ELECTRO-MOTIVE

M.I. 926
*Rev. F

MAINTENANCE INSTRUCTION

LUBE OIL FILTRATION

INTRODUCTION

Proper lubricating oil filtration is essential to engine life and efficient, reliable operation. Adequate filter maintenance will provide the lube oil system with ample clean oil. (Refer to the Engine and Locomotive Service Manuals for complete system information.)

FULL FLOW LUBE OIL SYSTEM

The scavenging oil pump draws oil out of the engine oil pan sump through the suction strainers. Oil is pumped under pressure through the main lube oil filter and oil cooler before returning to the strainer housing located at the front of the engine. The main oil and piston cooling oil pumps draw from this supply of filtered, cooled, lube oil to lubricate the engine. In addition, on turbocharged equipment, the lubricating oil to the turbocharger (from the main oil pump) passes through the turbocharger filter, prior to delivery to the turbocharger. Full flow filtration ensures that all of the lubricating oil is filtered before it is supplied to the engine. This is accomplished through the use of a positive sealing gate valve located at the strainer drain, Figs. 6 and 7.

NOTE

Refer to "Four Element Filters" for a system description of applications which do not utilize a positive sealing gate valve.

A bypass valve is provided in the filter tank, however, and will open and bypass lube oil around the filter elements during conditions of cold oil start, or when filter elements are plugged. The filter bypass valve ensures adequate lube oil to the engine, and prevents excessive scavenging oil pump outlet pressures. The valve begins to open at differential pressures above 207 kPa (30 psid), and is fully open at 276 kPa (40 psid).

NOTE

Continued operation with plugged main lube oil filters will eventually cause the turbo filter to plug resulting in a low oil pressure shutdown.

Proper filter elements, correctly installed and maintained, will ensure against bypass during normal operation.

DESCRIPTION

Basically, two types of lubricating oil filter assemblies are used, the single tank-multiple element models, Fig. 1, (available with four, five, seven and ten elements); and the two element-multiple tank model, Fig. 2. Many variations of the two basic assemblies exist. Usage is dependent upon application. (See applicable Parts Catalog.)

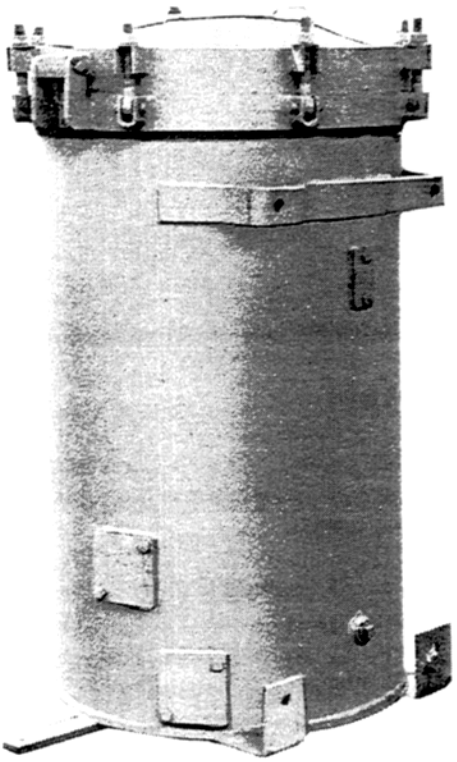
A single spring bypass valve is used on single tank type filters. This bypass valve may be mounted internally, Fig. 1A, or externally, Figs. 1B, 1C, and 1D, dependent upon the filter tank generation.

Replaceable filter elements, Fig. 3, remove contaminants and impurities from the oil as it flows through the filtering media. The cartridge-type element, Fig. 3, is composed of an outer perforated shell surrounding a pleated cotton-paper filter material, a perforated metal center tube, and end caps. Cageless waste elements remain available for older locomotive usage only. (See "Filter Element Characteristics.")

*This bulletin is revised and supersedes previous issues of this number. Areas of change are indicated by vertical bars.

A

TOP FILL
(With Internal Bypass Valve)



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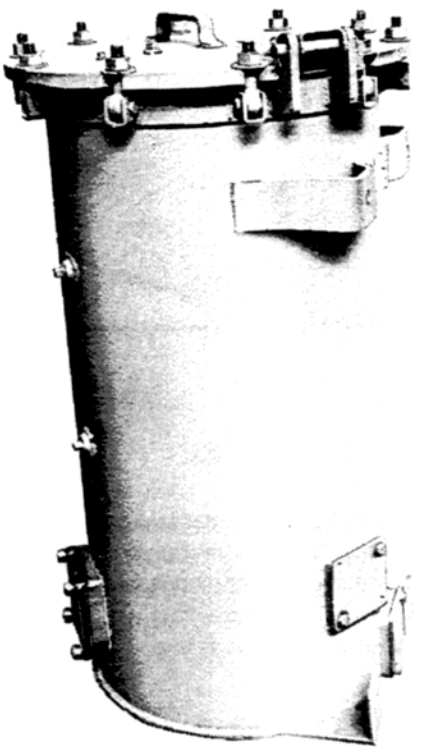
B

INTERNALLY MANIFOLDED
(With External Bypass Valve)



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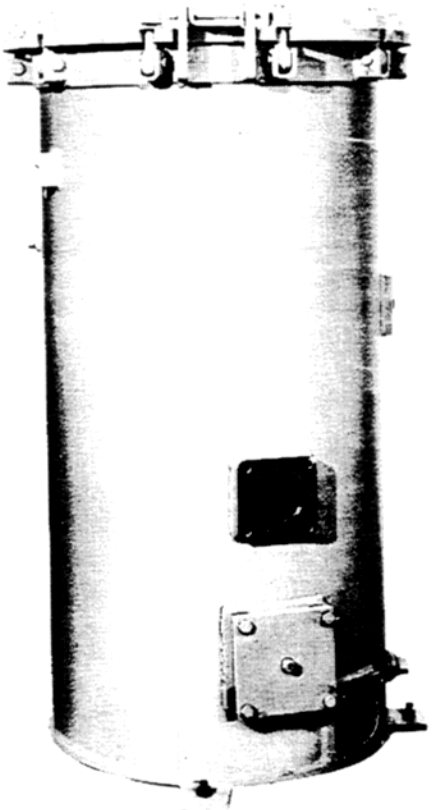
C

STANDARD DESIGN
(With External Bypass Valve)



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D

STANDARD DESIGN
Four Element
(With External Bypass Valve)

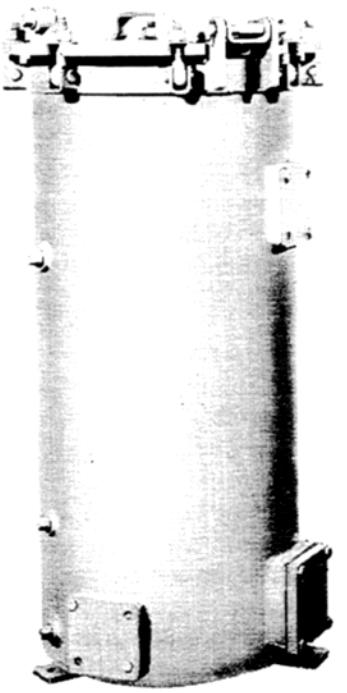

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Fig.1 – Four, Five, Seven, And Ten Element Single Tank Filters

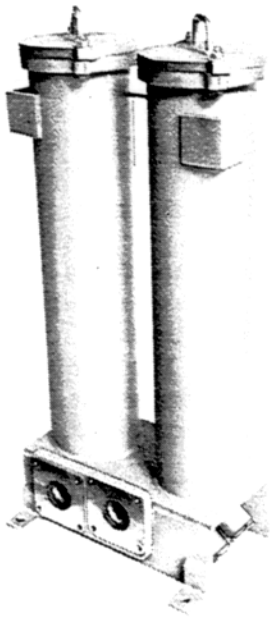


Fig.2 – Multiple Tank Filter

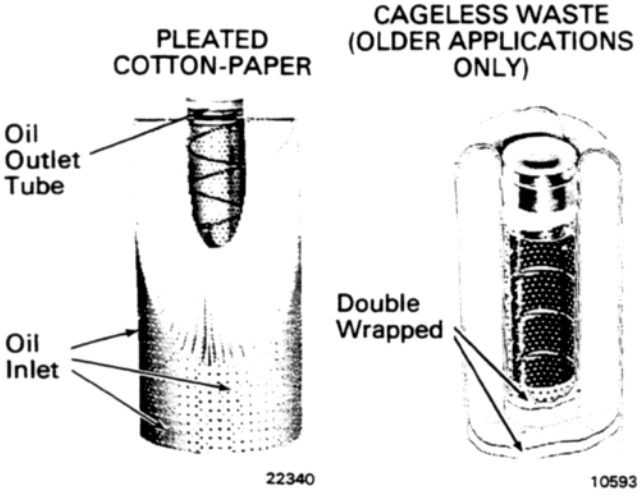


Fig.3 – Filter Elements

SINGLE TANK FILTER(S)

NOTE

For identification purposes, the designations *top fill* and *internally manifolded* are used in this publication to distinguish between different generations of filter housing tanks. The *top fill* designation indicates the latest design, and the designation *internally manifolded* indicates the previous design. *Both designs utilize a top fill/standpipe arrangement.*

TOP FILL SEVEN AND TEN ELEMENT FILTER HOUSINGS

The latest generation top fill single tank filter housing, Fig. 1A, is available in seven and ten element models depending upon the application. This design maintains all of the advantages inherent in the internally manifolded design, and also incorporates the use of an internal bypass valve, Fig. 9, to aid visual inspection of the valve during filter element changeout.

Effective in production approximately January 1985, the top fill seven element tank (with internal bypass valve) replaced the previously used internally manifolded seven element tank, Fig. 1B.

The ten element top fill tank is used on 60 Series locomotives. (These units are equipped with 710 engines which have higher flow rates.)

Refer to Service Data for replacement and service part numbers.

INTERNALLY MANIFOLDED SEVEN AND FIVE ELEMENT FILTER HOUSINGS

Effective February 1977, the internally manifolded seven element filter housing, Figs. 1B and 5 replaced the earlier standard design seven element filter on production equipment. (See Service Data for replacement part numbers.)

Electro-Motive also produces an internally manifolded five element housing, Fig. 6, generally used on export locomotives, twelve cylinder turbocharged engines, or applications where accessory rack weight and size limitations are critical. This filter (mounted in a more compact rack) is slightly smaller and lighter, yet provides good filtration and filter life.

GENERAL INFORMATION

Both the top fill and the internally manifolded designs result in a standpipe effect which retains 75% of the oil in the filter tank during normal shutdown. Oil is prevented from draining back through the scavenging pump into the strainer box through the use of a positive sealing valve (Michiana drain valve) located in the strainer box. Therefore, startup pressure and oiling is virtually immediate.

A hinged cover closes the open end of the tank, and is held tightly by the cover hold-down nuts which should be torqued to 75-81 N·m (55-60 ft-lbs). A 3/4″ sight glass is provided in the cover to allow for visual check of lube oil level in the filter tank, and to govern certain procedures prior to engine start. (See applicable Engine Maintenance and Operator's Manuals for "Starting Procedures.") The 1/4″ male quick-disconnect pressure fitting for monitoring filter pressure drop is also located in the cover near the sight glass. An "O" ring is now used between the cover and rim of the tank for more effective sealing.

Flanged inlet and outlet connections are located at the lower end of the tank opposite the cover, Figs. 4 and 5. The filter drain connection is positioned at the bottom. In some installations, a separate drain line (not shown) extends from the filter to a valve in the engine mounted strainer housing.

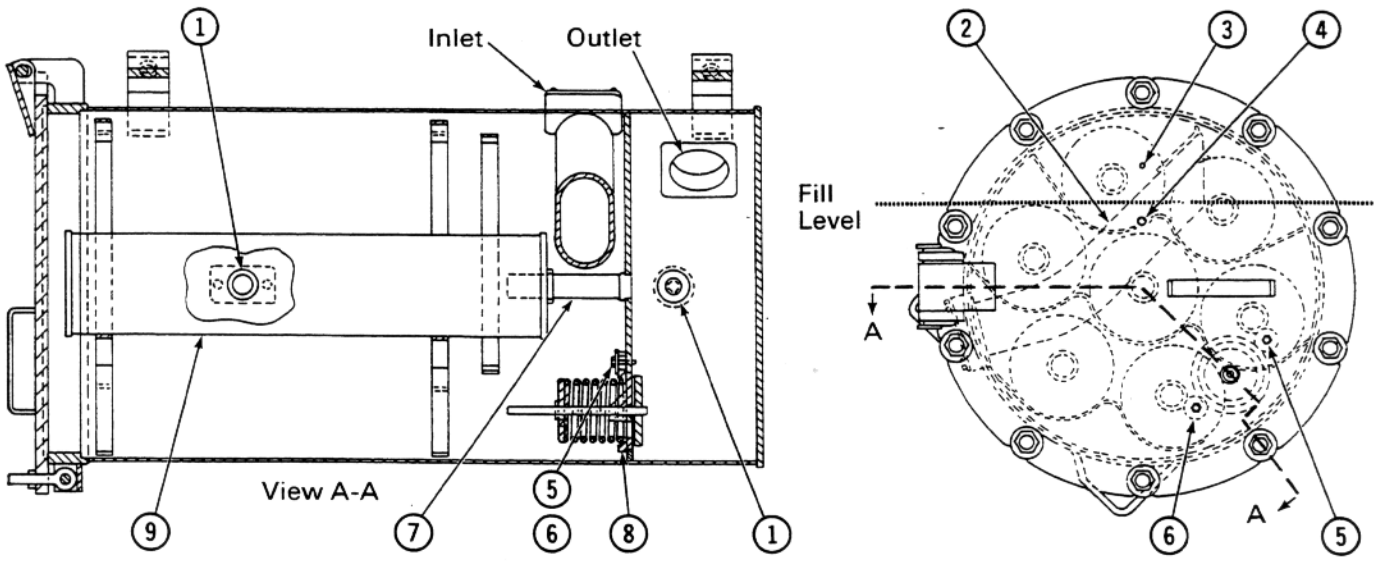
Both the top fill and the internally manifolded filters are compartmentalized by a separator plate. The separator plate is located approximately 305 mm (12″) from the end plate. The filter is divided into the element section which receives the unfiltered oil, and the discharge compartment which receives the filtered oil. Pictorial diagrams, Figs. 6 and 7 show the lube oil filter flow pattern described below.

LUBE OIL FILTER FLOW PATTERN

Oil is pumped from the strainer box through the scavenging pump into the internal inlet manifold (standpipe) where it continues to the top mounted inlet manifold. Oil passes through the openings and circulates through the pleated cotton-paper media of the filter elements. The filtered oil flows through the center of the elements and standpipes to the discharge compartment outlet, where it is directed to the oil cooler.

REPLACING STANDARD SEVEN ELEMENT TANK WITH INTERNALLY MANIFOLDED SEVEN ELEMENT TANK

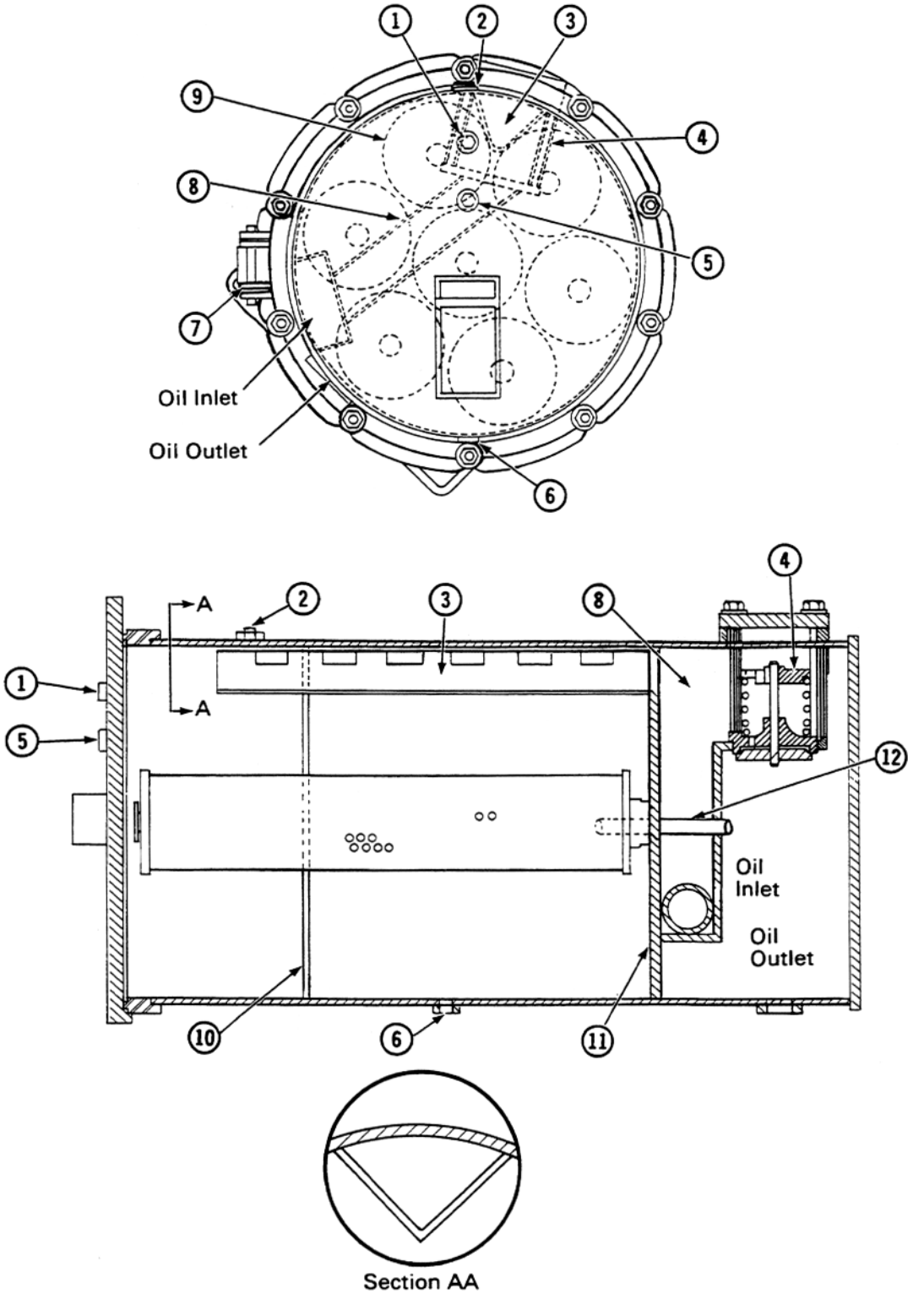
The internally manifolded tanks are interchangeable with the older design seven element tank, however, due to the new location of the inlet, a minor change in inlet piping from the scavenging pump to the tank inlet is required.



1. Drain
2. Fill Standpipe
3. Pressure Test Fitting
4. Sight Glass
5. Bolt 3/8"-16 Hex
6. Washer
7. Filter Element Standpipe
8. Relief Valve Assembly
9. Filter Element

28792

Fig.4 – Top Fill Seven Or Ten Element Filter



1. 1/4" Quick Disconnect Fitting
2. Vent Plug
3. Baffled Inlet Manifold
4. Relief Valve Assembly (276 kPa [40 psid])
5. Sight Glass
6. Drain
7. Cover Hinge
8. Internal Inlet Manifold Standpipe
9. Filter Element
10. Element Cradle
11. Separator Plate
12. Filter Element Standpipe

29004

Fig.5 – Internally Manifolded Seven Element Filter, Simplified Diagram

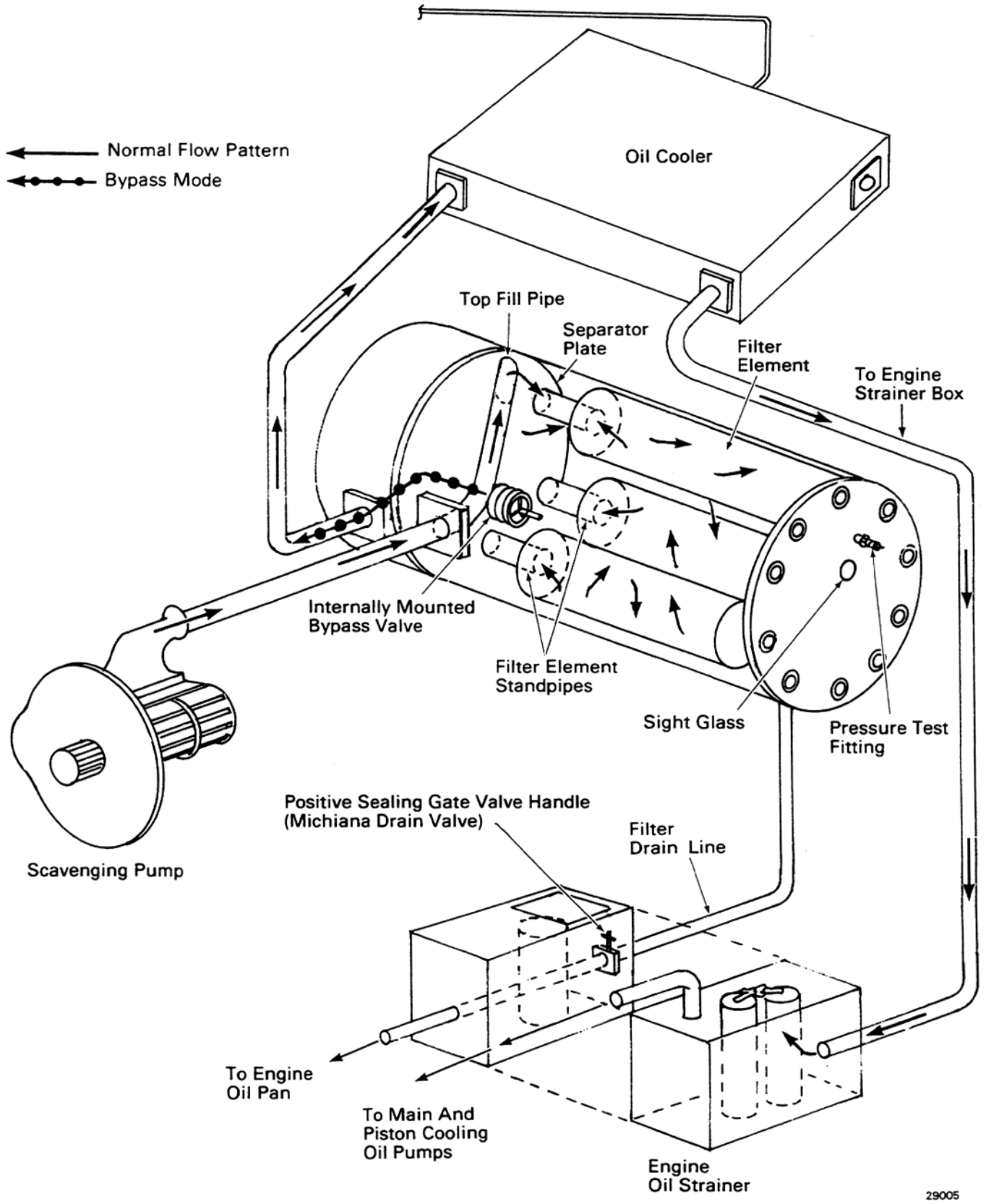


Fig.6 – Pictorial Diagram Of Lube Oil Filter Flow Pattern Through Top Fill Tank

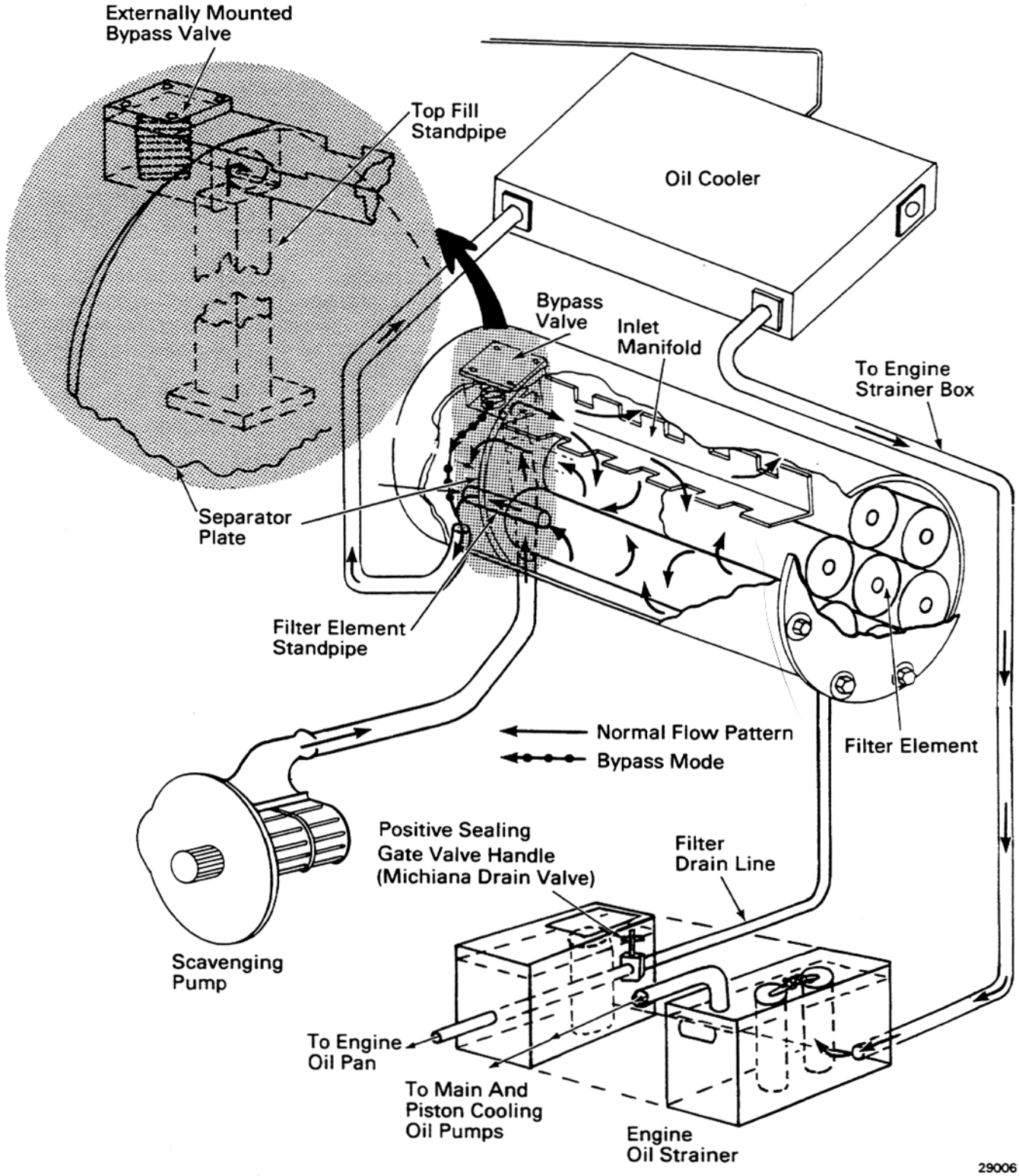


Fig.7 – Pictorial Diagram Of Lube Oil Filter Flow Pattern
Through Internally Manifolded Tank

FOUR ELEMENT FILTERS

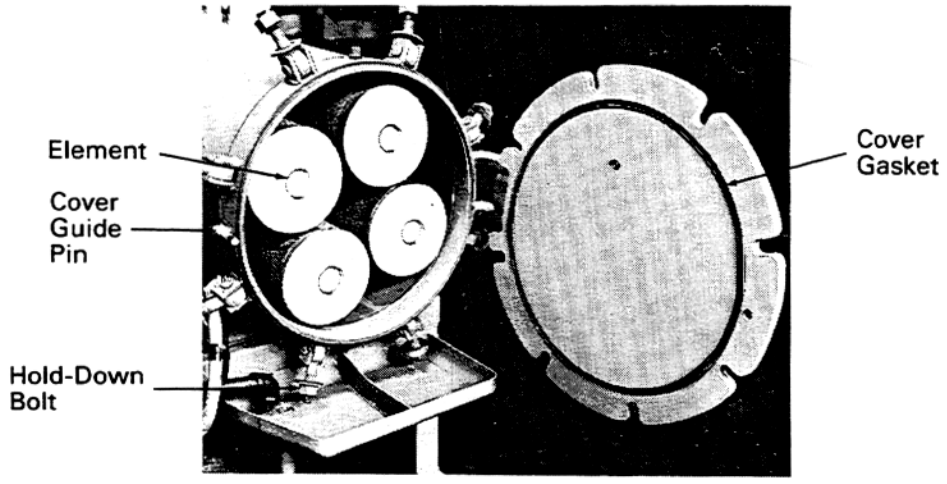
Four element filters, Fig. 8, are basically the same as seven element filters. However, because of the shorter fill time (due to its lower capacity and inlet piping configuration), startup oiling very similar to that of the seven element tank is achieved without the need of internal manifolding and a top fill standpipe.

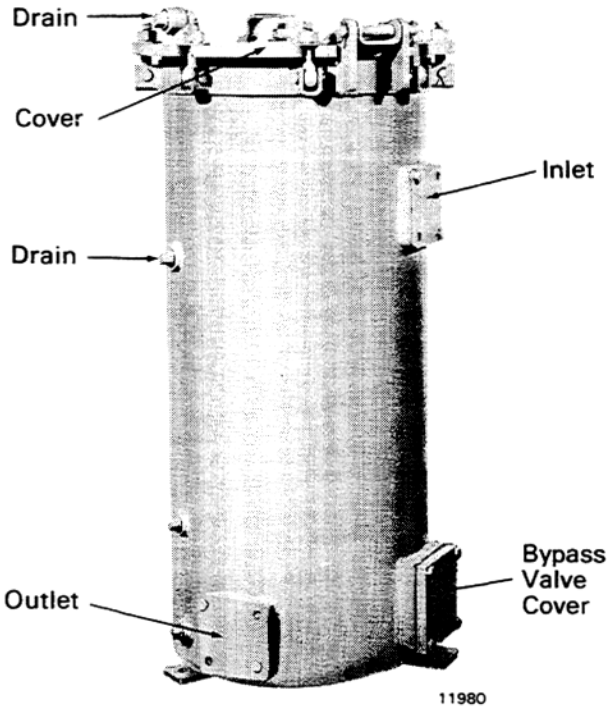
The oil enters the element compartment through the inlet hole, and passes through the pleated cotton paper filter elements flowing down the center of each element and into the discharge compartment. The bypass valve is provided to permit oil circulation in the event of cold oil or plugged filter elements. If the oil pressure exceeds 207 kPa (30 psid), the valve opens and the oil flows directly from the element compartment into the discharge compartment.

FILTER ELEMENT CHARACTERISTICS

PLEATED COTTON-PAPER

The filter element is made up of pleated filter paper, a metal center tube and end caps, and a paper outer jacket. The filter paper is corrugated to maintain pleat spacing, and to allow the lube oil to pass





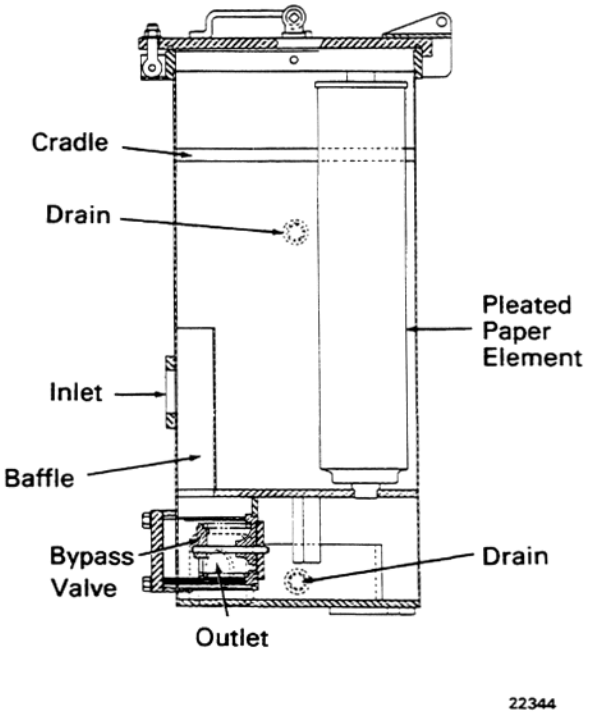


Fig.8 – Four Element Filter

between the center tube and the filter paper. The metal center tube supports the inside diameter formed by the filter paper pleats. The outer jacket, and/or netting, is bonded to the outer edges of the pleats to maintain spacing.

Filter element life is primarily dependent on a combination of two factors: (1) contaminant holding capacity; and, (2) filter paper structural stability. When high dispersant lube oils are used, contaminant plugging of the filter paper is not usually the major factor in establishing filter element life. Structural stability of the filter paper, therefore, becomes the primary factor governing element life. The filter paper and phenolic resins deteriorate, in time, in hot lube oil. The rate at which this occurs is dependent on the inherent characteristics of the paper media, resin, and on oil temperature. Because there are many possible paper and resin combinations, coupled with variable lube oil temperature environment, a positive filter element life cannot be predicted for all filter element applications.

This deterioration results in loss of the structural integrity necessary to resist the pressure differential across the element. As deterioration occurs, the filter paper corrugations around the center tube start to collapse, and the pressure drop across the element consequently increases. The more the corrugations collapse, the more the filter paper gathers around the center tube, resulting in a rapidly increasing pressure drop across the element. When this condition is severe, the filter paper can be extruded into the holes in the center tube. Once the filter starts collapsing, service life becomes very short. The final result is that the filter plugs, causing the oil to bypass the filter elements.

The structural stability of the filter paper is also affected by the presence of water in the lube oil. The pressure drop accelerates when this occurs. The longer the filter elements have been in service, the more sensitive they are to the presence of water.

COTTON WASTE FILTER (OLDER APPLICATIONS)

Cageless cartridges have tapered sections of loose waste packed uniformly into the cartridge between a knit cotton double-layered inner and outer sock. Both layers of inner sock are wire tied to the perforated center tube which is open at the bottom, and end capped at the top. A reinforcing spring supports the inside diameter of the center tube. Oil filtration is accomplished through media penetration and holding capacity. Because of their inability to provide full flow filtration, waste filters are no longer recommended for EMD applications.

SINGLE TANK FILTER ELEMENTS

All current single tank lube oil filters are supplied with pleated cotton-paper elements. However, some older units used the cageless cotton waste element.

MULTIPLE TANK FILTER ELEMENTS

The two element multiple tank filter uses pleated cotton-paper elements.

MULTIPLE TANK FILTER

The two element tank filter assembly shown in Fig. 2, has two individual filter housings mounted on a common base. Each housing contains one filter element.

The base is divided into inlet and outlet manifolds. The filter housings are located above openings to these manifolds so the outside of the filter element is connected to the inlet manifold, and the center or discharge portion of the element is connected to the oil outlet manifold. Flanged pipes to each manifold are provided for external oil line connections.

Three internal bypass valves, Fig. 11, (located in the base of the filter) operate simultaneously so oil can bypass the filter elements in the event of high pressure caused by cold oil, dirty elements, or oil flow in excess of the element capacity.

Each individual housing is provided with a removable cover to permit application and removal of the filter elements. The cover is bolted to the housing, and a gasket seals the cover.

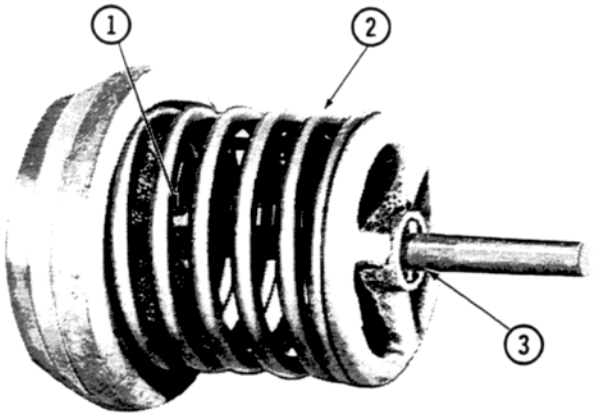
MAINTENANCE

ELEMENT CHANGEOUT AND FILTER TANK CLEANING

Maintenance intervals for the lube oil filter should be followed so the elements are changed prior to being bypassed. In addition, lube oil filter tank pressure monitoring should be performed regularly. Unusual conditions which warrant flushing of the diesel engine lubricating system also require element replacement. See applicable Scheduled Maintenance Program and M.I. 1757.

BYPASS VALVES

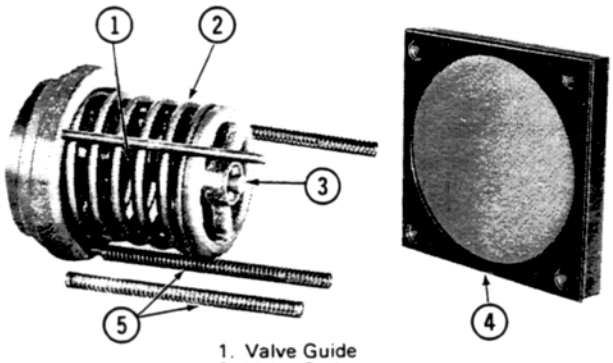
Filter bypass valves, Figs. 9, 10, and 11, should be removed and checked periodically at intervals stipulated in the Scheduled Maintenance Program or whenever improper oil filtration is suspected.



1. Valve Guide
2. Valve Spring
3. Poppet Valve And Stem

28999

Fig.9 – Single Spring Internal Bypass Valve Assembly



1. Valve Guide
2. Valve Spring
3. Poppet Valve And Stem
4. Cover Plate And Gasket
5. Assembly Retaining Springs

29007

Fig.10 – Single Spring External Bypass Valve Assembly

21714

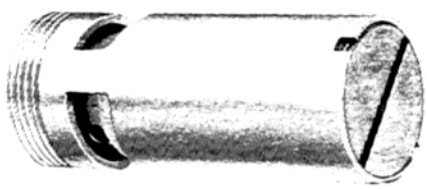


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Fig.11 – Multiple Tank Filter Internal Bypass Relief Valve Assembly

SINGLE SPRING INTERNAL BYPASS VALVE ASSEMBLY

This valve, Fig. 9, is mounted on the separator plate within the filtering compartment of top fill seven and ten element filters, Fig. 4.

PROCEDURE

1. After the oil has been drained from the filter housing, the elements removed, and the housing cleaned, remove the hold-down bolts from the bypass valve assembly and remove the assembly.

NOTE

The use of socket wrench extensions and an appropriate length of pipe that will slip over the protruding 13 mm (1/2″) diameter valve stem is recommended for ease of removal.

2. Wash the valve assembly in solvent to remove sludge and varnish. Carefully inspect assembly after cleaning. If poppet stem or valve body guide is worn, install replacement parts.

3. Test valve spring by compressing it to a height of 92 mm (3-5/8″). If pressure test indicates values outside of those shown under Specifications, install a new spring.

4. Reinstall qualified bypass valve assembly in filter (or replace, if necessary). Properly seat the assembly and tighten the hold-down bolts to 33 N·m (24 ft-lbs) torque.

SINGLE SPRING EXTERNAL BYPASS VALVE ASSEMBLY

This valve, Fig. 10, is located inside the oil discharge compartment on the previous design internally manifolded single tank type filter, Fig. 5.

PROCEDURE

1. After the oil has been drained from the filter housing, the elements removed, and the housing cleaned, remove the four hold-down nuts from the bypass valve port cover. Remove the valve assembly and discard the port cover gasket.

2. Wash the valve assembly in solvent to remove sludge and varnish. Carefully inspect assembly after cleaning. If poppet stem or valve body guide shows wear, install replacement parts.

3. Test valve spring by compressing it to a height of 92 mm (3-5/8″). If pressure test indicates values outside of those shown under Specifications, install a new spring.

4. Reinstall bypass valve assembly in filter. Ensure proper seating through placement of the three light guide springs.

5. Apply a new port cover gasket, and the port cover.

6. Tighten the cover hold-down nuts to 81.4 N·m (60 ft-lbs) torque, using standard tightening procedure.

MULTIPLE TANK INTERNAL BYPASS VALVE

1. After draining the tank, remove the hexagon plug, slotted head screw plug, spring, and piston, Fig. 11.

2. Clean and inspect the parts, and check the springs for proper tension. Minimum lengths of springs should not be less than 73 mm (2-7/8″) under a compressive load of 27.2 kg (60 lbs). If the springs do not meet these requirements, new springs should be installed.

3. Reassemble the valves by inserting the piston (closed end first), and insert the spring. Apply the spring screw plug all the way to the stop. Apply a new gasket on the hexagon plug and tighten it in place.

FOUR ELEMENT MULTIPLE TANK FILTER

NOTE

The four element multiple tank lube oil filter, Fig. 12, is included in this document as a matter of general information for those few customers having specifically requested this design. Its inclusion does not imply a blanket recommendation of this equipment for all applications.

In those instances where, by customer request, EMD has complied and applied this equipment, suitability of the application was predetermined based on the flow rates involved for the specific application. *Only where flow rates were deemed low enough to permit the use of a four element and standpipe design was this filter applied.*

This system consists of four filter housings with a common base, and utilizes 254 mm (10″) diameter elements and a single spring internal bypass valve.

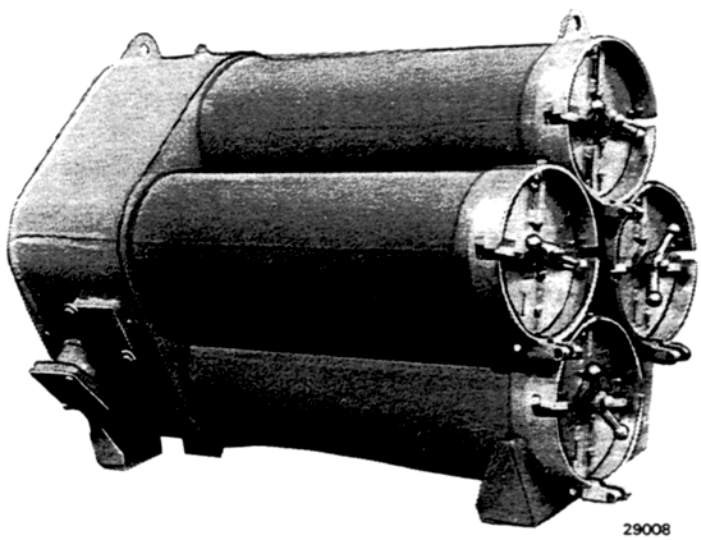

Fig.12 – Four Element Multiple Tank Filter

SERVICE DATA

TANK APPLICATION CHART

SINGLE TANK FILTERS

Top Fill Design

Tank (10 elements)	9557227
Tank (7 elements)	9536958
Filter Element (Pleated Cotton-Paper)	8345482
Bypass Valve Assembly (Single Spring, Internal)	9536955
Poppet Assembly	9536951
Valve Body	9536954
Retainer	9536953
Valve Spring	8317190
"O" Ring Seal (Cover) - 7 Element Tank	9544431
10 Element Tank	9557274

Internally Manifolded Design

Tank (7 elements)	9328261
Filter Element (Pleated Cotton-Paper)	8345482
Bypass Valve Assembly (Single Spring, External)	8320705
Poppet Valve	8322839
Valve Body	8322840
Spring Guide	8322841
Valve Spring	8317190
Valve Port Cover Gasket	8296030
"O" Ring Seal (Cover)	9544431
Tank (5 elements)	9562288
Filter Element (Pleated Cotton-Paper)	8345482
Bypass Valve Assembly (Single Spring, External)	8320705
Poppet Valve	8322839
Valve Body	8322840
Spring Guide	8322841
Valve Spring	8317190
Valve Port Cover Gasket	8296030
"O" Ring Seal (Cover)	9544262

SINGLE TANK FILTERS (Cont'd)

Standard Design Tank

Tank (7 elements)	9098654
Tank (7 elements)	8362640
Filter Element (Pleated Cotton-Paper)	8345482
Bypass Valve Assembly (Single-Spring, External)	8320705
Poppet Valve	8322839
Valve Body	8322840
Spring Guide	8322841
Valve Spring	8317190
Valve Port Cover Gasket	8296030
Cover Gasket	8268756
Tank (4 elements)	8373237
Tank (4 elements)	8412880
Tank (4 elements)	8449807
Filter Element (Pleated Cotton-Paper)	8345482
Bypass Valve Assembly (Single-Spring, External)	8320705
Poppet Valve	8322839
Valve Body	8322840
Spring Guide	8322841
Valve Spring	8317190
"O" Ring Seal (New Design Tank)	9547509
Cover Gasket (Old Design Tank)	8330035

Multiple Tank Design

Four Element Multiple Tank	9571481
Filter Element	9545152

FILTER ELEMENTS

Pleated Cotton-Paper	8345482
Cageless Waste	8275432

BYPASS VALVE ASSEMBLY

Single-Spring, Internal	9536955
Single-Spring, External	8320705
Internal (Used on two-element multiple tank filter)	8213373

PRESSURE TEST KIT

Kit; Lube Oil Tank Pressure Test (0-100 psi gauge, hose, and female quick disconnect fitting)	9325061
Quick Disconnect Male Fitting	9321340
Quick Disconnect Female Fitting	9321341

SPECIFICATIONS

Weight required to compress valve spring 8317190 92 mm (3-5/8″) must not be less than 182 kg (400 lbs) or more than 227 kg (500 lbs). Poppet stem wear step should not exceed 0.25 mm (0.010″) (0.51 mm [.020″] on the diameter). The valve body pilot should not exceed 13.34 mm (0.525″) bore diameter.

REFERENCES