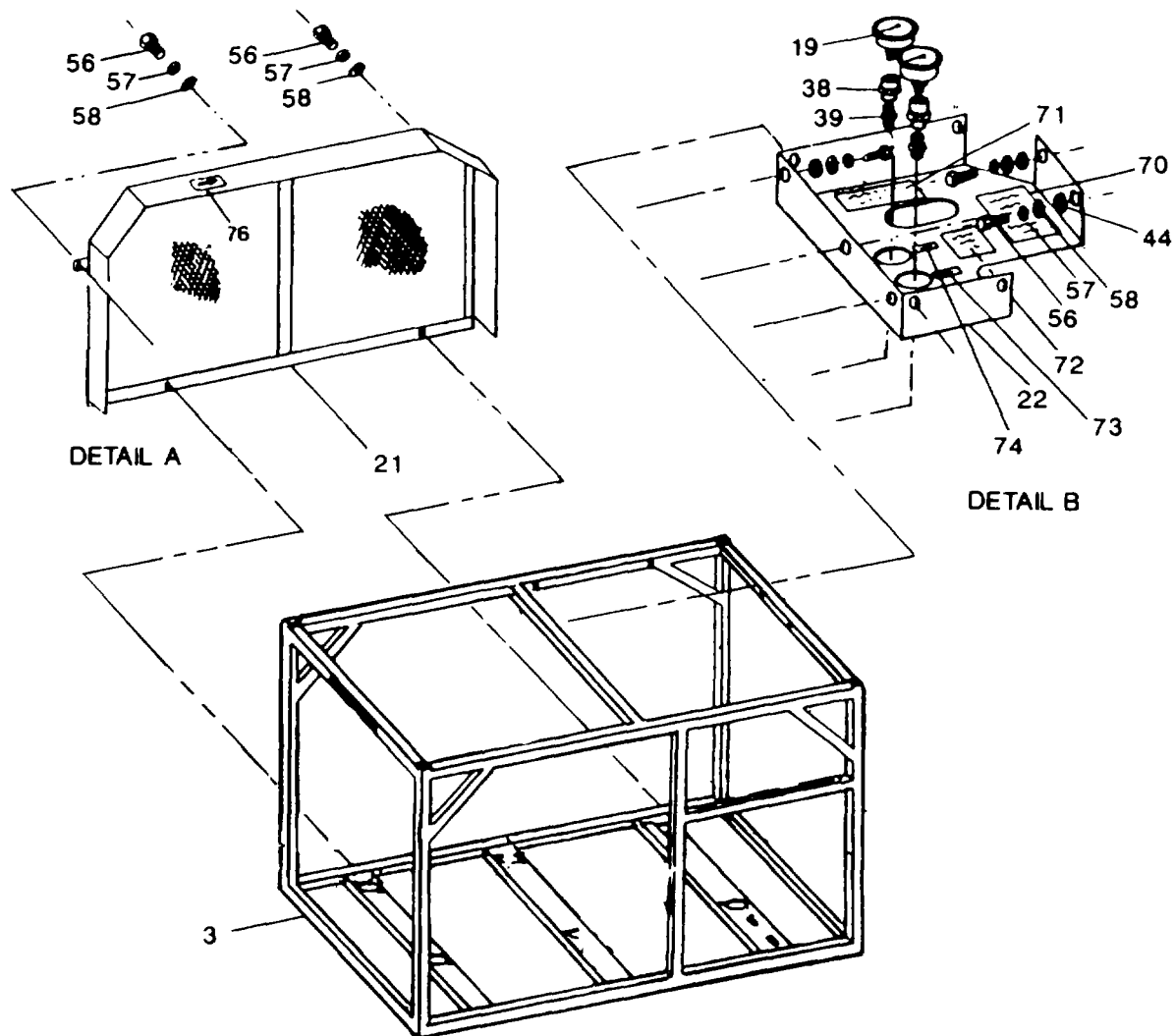


Figure D-2. Air Compressor, Diesel Engine Driven (Sheet 2 of 2)

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PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-2	C3-7D	8V006	.COMPRESSOR, AIR, 5 SCFM, 3200 psig, diesel engine driven (See Fig D-1 for NHA)			Ref.
1	MIS-H	8V006	.COMPRESSOR WITH FINAL SEPARATOR & SAFETY			1
2	18A430	08645	.ENGINE, Diesel			1
3	C30-002	8V06	.FRAME ASSY			1
4	A10-009	8V006	.TARPAULIN			1
5	C30-014	8V006	.PURIFIER (See Fig D-13)			1
6	2AK64H	71198	.SHEAVE, 6.4" P.D			1
7	H-1	71198	.BUSHING, 1" Bore			1
8	407-2228	08645	.STUB SHAFT, Engine			1
9	2A76	71198	.V-BELT, Banded			1
10	COML	8V006	.ELBOW 1" x45° copper			1
11	COML	8V006	.CLAMP, Hose, 1-inch			2
12	GS-11	04147	.SPARK ARRESTOR			1
13	011430	57328	.VALVE, Condensate drain			3
14	N1316	57328	.GASKET			2
15	120-1186	8V006	.HOSE, Air inlet, 1" x 15 ft			1
16	F-8-4	8V006	.PRE-FILTER, Inlet			1
17	211	8V006	.VALVE, Pressure maintaining			1
18	CV-4MSS	8V006	.VALVE, Check			1
19	7217	GIC	.GAUGE, Pressure, liquid filled			2
20	20119	5H413	.DIESEL START, Push knob kit			1
21	C30-015	8V006	.GUARD, Belt			1
22	C30-016	8V006	.PANEL, Gauge			1
23	C30-011	8V006	.SUB BASE			1
24	A10-019	8V006	.CLAMP, Purifier			1
25	COML	8V006	.CLAMP, Push knob			1
26	A10-043	8V006	.CLAMP, Diesel start container			1
27	206PD-30	76005	.MOUNT, Vibration isolation			4
28	206PD-45	76005	.MOUNT, Vibration isolation			2
29	MB444687	8V006	.DRAIN PLUG, Magnetic			2
30	520N-4	45681	.HOSE, SAE 100 RB 1/4 X 17# LG			1
31	10255-4-4	45681	.FITTING, Hose, 1/4" FPT			1
32	10655-4-4	45681	.FITTING, Hose, 1/4" JIC Swivel			1
33	1/4-MR0-S	45681	.STREET TEE			2
34	4-4-CTX-S	45681	.ELBOW, 114 NPTM X 370 JIC 1/4			1
35	1/4 CD-S	45681	.ELBOW, 11/4 NPT MIF			1
36	4-4-FBU-S	45681	.CONNECTOR, 1/4 Tube/ 1/4 NPTM			2
37	2-4FBU-S	45681	.CONNECTOR, 1/8 Tube/ 1/4 NPTM			2
38	1/4x1/8-GG-S	45681	.CONNECTOR, 1/8 x 1/4 NPTF			2
39	2-FBU-S	45681	.CONNECTOR, 1/8 tube/1/8 NPTM			2
40	COML	8V006	.TUBE, 1/8" OD S.S. x .035 wall			2.78 FT
41	COML	8V006	.TUBE, 1/4" OD S.S. x .049 wall			1.20
FT						
42	NB-2-031	45681	.TUBE, 1/8"OD nylon, diesel start			2.00 FT
43	J2049-3	76005	.WASHER, VIBRATION SNUBBING			6
44	COML	8V006	.GROMMET, Rubber, 3/8"			9
45	COML	8V006	.NUT, 5/16-18			4

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
46	COML	8V006	.WASHER, Lock 5-16			4
47	COML	8V006	.WASHER, Flat, 5-16			12
48	COML	8V006	.BOLT, Hex hd , 5/1618 x 1V4 LG.....			4
49	COML	8V006	.NUT, 3/8-16.....			10
50	COML	8V006	.WASHER, Lock, 3/8.....			12
51	COML	8V006	.WASHER, Flat, 3/8			28
52	COML	8V006	.BOLT, Hex hd., 3/8-16 x 4 in lg.....			4
53	COML	8V006	.SCREW, Rd hd., slotted, 6-32 x 11/2 in lg			2
54	COML	8V006	.WASHER, Lock, #6			2
55	COML	8V006	.WASHER, Flat, #6			2
56	COML	8V006	.BOLT, Hex Hd., 1/4-20 X 3/4 inches long			19
57	COML	8V006	.WASHER, Lock, 1/4			19
58	COML	8V006	.WASHER, Flat, 1/4			19
59	COML	8V006	.SCREW, Rd. Hd., slotted, 10-24 X 5/8 in. lg			12
60	COML	8V006	.WASHER, Flat, 10			12
61	COML	8V006	.NUT, Hex, nylok, 10-24.....			12
62	COML	8V006	.BOLT, Hex Hd., 3/8-16 X 3/4 inches long			2
63	COML	8V006	.BOLT, , Hex Hd., 3/8-16 X 2 in lg.....			6
64	FP-166	8V006	.PLUG, Plastic insert, 1" X 1"			4
65	1/4 X 1/4 F4HGS		45681 FITTING, Adaptor			
66	6 X 1/4 FSOGS	45681	FITTING, Adaptor.....			2
67	COML	8V006	.SCREW, Internal hex hd., 10mm X 50mm (included with Index No.8).....			4
68	COML	8V006	.WASHER, 10mm (included with Index No.8)			4
69	COML	8V006	.BOLT, Hex Hd., 1/4-20 X 3/4 in lg (included with Index No.7).....			2
70	B20-001	8V006	.LABEL, Slings, tie down, center of gravity			1
71	820-002	8V006	.LABEL, Operating instructions, flow schematic			1
72	A10-002	8V006	.LABEL, Nomenclature			1
73	A10-001	8V006	.LABEL, Fill pressure			1
74	A10-003	8V006	.LABEL, Final pressure			1
75	B20-000	8V006	.LABEL, Noise warning			4
76	A10-000	8V006	.LABEL, Belt rotation.....			1

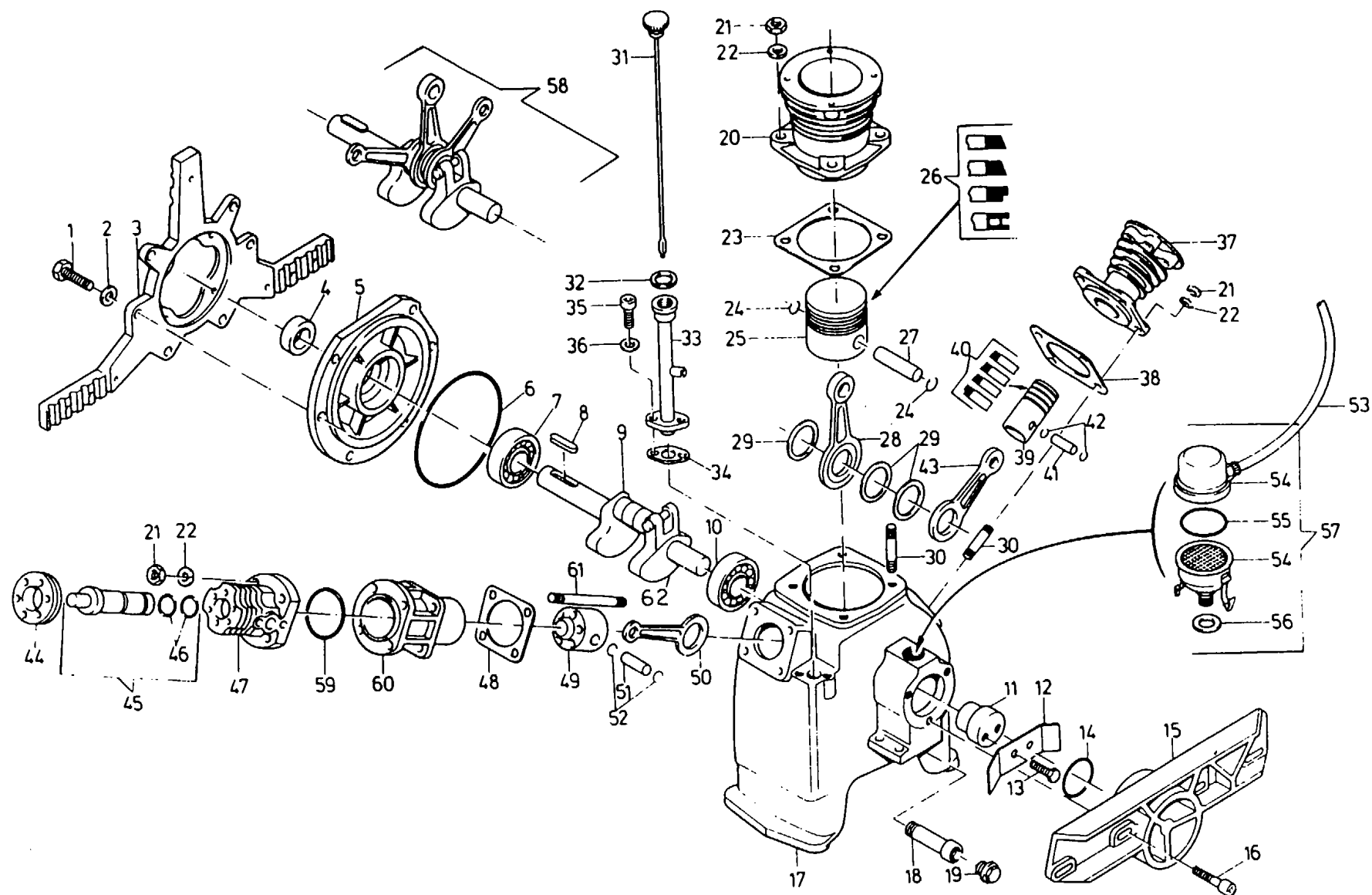


Figure D-4. Compressor crankcase, crankshaft, piston, cylinders and accessories.

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-4			COMPRESSOR CRANKCASE, Crankshaft, pistons, cylinders and accessories			Ref.
1	N 89	57328	.SCREW, Hex			6
2	N 58	57328	.WASHER			6
3	14998-860	57328	.BRACKET, Cooler.....			1
4	N 220	57328	.SEAL, Shaft			1
5	14878-030	57328	.COVER			1
6	N 3705	57328	.O-RING			1
7	N3703	57328	.BEARING, Ball			1
8	N 166	57328	.KEY			1
9	014608-010	57328	.CRANKSHAFT, Cpl			1
10	N 3702	57328	.BEARING, Ball			1
11	3196-650	57328	.ECCENTRIC			1
12	14888-655	57328	.PLATE, Locking			1
13	N 53	57328	.SCREW, Hex			2
14	N 3726	57328	.O-RING			1
15	58159-860	57328	.BRACKET, Separator			1
16	N 109	57328	.SCREW, Internal hex			3
17	14874-000	57328	.CRANKCASE			1
18	N 2911	57328	.EXTENSION			1
19	N 3707	57328	.PLUG			1
20	58258-060	57328	.CYLINDER			1
21	N 57	57328	.NUT, Hex			12
22	N 58	57328	.WASHER			12
23	1867-090	57328	.GASKET			1
24	NSP	57328	.SNAP RING			2
25	11612-050	57328	.PISTON			1
26	N 1787	57328	.PISTON RING SET			1
27	NSP	57328	.PISTON PIN			1
28	55678-040	57328	.CON-ROD, 1st stage			1
29	4180-040	57328	.SPACER			3
30	N 215	57328	.STUD			12
31	14886-650	57328	.DIP STICK			1
32	N 2050	57328	.GASKET			1
33	014887-635	57328	.PIPE, Oil filter			1
34	12560-090	57328	.GASKET			1
35	N 210	57328	.SCREW, Internal hex			2
36	N 3026	57328	.WASHER, Lock			2
37	10875-060	57328	.CYLINDER			1
38	3110-090	57328	.GASKET			1
39	N 2634	57328	.PISTON, 2nd stage			1
40	N 4158	57328	.RING SET, Piston			1
41	NSP	57328	.PIN, Piston			1
42	NSP	57328	.SNAP			2
43	4960-040	57328	.CON-ROD, 2nd stage			1
44	3051-070	57328	.COOLING RING			1
45	012094-050	57328	.PISTON AND SLEEVE, CPL. with o-rings			1
46	N 2320	57328	.O-RING			2
47	56189-060	57328	.CYLINDER, Upper			1

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
48	1866-090	57328	.GASKET.....			1
49	N 823	57328	.GUIDE PISTON			1
50	1509-040	57328	.CON-ROD, 3rd stage			1
51	NSP	57328	.PISTON PIN.....			1
52	NSP	57328	.SNAP RING			2
53	N 3857	57328	.HOSE			1
54	N 3207	57328	.DAMPING FILTER			1
55	N 3712	57328	.O-RING			1
56	N 293	57328	.GASKET.....			1
57	014892-635	57328	.EXHAUSTER			1
58	056904-010	57328	.DRIVE GEAR CPL			1
59	N 4064	57328	.O-RING			1
60	56141-060	57328	.CYLINDER, Lower			1
61	N 4065	57328	.STUD			1
62	NSP	57328	.CRANKSHAFT COUNTER-WEIGHT.....			1
NSP=NOT SEPARATELY PROCURABLE						

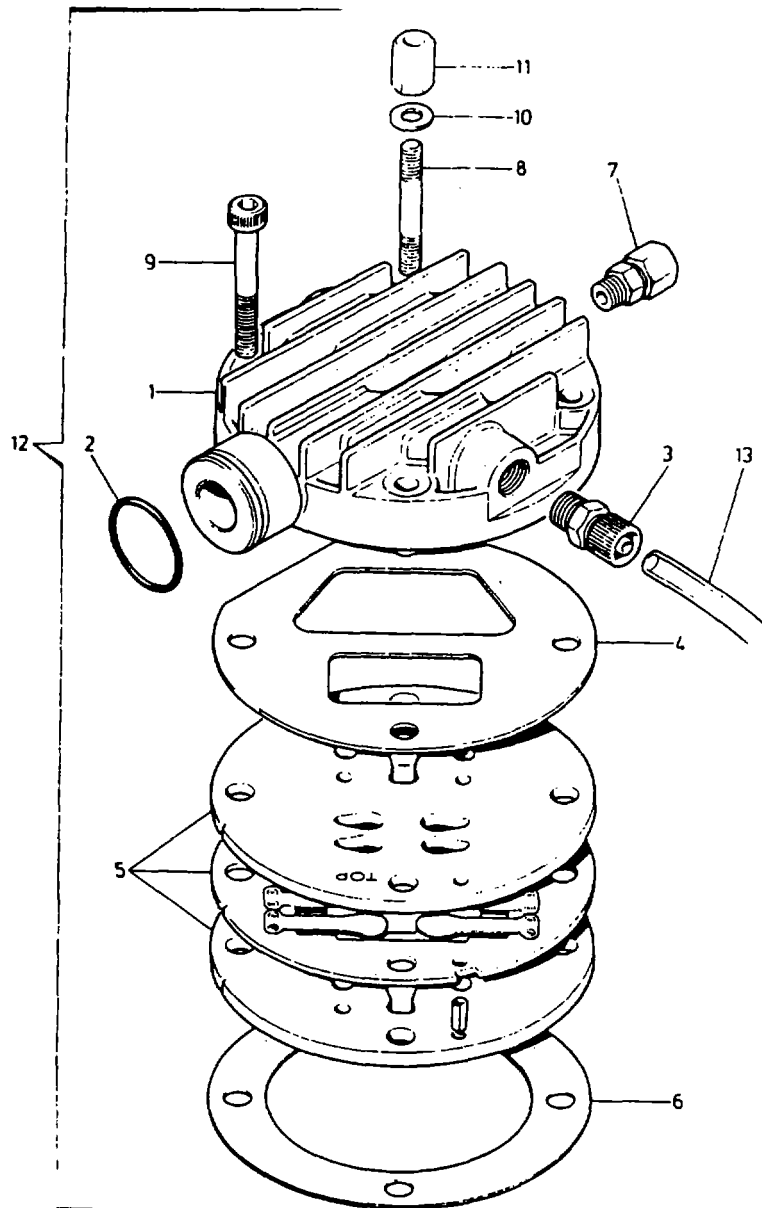


Figure D-5. First Stage Valve Head

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D- 5			.FIRST STAGE VALVE HEAD			Ref.
1	58261-070	57328	.HEAD			1
2	N 1539	57328	.O-RING			1
3	N3737	57328	.CONNECTOR			1
4	58545-090	57328	.GASKET.....			1
5	N 4670	57328	.VALVE, Reed type			1
6	58262-090	57328	.GASKET			1
7	N 7838	57328	.FITTING, Connector.....			1
8	N 4756	57328	.STUD			1
9	N 1234	57328	.SCREW, Internal hex			2
10	N 58	57328	.WASHER			1
11	5290-080	57328	.HEXAGON			1
12	058260-070	57328	.VALVE ANO HEAD, 1st stage cpl.....			1
13	N 3857	57328	.HOSE			1

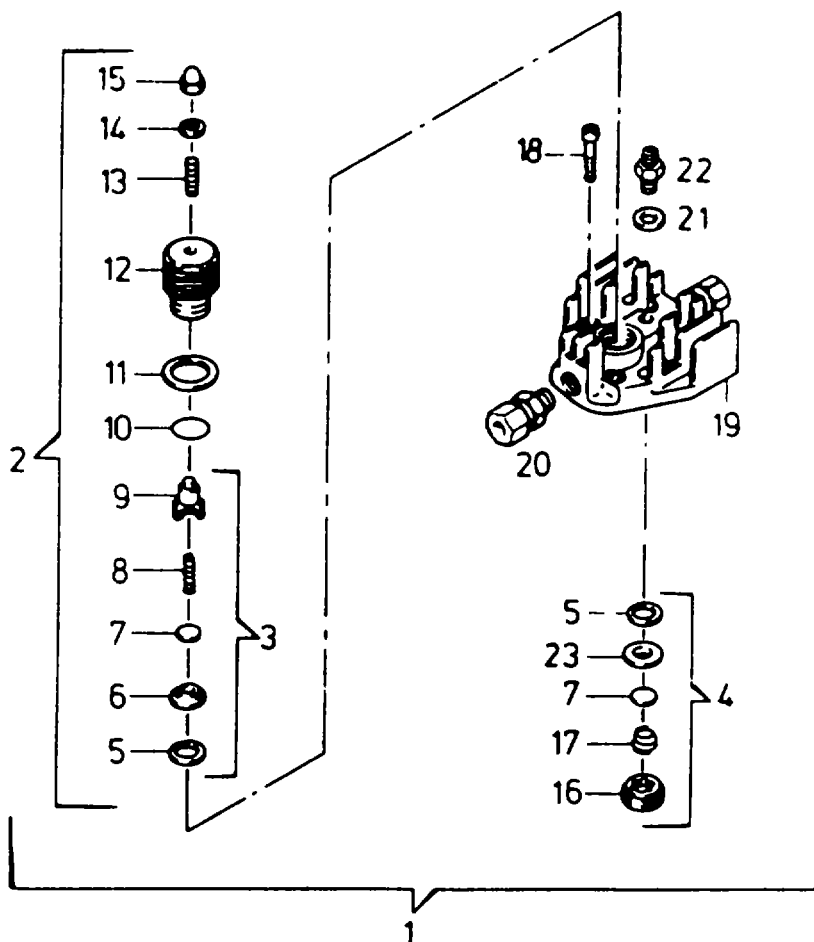


Figure D-6. Second Stage Valve Head

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-6			.SECOND STAGE VALVE HEAD			Ref.
1	014696-070	57328	.VALVES AND HEAD, 2nd stage assy			1
2	014582-080	57328	.VALVE, Discharge assy			1
3	012835-080	57328	.VALVE, Discharge insert			1
4	012841-080	57328	.VALVE, Inlet assy			1
5	240-080	57328	.GASKET.....			2
6	11001080	57328	.SEAT, Valve.....			1
7	232-080	57328	.DISC, Valve.....			2
8	1026640	57328	.SPRING, Discharge valve			1
9	228-080	57328	.INSERT, Discharge valve			1
10	N 3521	57328	.O-RING			1
11	14332-080	57328	.SPRING PLATE			1
12	14124-080	57328	.PLUG			1
13	N 3520	57328	.STUD			1
14	N 380	57328	.WASHER			1
15	N 84	57328	.NUT, Acorn			1
16	319-080	57328	.COVER, Inlet valve			1
17	279-640	57328	.SPRING, Inlet valve			1
18	N 503	57328	.SCREW, Internal hex			6
19	14123-070	57328	.HEAD, 2nd stage			1
20	N 7838	57328	.FITTING			1
21	N 1316	57328	.GASKET.....			1
22	N 3504	57328	.FITTING			1
23	233-080	57328	.SEAT, Valve.....			1

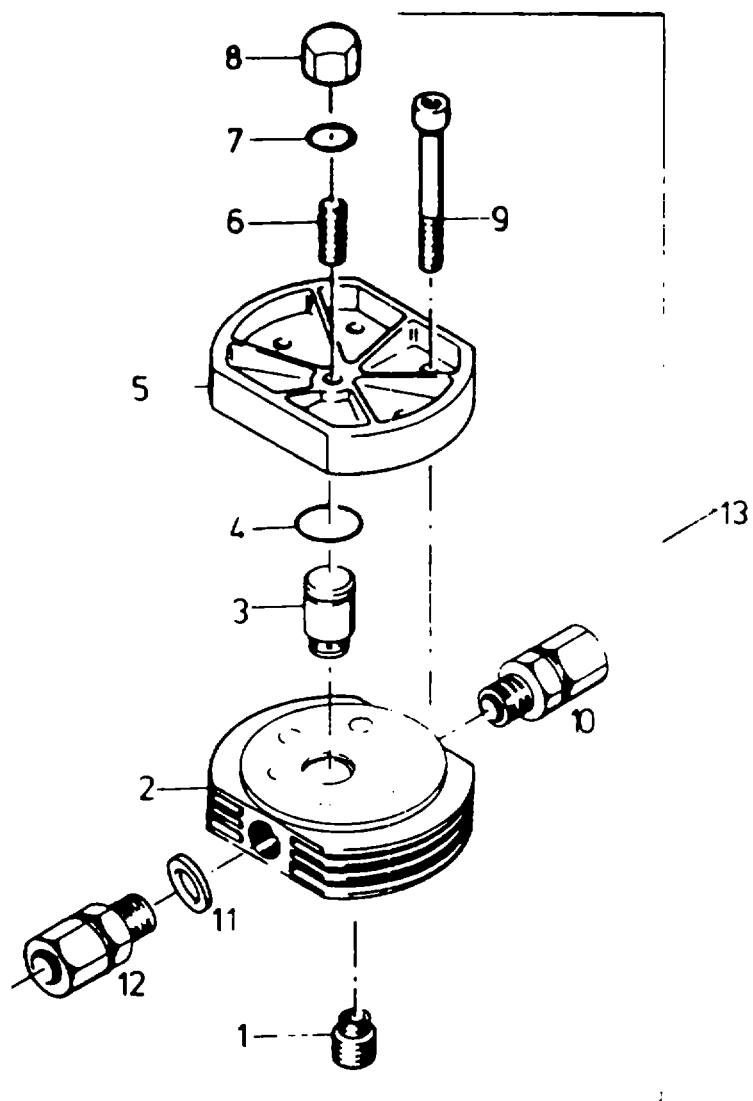


Figure D-7. Third Stage Valve Head

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-7			.THIRD STAGE VALVE HEAD.....			Ref.
1	07790-080	57328	.VALVE, Inlet.....			1
2	14117-070	57328	.HEAD			1
3	014121-080	57328	.VALVE, Discharge			1
4	N 2789	57328	.O-RING			1
5	14118-070	57328	.COVER, Head.....			1
6	N 3624	57328	.STUD			1
7	N 3625	57328	.GASKET.....			1
8	N 3623	57328	.ACORN NUT			1
9	N 1282	57328	.SCREW, Internal hex			6
10	N 7838	57328	.FITTING Connector.....			1
11	N 1316	57328	.GASKET.....			1
12	N 3811	57328	.FITTING, Connector.....			1
13	057058-070	57328	.VALVES AND HEAD, 3rd stage assy			1

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-8			.COOLER COILS AND FAN.....			Ref.
1	N 171	57328	.SCREW, Internal hex			1
2	N 108	57328	.WASHER, Lock.....			2
3	12754-110	57328	.FAN.....			1
4	N 1437	57328	.SCREW, Internal hex			1
5	13666-110	57328	.FAN HUB			1
6	58310-500	57328	.AFTER COOLER			1
7	N 3498	57328	.SCREW, Hex			1
8	14998860	57328	.BRACKET, Cooler.....			3
9	13662-500	57328	.BRACKET, Cooler.....			4
10	N 1042	57328	.NUT, Hex			10
11	14564-500	57328	.BRACKET, Cooler.....			1
12	13663-500	57328	.INTERMEDIATE PIECE.....			2
13	NSP	57328	.COOLING TUBE, Spiral, 2nd stage			1
14	14370-500	57328	.CLAMP, Pipe.....			1
15	N 102	57328	.WASHER			1
16	N 101	57328	.SCREW, HEX			1
17	14139-500	57328	.CLAMP.....			1
18	55697-500	57328	.COOLER.....			1
19	N 3464	57328	.FITTING, Connector.....			1
20	NSP	57328	.COOLING TUBE, Spiral, 1st stage			1
21	056716-500	57328	.INTERCOOLER, 1st stage.....			1
22	058992-500	57328	.INTERCOOLER, 2nd stage			1
23	55699-500	57328	.THREADED PIN			1
24	14605-510	57328	.FIXING TUBE.....			1
25	55698-500	57328	.BRACKET COVER.....			1
26	N 287	57328	.NUT, Hex			1
NSP = NOT SEPARATELY PROCURABLE						

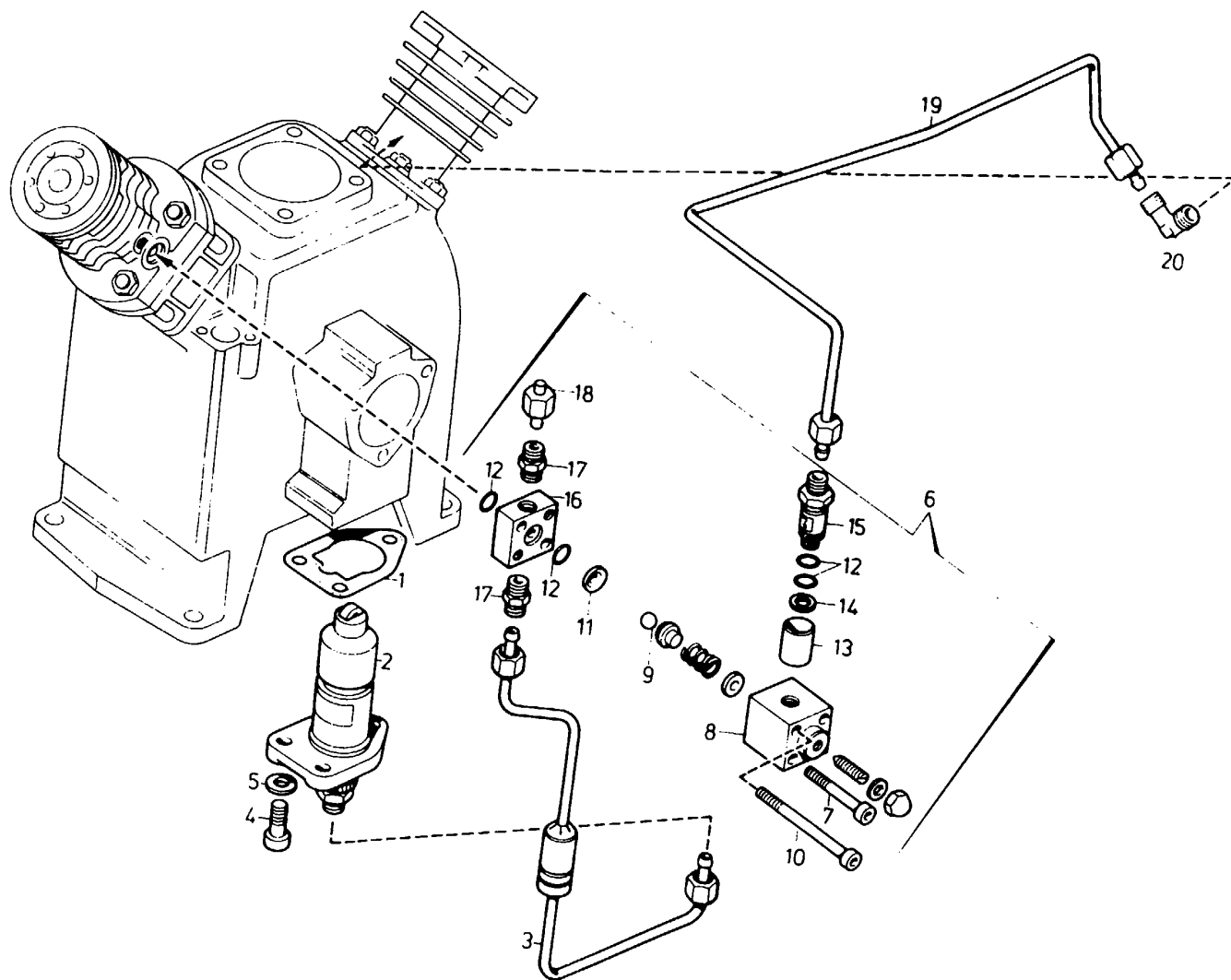


Figure D-9. Force Feed Lubrication

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-9			.FORCE FEED LUBRICATION			Ref.
1	2010-090	57328	.GASKET.....			1
2	N 83	57328	.PUMP, Oil			1
3	57150-050	57328	.TUBE, Supply.....			1
4	N 61	57328	.SCREW, Internal hex			3
5	N 58	57328	.WASHER			1
6	058138-341	57328	.VALVE, OOI pressure.....			1
7	N 781	57328	.SCREW, Internal hex			2
8	58102-341	57328	.VALVE, Body			1
9	N 2768	57328	.BALL			1
10	N 3407	57328	.SCREW, Internal hex.			2
11	58119-341	57328	.SEAT, Ball valve			1
12	N7091	57328	.O-RING			2
13	56302-635	57328	.OIL-GAUGE GLASS			1
14	N 4051	57328	.GASKET.....			1
15	56301-635	57328	.SCREW, Oil level check			1
16	57132-341	57328	.VALVE, Body.			1
17	N 4140	57328	.FITTING, Connector.....			1
18	N 4530	57328	.PLUG			1
19	56981-650	57328	.TUBE, Oil return.....			1
20	N 1057	57328	.FITTING, Elbow.			1

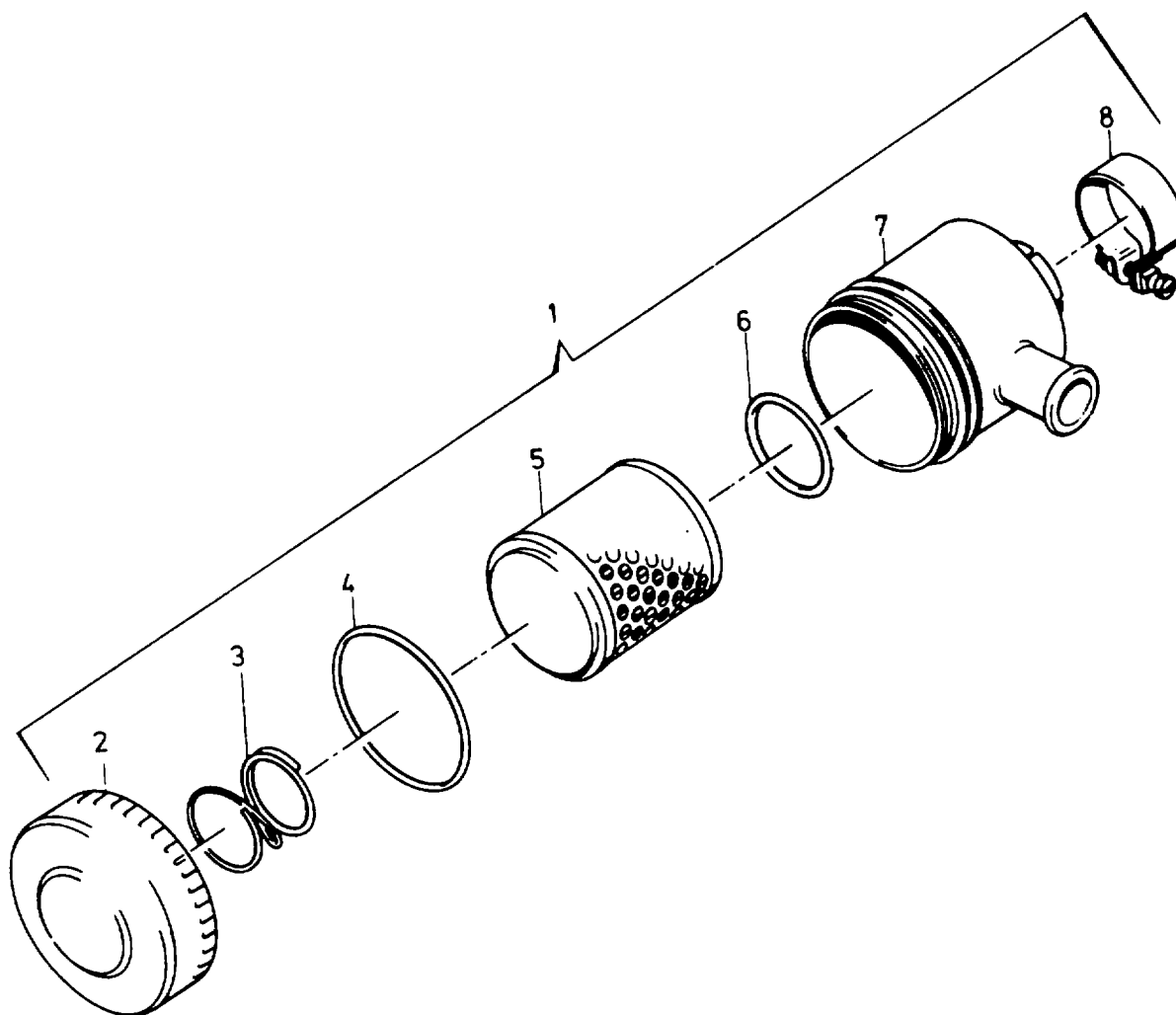


Figure D-10. Intake Filter Assy.

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-10			.INTAKE FILTER ASSY			Ref.
1	013758400	57328	.INTAKE FILTER ASSY			1
2	12771400	57328	.COVER, Intake filter.....			1
3	10528-640	57328	.SPRING			1
4	N 4451	57328	.O-RING			1
5	N 70	57328	.ELEMENT, Filter			1
6	13757-090	57328	.O-RING			1
7	12770-400	57328	.HOUSING, Intake filter.....			1
8	N 3374	57328	.CLAMP			1

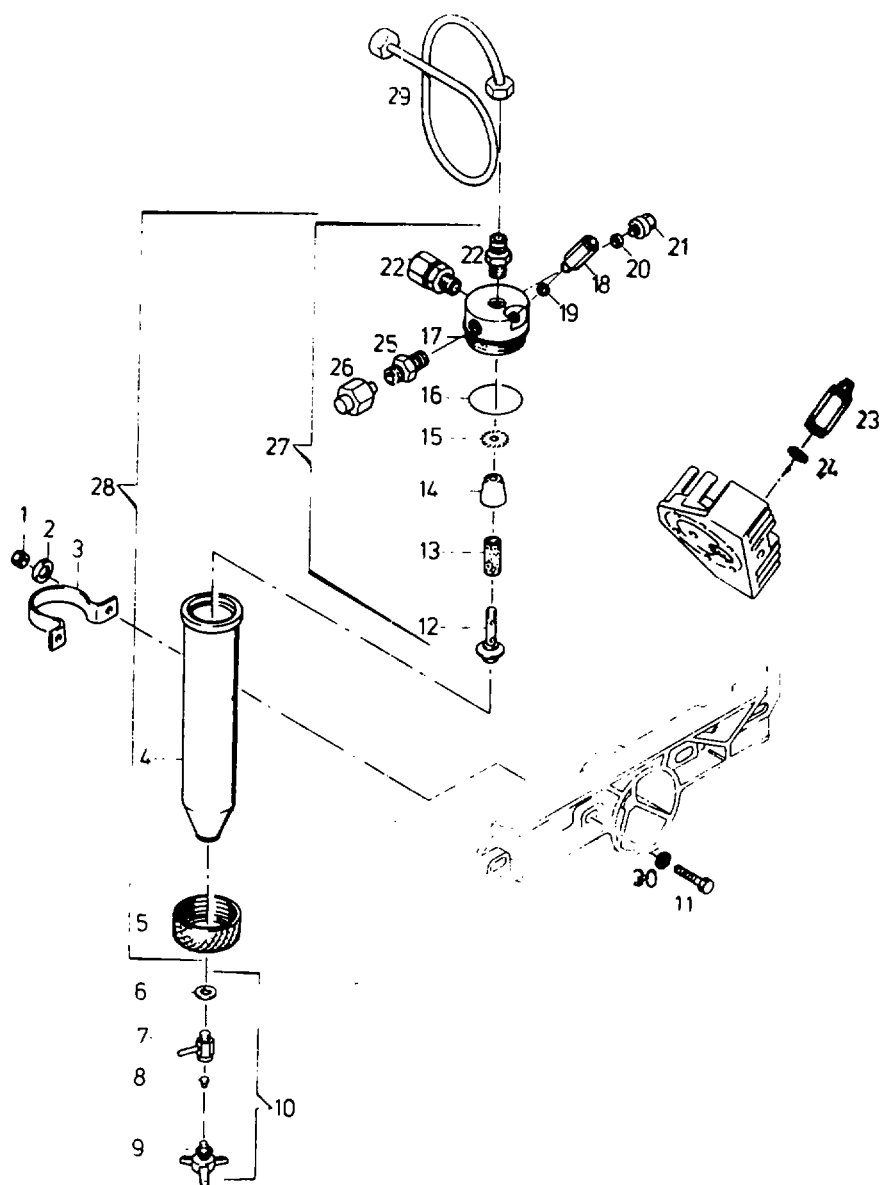


Figure D-11. Interstage Separator.

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-11			.INTERSTAGE SEPARATOR			Ref.
1	N 57	57328	.NUT, Hex			2
2	N 2862	57328	.WASHER			2
3	14368-655	57328	.CLAMP			1
4	14150-430	57328	.HOUSING, Separator.....			1
5	13937-430	57328	.COLLAR, Threaded			1
6	N 1316	57328	.GASKET.....			1
7	2371-635	57328	.BODY, Drain valve			1
8	13283-090	57328	.GASKET.....			1
9	055888635	57328	.HANDLE, Drain valve.....			1
10	011430-635	57328	.VALVE, Condensate drain			1
11	N 89	57328	.SCREW, Hex			2
12	12786-430	57328	.SCREW.....			1
13	N 2726	57328	.CARTRIDGE, Separator			1
14	12785-430	57328	.BAFFLE CONE			1
15	12784-430	57328	.VORTEX PLATE			1
16	N 3556	57328	.O-RING			1
17	13930-430	57328	.HEAO, Separator			1
18	011656-340	57328	.VALVE, Safety			1
19	4479-090	57328	.GASKET.....			1
20	N 4051	57328	.GASKET.....			1
21	N 3459	57328	.PLUG			1
22	N 7838	57328	.FITTING, Connector.....			2
23	010670-340	57328	.VALVE, Safety			1
24	8264-090	57328	.GASKET.....			1
25	N 1051	57328	.FITTING			1
26	N 4530	57328	.PLUG			1
27	014151-430	57328	.HEAD, Separator			1
28	014427-430	57328	.SEPARATOR, Interstage assy.....			1
29	58249-500	57328	.TUBE, Connection			1
30	N 58	57328	.WASHER			2

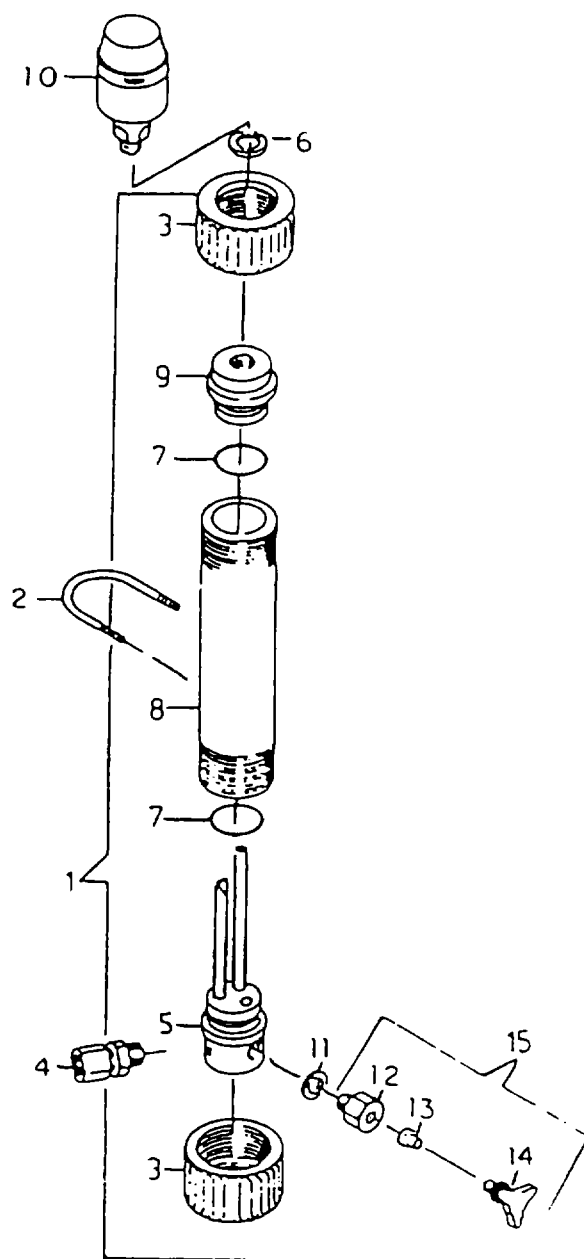


Figure D-12. Final Separator

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-12			.SEPARATOR, Final			Ref.
1	055085	57328	.SEPARATOR, Oil and water			1
2	55664	57328	.U-CLAMP			1
3	13932	57328	.COLLAR Threaded			2
4	N 2466	57328	.FITTING, Connector.....			1
5	055419	57328	.SEPARATOR, Oil and water			1
6	N 1314	57328	.GASKET			1
7	N 62	57328	.O-RING			2
8	55421	57328	.HOUSING			1
9	55420	57328	.PLUG			1
10	03063-340	57328	.VALVE, SAFETY.....			1
11	N 1316	57328	.GASKET.....			1
12	2371	57328	.BODY, Valve			1
13	13283	57328	.GASKET.....			1
14	55888	57328	.HANDLE, Valve.....			1
15	011430	57328	.VALVE, Condensate drain			1

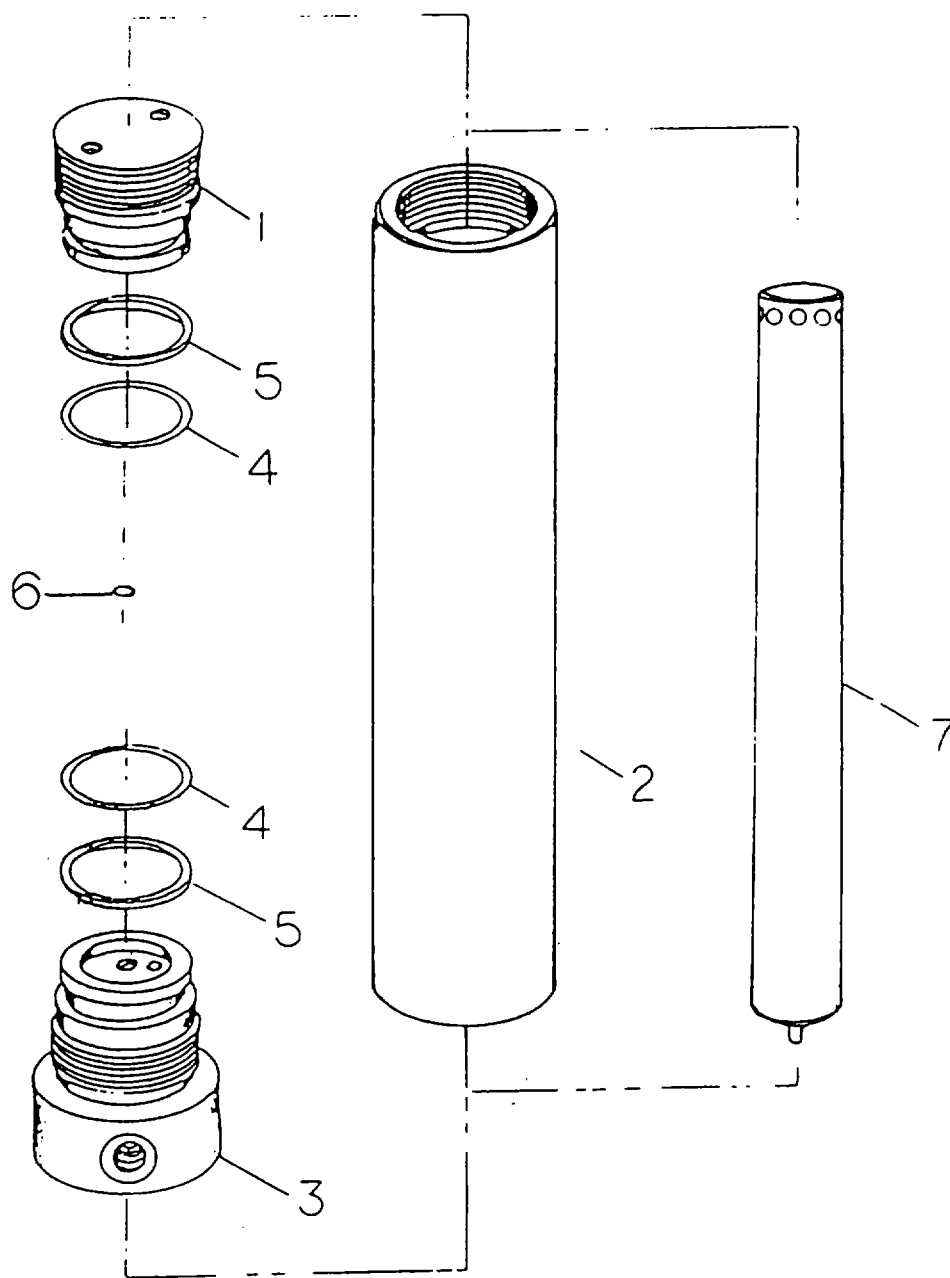


Figure D-13. Purifier

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-13	C30-014	8V006	.PURIFIER (See Fig. D-1 for NHA)			Ref.
1	20-003	8V006	.PLUG, Top, cylinder cap			1
2	20-004	8V006	.CYLINDER			1
3	30-003	8V006	.PLUG, Bottom			1
4	2-333	45681	.O-RING			2
5	8-333	45681	.RING, Back-up			2
6	2-112	45681	.O-RING			1
7	10-005	8V006	.CARTRIDGE			1

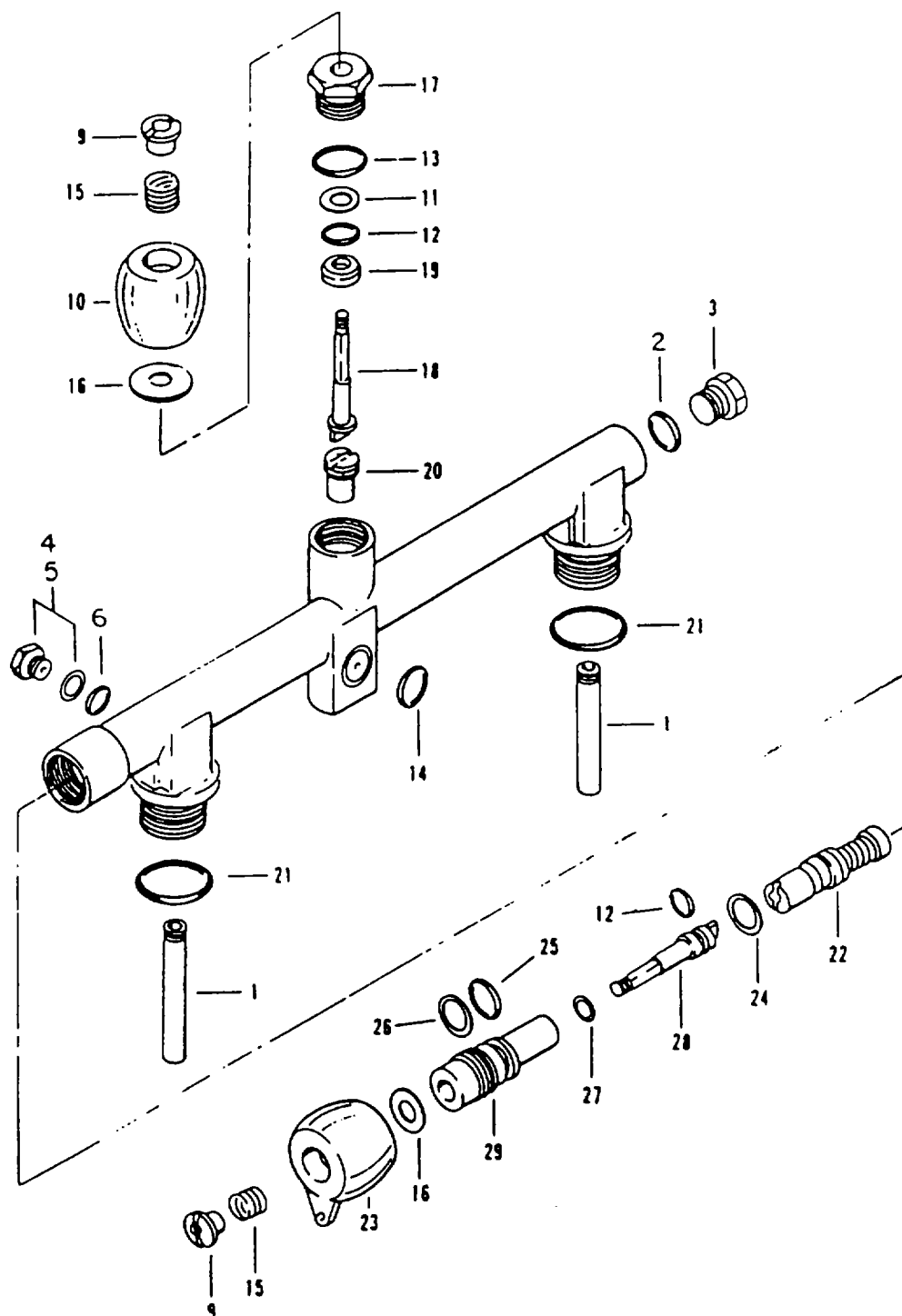


Figure D-14. Air Manifold

PARTS LIST

FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-14	2800-00	94120	.MANIFOLD, Air, 2-cylinder with air reserve (See Fig D-1 for NHA)			Ref.
1	0518-21	94120	.DIPTUBE.....			2
2	8210-11	94120	.GASKET.....			1
3	0502-21	94120	.PLUG			1
4*	0502-41	94120	.SAFETY DISC ASSY FOR 3000) PSI SERV			2
5*	0502-42	94120	.SAFETY DISC ASSY FOR 2250 PSI SERV			2
6	8210-19	94120	.GASKET.....			2
7	NOT USED					
8	NOT USED					
9	0524-18	94120	.LOCKNUT			2
10	0525041	94120	.HANDWHEEL			1
11	8285-10	94120	.BACKUP RING			1
12	8200-10	94120	.O-RING			2
13	9570-07	94120	.O-RING			1
14	8201-20	94120	.O-RING			1
15	0501-07	94120	.SPRING			2
16	8450-58	94120	.WASHER			2
17	0502-33	94120	.BONNET			1
18	0525-21	94120	.STEM			1
19	921019	94120	.THRUST WASHER			1
20	2800-13	94120	.DISC & RETAINER ASSY.....			1
21	8202-14	94120	.O-RING			1
22	0525-08	94120	.CAM RETAINER ASSY.....			1
23	2800-40	94120	.LEVER			1
24	8450-21	94120	.WASHER			1
25	8200-15	94120	.O-RING			1
26	8285-15	94120	.BACK-UP RING			1
27	8210-14	94120	.GASKET.....			1
28	0525-14	94120	.STEM			1
29	0525-15	94120	.BONNET			1
<p>*NOTE: CGA Standard S1.1 Ref. 49CFR1002199 (D.O.T.) prohibits Interchange between manufacturers on these parts A new washer (#6) must be replaced whenever a new burst disc is installed.</p> <p>Available as assemblies only.</p>						

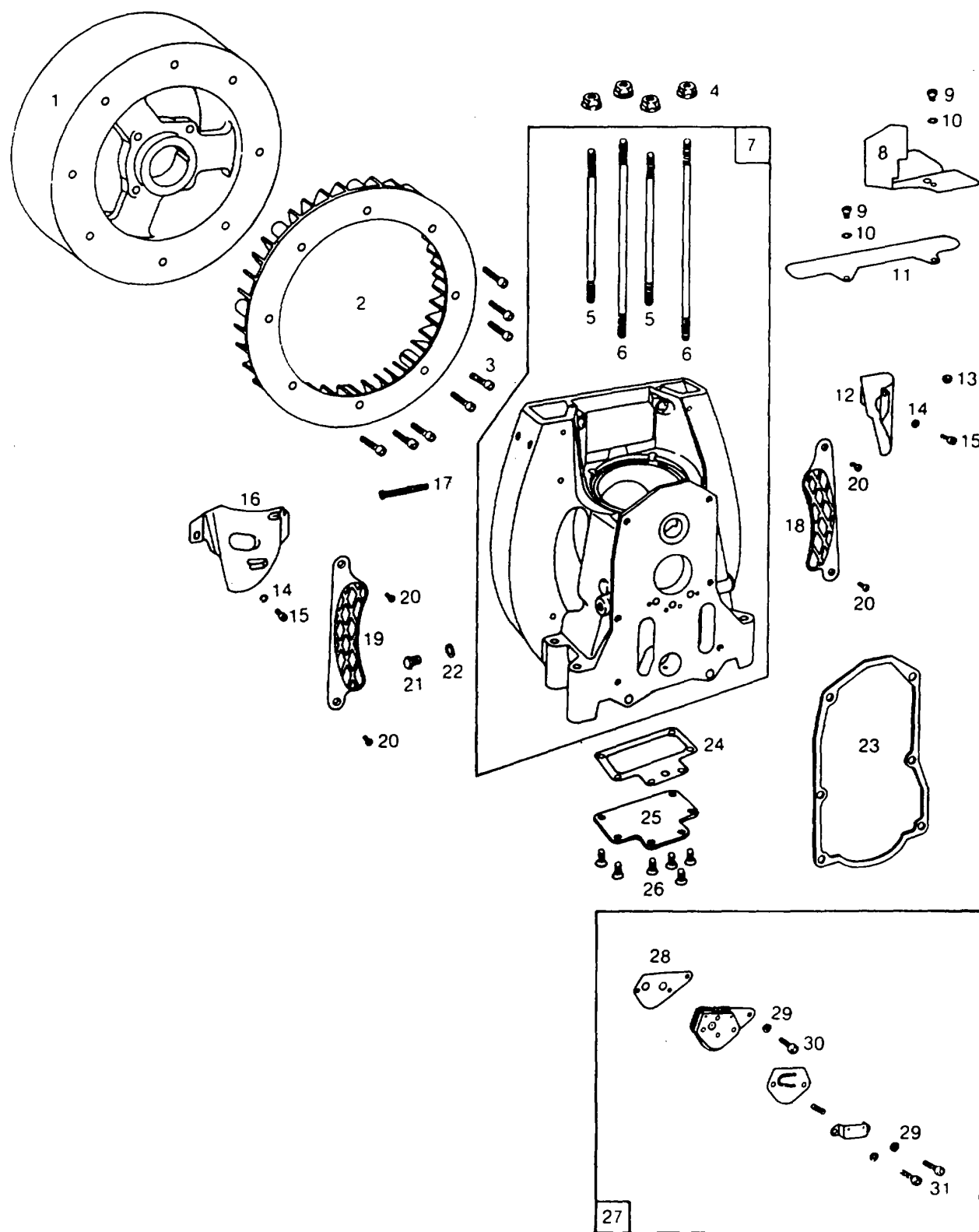


Figure D-15. Flywheel, Crankcase

PARTS LIST

FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-15						
1	738 1814	08645	.FLYWHEEL.....			1
2	719 0214	08645	.FAN, FLYWHEEL			1
3	890 3131	08645	.SCREW, Socket head DIN 912 M 6 x 30			
4	514 0374	08645	.NUT.....			4
5	512 0884	08645	.STUD, Cylinder Mounting, Flywheel Side			2
6	512 0894	08645	.STUD, Cylinder Mounting, Governor Side			2
7	7111237	08645	.CRANKCASE ASSEMBLY.....			1
8	937 0115	08645	.GUIDE, Air			1
9	890 9601	08645	.SCREW, Socket Head, DIN 7985 M 5X10			2
10	890 7801	08645	.WASHER, Lock DIN 7980 A 5			2
11	917 2304	08645	.PLATE, Cover			1
12	751 0514	08645	.SHIELD, Cylinder			1
13	890 4701	08645	.LOCKNUT DIN 985 M 4			1
14	890 7801	08645	.WASHER, Lock, DIN 7980 5			2
15	890 9501	08645	.SCREW, Socket Head, DIN 965 M 5X10			2
16	751 0524	08645	.SHIELD, Cylinder			1
17	890 9602	08645	.SCREW, DIN 7985 M 4X50			1
18	934 0414	08645	.GUARD, Flywheel			1
19	934 0404	08645	.GUARD, Flywheel			1
20	890 9501	08645	.SCREW, Flat Head, DIN 965 M 5X10			4
21	890 7501	08645	.SCREW, Plug, DIN 7604 M 8x1			1
22	890 7406	08645	.WASHER, Copper, DIN 7603 A 8X12			1
23*	770 1454	08645	.GASKET, Gear Cover			1
24*	770 1484	08645	.GASKET, Cover Plate.....			1
25	917 1504	08645	.PLATE, Cover			1
26	890 9502	08645	.SCREW, Flat Head			6
27	724 0208	08645	.PUMP ASSEMBLY, Oil			1
28*	770 1674	08645	.GASKET, Oil Pump.....			1
29	8901104	08645	.WASHER, Spring, DIN 137 B6			3
30	890 3106	08645	.SCREW, Socket Head, DIN 912 M 6X20.....			1
31	890 3131	08645	.SCREW, Socket Head, DIN 912 M 6X30.....			2
*Included in Gasket Set - Part No. 770 1868						

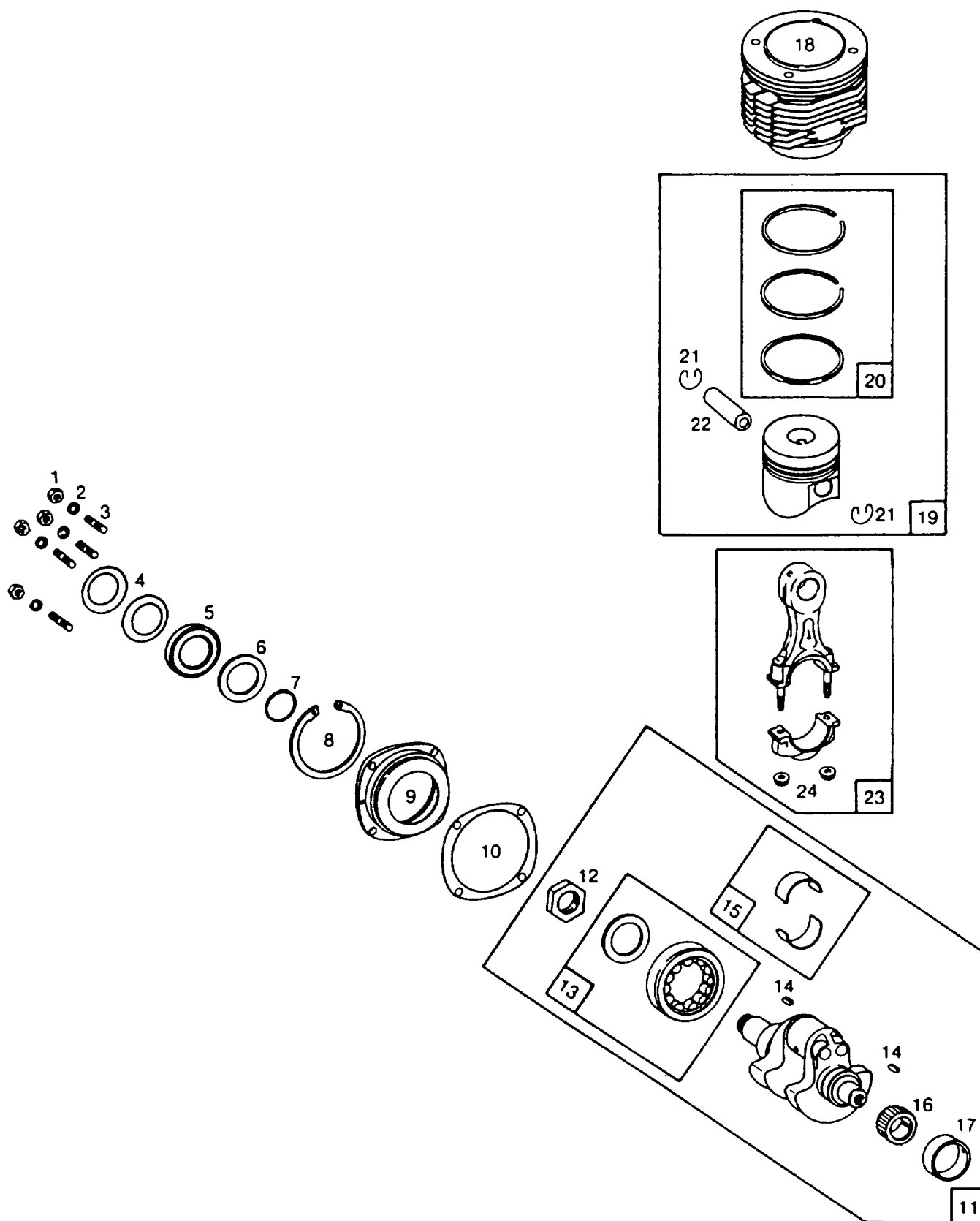


Figure D-16. Cylinder, Piston and Rod Assembly

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-16						
1	890 3805	08645	.NUT, Hex, DIN 934 M 8			4
2	890 6509	08645	.WASHER, External Tooth			4
			.WASHER, DIN 6797 J X 8.4			4
3	512 0074	08645	.STUD			4
4	804 0064	08645	.WASHER, Belleville			2
5	890 5928	08645	.SEAL, Oil, DIN 3760 60X80X8.....			1
6*	519 0234	08645	.RETAINER, O-ring			1
7	850 0104	08645	.SEAL, O-ring			1
8	890 2023	08645	.RING, Retaining DIN 472 80X2.5			1
9*	727 0364	08645	.SUPPORT, Bearing			1
10	770 1444	08645	.GASKET, Bearing Support.....			1
11	715 0567	08645	.CRANKSHFT			1
12	514 0444	08645	.NUT, Flywheel.....			1
13	800 0252	08645	.BEARING, Main, Flywheel Side			1
14	890 6802	08645	.KEY			2
15	470 0084	08645	.BEARING, Connecting Rod, Standard			1
	470 0094	08645	.BEARING, Connecting Rod, 0.25 mm undersize			1
	470 0124	08645	.BEARING, Connecting rod, 0 50 mm undersize			1
16	452 0794	08645	.GEAR, Crankshaft.....			1
17	775 0204	08645	.BEARING, Main, Governor side, standard			11
	775 0214	08645	.BEARING, Main, Governor side, 0.25 mm undersize			1
	775 0244	08645	.BEARING, Main, Governor side 0 50 mm undersize			1
18	730 0276	08645	.CYLINDER			1
19	725 0908	08645	.PISTON ASSEMBLY.....			1
20	535 0411	08645	.RING SET, Piston			1
21	890 9101	08645	.LOCK, Piston pin			2
22	418 0094	08645	.PIN, Piston			1
23	726 0276	08645	.ROD, Connecting			1
24	514 0374	08645	.NUT.....			2
			*Included in Gasket Set-Part No. 770 1868			

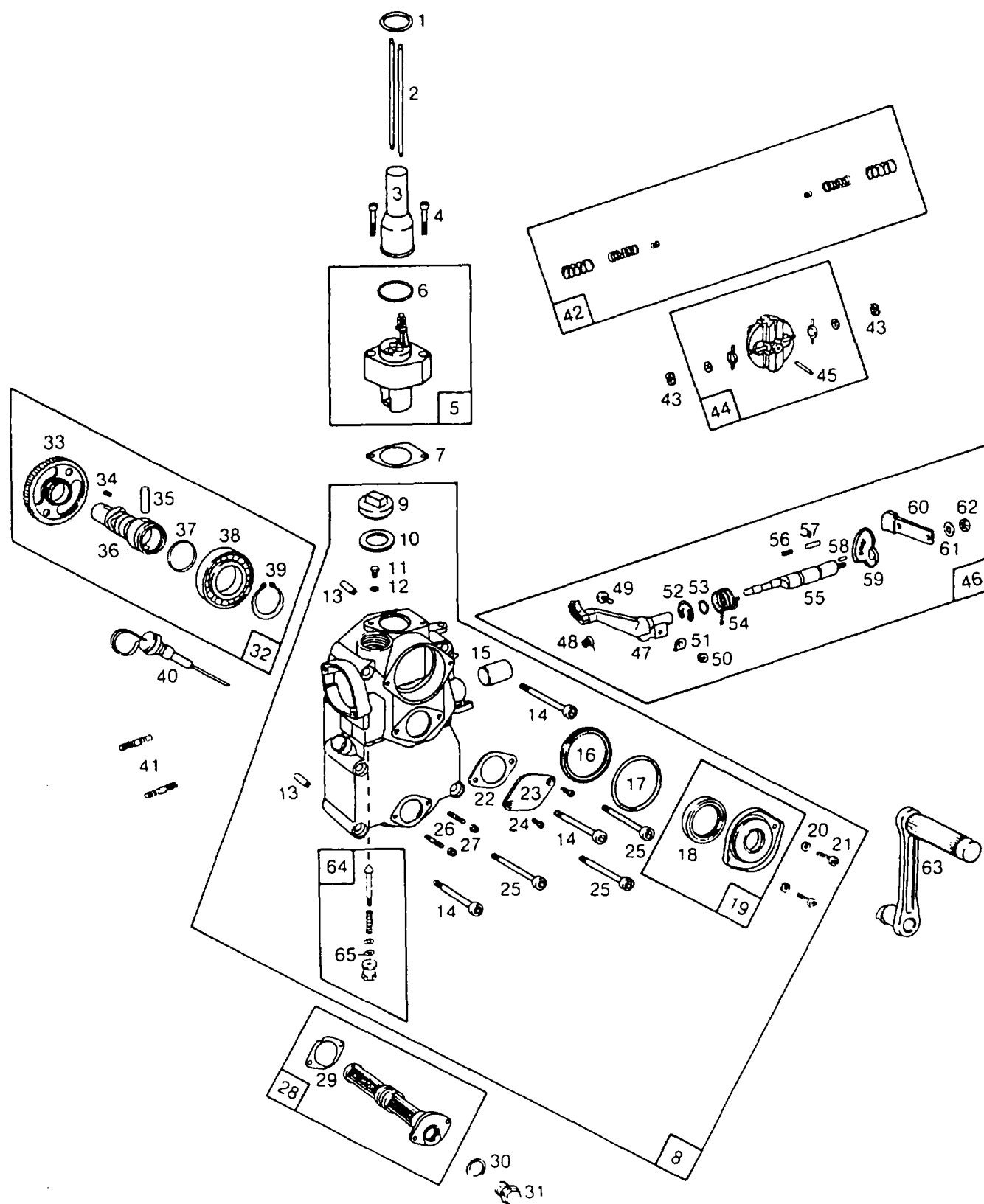


Figure D-17. Block, Camshaft and Governor Assemblies

PARTS LIST

FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D - 17						
1*	850 0644	08645	.SEAL, O-RING			1
2	421 0514	08645	.ROD, Push			2
3	9210254	08645	.TUBE, Push Rod.....			1
4	890 3104	08645	.SCREW, Socket head, DIN 912 M 5 x 30.			2
5	128 0108	08645	.COMPRESSION Release			1
6	850 0654	08645	.SEAL, O-RING			1
7-	770 1664	08645	.GASKET, Compression release			1
8	718 0497	08645	.COVER, Gear			1
9	509 0184	08645	.CAP, Oil filler.....			1
10	850 0664	08645	.GASKET, Oil filler cap.....			1
11	512 0944	08645	.SCREW, Set			1
12	8901103	08645	.WASHER, Spring, DIN 137 A 6.....			1
13	890 7202	08645	.PIN, Roll, DIN 7346 10 x 16			2
14	890 3130	08645	.SCREW, Socket head, DIN 912 M 8 x 80			3
NOTE The 3 longer gear cover screws (80 mm) are placed in the top 2 and bottom left holes The shorter 3 gear cover screws, (Ref. 25) go in the middle and bottom right holes.						
15	465 1004	08645	.BUSHING, Shaft			1
16	521 1574	08645	.RETAINER,O-RING			1
17	850 0894	08645	.SEAL,O-RING			1
18	890 5908	08645	.SEAL, Oil, DIN 3760 35 x 50 x 7.			1
19	118 0544	08645	.GUIDE, Crank handle assembly.....			1
20	890 7802	08645	WASHER, Lock, DIN 7980 A 6.			2
21	890 7006	08645	SCREW, Socket head, DIN 6912 M 6 x 16.			2
22*	770 0254	08645	.GASKET, Plate cover			1
23	9172944	08645	.PLATE, Cover			1
24	890 4402	08645	.SCREW, Flat head, DIN 963 M 5 x 12			2
25	890 3129	08645	.SCREW, Socket head, DIN 912 M 8 x 70			3
NOTE: See Ref. #14						
26	890 2802	08645	.STUD, DIN 835 M 6 x 12.....			2
27	890 4703	08645	.LOCKNUT, DIN 985 M 6			2
28	734 0326	08645	.OIL FILTER SCREEN			1
29	7701684	08645	.GASKET, Oil filter screen.....			1
30	890 7425	08645	.WASHER, Copper, DIN 7603 A 17 x 23.....			1
31	890 3003	08645	.PLUG, Oil drain, DIN 910 R 3/8.....			1
32	721 0746	08645	.CAMSHAFT ASSEMBLY			1
33	452 0854	08645	.GEAR, Cam			1
34	890 6802	08645	.KEY, DIN 6885 6 x 4 x 12.			1
35	415 1054	08645	.PIN. Shaft			1
36	721 0744	08645	.SHAFT, Cam			1

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
37	850 0884	08645	.SEAL, O-RING			1
38	890 2504	08645	.BEARING, Camshaft.....			1
39	8901908	08645	.RING, Retaining, DIN 471 A 35 x 1.5			1
40	762 1065	08645	.DIPSTICK, Oil			1
41	890 2814	08645	.STUD, DIN 835 M 8 x 20			2
42			.SPRINGS, GOVERNOR NOTE: To replace original governor springs, see RPM stamped on engine identification plate and order by part number from list below			
	540 0292	08645	.GOVERNOR SPRING ASSY 3600 RPM			1
	540 0302	08645	.GOVERNOR SPRING ASSY 3600 RPM, generator only			1
	540 0727	08645	.GOVERNOR SPRING ASSY 3000 RPM			1
	540 0262	08645	.GOVERNOR SPRING ASSY 3600 RPM, generator only.			1
	540 0252	08645	.GOVERNOR SPRING ASSY, 2850 RPM			1
	540 0242	08645	.GOVERNOR SPRING ASSY, 2650 RPM			1
	540 0232	08645	.GOVERNOR SPRING ASSY, 2500 RPM			1
	540 0222	08645	.GOVERNOR SPRING ASSY, 2300 RPM			1
	540 0212	08645	.GOVERNOR SPRING ASSY 2000 RPM			1
	540 0202	08645	.GOVERNOR SPRING ASSY 1800 RPM			1
43	514 0692	08645	.LOCKNUT			2
44	540 0182	08645	.GOVERNOR ASSY			1
45	890 6401	08645	.PIN, Governor			1
46	722 0358	08645	.SPEED CONTROL ASSEMBLY			1
47	622 0224	08645	.ARM, Governor			1
48	807 0114	08645	.SPRING, Return.....			1
49	513 0034	08645	.SCREW.....			1
50	890 4101	08645	.NUT, Castle 1			1
51	941 0274	08645	.LOCKING TAB			1
52	820 0114	08645	.SPRING, Retaining			1
53	850 0044	08645	.SEAL, ORING			1
54	807 0354	08645	.SPRING, Return.....			1
55	403 0234	08645	.SHAFT, Speed control			1
56	805 0114	08645	.SPRING, Detent.....			1
57	415 0914	08645	.PIN, Detent			1
58	890 0101	08645	.PIN, Roll.			1
59	920 0094	08645	.PLATE, Control			1
0	905 1145	08645	.LEVER, Speed control			1
61	890 6509	08645	.WASHER, Internal tooth, DIN 6797 J 8.4			1
62	890 3805	08645	.NUT, Hex, DIN 934 M 8			1
63	110 1435	08645	.HANOLE, Crank.....			1
64	714 0108	08645	.PRIMER ASSEMBLY	1		
65	850 0054	08645	.O-RING	1		
			Included in Gasket Set-Part No. T770 1868			

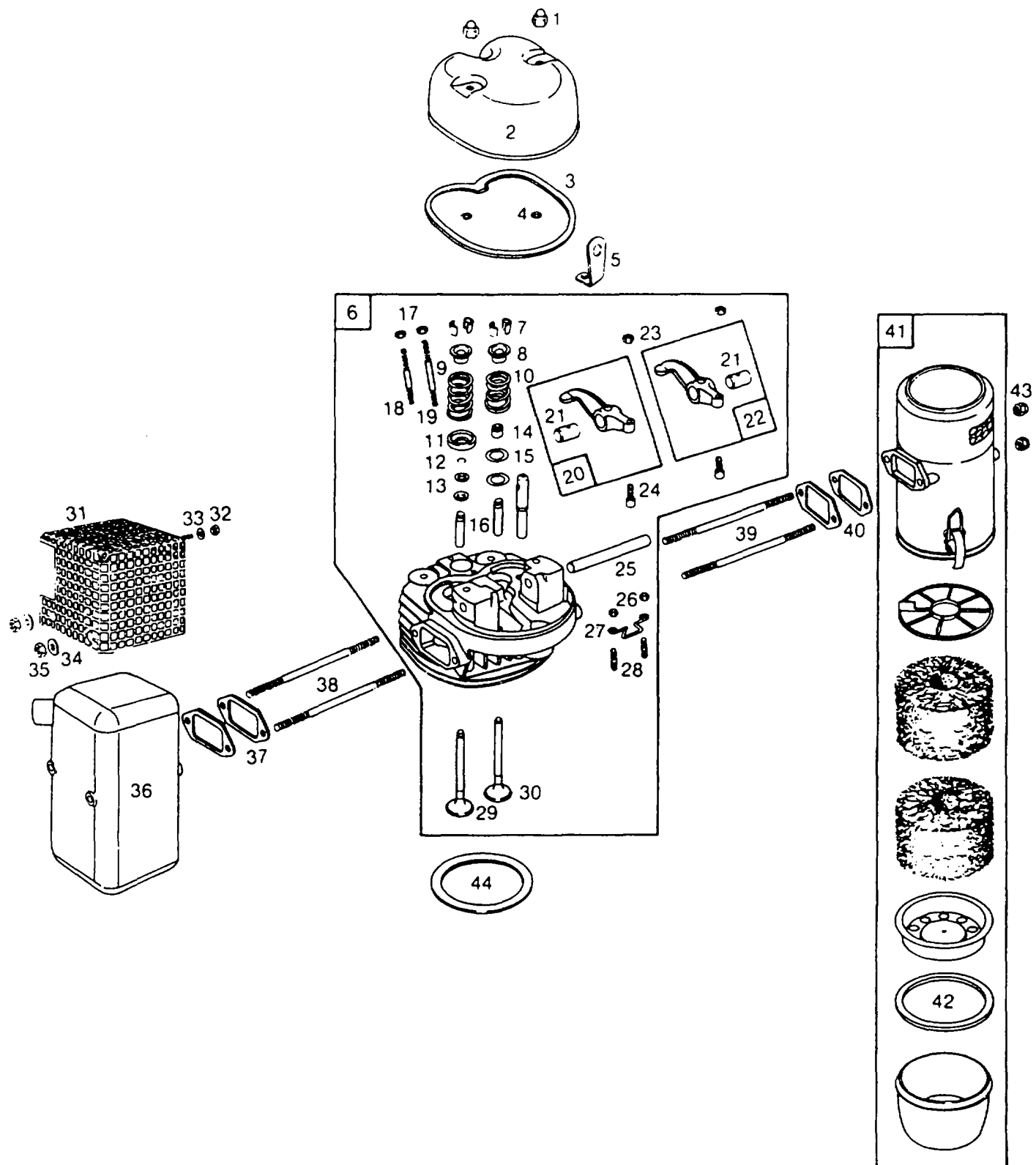


Figure D-18. Cylinder Head, Muffler, Air Cleaner

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-18						
1	5140702	08645	.NUT, Sealing.....			2
			NOTE: 514 0702 nut eliminates need for O-rings, Ref. #4			
2	651 0324	08645	.COVER, Rocker arm.....			1
3 *	770 1424	08645	.GASKET, Rocker arm cover.			1
4	850 0904	08645	.SEAL, O-RING.....			2
			NOTE See Ref. #1			
5	924 0074	08645	.BRACKET, Tote.....			1
6	731 0687	08645	.CYLINDER HEAD.....			1
7	527 0024	08645	.RETAINER, Valve spring			4
8	531 0054	08645	.COLLAR, Valve spring			2
9	805 0474	08645	.SPRING, Exhaust valve			1
10	805 0444	086445	.SPRING, Intake valve			1
11	555 0012	08645	.ROTO CAP			1
12	820 0164	08645	.RING, Retaining.....			1
13	5211314	08645	.WASHER, Valve spring.....			2
14	861 0054	08645	.SEAL, Valve ,			1
15	927 0154	08645	.WASHER, Valve spring.....			2
16	426 0164	08645	.GUIDE, Valve.....			2
17	890 4703	08645	.LOCKNUT, DIN 985 M 6.....			2
18	890 2809	08645	.STUD, DIN 835 M 6 x 45.....			1
			NOTE: This stud goes toward flywheel side Ref. #19 goes toward governor side.			
19	890 2810	08645	.STUD, DIN 835 M 6 x 50.....			1
			NOTE. See Ref. #18			
20	633 0356	08645	.ROCKER ARM, Exhaust.....			1
21	775 0194	08645	.BUSHING, Rocker arm			2
22	633 0346	08645	.ROCKER ARM, Intake			1
23	890 3804	08645	.LOCKNUT, DIN 934 M 7			2
24	513 0174	08645	.SCREW, Adjusting.....			2
25	415 0824	08645	.SHAFT, Rocker arm.....			1
26	890 4202	08645	.LOCKNUT, DIN 985 M 5.....			2
27	807 0414	08645	.SPRING, Retaining			1
28	890 2801	08645	.STUD, DIN 939 M 5 x 20.....			2
29	427 0174	08645	.VALVE, Exhaust			1
30	427 0164	08645	.VALVE, Intake			1
31	925 0795	08645	.GUARD, Muffler			1
32	890 3803	08645	.NUT, Hex, DIN 934 M 6			1
33	890 1003	08645	.WASHER, Lock, DIN 127 A 6			1
34	890 1105	08645	.WASHER, Flat, DIN 137 A 8.....			1
35	890 3805	08645	.NUT, Hex, DIN 934 M 8			2
			NOTE: Older style muffler (round) uses four 890 3805 nuts 2 nuts and 2 Ref. #34 flat washers outside of muffler guard and 2 nuts inside guard			

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
36	742 1035	08645	.MUFFLER			1
37*	770 1824	08645	.GASKET, Muffler mounting			2
			NOTE: One 7701824 exhaust gasket mounted next to muffler, the other gasket mounted between cylinder head and exhaust bracket, Ref. #17, Fig D-1B.			
38	890 2829	08645	.STUD, Muffler mounting, DIN 835 M 8 x 125			2
39	890 2828	08645	.STUD, Air cleaner mounting, DIN 835 M 8 x 115			2
40	770 1584	08645	.GASKET, Air cleaner mounting			2
			NOTE. One 770 1584 intake gasket mounted next to air cleaner, the other gasket mounted between cylinder head and muffler bracket. Ref. #18, Fig D-18.			
41	136 0686	08645	.AIR CLEANER, Oil bath			1
42*	850 0934	08645	.GASKET, Oil cup			1
43	890 4704	08645	.LOCKNUTS			2
44*	771 0174	08645	.GASKET, Cylinder head,			1
			Included in Gasket Set-Part No. 770 1868			

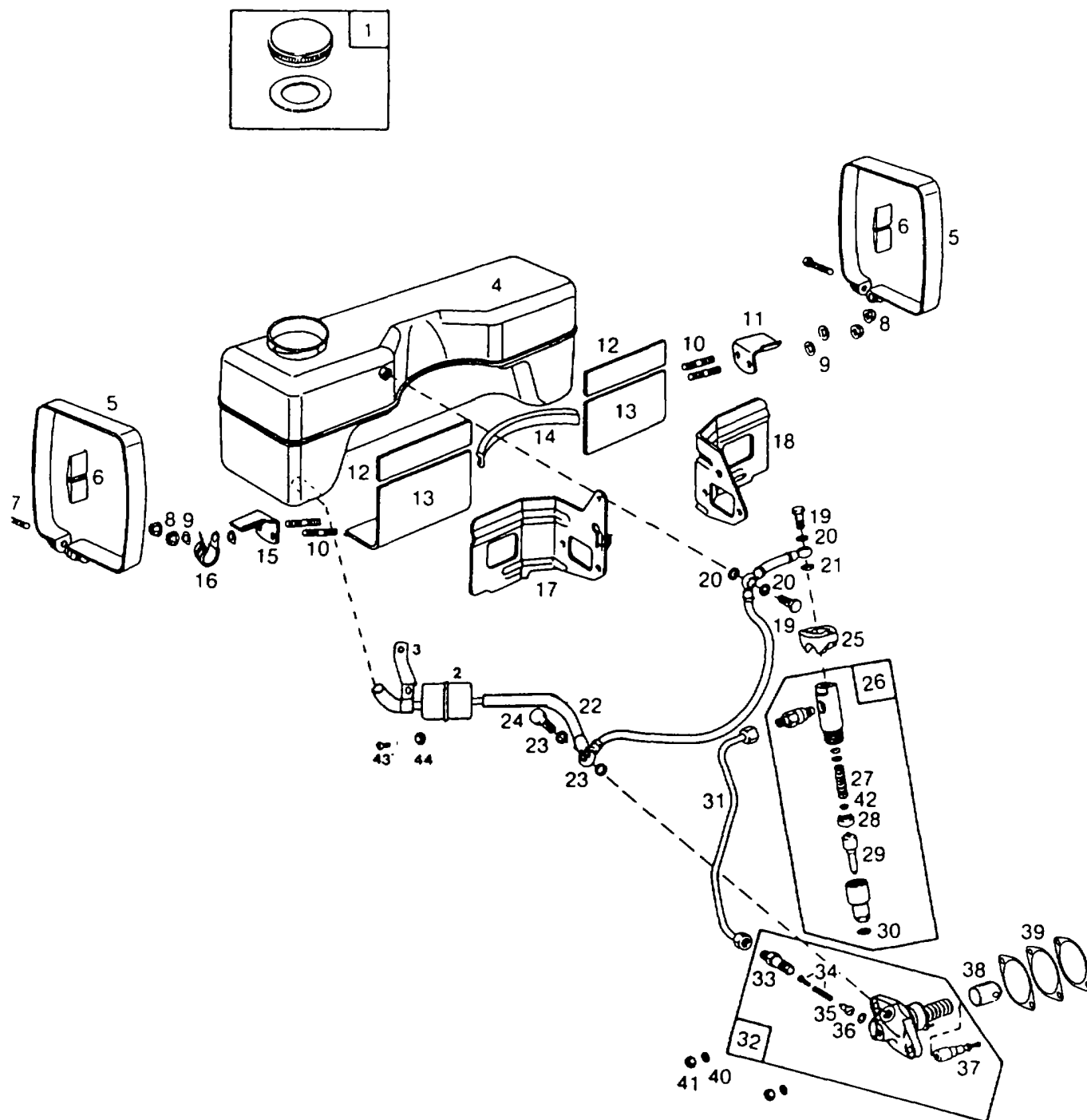


Figure D-19. Fuel Tank, Fuel Lines, Fuel Pump and Injector

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
D-19	1	848 0062	08645	.CAP, Fuel tank		1
			NOTE: Beginning with some model year 34 engines (shown on engine identification plate as 34K54)...., a new style fuel tank, fuel cap and fuel filter are used. The new style system has a smaller diameter fuel cap opening which requires a smaller diameter fuel cap and a smaller diameter fuel filter			
			New style fuel tank cap 848 0062 has a 64 mm outside diameter and is used with new style fuel tank 744 0875 with a 48 mm diameter fuel cap opening			
			Old style cap 848 0072 has a 73 mm outside diameter and is used with old style fuel tank 744 0795 with a 56 mm diameter fuel cap opening.			
	2	541 0382	08645	.FILTER, Fuel		1
	3	922 1654	08645	.BRACKET		1
	4	744 0875	08645	.TANK, Fuel		1
			NOTE: New tank 744 0875 has 48 mm diameter fuel cap opening. Old tank 744 0795 has 56 mm opening They are not interchangeable unless fuel tank caps and fuel filters are also changed.			
	5	922 1212	08645	.STRAP, Fuel tank		2
	6	861 0204	08645	.PROTECTOR, Tank seam		2
	7	890 3724	08645	.SCREW, Hex, DIN 933 M 8 x 45.....		2
	8	890 3805	08645	.NUT, Hex, DIN 934 M 8		
	4					
	9	890 1005	08645	.LOCKWASHER, DIN 127 A 8		
	4					
	10	512 0904	08645	.STUD		4

PARTS LIST						
FIG & ITEM	PART NO	FSCM	DESCRIPTION	ITEM OF SUPPLY PART NO.	NSN	QTY
11923 7124	08645		.Support-Fuel Tank			1
12	852 0124	08645	.Pad-Fuel Tank			2
13	852 0114	08645	.Pad-Fuel Tank			2
14	861 0344	OB45	.Protector-Tank Seam			1
15	923 7134	08645	.Support-Fuel Tank			1
16	820 0364	08645	.Clamp-Fuel Line			1
17	923 7114	08645	.Bracket-Fuel Tank Muffler Side			1
18	923 7014	08645	.Bracket-Fuel Tank Air Cleaner Side			1
19	890 7701	08645	.Bolt-Banjo-DIN 7623 A 3m8xl			2
20	890 7406	08645	.Washer-Copper-DIN 7603 A 8x12			3
21	850 0674	08645	.Washer-Copper			1
22	971 2516	08645	.Line-Fuel			1
23	890 7414	08645	.Washer-Copper-DIN 7603 A 12x16			2
24	890 7702	08645	.Bolt-Banjo-DIN 7623 A6M 12x1 5			1
25	928 0454	08645	.Clamp-Injector			1
26	537 0041	08645	.Fuel Injector			1
27	537 2212	08645	.Spring-Nozzle			1
28	537 2142	08645	.Locator-Nozzle			1
29	537 2082	08645	.Nozzle-Fuel Injector			1
30	850 0704	08645	.Gasket-Fuel Injector			1
31	971 1855	08645	.Pipe-Fuel			1
32	536 0181	08645	.Fuel Injection Pump			1
33	536 2392	08645	.Holder-Delivery Valve			1
34	536 2272	08645	.Spring-Delivery Valve			1
35	536 2172	08645	.Valve-Delivery			1
36	536 2222	08645	.Washer-Delivery Valve			1
37	536 2422	08645	.Element-Plumbing			1
38	536 2322	58645	.Tappet-Roller			1
39	945 0094	08645	.Shim-injection Pump 0.2 mm			
	945 0174	08645	.Shim-Injection Pump 0.5 mm			
	945 0114	08645	.Shim-Injection Pump 1.0 mm			
			Note: Total amount of shims determines engine timing (mm) 8. T. D. C. Check specification chart for correct tolerance.			
40	890 1005	08645	.Washer-Lock-DIN 127 A8			2
41	890 3805	08645	.Nut-Hex-DIN 934 M8			2
42	537 2142	08645	.Plunger-Fuel Injector			1
43	890 3707	08645	.Screw			1
44	890 4703	08645	.Nut			1

NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
8V006	A10-000		D-2	76
8V006	A10-001		D-2	73
8V006	A10-002		D-2	72
8V006	A10-003		D-2	74
8V006	A10-009		D-2	4
8V006	A10-019		D-2	24
8V006	A10-043		D-2	26
8V006	B20-000		D-2	75
8V006	B20-001		D-2	70
8V006	B20-002		D-2	71
9N865	CH25601		D-1	5
9N865	CH304		D-1	3
9N865	CH30801		D-1	4
8V006	CV-4MSS		D-2	18
8V006	C3-7D		D-1	1
8V006	C3-7D		D-2	
8V006	C30-002		D-2	3
8V006	C30-011		D-2	23
8V006	C30-014		D-1	6
8V006	C30-014		D-2	5
8V006	C30-014		D-13	
8V006	C30-015		D-2	21
8V006	C30-016		D-2	22
8V006	DS-7		D-1	
8V006	F-8-4		D-2	16
8V006	FP-166		D-2	64
04147	GS-11		D-2	12
71198	H-1		D-2	7
76005	J2049-3		D-2	43
8V006	MB444687		D-2	29
8V006	MIS-H		D-2	1
57329	N 101		D-8	16
57328	N 102		D-8	15
57328	N 1042		D-8	10
57328	N 1051		D-11	25
57328	N 1057		D-9	20
57328	N 108		D-8	2
57328	N 109		D-4	16
57328	N 1282		D-7	9
57328	N 1314		D-12	6
57328	N 1316		D-2	14
57328	N 1234		D-5	9
57328	N 1316		D-6	21
57328	N 1316		D-7	11
57328	N 1316		D-17	6
57328	N 1316		D-12	11
57328	N 1437		D-8	4
57328	N 1539		D-5	2
57328	N 166		D-4	8
57328	N 171		D-8	1
57328	N 1787		D-4	26
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NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
57328	N 210		D-4	35
57328	N 215		D-4	30
57328	N 2050		D-4	32
57328	N 220		D-4	4
57328	N 2320		D-4	46
57328	N 2466		D-12	4
57328	N 2634		D-4	39
57328	N 2726		D-11	13
57328	N 2768		D-9	9
57328	N 2789		D-7	4
57328	N 2862		D-11	2
57328	N 287		D-8	26
57328	N 2911		D-4	18
57328	N 293		D-4	56
57328	N 3026		D-4	36
57328	N 3207		D-4	54
57328	N 3374		D-10	8
57328	N 3407		D-9	10
57328	N 3459		D-11	21
57328	N 3498		D-8	7
57328	N 3504		D-6	22
57328	N 3520		D-6	13
57328	N 3521		D-6	10
57328	N 3556		D-11	16
57328	N 3623		D-7	8
57328	N 3624		D-7	6
57328	N 3625		D-7	7
57328	N 3702		D-4	10
57328	N 3703		D-4	7
57328	N 3705		D-4	6
57328	N 3707		D-4	19
57328	N 3712		D-4	55
57328	N 3726		D-4	14
57328	N 3737		D-5	3
57328	N 3464		D-8	19
57328	N 380		D-6	14
57328	N 3811		D-7	12
57328	N 3857		D-5	13
57328	N 3857		D-14	53
57328	N 4051		D-9	14
57328	N 4051		D-11	20
57328	N 4064		D-4	59
57328	N 4065		D-4	61
57328	N 4140		D-9	17
57328	N 4158		D-4	40
57328	N 4451		D-10	4
57328	N 4530		D-9	18
57328	N 4530		D-11	26
57328	N 4670		D-5	5
57328	N 4756		D-5	8
57328	N 503		D-6	18

NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
57328	N 53		D-4	
57328	N 57		D-4	13
57328	N 57		D-4	21
57328	N 58			21
57328	N 58		D-4	2
57328	N 58		D-4	22
57328	N 58		D-4	10
57328	N 58		D-9	5
57328	N 58		D-11	30
57328	N 61		D-9	4
57328	N 62		D-12	7
57328	N 70		D-10	5
57328	N 7091		D-9	12
57328	N 781		D-9	7
57328	N 7838		D-5	7
57328	N 7838		D-6	20
57328	N 7838		D-7	10
57328	N 7838		D-11	22
57328	N 83		D-9	2
57328	N 84		D-6	15
57328	N 89		D-4	1
57328	N 89		D-1	11
57328	N 823		D-4	49
45681	NB-2-031		D-2	42
45681	1/4-MRO-S		D-2	33
45681	1/4-CD-S		D-2	35
45681	1/4X1/4F4HGS		D-2	65
45681	1/4X1/8-GG-S		D-2	38
57328	010670-340		D-11	23
57328	011430		D-2	13
57328	011430		D-12	15
57328	011430-635		D-11	10
57328	011656-340		D-11	18
57328	012094-050		D-4	45
57328	012835-080		D-6	3
57328	012841-080		D-6	4
57328	013758-400		D-10	1
57328	014121-080		D-7	3
57328	014151-430		D-11	27
57328	014427-430		D-11	28
57328	014582-080		D-6	2
57328	014608-010		D-4	9
57328	014696-070		D-6	1
57328	014887-635		D-4	33
57328	014892-635		D-4	57
57328	03063-340		D-12	10
94120	0501-07		D14	15
94120	0502-21		D-14	3
94120	0502-33		D-14	17
94120	0502-41		D-14	4
94120	0502-42		D-14	5
94120	0518-21		D-14	1
94120	0524-18		D-14	9
			D-14	

NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
94120	0525-08		D-14	22
94120	0525-14		D-14	28
94120	0525-15		D-14	29
94120	0525-21		D-14	18
94120	0525041		D-14	10
57328	055085		D-12	1
57328	055419		D-12	5
57328	055888-635		D-11	9
57328	056716-500		D-8	21
57328	056904-010		D-4	58
57328	057058-070		D-7	13
57328	058138-341		D-9	6
57328	058260-070		D-5	12
57328	058992-500		D-8	22
94120	0743-03		D-1	
94120	0743-05		D-1	
94120	0757-80		D-1	2
57328	07790-080		D-7	1
94120	0834-00		D-1	
8V006	1 0-005		D-13	7
45681	10255-4-4		D-2	31
57328	1026-640		D-6	8
57328	10528-640		D-10	3
45681	10655-4-4		D-2	32
57328	10875-060		D-4	37
08645	110 1435		D-17	63
57328	1100-080		D-6	6
57328	11612-050		D-14	25
08645	118 0544		D-17	19
8V006	120-1186		D-2	15
57328	12560-090		D-4	34
57328	12754-110		D-8	3
57328	12770-400		D-10	7
57328	12771-400		D-10	2
57328	12784-430		D-11	15
57328	12785-430		D-11	14
57328	12786-430		D-11	12
08645	128 0108		D-17	5
57328	13283		D-12	13
57328	13283-090		D-11	8
08645	136 0686		D-16	41
57328	13662-500		D-8	9
57328	13663-500		D-8	12
57328	13666-110		D-8	5
57328	13757-090		D-10	6
57328	13930-430		D-11	17
57328	13932		D-12	3
57328	13937430		D-11	5
57328	14117-070		D-7	2

NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
57328	14118-070		D-7	5
57328	14123-070		D-6	19
57328	14124-080		D-6	12
57328	14139-500		D-8	17
57328	14150-430		D-11	4
57328	14332-080		D-6	11
57328	14368-655		D-11	3
57328	14370-500		D-8	14
57328	14564-500		D-8	11
57328	14605-510		D-8	24
57328	14874-000		D-4	17
57328	14878-030		D-4	5
57328	14886650		D-4	31
57328	14888-655		D-4	12
57328	14998-860		D-4	3
57328	14998-860		D-8	8
57328	1509-040		D-4	50
08645	18A430		D-2	2
57328	1866-090		D-4	48
57328	1867-090		D-4	23
45681	2-FBU-S		D-2	39
45681	2-112		D-13	6
45681	2-333		D-13	4
45681	2-4-FBU-S		D-2	37
71198	2AK64H		D-2	6
71198	2A76		D-2	9
8V006	20-003		D-13	1
8V006	20-004		D-13	2
57328	2010-090		D-9	1
5H413	20119		D-6	20
76005	206PD-30		D-6	27
76005	206PD-45		D-6	28
8V006	211		D-12	17
57328	228-080		D-11	9
57328	232-080		D-6	7
57328	233-080		D-6	23
57328	2371		D-14	12
57328	2371-635		D-11	7
57328	240-080		D-6	5
57328	279-640		D-6	17
94120	2800-00		D-14	
94120	2800-00		D-1	
94120	2800-13		D-14	20
94120	2800-40		D-14	23
8V006	30-003		D-13	3
57328	3051-070		D-4	44
57328	3110-090		D-4	38
57328	319-080		D-6	16
57328	3196-650		D-4	11
08645	403 0234		D-17	55

NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
45681	4-4-CTX-S		D-2	34
45681	4-4-FBU-S		D-2	36
08645	407-2228		D-2	8
08645	415 0824		D-18	25
08645	415 0914		D-17	57
08645	415 1054		D-17	35
08645	418 0094		D-16	22
57328	4180-040		D-4	29
08645	421 0514		D-17	2
08645	426 0184		D-18	16
08645	427 0164		D-18	30
08645	427 0174		D-18	29
57328	4479-090		D-11	19
08645	452-0794		D-16	16
08645	452 0854		D-17	33
08645	465 1004		D-17	15
08645	470 0084		D-16	15
08645	470 0094		D-16	
08645	470 0124		D-16	
57328	4960-040		D-4	43
08645	509 0184		D-17	9
08645	512 0074		D-16	3
08645	512 0884		D-15	5
08645	5120894		D-15	6
08645	5120904		D-19	10
08645	512 0944		D-17	11
08645	5130034		D-17	49
08645	513 0174		D-18	24
08645	514 0374		D-15	4
08645	514 0374		D-16	24
08645	5140444		D-16	12
08645	5140692		D-17	43
08645	514 0702		D- 18	1
08645	519 0234		D-16	6
45681	520N-4		D-2	30
08645	521 1314		D-18	13
08645	521 1574		D-17	16
08645	527 0024		D- 18	7
57328	5290-080		D-5	11
08645	531 0054		D-18	8
08645	535 0411		D-16	20
08645	536 0181		D-19	32
08645	536 2172		D-19	35
08645	536 2222		D-19	36
08645	536 2272		D-19	34
08645	536 2322		D- 19	38
08645	536 2392		D-19	33
08645	536 2422		D-19	37
08645	537 0041		D-19	26
08645	537 2082		D-19	29
08645	537 2142		D-19	28

NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
08645	537 2142		D-19	42
08645	537 2212		D-19	27
08645	540 0182		D-17	44
08645	540 0202		D-17	
08645	540 0212		D-17	
08645	540 0222		D-17	
08645	540 0232		D-17	
08645	540 0242		D-17	
08645	540 0252		D-17	
08645	540 0262		D-17	
08645	540 0292		D-17	
08645	540 0727		D-17	
08645	540 0302		D-17	
08645	541 0382		D-19	2
57328	55420		D-12	9
57328	55421		D-12	8
08645	555 0012		D-18	11
57328	55664		D-12	2
57328	55678-040		D-4	28
57328	55697-500		D-8	18
57328	55698-500		D-8	25
57328	55699-500		D-8	23
57328	55888		D-1	14
57328	56141-060		D-4	60
57328	56189-060		D-4	47
57328	56301-635		D-9	15
57328	56302-635		D-9	13
57328	56981-650		D-9	19
57328	57132-341		D-9	16
57328	57150-050		D-9	3
57328	58102-341		D-9	8
57328	58119-341		D-9	11
57328	58159-860		D-4	15
57328	58249-500		D-11	29
57328	58258-060		D-4	20
57328	58261-070		D-5	1
57328	58262-090		D-5	6
57328	58310-500		D-8	6
57328	58545-090		D-5	4
45681	6X1/4F50GS		D-2	66
08645	622 0224		D-17	47
08645	633 0346		D-18	22
08645	633 0356		D-18	20
08645	651 0324		D-18	2
08645	711 1237		D-15	7
08645	714 0108		D-17	64
08645	715 0567		D-16	11
08645	718 0497		D-17	8
08645	719 0214		D-15	2
08645	721 0744		D-17	36
08645	721 0746		D-17	32

NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
GIC	7217		D-2	19
08645	722 0358		D-17	46
08645	724 0208		D-15	27
08645	725 0908		D-16	19
08645	726 0276		D-16	23
08645	727 0364		D-16	9
08645	730 0276		D-16	18
08645	731 0687		D- 18	6
08645	734 0326		D-17	28
08645	738 1814		D-15	1
08645	742 1035		D-18	36
08645	744 0875		D-19	4
08645	751 0514		D-15	12
08645	751 0524		D-15	16
08645	762 1065		D-17	40
08645	771 0174		D-18	44
08645	775 0194		D-18	21
08645	775 0204		D-16	17
08645	775 0214		D-16	
08645	775 0244		D-16	
08645	770 0254		D-17	22
08645	770 1424		D-18	3
08645	770 1444		D-16	10
08645	770 1454		D-15	23
08645	770 1484		D-15	24
08645	770 1584		D-18	40
08645	770 1664		D-17	7
08645	770 1674		D-15	28
08645	770 1684		D-17	29
08645	770 1824		D- 18	37
45681	8-333		D-13	5
08645	800 0252		D-16	13
08645	804 0064		D-16	4
08645	805 0114		D-17	56
08645	805 0444		D- 18	10
08645	805 0474		D- 18	9
08645	807 0114		D-17	48
08645	807 0354		D-17	54
08645	807 0414		D-18	27
08645	820 0114		D-17	52
08645	820 0164		D-18	12
08645	820 0364		D-19	16
94120	8200-10		D-14	12
94120	8200-15		D-14	25
94120	8201-20		D-14	14
94120	8202-14		D-14	21
94120	8210-14		D-14	27
94120	8210-11		D-14	2
94120	8210-19		D-14	6
57328	8264-090		D-11	24

NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
94120	8285-10		D-14	11
94120	8285-15		D-14	26
94120	8450-21		D-14	24
94120	8450-58		D-14	16
98645	848 0062		D-19	1
08645	850 0044		D-17	53
08645	850 0054		D-17	65
08645	850 0104		D-16	7
08645	850 0644		D-17	1
08645	850 0654		D-17	6
08645	850 0664		D-17	10
08645	850 0674		D-19	21
08645	850 0704		D-19	30
08645	850 0884		D-17	37
08645	850 0894		D-17	17
08645	850 0904		D-18	4
08645	850 0934		D-18	42
08645	852 0114		D-19	13
08645	852 0124		D-19	12
08645	861 0054		D-18	14
08645	861 0204		D-19	6
08645	861 0344		D-19	14
08645	890 0101		D-17	58
08645	890 1003		D-18	33
08645	890 1005		D-19	9
08645	890 1005		D-19	40
08645	890 1103		D-17	12
08645	890 1104		D-15	29
08645	890 1105		D-18	34
08645	890 1908		D-17	39
08645	890 2023		D-16	8
08645	890 2504		D-17	38
08645	890 2801		D-18	28
08645	890 2802		D-17	26
08645	890 2809		D-18	18
08645	890 2810		D-18	19
08645	890 2814		D-17	41
08645	890 2828		D-18	39
08645	890 2829		D-18	38
08645	890 3003		D-17	31
08645	890 3106		D-15	30
08645	890 3130		D-17	14
08645	890 3131		D-15	3
08645	890 3131		D-15	31
08645	890 3104		D-17	4
08645	890 3129		D-17	25
08645	890 3707		D-18	43
08645	890 3724		D-19	7
08645	890 3803		D-18	32
08645	890 3804		D-18	23
08645	890 3805		D-16	1

NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
08645	890 3805		D-17	62
08645	890 3805		D-18	35
08645	890 3805		D-19	8
08645	890 3805		D-19	41
08645	890 4101		D-17	50
08645	890 4202		D-18	26
08645	890 4402		D-17	24
08645	890 4701		D-15	13
08645	890 4703		D-17	27
08645	890 4703		D-18	17
08645	890 4703		D-19	44
08645	890 4704		D-18	43
08645	890 5908		D-17	18
08645	890 5928		D-18	5
08645	890 6401		D-17	45
08645	890 6509		D-16	2
08645	890 6509		D-17	61
08645	890 6802		D-16	14
08645	890 6802		D-17	34
08645	890 7006		D-17	21
08645	890 7202		D-17	13
08645	890 7406		D-15	22
08645	890 7406		D-19	20
08645	890 7414		D-19	23
08645	890 7425		D-16	30
08645	890 7501		D-15	21
08645	890 7701		D-19	19
08645	890 7702		D-19	24
08645	890 7801		D-15	14
08645	890 7801		D-15	10
08645	890 7802		D-17	20
08645	890 9101		D-16	21
08645	890 9501		D-15	20
08645	890 9501		D-15	15
08645	890 9502		D-15	26
08645	890 9601		D-15	9
08645	890 9602		D-15	17
08645	905 1145		D-17	60
08645	917 1504		D-15	25
08645	917 2044		D-17	23
08645	917 2304		D-15	11
08645	920 0094		D-17	59
08645	921 0254		D-17	3
94120	9210-19		D-14	19
08645	922 1212		D-19	5
08645	922 1654		D-19	3
08645	923 7104		D-19	18
08645	923 7114		D-19	17
08645	923 7124		D-19	11

NATIONAL STOCK NUMBER AND PART NUMBER INDEX PART NUMBER INDEX				
FSCM	PART NUMBER	STOCK NUMBER	FIG.	ITEM
08645	923 7134		D- 19	15
08645	924 0074		D-18	5
08645	925 0795		D-18	31
08645	927 0154		D-18	15
08645	928 0454		D-19	25
08645	934 0404		D- 15	19
08645	934 0414		D-15	18
08645	937 0115		D-15	8
08645	941 0274		D-17	51
08645	945 0094		D-19	39
08645	945 0114		0-19	
08645	945 9174		D-19	
94120	9570-07		D-14	13
08645	971 1855		D-19	31
08645	971 2516		D-19	22

Appendix E

References

E-1. SCOPE

This appendix lists all forms, field manuals, technical manuals and miscellaneous publications referenced in this manual.

E-2. FORMS

DA FORM 2028-2

Recommended Changes to
Equipment Technical Publications

E-3. FIELD MANUALS

FM 20-11-1

Military Diving Manual, Vol. One

E-4. MISCELLANEOUS PUBLICATIONS

Briggs and Stratton
Corp. Manual No. 271451

Engine Service and Repair
Instructions for Engine Model 18A430

National Draeger Inc.,
Special List 2340E 4th Edition

Detector Tube Handbook

SB 708-42
Manufacturers

Federal Supply Code for

By Order of the Secretary of the Army:

Official:

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Brigadier General, United States Army
The Adjutant General

JOHN A. WICKHAM, JR.
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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
 1 decimeter = 10 centimeters = 3.94 inches
 1 meter = 10 decimeters = 39.37 inches
 1 dekameter = 10 meters = 32.8 feet
 1 hectometer = 10 dekameters = 328.08 feet
 1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
 1 decigram = 10 centigrams = 1.54 grains
 1 gram = 10 decigrams = .035 ounce
 1 dekagram = 10 grams = .35 ounce
 1 hectogram = 10 dekagrams = 3.52 ounces
 1 kilogram = 10 hectograms = 2.2 pounds
 1 quintal = 100 kilograms = 220.46 pounds
 1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
 1 deciliter = 10 centiliters = 3.38 fl. ounces
 1 liter = 10 deciliters = 33.81 fl. ounces
 1 dekaliter = 10 liters = 2.64 gallons
 1 hectoliter = 10 dekaliters = 26.42 gallons
 1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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