SD45
LOCOMOTIVE
SERVICE MANUAL

The Railway Educational Bureau

THIS MANUAL TO BE USED TO COMPLETE LESSONS

LS. 1M thru LS. 5M

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Electro-Motive Division
La Grange, Illinois

GM
MARK OF EXCELLENCE

The Railway Educational Bureau ■ *1809 Capitol Avenue* ■ *Omaha, Nebraska 68102*

FOREWORD

This manual covers mechanical and electrical maintenance. Its purpose is to provide instructions for what may be called "on-the-locomotive" maintenance, along with instructions for testing and adjustment of systems. It will also serve to relieve the locomotive operating manual of detail and to provide under separate cover material for general familiarization with locomotive components and systems.

Instructions for maintenance that requires deep involvement with component repair, or instructions for rework that involves use of bench apparatus, continues to be presented in the standard EMD Maintenance Instruction form. Instructions covering the diesel engine appear in the EMD Engine Maintenance manual. Certain engine mounted equipment may receive brief mention in this locomotive service manual, but information in the engine maintenance manual covering such equipment takes precedence.

SERVICE DATA PAGES

A Service Data page is included at the back of each section of the Locomotive Service manual. This page provides the following:

1. Reference to applicable Maintenance Instructions.
2. Reference to applicable replacement part numbers.
3. Reference to component manufacturer's technical literature.
4. Reference to applicable tool and testing apparatus numbers.
5. Reference to instruction file numbers for customer manufacture of testing apparatus.
6. Specific system values for operation or testing.

SD45 GENERAL INFORMATION

Model Designation	SD45
Locomotive Type	(C-C) 0660
Locomotive Horsepower	3600
Diesel Engine	
Model	645E3
Number Of Cylinders	20
Cylinder Arrangement	45° "V"
Cylinder Bore And Stroke	9-1/16" × 10"
Operating Principle	2 Stroke Cycle, Turbocharged, Unit Injection, Water Cooled
Full Speed	900 RPM
Idle Speed	315 RPM
Main Generator Model	AR10 - D14
Traction Alternator (Rectified Output)	AR10
Number Of Poles	10
Nominal Voltage (DC)	600
Frequency (at 900 RPM)	75 cps
Companion Alternator	D14
Nominal Voltage (AC)	215
Number Of Poles	16
Frequency (at 900 RPM)	120 cps
Auxiliary Generator	
Voltage (DC)	74
Rating	10 KW
Traction Motors	
Model	D77
Number	6
Type	DC, Series Wound, Axle Hung
Driving Wheels	
Number	6 Pair
Diameter	40"
Tread	Tapered

SD45 GENERAL INFORMATION (CONT'D)

Curve Negotiation

Truck swing limits single unit curve negotiation to a 30° or 193 ft. radius curve.
Single unit coupled to a 50 ft. car is limited by car coupler swing to a 17° or 338 ft. radius curve.
Two (2) units coupled in multiple limited by footboards to a 23° or 250 ft. radius curve.

Maximum Speed Options With Gear Ratio
And Continuous Ratings

Gear Ratio	Top Speed MPH	Continuous Drag MPH
62:15	71	11.3
61:16	77	12.2
60:17	83	13.2
59:18	89	14.2

Air Brakes ..... Type 26L

Air Compressor
- Type ..... 2 Stage
- Number Of Cylinders 3
- Capacity (at 900 RPM) ..... 254 Cu. Ft./Min.
- Air Compressor Cooling ..... Water
- Lube Oil Capacity ..... 10-1/2 Gal.

Storage Battery
- Number Of Cells 32
- Voltage 64
- Rating (8 Hour) ..... 420 Amp Hr.

Supplies

Lube Oil Capacity
- Basic Oil Pan ..... 294 Gal.
- Increased Capacity Oil Pan ..... 466 Gal.

Usable Oil
- Basic Oil Pan ..... 92 Gal.
- Increased Capacity Oil Pan ..... 234 Gal.

Fuel Tank Capacity
- Basic ..... 3200 Gal.
- Modifications ..... 4000 Gal.
  3600 Gal.
  2600 Gal.
  1700 Gal.

SD45 GENERAL INFORMATION (CONT'D)

Cooling Water Capacity	288 Gal.
Sand	56 Cu. Ft.

Major Dimensions

Distance, pulling fact of coupler to centerline of truck	12' 10"
Distance between bolster centers	40' 0"
Truck - rigid wheel base	13' 7"
Distance, pulling face front coupler to rear coupler	65' 8"
Width over cab sheeting	10' 0"
Width over grab irons	10' 3-1/8"
Height, top of rail to top of colling fan guard	15' 7-3/16"
Width over basic arm rests	10' 4"
Approximate Weight On Rails	368,000 lbs.
Weight On Drivers	100%

WEIGHTS

The weights as listed below are approximate and are intended as an aid in determining the handling procedure to be used. Weights represent lbs. per unit as described.

20-645E Diesel Engine	40600
Starter Motor	80
Starter Motor Bracket	60
Engine Governor	120
Turbocharger	1800
AR10 Main Generator Assembly	18000
Engine Air Filter Oil-Type	917
Inertial Air Filter	600
Inertial Filter Screen	35
Inertial Filter Compartment And Hatch	4700
Inertial Filter Hatch - Less Filters	500
Fuel Tank 3200 Gal.	6650
Fuel Tank 4000 Gal.	9940
Truck Assembly	56000
Traction Motor	6000
Axle	4150
Wheel	1015
Gear 62 Tooth	409
Bearing - Inner Race	33
Air Compressor	2325
Air Compressor Shaft Guard	68
Air Compressor Coupling	48
Lube Oil Cooler	845
Lube Oil Filter	675

SD45 GENERAL INFORMATION (CONT'D)

EMD SERVICE DEPARTMENT

LOCOMOTIVE SERVICE MANUAL

FUEL SYSTEM

DESCRIPTION

A pictorial diagram of the fuel oil system is shown in Fig. 1-1. Fuel is drawn from the storage tank through a suction fuel strainer by the motor driven gear type fuel pump.

From the pump the fuel is forced through a large vertical fuel filter to the engine mounted filter. After passing through the double element engine mounted filter, the fuel flows through manifolds that extend along both banks of the engine.

These manifolds supply fuel to the injectors. The excess fuel not used by the injectors returns to the fuel tank through the return fuel sight glass mounted on the filter housing. A restriction inside the return glass causes a back pressure, thus maintaining a positive supply of fuel for the injectors.

The fuel pump delivers more fuel to the engine than is burned in the cylinders. The excess fuel circulated is used for cooling and lubricating the fine working parts of the injectors.

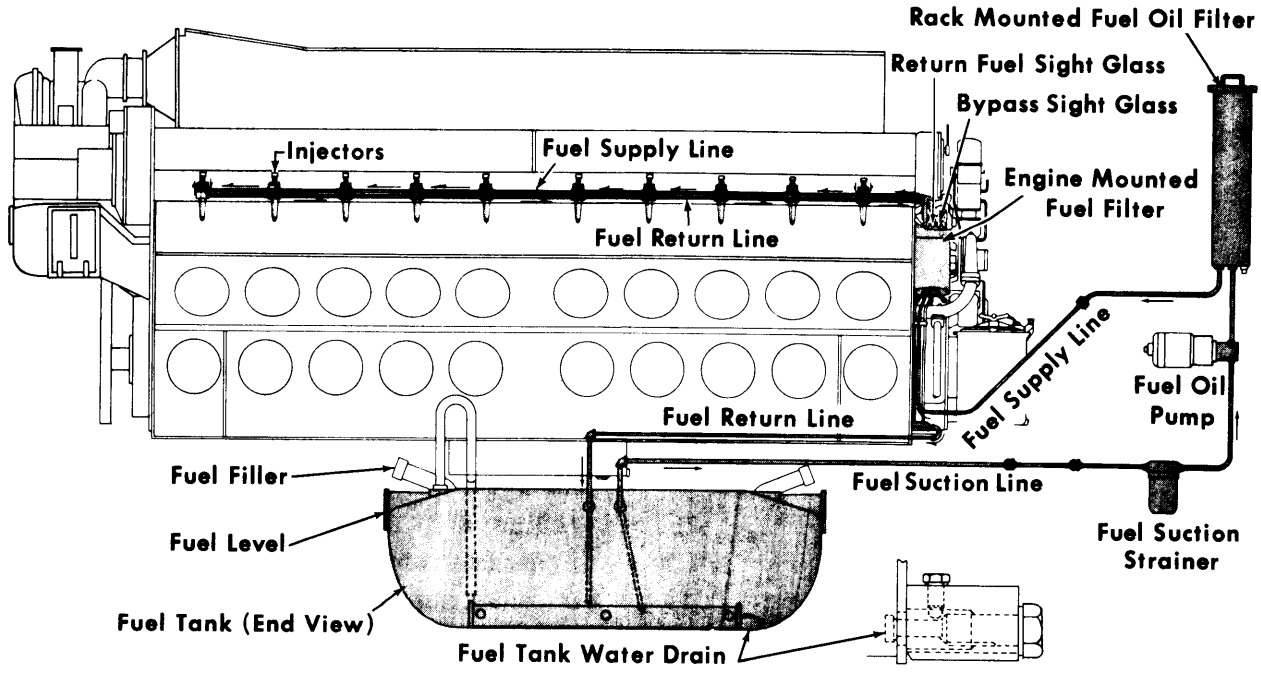

Fig. 1-1 — Fuel Oil System Pictorial Diagram

FUEL SIGHT GLASSES

Two sight glasses, Fig. 1-2, are located on the engine mounted filter housing to give visual indication of fuel system condition.

For proper engine operation the return fuel sight glass (the glass nearer the engine) should be full, clear, and free of bubbles. The fuel flowing through this glass is the excess not required by the engine. Upon leaving the glass it returns to the fuel tank for recirculation.

At the time of engine start the sight glass will be empty. When the fuel system is primed, turbulent flow will occur and then the fuel in the glass will flow clear and free of bubbles. At such time the engine may be cranked.

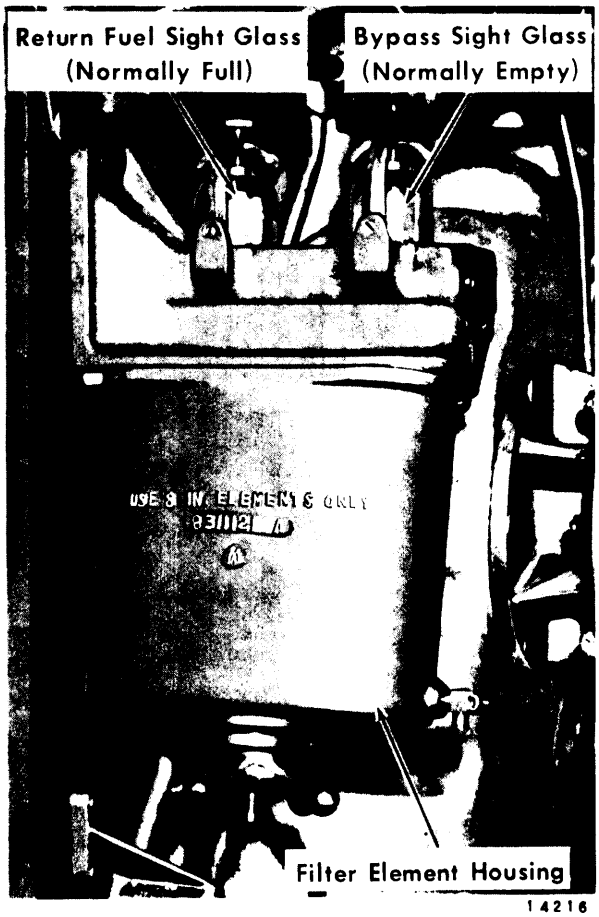

Fig. 1-2 — Fuel Oil Sight Glasses

The engine mounted filter is also equipped with a bypass relief valve and sight glass. This sight glass, farther from the engine, is normally empty. When more than a trickle of fuel is seen in the bypass sight glass, it indicates that the relief valve is open. Fuel will pass through the bypass sight glass and relief valve to bypass the engine and return to the fuel tank in case the filter elements become clogged. This condition may become serious and cause the engine to shut down from lack of fuel.

EMERGENCY FUEL CUTOFF SWITCHES

In the event of an emergency, the fuel supply to the engine can be stopped by pressing in on any one of the three emergency fuel cutoff switches. Two switches are located, one on either side of the locomotive, at the fuel tank, and the third switch is located at the upper left hand side of the electrical cabinet in the cab. The switches are connected in series with the fuel pump contactor FPC. Pressing in on any of the switch buttons momentarily will de-energize the FPC, stop the fuel pump, and shut down the engine. The buttons are spring loaded and do not need to be reset. See the fuel pump circuit drawing at the end of this section.

MAINTENANCE

FUEL STORAGE FACILITIES

The presence of slime on fuel filters indicates that bacteria and fungi are present in troublesome quantities. Water in the fuel storage tanks should be kept at the minimum possible level. Contact the Electro-Motive Division of General Motors Corporation or the fuel oil supplier for recommendations regarding antiseptic treatment of fuel storage facilities.

DRAINING CONDENSATE FROM THE FUEL TANK

Condensate should be drained from the locomotive fuel tank at the intervals stipulated in the Scheduled Maintenance Program, or more frequently if conditions warrant. During draining, the locomotive should be placed on an incline with the drain end of the tank facing down hill. This will ensure that the condensate accumulates at the drain plug, Fig. 1-1, and allow adequate drainage without loss of fuel. The drain plug is secured to the drain block by a retaining screw. The plug should be loosened until the drain slot in the plug is exposed. Inspect the drain plug gasket whenever condensate is being drained from the fuel tank.

FILLING THE FUEL TANK

The fuel tank can be filled from either side of the locomotive. A short sight level gauge is located next to each fuel filter. This fuel gauge indicates the fuel level from the top of the tank to about 4-1/2" below the top and should be observed while filling the tank to prevent overfilling. DO NOT HANDLE FUEL OIL NEAR AN OPEN FLAME.

The basic filler cap assembly, Fig. 1-3 is equipped with a strainer and a pressure relief cap. Periodically inspect the fuel strainer and test the relief cap for operation against the spring. Also check the condition of the filler cap gasket.

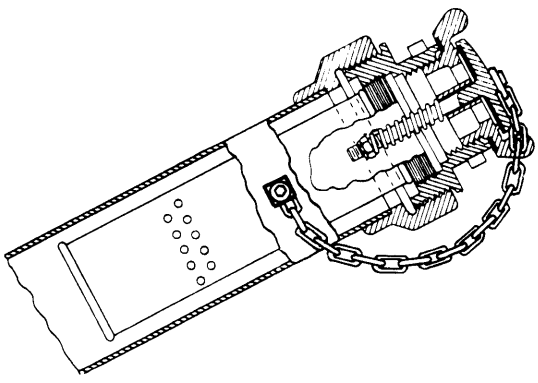

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Fig. 1-3 — Fuel Filler Assembly

PRIMARY FUEL SUCTION STRAINER, Fig. 1-4

The fuel suction strainer should be cleaned and inspected at the intervals stated in the Scheduled Maintenance Program or at shorter intervals if operating conditions warrant.

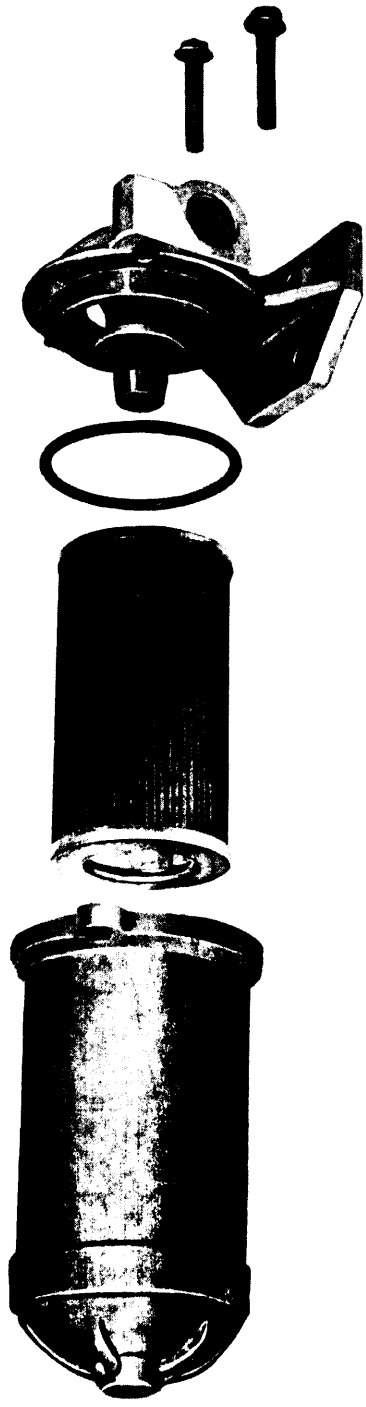

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Fig. 1-4 — Fuel Suction Strainer, Exploded View

CLEANING PROCEDURE

1. Stop the diesel engine, and place the fuel pump circuit breaker in the OFF position.
2. Remove the bolts holding the filter shell to the filter cover, and remove the shell and filter from the cover. To prevent loss, thread the bolts with washers into the strainer shell threaded openings.
3. Withdraw the wire mesh filter element, and discard the oil and sediment held in the strainer shell.
4. Clean the wire mesh element in a container of clean fuel oil. A brush may be used and a round wooden dowel employed to spread the pleats and determine the degree of cleanliness, but no special tools are necessary.

CAUTION: Chlorinated hydrocarbon solvents and temperatures above 180° F. will damage the epoxy material in the filter element assembly.

5. Clean the shell with fuel oil and wipe it clean. Note that the spring at the bottom of the shell is spot welded to the shell.
6. Inspect the housing-to-cover "O" ring, and replace it with a new ring if necessary.
7. Place the cleaned strainer element in the shell and reapply the shell to the strainer cover. Tighten firmly into place after making certain the "O" ring is properly seated.

PRIMARY FUEL FILTER, Fig. 1-5

The primary fuel filter element should be changed at the intervals stated in the Scheduled Maintenance Program or at shorter intervals if operating conditions warrant.

CLEANING PROCEDURE

1. Stop the diesel engine; place isolation switch in ISOLATE position.
2. Place a container (about 5 gallon size) to catch fuel drainage, and open the 1/2 inch pipe plug drain located at the bottom plate of the filter housing.

NOTE: If the pipe plug or the filter cover are opened shortly after the engine shutdown, pressure retained in the system will cause fuel to spurt out of the opening.

3. Loosen the filter cover plate retaining nuts, then twist the cover and remove it. Withdraw and discard the cageless waste-type filter element.
4. Place the fuel prime switch in FUEL PRIME position to introduce a flow of fuel and wash out any sediment that may be held at the base of the filter housing.
5. Insert a new filter element into the housing, being careful not to damage the lower seal on the filter element.
6. Inspect the filter housing cover gasket and replace with a new gasket if necessary. Replace the housing cover and firmly tighten the retaining bolts.

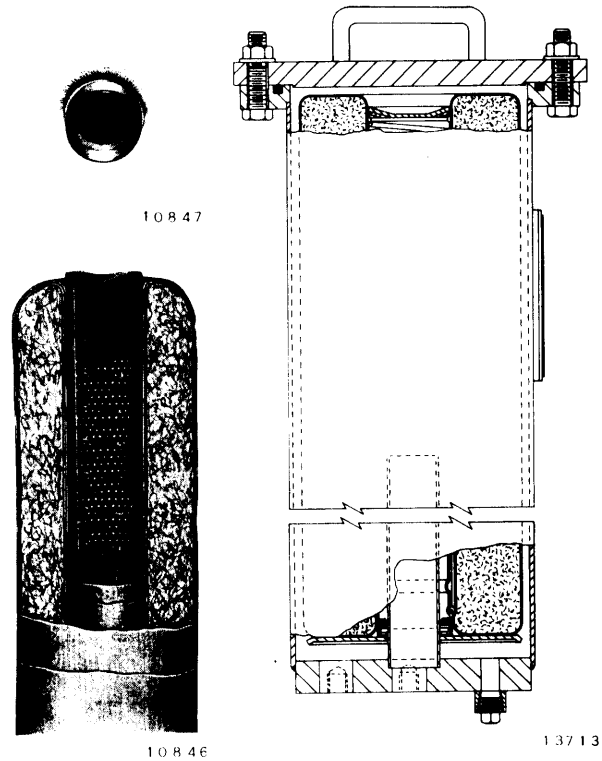


Fig. 1-5 — Primary Fuel Filter And Housing

7. Retighten the 1/2 inch pipe plug at the base of the filter housing.

8. Operate the fuel prime switch until fuel runs free and clear of bubbles in the return fuel sight glass. Check for leakage at the drain plug and the housing cover.

ENGINE MOUNTED FUEL FILTERS

The engine mounted fuel filters should be changed at the intervals stipulated in the Scheduled Maintenance Program and the filter assembly should be cleaned in accordance with the instructions in the Engine Maintenance Manual.

Check the ends of the filter elements for indications of rust. The presence of a combination of water and dirt can cause premature clogging of the filter elements and damage to the engine fuel injectors.

FUEL PUMP AND MOTOR

The motor driven fuel pump, Fig. 1-6, is mounted on the equipment rack. It is an "internal" gear pump driven by battery power during system priming and by power from the auxiliary generator during operation.

Fuel is drawn into the inlet portion to fill a space created by the gear teeth coming out of mesh. The fuel is then trapped in the space between the gear teeth and carried to the outlet side of the pump. There the gears mesh, which forces the fuel from between the gear teeth and through the outlet.

The fuel pump and motor need no routine maintenance if operation is satisfactory. However, the motor and pump should be reconditioned in accordance with EMD Maintenance Instructions listed on the Service Data page. Maintenance should be performed at the intervals stipulated in the Scheduled Maintenance Program.

CAUTION: Use care during washing of the engineroom to protect the fuel pump motor from water. Water applied to the motor can cause an electrical ground.

FUEL PUMP CIRCUIT, Fig. 1-7

When both the main battery switch and the fuel pump circuit breaker are closed, the circuit to the No. 1 contact of the fuel prime/engine start switch is energized. Power is supplied to the fuel pump motor through the No. 1 and 2 contacts of the switch when it is held in the FUEL PRIME and ENGINE START positions. At such times the No. 5 and 6 contacts are open to prevent motoring of the auxiliary generator by the storage battery. Note that the No. 1 and 2 terminals remain closed during engine cranking. This is to

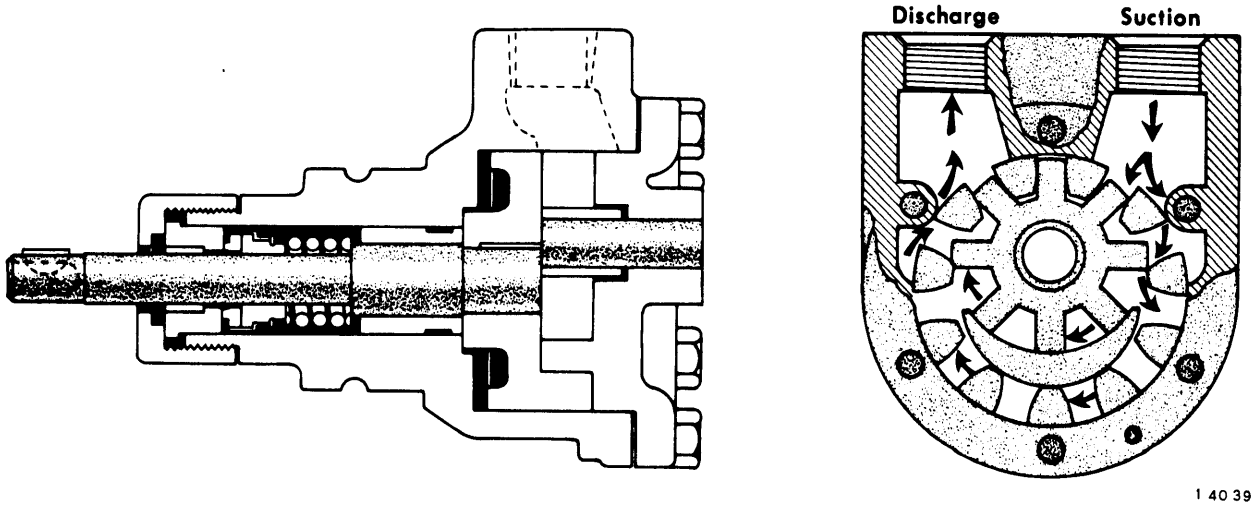


Fig. 1-6 — Fuel Pump Cross-Section

ensure an adequate supply of fuel to the engine during cranking.

Once the engine has started and the fuel prime/engine start switch is released, power from the auxiliary generator drives the fuel pump, provided that the fuel pump contactor FPC and the fuel pump relay FPR remain picked up. The purpose of the FPR is to provide control of the fuel supply through a switch on the engineer's control stand. The purpose of FPC is to provide a means for normal and emergency engine shutdown.

Fuel pump relay interlocks that do not appear on Fig. 1-7 prevent the engine from being cranked if the FPR relay has not picked up. Also, if fuel pump contactor FPC has not picked up during engine cranking, interlocks that do not appear on Fig. 1-7 will cause the engine to shut down as soon as manual control of the layshaft lever is relinquished.

FUEL PRIME/ENGINE START SW LEGEND

X-Denotes Contacts Closed			
Contacts	Position		
	Prime	Release	Start
1-2	X		X
3-4		X	
5-6		X	
7-8			X
9-10			X

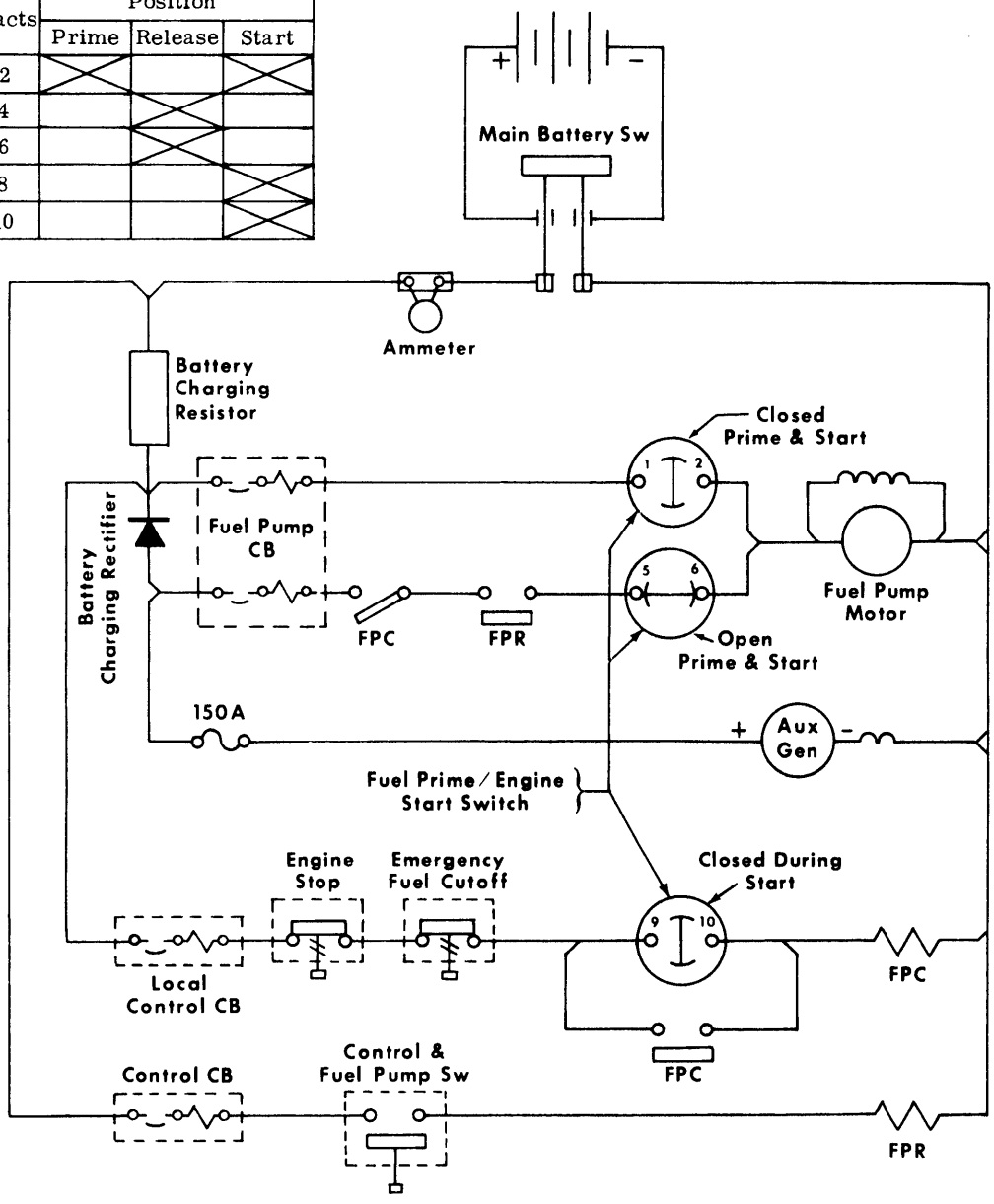


Fig. 1-7 — Fuel Pump Circuit, Schematic Diagram

SERVICE DATA

FUEL SYSTEM

REFERENCES

Fuel Oil Specifications	M.I. 1750
Fuel Pump Maintenance	M.I. 4110
Fuel Pump Motor Maintenance	M.I. 4101

ROUTINE MAINTENANCE PARTS AND EQUIPMENT

FILTERS

	Part No.
Primary Fuel Filter	
Cageless Waste Type Element	8275432
Cover Gasket	8358905
Engine Mounted Filter	
Honeycomb Element	8299457
Seal, Housing-To-Body	8177030
Suction Strainer	
Wire Mesh Element	8344103
"O" Ring, Housing-To-Cover	8343161

FUEL TANK

Drain Plug Gasket	8010874
Filler Cap Gasket	8065493

SPECIFICATIONS

Fuel Tank Capacity	
Basic	3200 Gal.
Modifications	4000 Gal.
	3600 Gal.
	2600 Gal.
	1700 Gal.

LUBRICATING OIL SYSTEM

DESCRIPTION

A pictorial diagram of the lubricating oil system is shown in Fig. 2-1. Oil under pressure is forced through the engine for lubrication and piston cooling by the positive displacement combination piston cooling and lubricating oil pump. After circulating through the engine, the lubricating oil drains into the oil pan. The positive displacement scavenging oil pump draws oil from the sump and strainer housing, then forces it through the oil filter and cooler. From the cooler, the oil is delivered to another compartment in the oil strainer assembly where it is available for recirculation by the combination piston cooling and lubricating oil pump.

The lubricating oil pumps are mounted on the front end of the engine and are gear driven by the engine through the accessory drive gear train. The oil strainer housing is also mounted on the front of the engine. The oil cooler and filter assemblies are located in the equipment rack adjacent to the front of the engine at the long hood end of the locomotive.

TURBOCHARGER

The turbocharger lubricating oil is obtained from the engine lubrication system. A separate automatically started motor driven turbocharger auxiliary lube oil pump is used to supply oil to the turbocharger prior to starting the engine and whenever the engine is shut down. The motor is timed to operate approximately 35 minutes after each time it is started. Oil circulation through the turbocharger is necessary prior to starting the engine and during the period when the engine oil pressure is building up to provide proper lubrication. After the engine is shut down, continued oil circulation is necessary to remove residual heat from the turbo and return the hot oil to the oil pan sump. For this auxiliary pump to do the work for which it is intended, the main battery switch and the turbocharger auxiliary pump circuit breaker must be closed. See Fig. 2-2.

The turbocharger auxiliary lube oil pump draws oil from the oil pan sump. Discharge from the pump is then filtered and fed into the head assembly of the main turbocharger oil filter. This head assembly contains the check valves required for proper lube oil flow. Oil from the filter head assembly is then directed to the turbocharger.

TURBOCHARGER AUXILIARY LUBE PUMP CIRCUIT

The following text in conjunction with Fig. 2-2 explains the function of the turbo lube pump circuit.

When the main battery switch is moved from an open to a closed position, battery power will flow through the turbo pump circuit breaker and through normally closed contacts of the no voltage relay NVR. (The NVR relay contacts remain closed until the engine is turning

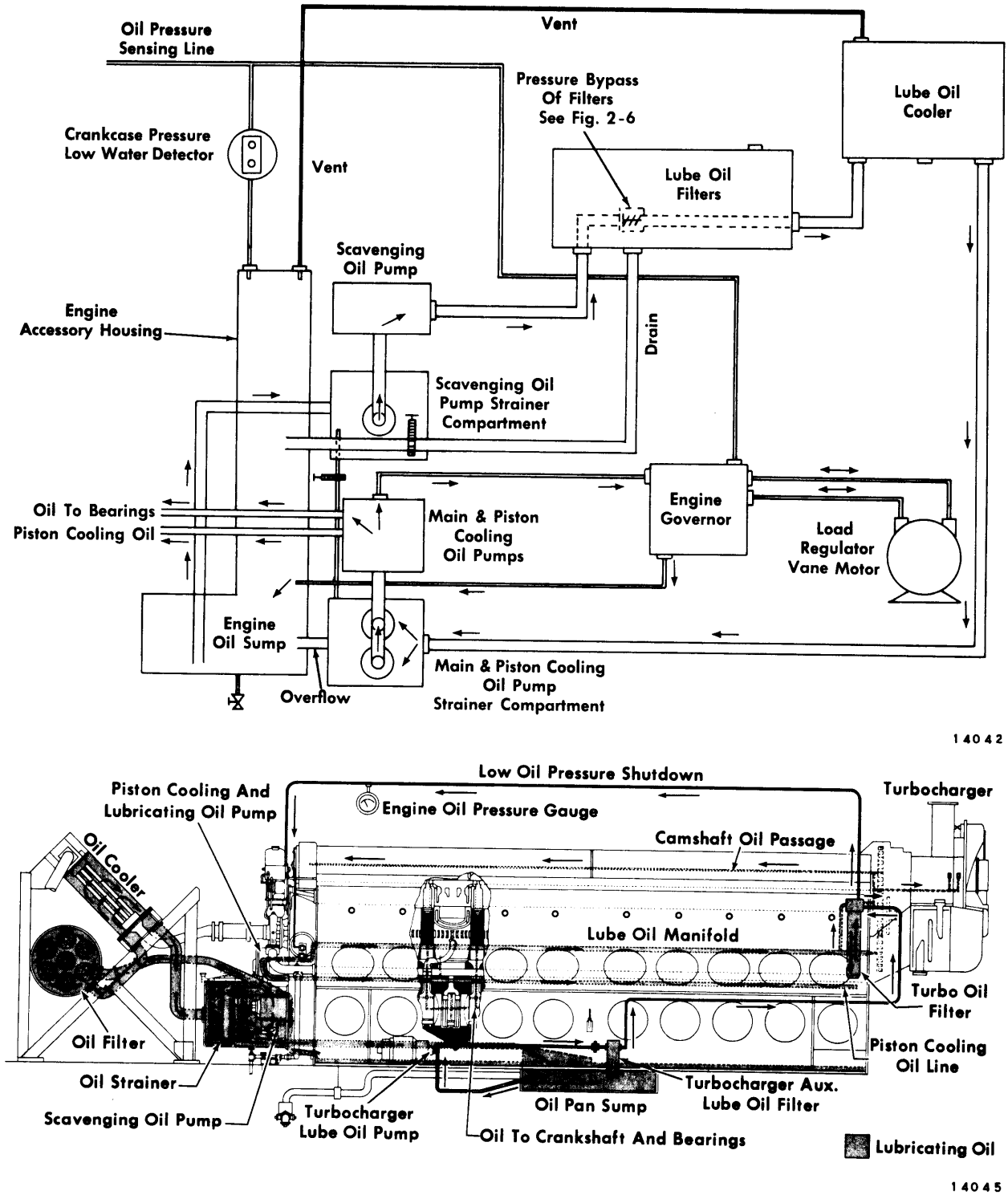


Fig. 2-1 — Lubricating Oil System Pictorial And Schematic Diagram

and the D14 alternator is delivering AC power.) NVR contacts close upon loss of AC power from the D14 alternator at engine shutdown.

Power through NVR contacts then flows through closed contacts of the fuel prime - engine start switch and through normally closed stop pushbutton contacts to energize the turbo lube time delay relay TLTD. The relay begins timing and normally closed time delay contacts of TLTD remain closed for the period set by the timing device (nominally 35 minutes).

Current flows through the closed time delay pickup contacts of TLTD to energize turbo lube pump contactor TLPC.

Contacts of TLPC seal the relay in against NVR pickup, energize the turbo lube pump light, energize the turbo lube pump motor, and set up the circuit to the start contacts of the fuel prime - engine start switch.

The timing relay continues to time so long as current flows to the relay coil. When the relay times out, TLTD contacts identified on Fig. 2-2 with upward pointing arrows, pick up, and TLPC is de-energized. TLPC contacts drop open. The turbo lube pump motor stops, and the turbo aux pump light goes out. If the engine is running at the time of relay time-out, NVR contacts are open and TLTD is de-energized. Dropout of NVR, pressure on the engine stop pushbutton, or movement of the fuel prime - engine start switch will re-establish the timing cycle and turbo lube pump operation.

If the engine is not running when TLTD times out, NVR contacts being closed will hold TLTD energized when TLPC drops out after TLTD pickup. The timing cycle and turbo lube pump operation can be re-established by operation of the fuel prime - engine start switch or by pressure on the engine stop pushbutton.

CAUTION: During certain electrical testing procedures the NVR relay may be latched closed, either by means of the latching mechanism built into the relay or

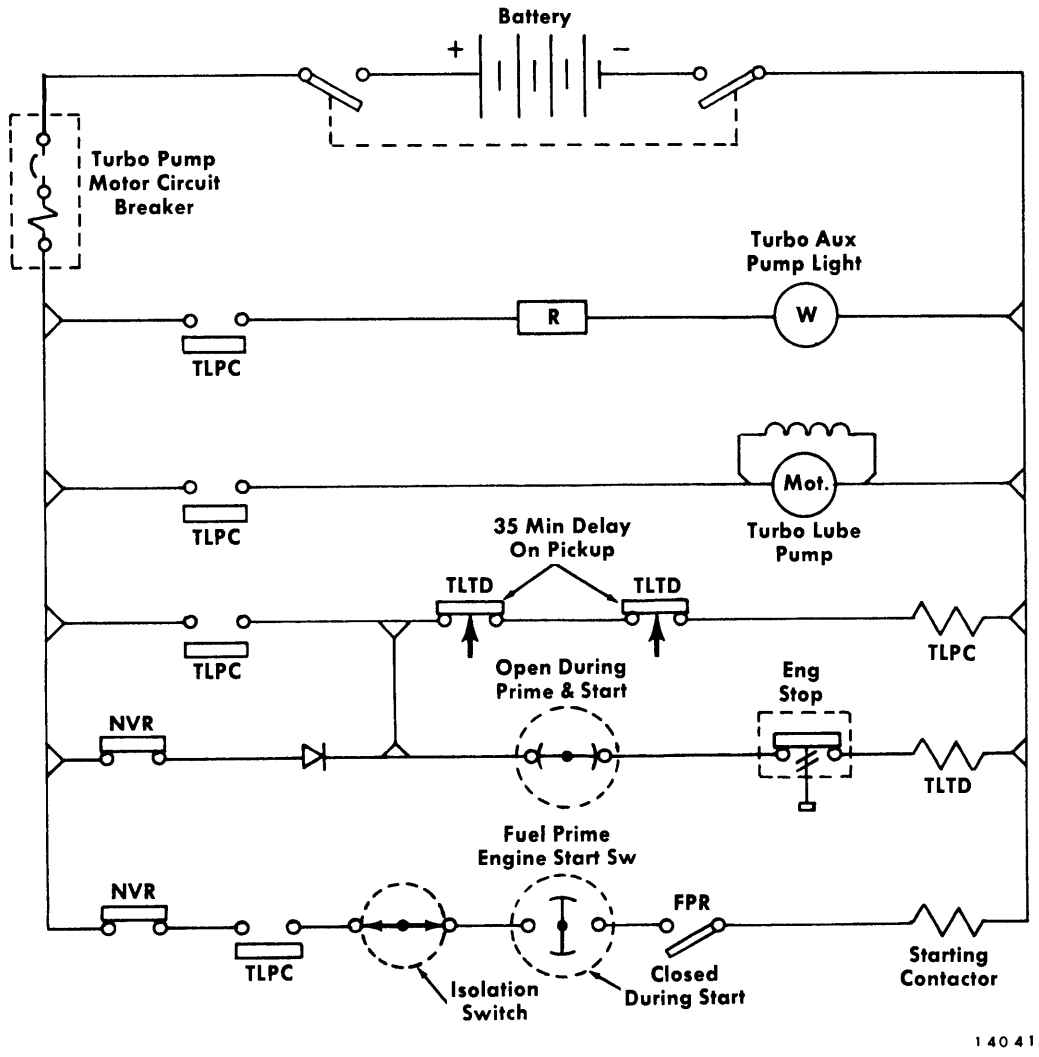


Fig. 2-2 — Turbocharger Auxiliary Lube Oil Pump Circuit

by insertion of something (a folded matchbook) to hold the relay contacts closed. If the locomotive is returned to service with NVR latched closed (engine running), the NVR contacts that are part of the turbo lube pump circuit can not drop closed. Serious turbocharger damage is possible.

LUBE OIL LEVEL GAUGE (DIPSTICK)

An oil level gauge, Fig. 2-3, extends from the side of the oil pan into the oil pan sump. The oil level should be maintained between the low and full marks on the gauge, with the reading taken when the engine is at idle speed and the oil is hot.

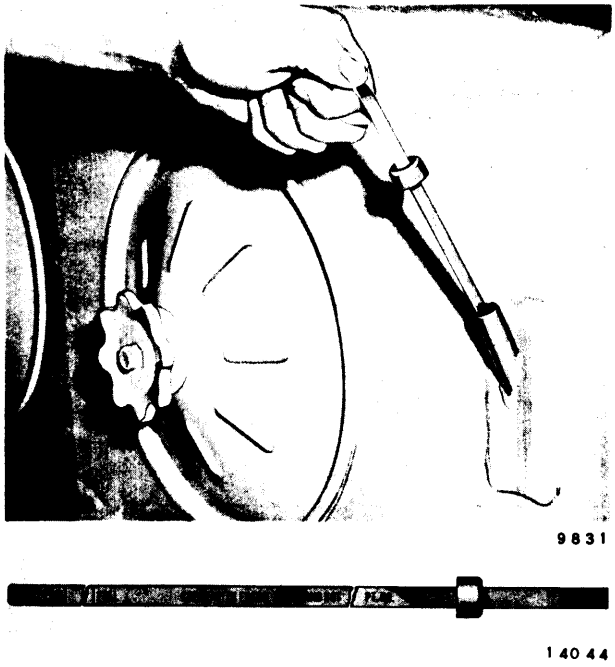


Fig. 2-3 — Oil Level Gauge - Dipstick

NOTE: Under some conditions the oil level may be above the bottom of the oil pan handholes, so care must be taken when the oil pan handhole covers are removed.

LUBRICATING OIL SAMPLING AND ANALYSIS

A lubricating oil sample should be taken for analysis at the intervals stipulated in the Scheduled Maintenance Program. The sample should be submitted to a competent laboratory to monitor the suitability of the oil for continued use. Obtain the sample in the following manner.

1. Run the engine long enough to ensure thorough circulation.
2. Shut the engine down and remove the starting fuse.
3. Obtain the oil sample (normally 1 pint) at the center of the oil pan halfway between the surface and the bottom of the pan.

NOTE: Inconsistent sampling techniques will produce inconsistent results.

OIL COOLER INSPECTION AND MAINTENANCE

Major servicing of the oil cooler should not be undertaken until the need for such maintenance is definitely established by unsatisfactory operation, suspected oil cooler core leaks, or wide temperature differential between cooling water and engine oil.

DETECTION OF LEAKS

There are no simple methods of detecting water leaks to the oil side of the lubricating oil cooler assembly; however, evidence of water contamination will show up in the routine engine oil samples taken and analyzed as prescribed in the Scheduled Maintenance Program. Any such evidence calls for a close examination of the cooler. Maintenance instructions for cleaning and repair of the lubricating oil cooler are listed on the Service Data page.

DETECTION OF DIRTY OIL COOLER CORE

Proper lubricating oil temperatures are dependent upon maximum lube oil cooler performance. In order to obtain a valid

indication of oil cooler performance, the locomotive must be operated at its full rated load and engine speed while the oil and water temperatures are allowed to stabilize.

PROCEDURE

1. Remove the 1/4 inch pipe plug located in the water pump discharge elbow and in its place insert a thermometer well as shown in Fig. 2-4. Fill the well with oil. Water temperature into the engine will be taken at this point.

2. Set up engine loading apparatus capable of taking the full rated load of the locomotive. Refer to the Load Testing section of this manual for instructions covering the load testing setup.

CAUTION: Most standard load boxes are not of sufficient capacity to fully load the locomotive.

3. Remove the square cover from the engine mounted oil strainer and hang a caged thermometer in the overflow oil compartment of the strainer housing, Fig. 2-3. This is oil out of the cooler. Make certain that the thermometer bulb is well below the surface of the oil and is kept well submerged when the reading is taken.

4. Insert a thermometer into the well located at the engine water inlet.

5. Operate the engine and apply load. Do not operate above throttle position No. 3 until water temperature is above 130° F. Operate at full load and full engine speed until engine water inlet temperature is stabilized. It may be necessary to energize or block open engine cooling fans to maintain a constant water temperature in the range of 160° to 175° F. Refer to the cooling system schematic diagram in Section 3.

NOTE: Equal readings taken at 15 minute intervals will indicate a stable operating condition.

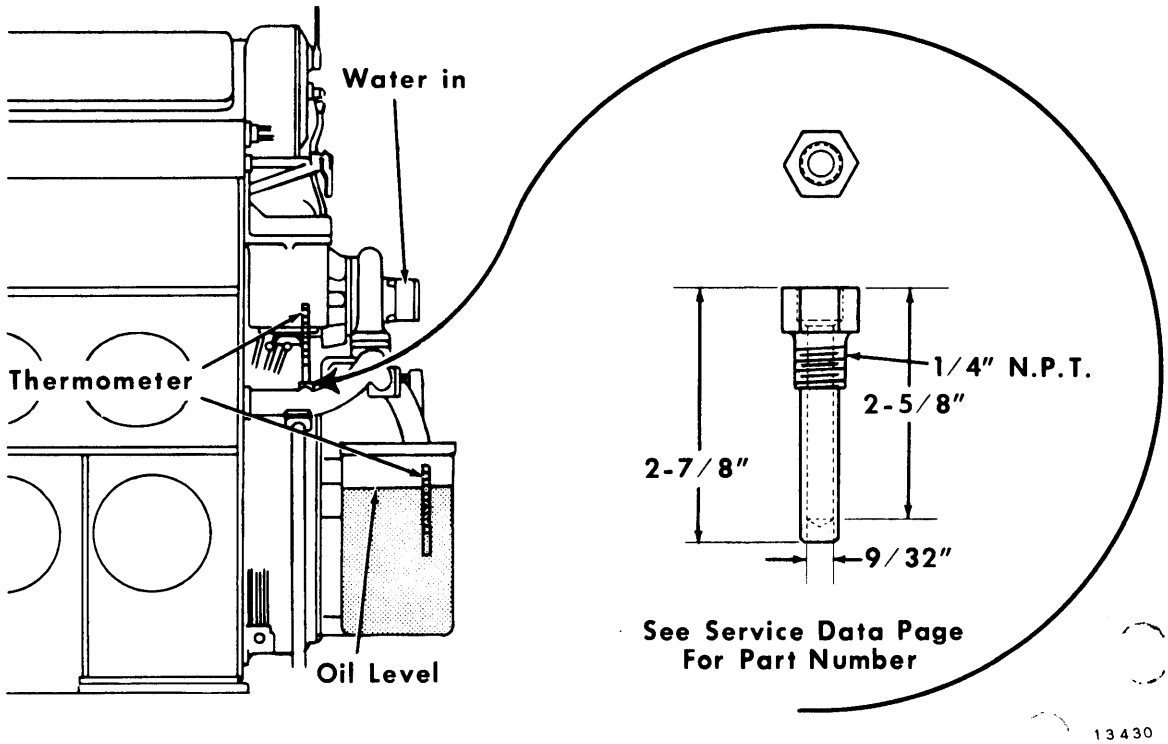
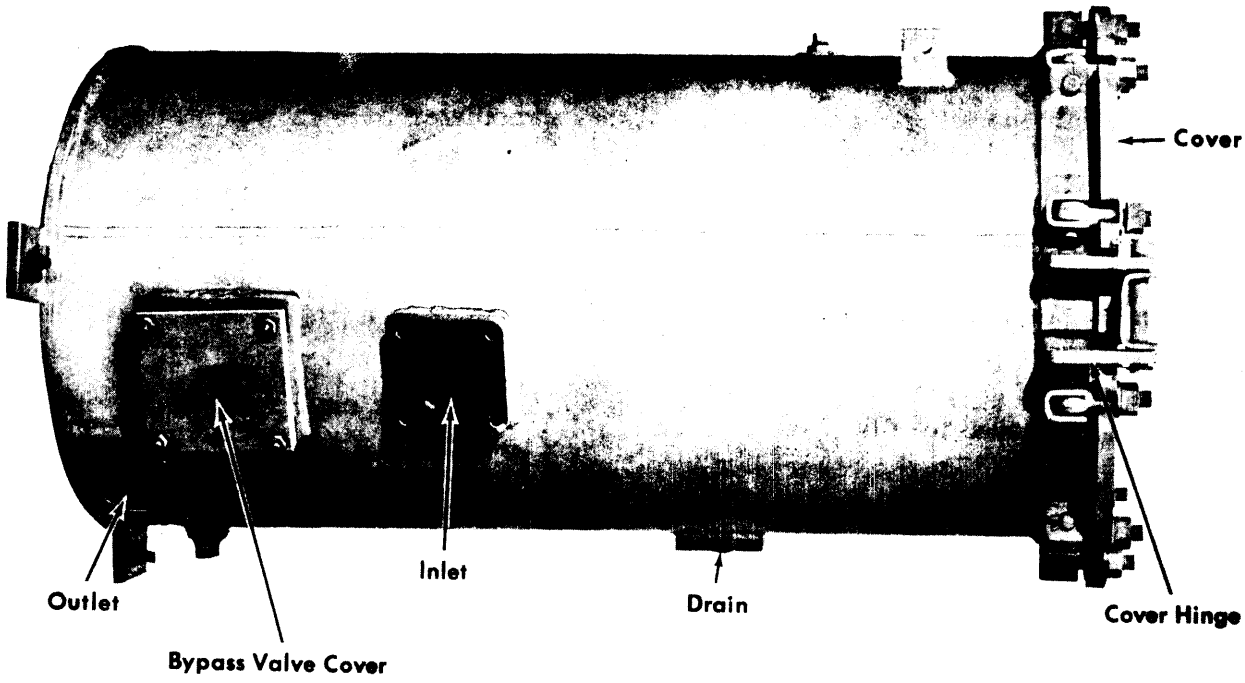


Fig. 2-4 — Location Of Thermometers To Determine Oil And Water Temperature Differential



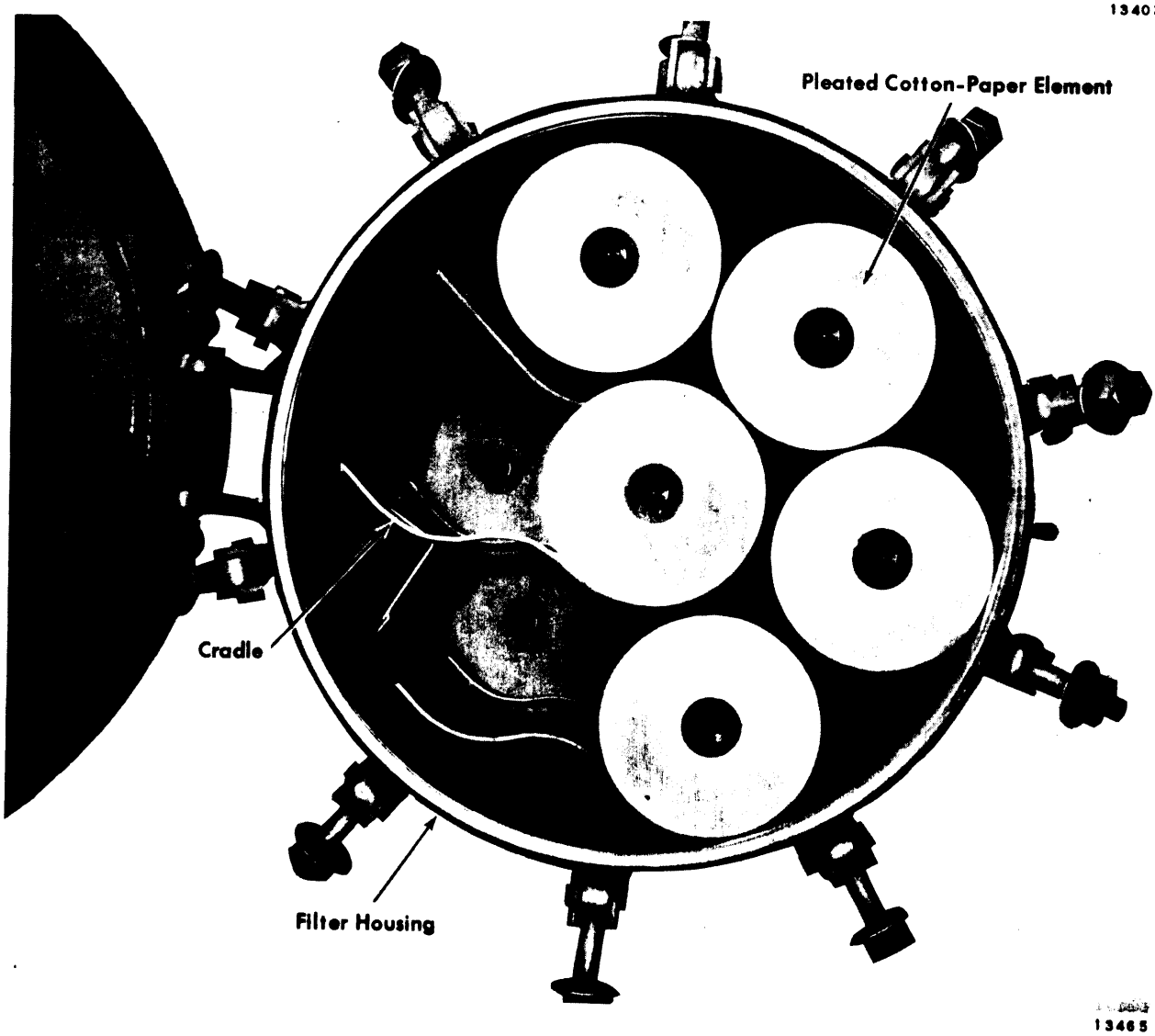


Fig. 2-5 — Seven Element Lubricating Oil Filter Assembly

6. Record the temperature readings and compare them with the performance baseline given on the Service Data page. When oil temperature for a given water temperature reading is higher than the limit indicated by the line, the oil cooler should be serviced in accordance with the Maintenance Instruction listed on the Service Data page.

OIL FILTER INSPECTION AND MAINTENANCE, Fig. 2-5

Oil filter elements should be replaced with new elements at the intervals stipulated in the Scheduled Maintenance program. Use only approved element combinations as indicated on the Service Data page.

PROCEDURE

1. Operate the diesel engine until oil is warm and circulating freely, then stop the engine and remove the starting fuse.

2. Remove the square cap from the engine mounted lube oil strainer housing, Fig. 2-6.

3. Raise and latch the gate valve handle in the engine strainer housing to drain oil from the filter housing into the engine sump. It is not necessary to move the valve handle that drains the oil strainer housing.

NOTE: Depending upon the temperature of the oil and system at the time that the drain valve is opened, adequate drainage of the lube oil filters can take from 1/2 hour for hot oil and a hot system to several hours for a cool system.

If the system is fully charged at the time the system is to be drained, the oil level will rise above the bottom of the oil pan inspection covers.

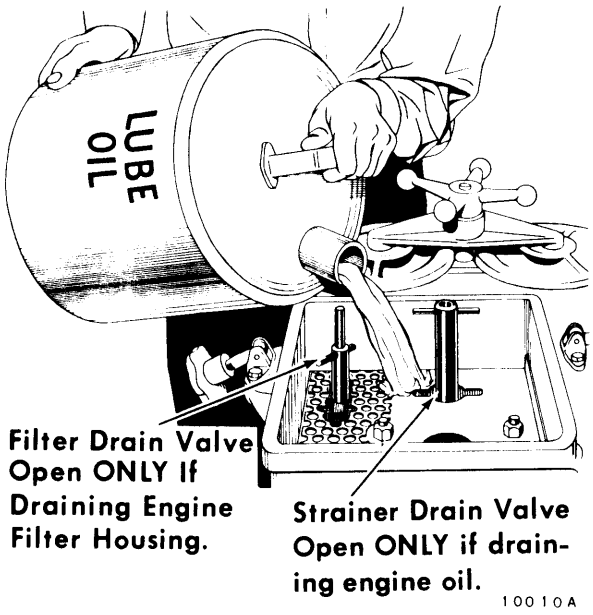


Fig. 2-6 — Adding Oil To Engine Through Strainer Housing

4. After enough time has elapsed to allow adequate drainage and easy handling of the filters, slightly loosen the nuts on the filter housing cover. Oil remaining at the bottom of the housing will leak into the drain pan. From there it is piped to the engineroom drainage sump.

5. Provide adequate quantities of bound edge towels.

6. Place a container for used filter elements at a convenient location.

7. After oil has stopped draining from under the flat filter housing cover, loosen the retaining nuts and swing the hinge bolts clear of the cover. Swing the cover open. Remove and quickly dispose of used filter elements.

8. Using only clean bound edge towels, clean out the interior of the filter housing. Clean up the drain pan and surrounding area.

9. Insert a set of seven new filter elements consisting of part numbers shown on the Service Data page. Make certain that the elements are fully seated over the standpipes.

NOTE: Approved pleated paper elements have a red casing. When the compliment of seven paper elements is used, be certain to use approved elements.

10. When the filter elements are properly inserted, place a new gasket into the circular groove in the housing cover. Discard the used gasket.

11. Close the cover. A guide hole in the filter cover must mate with a dowel on the filter housing body before the cover can be closed.

12. Swing the hinge bolts into place and tighten the hold-down nuts.

13. At the intervals stipulated in the Scheduled Maintenance Program, remove and inspect the pressure relief valve assembly, Fig. 2-7. The procedure is detailed in the article entitled Inspection Of Bypass Valve Assembly.

14. Close the filter drain gate valve at the oil strainer.

15. Before starting the engine, check the oil level, using the dipstick. Oil level should be above the full mark on the dipstick with the engine shut down. Start the engine and allow it to run at idle speed. Check the oil level at the dipstick. Add oil if necessary. See Fig. 2-6.

16. Replace and tighten down the square cover on the oil strainer.

17. Inspect for oil leaks at the filter housing. Tighten the hold-down nuts as necessary to stop any leaks.

INSPECTION OF BYPASS VALVE ASSEMBLY

The bypass valve assembly, Fig. 2-7, should be removed and checked periodically at intervals stipulated in the Scheduled Maintenance Program or whenever improper oil filtration is suspected. However, operation of the valve assembly can not be effectively checked on the locomotive. For this reason it is recommended that qualified spare assemblies be available for exchange with the assembly in use. A bench test and inspection may then be performed in accordance with the appropriate Maintenance Instruction listed on the Service Data page.

PROCEDURE

1. After the oil has been drained from the filter housing, the filters removed, and the housing cleaned; remove the

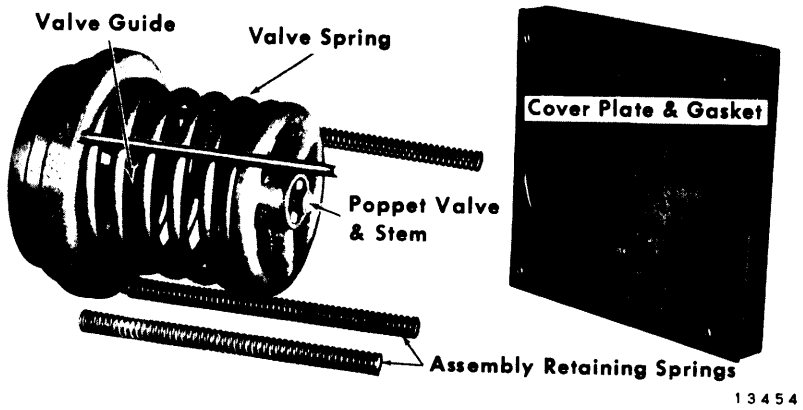


Fig. 2-7 — Filter Bypass Valve Assembly

four hold-down nuts from the bypass valve port cover. Remove the valve assembly and discard the port cover gasket.

NOTE: Three light springs hold the valve assembly seated in position and against the valve port cover. Bypass valve spring pressure is not felt during removal of the assembly.

2. Replace the bypass valve assembly with a qualified spare. Seat the assembly properly with the three light guide springs in place. Apply a new port cover gasket and the port cover. Tighten the cover hold-down nuts to between 55 and 60 ft-lbs torque, using standard tightening procedure.

If a qualified spare is not available the valve assembly should nevertheless be be removed from the filter housing and cleaned free of sludge and varnish by washing in solvent. The assembly should be carefully inspected after cleaning. If the poppet stem or valve body guide is worn, those pieces should be replaced with new pieces. Part numbers are listed on the Service Data page.

TEST OF VALVE SPRING

If a qualified spare is not available, the valve spring should be tested by compressing it to a specific height. If this requires more or less than the values shown on the Service Data page, the spring should be replaced with a new spring.

REFERENCES

Lubricating Oil Filter Maintenance ..... M.I. 926
Lubricating Oil Cooler Maintenance ..... M.I. 927
Lube Oil Qualified For Use In 645E3 Engine ..... M.I. 1752

ROUTINE MAINTENANCE PARTS AND EQUIPMENT

FILTERS

	Part No.	Or Part No.
Pleated Cotton-Paper Elements (7 per housing)	8345482	8398833

NOTE: Filter changeout recommendation is 60 days, but maximum filter life is 90 days with high dispersant oils - engine working and elements subjected to hot oil at normal operating pressure.

Filter Housing Cover Gasket 8268756
Bypass Valve Port Cover Gasket 8296030

MISCELLANEOUS

Thermometer Well, 1/4" NPT 8268162

BYPASS VALVE ASSEMBLY 8320705

NOTE: It is recommended that qualified spare bypass valve assemblies be kept available for scheduled maintenance replacement.

Poppett Valve 8322839
Valve Guide 8322840
Valve Spring 8317190

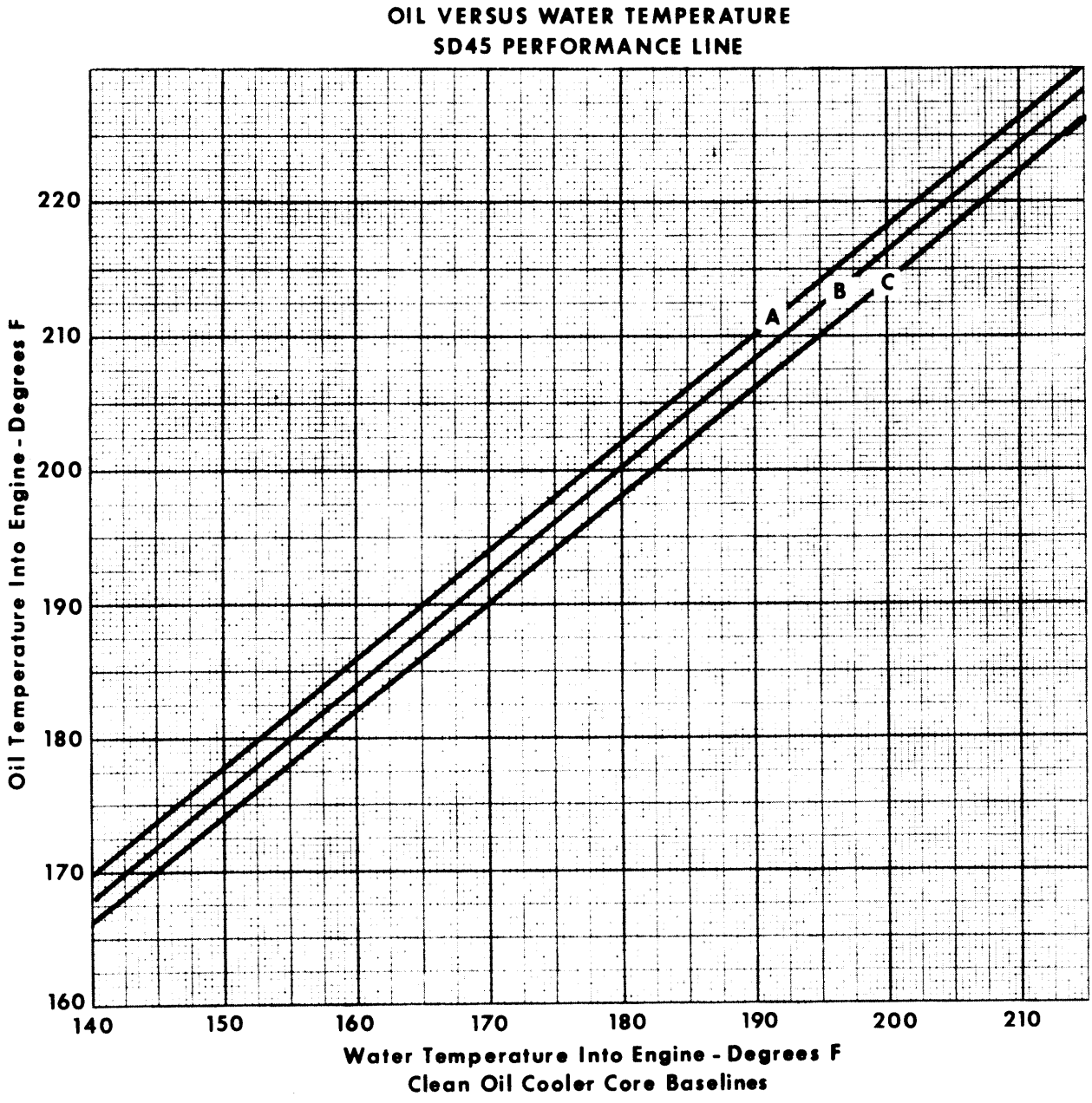
SPECIFICATIONS

Weight required to compress valve spring 8317190 3-5/8 inches must be not less than 420 pounds or more than 500 pounds. (This is the 40 psi spring.)

Lube Oil Capacity
Basic Oil Pan ..... 294 Gal.
Increased Capacity Oil Pan ..... 466 Gal.

Usable Oil
Basic Oil Pan ..... 92 Gal.
Increased Capacity Oil Pan ..... 234 Gal.

Oil Level Gauge (Dipstick) For 20-645E3 Engine ..... Pt. No. 8378325



A - Cooler Assembly 8364235 - Soldered Copper Cores 8318804 or 3146250

B - Cooler Assembly 8367842 - Mechanical Aluminum Core 8393169
Identified by two "X" marks stamped into the flange of the bottom header.

C - Cooler Assembly 8367842 - Mechanical Copper Core 8367841

CAUTION: Do not use caustic cleaning agent on aluminum core.

Service condemning limits are 15 degrees F. higher than the clean oil cooler performance base line.

COOLING SYSTEM

DESCRIPTION

The cooling system is pressurized to provide uniform cooling throughout the operating range of the diesel engine. A schematic diagram of the system is shown in Fig. 3-1. Coolant is pumped by the engine mounted pumps from the cooling water expansion tank and lubricating oil cooler assembly and into the engine. The heated water leaves the engine and flows through the radiator assembly where it is cooled. The cooled water returns to the oil cooler to repeat the cycle.

Part of the water from the engine mounted water pumps is piped to the air compressor. There are no valves in the line, thus air compressor cooling will be provided whenever the engine is running. Upon leaving the air compressor, water is piped through a temperature switch manifold, then back to the water tank for recirculation. Temperature sensing elements located in the manifold operate switches that control radiator fan and shutter operation and a hot engine alarm.

Part of the water from the engine mounted pumps is piped to the cab heaters. A shutoff valve is located in the supply line to the heaters and another shutoff valve is located in the return line from the cab heaters. These valves, Fig. 3-2, along with a cooling system drain valve and an emergency heater drain valve are located at the sump between the engine and the engine accessory rack.

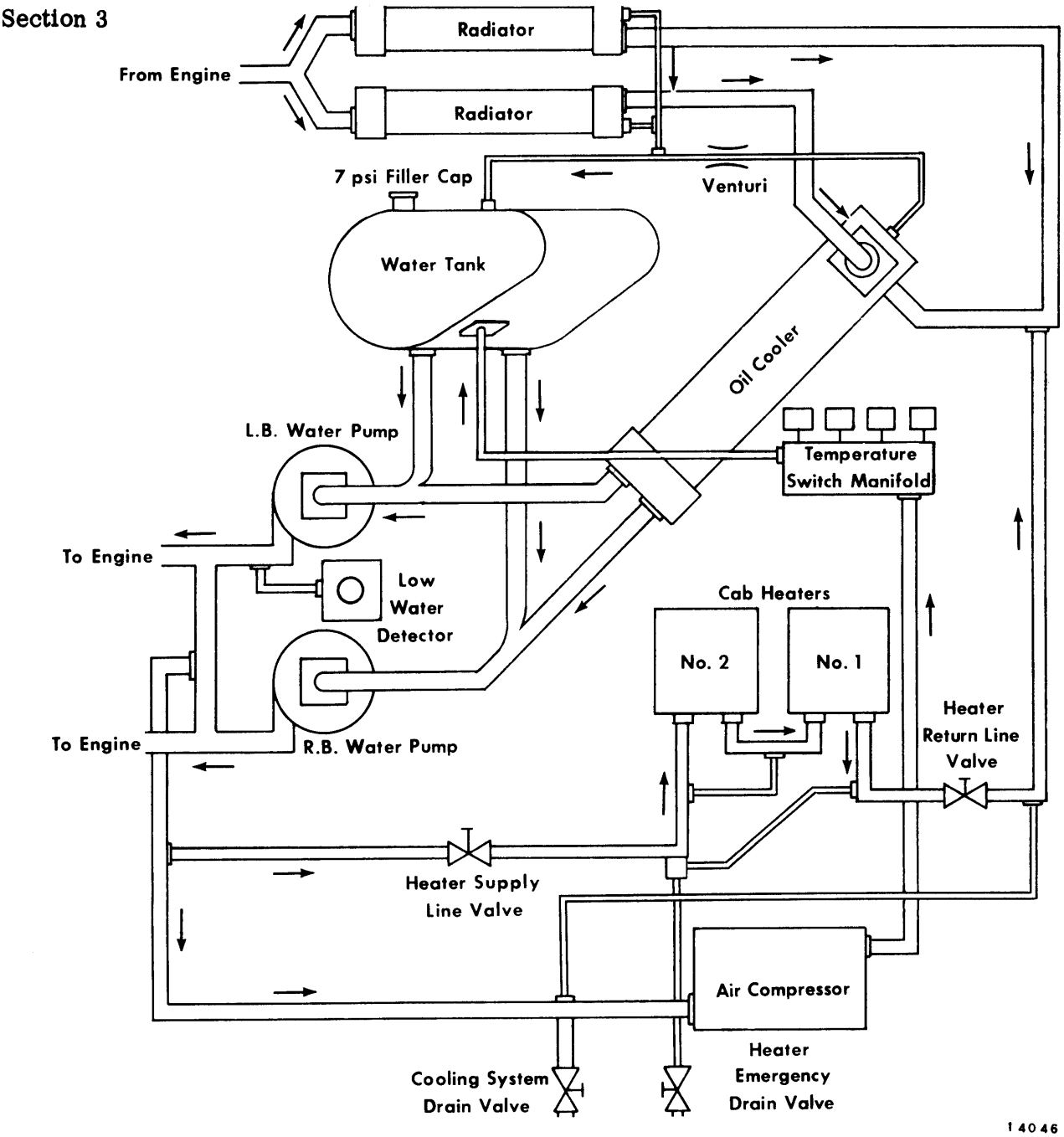
The entire cooling system may be drained by opening the cooling system drain valve, providing that the cab heater supply and return valves are open for heater operation. If it is necessary to independently drain the cab heaters, the heater supply and return valves must be closed and the emergency heater drain valve opened.

CAUTION: Whenever the heater supply and return valves are closed, it is good practice to open the emergency cab heater drain valve and drain the cab heaters and associated piping. Always check to see that the heater drain valve is tightly closed before opening the cab heater supply and return valves.

TEMPERATURE CONTROL

During circulation through the diesel engine and air compressor, the cooling system water picks up heat which must be dissipated. This heat is dissipated and the water temperature controlled by means of a radiator assembly and AC motor driven cooling fans.

The radiators are assembled in a hatch in the top of the long hood end of the locomotive. The hatch contains radiator sections which are grouped in two banks. Three AC motor driven cooling fans which operate independently are located in the roof above the radiators. They are numbered 1 to 3 from front to rear, with the



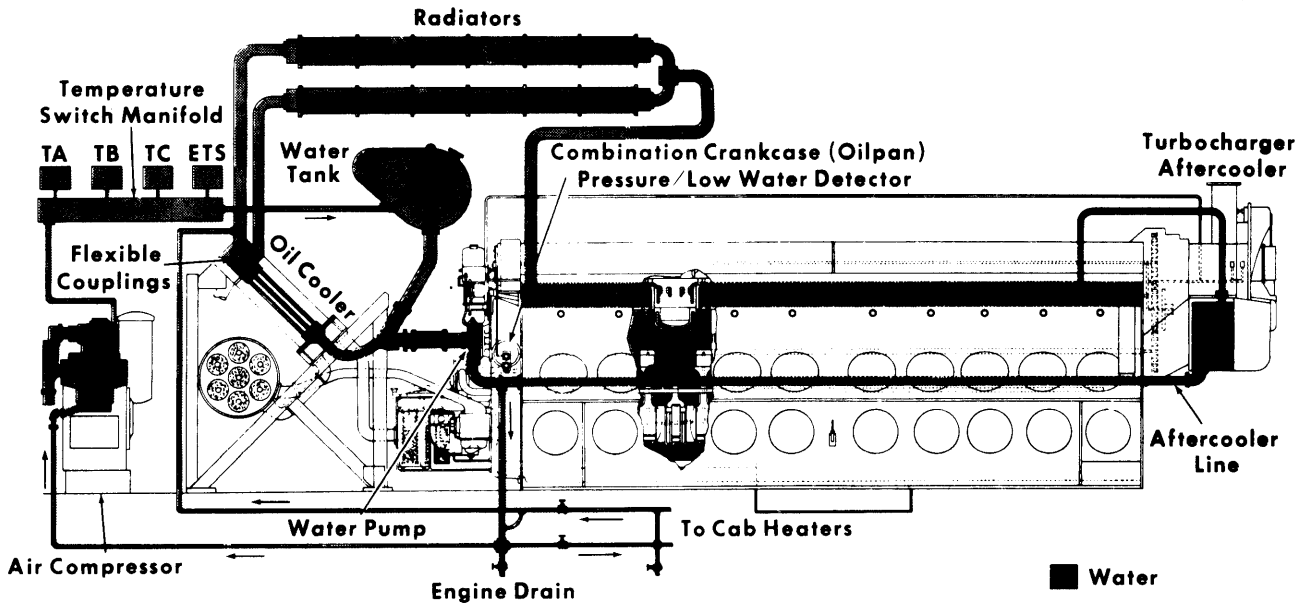
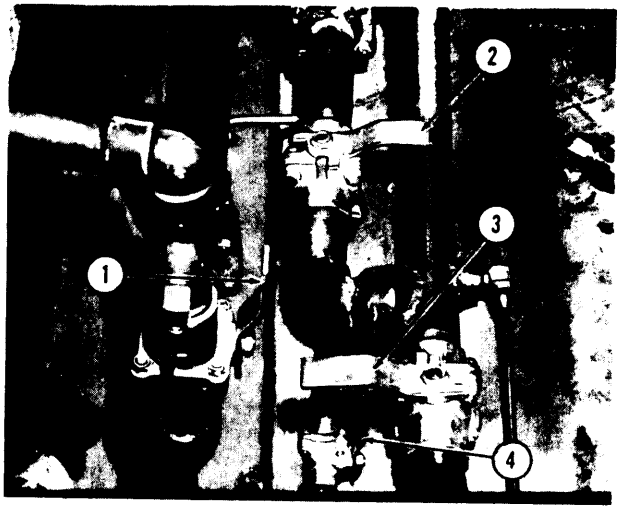


Fig. 3-1 — Cooling System Pictorial Diagram



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1. Cab Heater Return Line Valve
2. Cab Heater Supply Line Valve
3. Cooling System Drain Valve
4. Emergency Cab Heater Drain Valve

Fig. 3-2 — Engine And Cab Heater Drain Valves

No. 1 fan being closest to the cab. Shutters, located along the sides of the hood, adjacent to the radiators, are operated by air cylinders controlled by the shutter magnet valve SMV. Control of the fans and shutters, and thus of the water temperature, is entirely automatic.

The temperature control switches, Fig. 3-3 are designated TA, TB, and TC. These switches are located at the equipment rack and are flange mounted to a manifold that is installed in the cooling system piping. As the water discharges from the compressor, it acts upon the thermal elements which in turn cause their switches to respond and establish electrical circuits to bring in the cooling fan contactors.

The cooling fan contactors are designated AC1, AC2, and AC3. These contactors are located in a cabinet mounted on the equipment rack, see Fig. 3-8. When energized, they electrically connect their respective AC cooling fans to the alternating current supply from the alternator to run the fans.

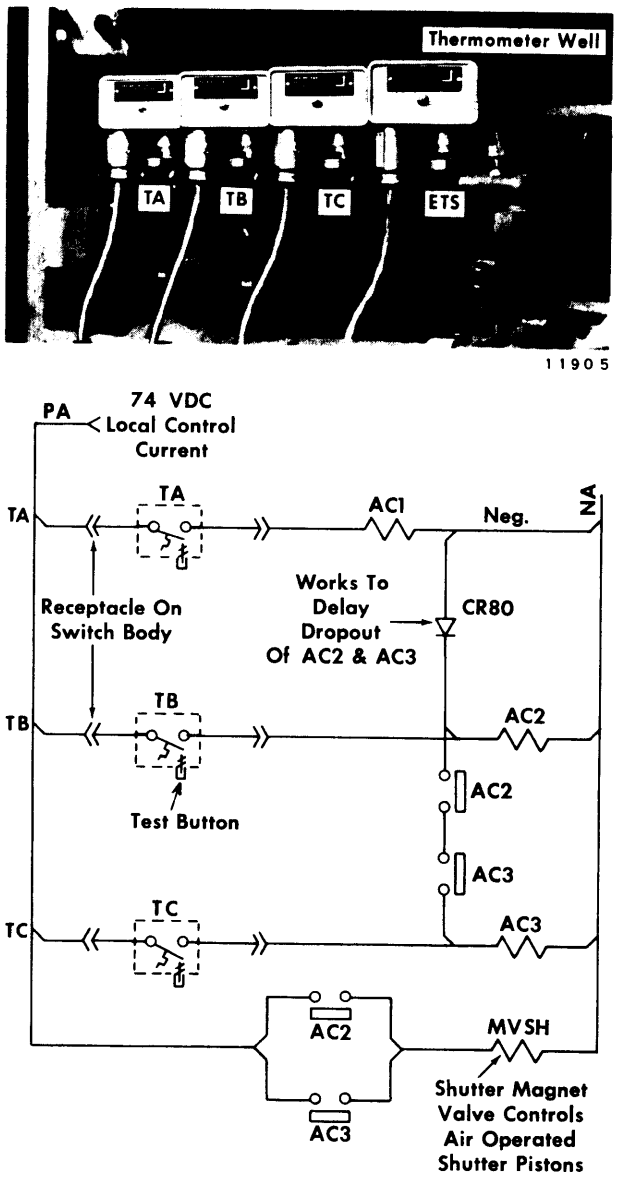

Fig. 3-3 — Engine Temperature Switches And Circuit Diagram

The automatic temperature control functions as follows:

TA picks up first. This energizes AC1, which starts the No. 1 cooling fan. Since the shutters are closed, this fan receives its air by reverse flow through the adjacent non-operating cooling fans. Cool air flows over the radiators. The TA switch is not interlocked in the cooling sequence. TA operates independent of TB and TC. When TA drops out it de-energizes AC1 and stops the fan.

TB picks up next. This energizes AC2, which starts the No. 2 cooling fan and

establishes the first part of a holding circuit to AC3. It simultaneously energizes shutter magnet valve SMV, applying air pressure to open the shutters and allowing passage of air through the radiators. When TB drops it de-energizes AC2, which in turn releases SMV and breaks the holding circuit to AC3.

TC picks up last. This energizes AC3, which starts No. 3 and completes the holding circuit to AC3. Once started, both the No. 2 and No. 3 fans operate until TB drops out to break the holding circuit.

The operating temperature of TA, TB, and TC are given on the Service Data page.

During operation, outside air is either drawn by a single operating fan through the remaining non-operating fans and over the top of the radiators; or, if greater cooling is required, an additional fan or all fans are energized and the side shutters are opened. Air is then drawn through the shutters and radiators. The flow of air over or through the radiators picks up heat from the circulating water. The heat is then discharged through the roof of the locomotive.

Since the shutters are closed a large percentage of the operating time, less air and accompanying dirt is drawn through the radiators. This greatly lessens the chances of clogging the radiators. Information covering the shutter operating piston appears in Section 5, Compressed Air System.

COOLING SYSTEM PRESSURIZATION

The cooling system is pressurized to increase the boiling point of the coolant and prevent cavitation at the water pumps during transient high temperature conditions, such as operation through long tunnels. A pressure cap, Fig. 3-4, on

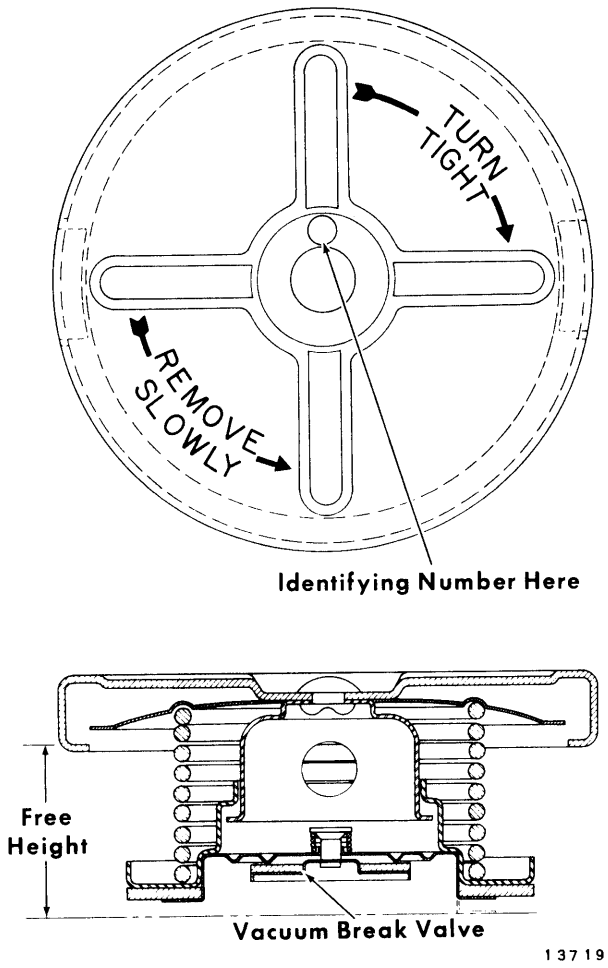

Fig. 3-4 — Cooling System Pressure Cap

the water tank filler pipe opens at approximately 7 psi to relieve excessive pressure and prevent damage to cooling system components. The cap is also equipped with a vacuum breaker valve that operates as the system cools. Refer to the Service Data page for pressure cap operating limits and identifying number.

HOT ENGINE ALARM

A hot engine alarm switch will close when water temperature at the outlet from the engine approaches the boiling point of water in the pressurized system. This is not the temperature at the switch sensing element. There is heat loss between the engine outlet and the temperature switch, therefore the switch is calibrated to pick

up at a lower temperature. This temperature, however, is close to the normal boiling point of water, but much lower than the boiling point of water in the pressurized system.

When the switch picks up the alarm will ring in all units of a consist and the hot engine light (red) will come on in the unit affected. The alarm can be silenced only by reducing the cooling system temperature to a normal level.

Engine water temperature may be readily checked by means of a gauge located in the water inlet line leading to the left bank water pump. The gauge is color coded to indicate COLD (blue), NORMAL (green), and HOT (red) engine temperatures.

A more accurate check of engine water temperature may be obtained by placing a thermometer in the thermometer well located on the temperature switch manifold, Fig. 3-3. The proper operating temperature for the engine temperature switch is given on the Service Data page.

LOW WATER SHUTDOWN

A low water detecting device, Fig. 3-5, balances water pressure against airbox pressure. When water pressure falls the device dumps oil from the governor supply line, causing an engine shutdown.

While there is no air box pressure when an engine is shut down, there is spring pressure. This spring pressure must be acted against by water pressure in order to keep the device latched in. On certain devices the static water pressure working against spring pressure will not keep the device latched in when the engine is shut down. This is not necessarily an indication that the device is defective. It is merely necessary to reset the device immediately after engine start.

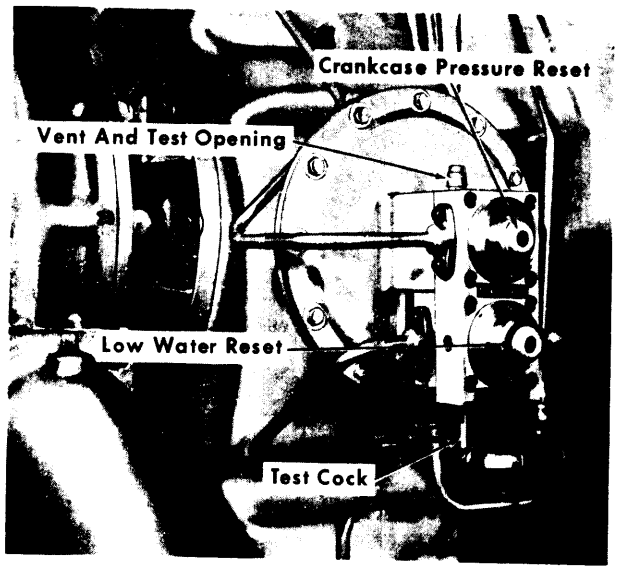

Fig. 3-5 — Low Water And Crankcase (Oil Pan) Pressure Detector

If the low water detector latches in with the engine shut down, it still may trip at engine start, particularily when the engine is cold or after the pressure in the system has been released. The reason for the trip being that the water pumps may cavitate until water is drawn from the makeup tank and distributed to the radiators for proper circulation. Tripping of the device at engine start is not an indication that the device is defective. It is merely necessary to reset the device immediately after engine start.

OPERATING WATER LEVEL

An operating water level instruction plate, Fig. 3-6, is provided next to the water level sight glass. The instructions indicate minimum and maximum water level with the engine running or stopped. The water level mark should not be permitted to go below the applicable "low" water level mark.

Progressive lowering of the water in the gauge glass indicates a water leak in the cooling system, and should be reported.

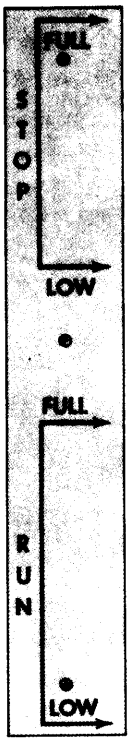

Fig. 3-6 — Water Level Instruction Plate

Normally, there should be no need to add water to the cooling system, except at extended intervals.

MAINTENANCE

FILLING THE COOLING SYSTEM

The coolant used in the engine cooling system should be made up and tested in accordance with instructions appearing in Section 9 of the Engine Maintenance Manual. If operating conditions are such that the use of anti-freeze is essential, the coolant should be made up and tested in accordance with the coolant Maintenance Instruction listed on the Service Data page.

The system is filled through a filler opening located at the top of the engine water expansion tank. Water is added until it reaches the full mark on the upper instruction plate at the water sight glass. Care must be taken during the final stages of filling to prevent overfilling.

An overfill drain pipe is provided to allow run-off in the event of overfilling or excessive water expansion during operation.

After filling a dry or nearly dry system, the engine should be run, with the filler cap removed, to eliminate any air pockets in the system. After running the engine, check the water level and if necessary add water to the system.

NOTE: Draining of the cooling system will trip the low water shutdown device; therefore, when filling the cooling system the low water reset button must be pressed before or immediately after engine start.

After filling operations have been completed and before starting the engine, the pressure cap should be replaced. The cap prevents loss of water due to evaporation during operation and limits the maximum pressure on the cooling system to provide better cooling for the engine. The cap, Fig. 3-4, is designed to open and relieve the system of excessive pressure during operation.

While the system is cooling down after operation, a slight vacuum may develop due to contraction of the water. The pressure cap is designed to release this vacuum by allowing atmospheric pressure to enter the system and replace the vacuum.

DRAINING THE COOLING SYSTEM

The engine cooling system should be drained in the event that the diesel engine is stopped and danger of freezing exists. The draining procedure is as follows:

1. Remove fill cap.
2. Open the cooling system drain valve, Fig. 3-2, located at the floor in front

of the engine. This will drain the engine, radiators, water tank, oil cooler, air compressor, and cab heaters, provided the cab heater supply and return valves are open.

3. Open the cab heater supply and return valves, and open the emergency cab heater drain valve, Fig. 3-2.

CAUTION: If a hot engine is drained, always allow the engine to cool before refilling with fresh coolant.

OBTAINING AN ENGINE WATER SAMPLE

When a sample of engine coolant is desired, it should be obtained with the engine warm and running. The coolant should be taken from a point where water flow is turbulent. For this reason the sample should not be obtained from the drain in the water level sight glass.

It is recommended that the 1/4" pipe plug be removed from the flange of the right bank water pump and a valve be inserted in its place. The water sample may then easily be obtained under ideal sampling conditions.

TESTING ENGINE WATER TEMPERATURE SWITCHES

Pickup and dropout check of temperature switches can not be effectively performed on the locomotive without special equipment or without the laborious and time consuming means of subjecting the engine to load and disabling the fans. For these reasons, it is recommended that the routine check of temperature switch operation at the intervals recommended in the Scheduled Maintenance Program, or any check resulting from suspected faulty operation be made with bench equipment and test apparatus.

Temperature switches, Fig. 3-7, are easily removed from the temperature switch manifold and replaced with new switches. If a replacement switch with a new gasket attached is held at a ready position, the old switch and gasket can be removed and the new switch inserted with only a small loss of engine coolant.

The correct part numbers for replacement switches is most readily available on the Service Data page and in the book entitled "Locomotive Wiring Running List" that is supplied with the locomotive wiring diagrams. The part number for the running list itself is referenced in the lower right corner of the wiring diagram.

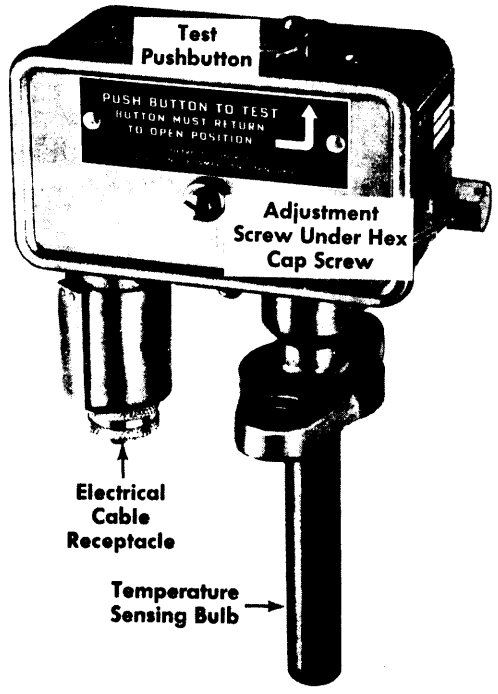

Fig. 3-7 — Engine Temperature Switch

After replacement switches are installed and the engine is running, press the switch test pushbuttons in sequence to verify fan operation.

CAUTION: Do not press switch test pushbuttons in simultaneously. Allow time for a given fan to pick up speed before pressing the test buttons to bring in more than one fan.

Instructions for checking the temperature switches are referenced on the Service Data sheet, and instructions for construction of bench testing apparatus can be obtained from the Service Department of EMD by requesting information listed on the Service Data page. Note that in any test of temperature switches, critical factors such as circulation of the test bath to prevent stratification, immersion of the temperature bulb to a proper depth, and ambient temperature approximating engineroom conditions must be observed.

INDICATIONS OF FAULTY SWITCH OPERATION

1. False hot engine indication due to incorrect ETS pickup.

2. Low oil shutdown due to hot engine oil. A fault exists in the cooling system and ETS did not operate properly.

3. Temperature switch cycling and picking up too soon after dropout. If the switch opens during a starting surge, fan contactor tips may be damaged. It is possible for the tips to weld closed. Damage to fan motors and the D14 alternator is also possible.

4. Two fan contactors must not pick up at the same time. If this occurs, switches may be operating improperly or an incorrect switch is installed. The strong starting surge resulting from such a condition can cause damage to the D14 alternator. The condition can be noted at the layshaft as the fans come in, and it may also be indicated by a deflection of the load indicating meter needle caused by a disturbance in the generator excitation system.

5. A cold engine may result from welded fan contactor tips or from sticking temperature switch pushbuttons.

TESTING FOR LOW WATER SHUTDOWN

Operation of the low water shutdown device, see Fig. 3-5, should be checked at the intervals stated in the Scheduled Maintenance Program or whenever faulty operation is suspected.

With the engine idling, turn the test cock handle to the horizontal position. The low water reset button should pop out smoothly without hesitation after water trapped behind the operating diaphragm escapes through the drain hole provided (in not more than a few seconds of time). Note that the low oil plunger on the governor also pops out when the engine shuts down.

If the low water shutdown reset pushbutton does not pop out freely without assistance when the test cock is opened and the engine is at idle, the device should be removed and replaced with an operative device. Refer to the Service Data page for a listing of instructions covering maintenance and qualification of the low water protector. Special apparatus is required for proper testing.

INSPECTION AND CLEANING OF RADIATORS

The access covers between the engineroom and the radiator compartment must always be securely bolted in place during locomotive operation. If a cover is not in place, improper circulation of cooling air will result, and the slight pressurization of the engineroom provided by cooling air from the main generator will be lost.

Periodic inspection and cleaning of the radiators should be performed at the minimum intervals called for in the Scheduled Maintenance Program, at more frequent intervals as determined by operating conditions, or when trouble is suspected. Since the pressurized system will

require only rare addition of water, any progressive lowering of the water level indicates that an inspection should be made for leaks. Inspect carefully for small leaks called "weep" at the junction of the radiator tubes and header.

Normally, the application of clean dry compressed air to the top surface of the radiators, followed by reverse operation of the cooling fans will satisfactorily clean the radiator cores and radiator compartment.

Reverse operation of cooling fans can be easily accomplished by interchanging the position of two AC leads that are bolted to the buses connecting to the fan contactors in the AC cabinet. The leads are indicated on Fig. 3-8. Reversal of AC leads at the alternator terminal board is not recommended because the dirt evacuating blower in the central air compartment will also be reversed.

After the AC leads are reversed, fan operation can be controlled by pressing the test pushbuttons on the manifold-mounted engine water temperature switches, Fig. 3-2. Two fans must be working to ensure automatic opening of the radiator shutters.

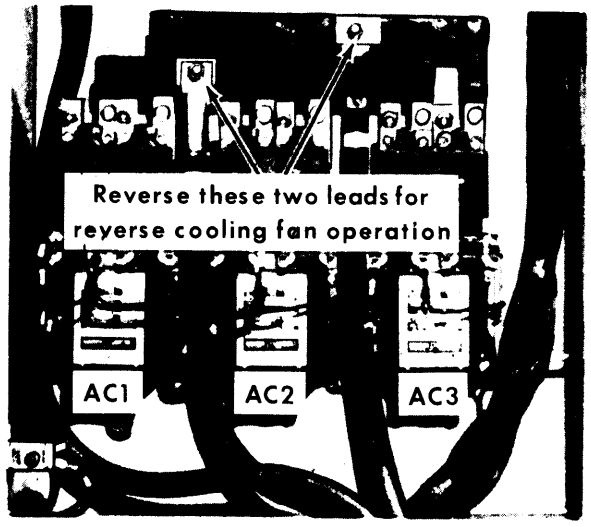

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Fig. 3-8 — AC Cable Terminals To Be Reversed For Reverse Cooling Fan Operation

CAUTION: When using fan test pushbuttons, be careful not to accidentally release a button during the starting surge of current, and be sure to allow a given fan time to speed up before pressing another button.

Make certain that the AC cables are returned to their proper connection points after radiator cleaning is completed.

SERVICE DATA
COOLING SYSTEM

REFERENCES

Temperature Control And Hot Engine Alarm Switches ..... M.I. 5511

Engine Coolant ..... M.I. 1748

Engine Water Treatment ..... Engine Maintenance Manual - Section 9

Maintenance And Qualification Of Low Water Detector ..... M.I. 259

Cooler, Lube Oil ..... M.I. 927

ROUTINE MAINTENANCE PARTS AND EQUIPMENT

	Part No.
Low Water Detector Qualification And Testing Apparatus	8349133
Thermometer Well 1/4" NPT	8268162
Temperature Switch-To-Manifold Gasket	8314926
Drain Cock 1/4" NPT	8386667

SPECIFICATIONS

Temperature Switch Settings				
Switch	Pickup	Dropout	Part No.	Optional Part No.
TA	155° F.	140° F.	8314889	8334771
TB	163° F.	148° F.	8314888	8334772
TC	171° F.	156° F.	8314887	8334773
ETS	208° F.	198° F.	8379564	

Pressure Cap 7 psi 8367366

Special 12 psi Pressure Cap Assembly 8387218

CENTRAL AIR SYSTEM

DESCRIPTION

Air is taken into the carbody (hood) of the locomotive to supply three separate systems.

1. Engine cooling.
2. Dynamic brake grid cooling.
3. Central system for motor and generator cooling, engine fuel combustion, and compartment pressurization.

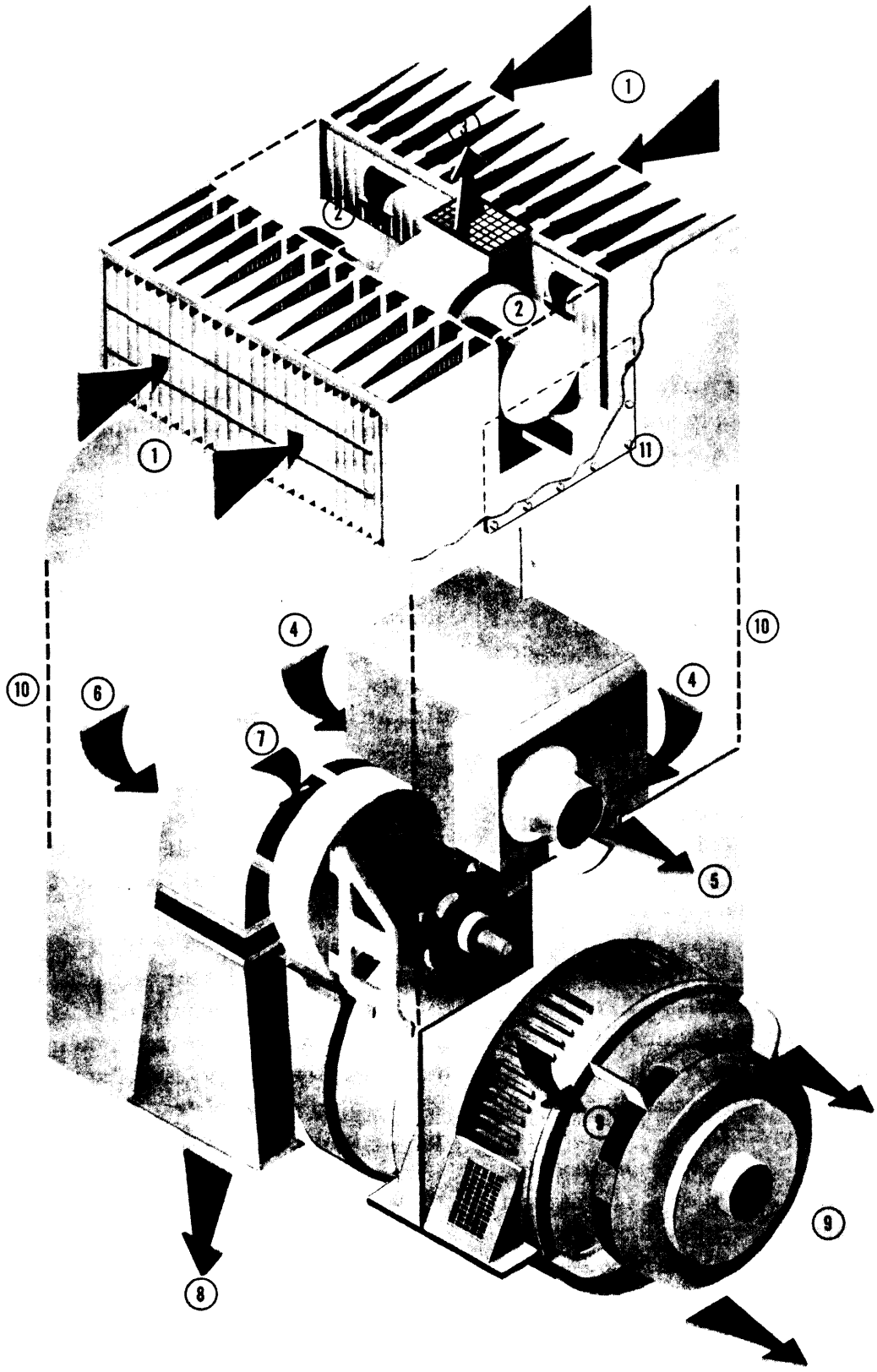
This section of the locomotive maintenance manual covers the central system, the components of which are in an airtight compartment, Fig. 4-1, located directly behind the locomotive cab.

The rear of the electrical cabinet, on which various electrical resistors are mounted to utilize the cooling air available, makes up the front wall of the air compartment. The back wall is made up of the AR10 generator and a partition fitted around the generator. One opening is provided for air to the engine and another opening is provided for the auxiliary generator and blower drive.

The hood sides and roof and the generator pit complete the central air compartment. Ambient air enters the compartment through the carbody inertial filters that are located high on the sides of the hood. The filters are made up of wedge shaped cells, Fig. 4-2, which have shaped slots forming each wall of the wedge. The demands of devices that draw air from the central compartment create an air pressure depression within the compartment. Outside air is forced rapidly through the wedge shaped cells. Dirt particles, because they are heavier than air, tend to travel in a straight line and are carried into a bleed duct located at the narrow end of the wedge. The main portion of the air, separated by the action of inertia from the dirt it carries, changes direction abruptly, passes through the narrow side passages, and enters the compartment as clean air. The bleed air containing dirt is drawn through an electrically driven bleed blower and is expelled through the roof of the locomotive.

Approximately two-thirds of the filtered air goes to the generator and tractor motor blowers to provide cooling air to the generator and motors. Supplementary use is also made of traction motor cooling air in the following manner.

1. Provides pressure to counteract the pressure depression of the central compartment and enables an aspirator, Fig. 4-3, to drain water from the generator pit.
2. Provides pressure to the engine air filter in order to alter its mode of operation and prevent filter oil from being drawn into the engine when it is operating at higher speeds.



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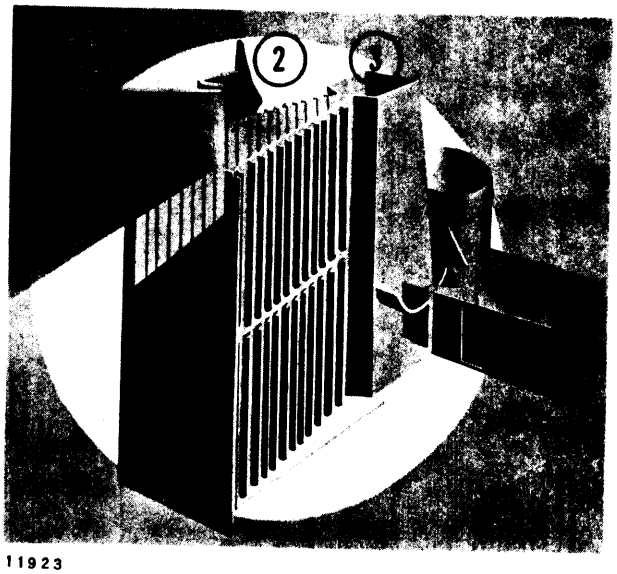
1 - Outside Air Intake To Inertial Filters
2 - Clean Air Into Sealed Compartment
3 - Blower Driven Air Carrying Dirt
4 - Intake For Engine Oil Bath Filter
5 - Clean Air To Engine
6 - Intake To Traction Motor Blower
7 - Intake To Generator Blower
8 - Cooling Air Ducted To Traction Motors
9 - Generator Cooling Air Pressurizes Engine Compartment
10 - Outline Of Sealed Central Air Compartment
11 - Access Panel

Fig. 4-1 — Central Carbody System



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1 - Outside Air Intake
2 - Clean Air Into Sealed Compartment
3 - Blower Driven Air Carrying Dirt

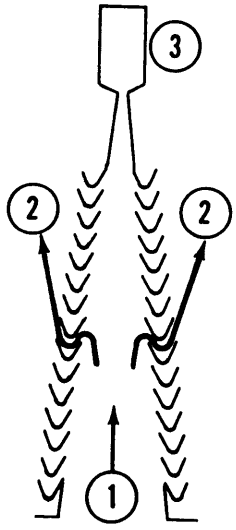

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Fig. 4-2 — Inertial Air Filter Cell Diagram

Air from the generator blower is applied first to cool the AR10 rectifier banks. From there it passes through the generator and into the engineroom. This creates a slight engineroom pressure which tends to keep dirt from entering the engineroom. The filtered air from the engineroom supplies air compressor intake, however the compressor is provided with its own intake filter assembly.

INSPECTION AND MAINTENANCE OF THE CENTRAL AIR SYSTEM

COMPARTMENT INSPECTION

If any leaks exist in the central air compartment, unfiltered air will enter. This may be caused by any of the following defects.

1. Access panel bolts removed.

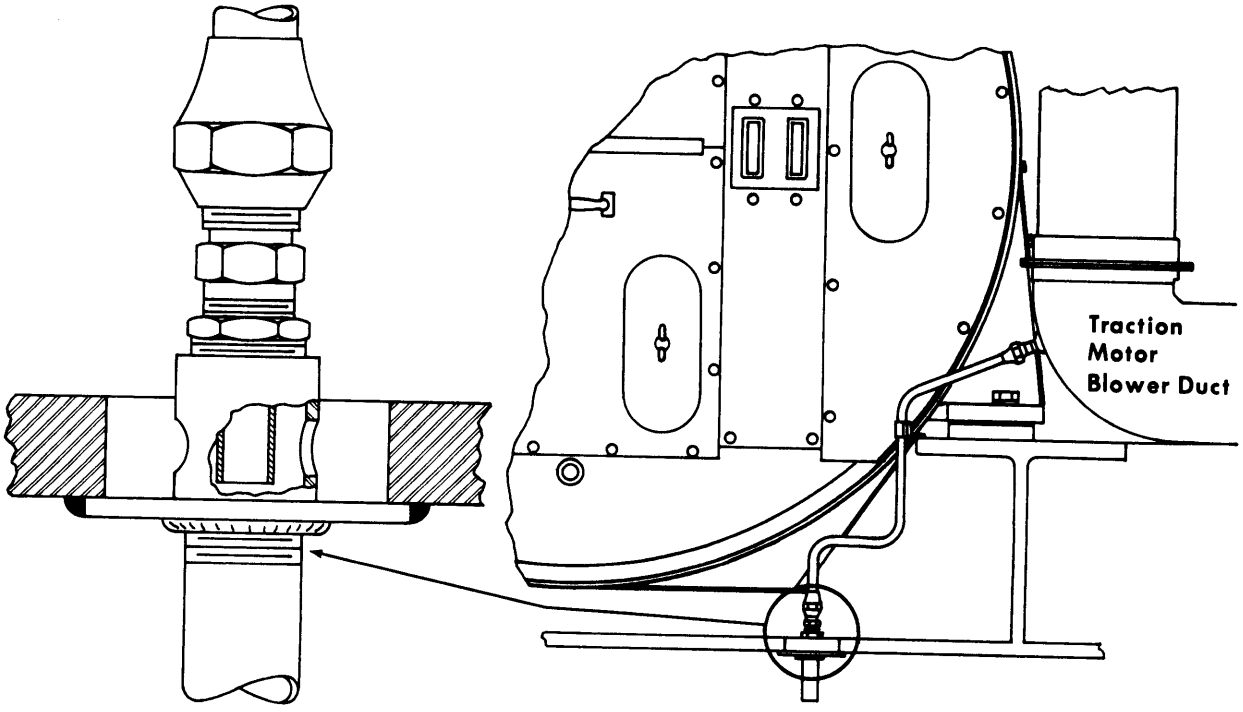

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Fig. 4-3 — Generator Pit Aspirator

2. Access panel gaskets or seals not properly applied.

3. Compartment door not properly sealed closed.

4. Engineroom partition and attached cover plates not properly applied and sealed.

5. Generator pit aspirator not properly connected.

ASPIRATOR INSPECTION

At the intervals stipulated in the Scheduled Maintenance Program, inspect the main generator pit aspirator, Fig. 4-3, as follows:

1. Check aspirator drain holes for obstructions.

2. Check that traction motor cooling air is exhausting from the aspirator tube causing venturi action at the aspirator drain holes.

FAULTY BLEED BLOWER OPERATION

The efficiency of the inertial carbody air filters will be significantly reduced if the bleed blower is faulty. If the blower is not operating, unfiltered air will be drawn in through the bleed blower exhaust stack, or if improper electrical connection is made, the blower may run backward with a resulting large drop in blower effectiveness. Either of the aforementioned conditions will cause an excessive amount of dirt to be blown into the generator and traction motor ducts. The oil bath engine filter will effectively clean the air taken in by the engine, but the added burden placed upon the engine filter may bring about the need for an early change of filter oil to eliminate sludge.

Proper operation of the bleed blower can be most readily verified in the following manner. Climb to the top of the locomotive before the engine is started, and observe the squirrel cage blower through the exhaust hatch at the roof of the inertial filter compartment. When the engine is started, the blower will turn so that the vanes move up toward the observer.

NOTE: It is not sufficient merely to check that air is exhausting from the bleed blower hatch of an already running engine. The squirrel cage blower, if running backward, will still exhaust air from the hatch, but at a greatly reduced volume.

INSPECTION OF CARBODY INERTIAL FILTERS

When dirt accumulates on the inertial filter cell vanes, the pressure drop across the filter increases, thus increasing the depression inside the filter compartment. As the depression increases, the carbody inertial filter becomes less efficient, but this in itself is not critical, since the efficiency of the engine filter, being the oil bath type, will not be affected. However, as filter department depression increases, the traction motor and generator blowers, which take their air from the compartment, will put out less cooling air.

When the pressure differential between ambient and the filter compartment reaches the maximum value stipulated on the Service Data page, cooling air flow is insufficient and damage to the main generator and traction motors is possible.

It is not possible to determine by a visual inspection whether the carbody filters are sufficiently clean or are plugged to the maximum allowable limit. It is possible for the filters to appear very dirty and

still provide adequate filtration and adequate cooling air.

If dirt on the filters is evenly distributed, it has no adverse effect upon filtration, except for the resulting increased pressure drop that the cooling blowers must work against. However, if dirt is unevenly distributed, filtering efficiency can be reduced without an increase in pressure drop.

It has been determined from experience that inertial filters should be cleaned at the intervals recommended in the Scheduled Maintenance Program. This recommendation should be followed even though the filter compartment depression is below the maximum allowable value. However, if compartment depression exceeds the maximum at any time between scheduled cleanings, the filter should be immediately cleaned.

CHECKING FILTER COMPARTMENT DEPRESSION

Filter compartment depression may be checked when operating conditions or the appearance of the filters seem to warrant such a check. Perform the following:

CAUTION: Do not allow satisfactory filter compartment depression readings to be used to extend the filter cleaning interval stipulated in the Scheduled Maintenance Program.

1. At the locomotive cab, open the switch and fuse compartment door and connect a 1/4 inch I.D. rubber hose to the hose stem, Fig. 4-4, located at the side wall of the compartment. Connect the other end of the hose to a U-tube manometer or other pressure measuring device.

2. Operate the diesel engine until it is warm, then with reverser lever in neutral position and generator field fuse removed, place throttle in run 8 position. Loading is not necessary.

3. If filter compartment depression is less than the minimum stipulated on the Service Data page, make certain that all central air compartment panels, partitions, and cover plates are properly applied and that no air is bypassing the carbody filters.

4. When the filters are clean, the central air compartment depression should be near the value stipulated on the Service Data page. Depression readings greater than the maximum stipulated are cause for immediate cleaning of the carbody inertial filters.

CLEANING THE CARBODY INERTIAL AIR FILTERS

The only approved and recommended method of cleaning the carbody filters is immersion in a hot caustic or detergent bath followed by a cold wash. The filters should be removed from the locomotive and cleaned at the intervals prescribed in the Scheduled Maintenance Program.

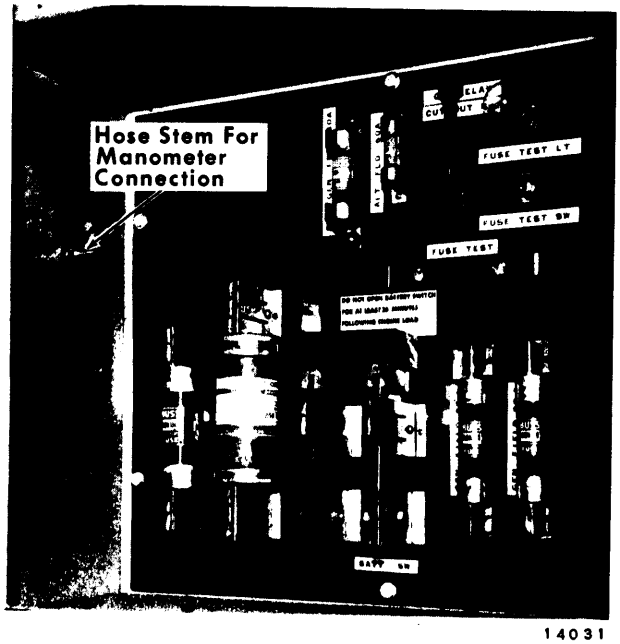

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Fig. 4-4 — Hose Stem For Manometer Connection

The filters should also be cleaned if filter compartment depression exceeds the maximum value shown on the Service Data page, but compartment pressure readings should not be used to extend the scheduled cleaning interval.

REMOVAL AND CLEANING PROCEDURE

In order to facilitate inertial air filter cleaning and changeout, a spare set of filters may be made available for rapid exchange with dirty filters. Such availability of replacement assemblies will allow proper cleaning and maintenance of the filter assemblies without tying up a locomotive.

CAUTION: Observe filter interchangeability specifications listed on the Service Data page.

To remove the inertial air filter assemblies from the locomotive, perform the following:

1. In the engineroom, at a position adjacent to the turbocharger, remove 22 hex head 1/2-20 screws and the filter compartment access panel from the engineroom - air compartment partition. This provides access to clamps on dirt evacuating hoses, 11, Fig. 4-1.
2. Loosen the clamps on the hose that connects the inertial filter dust bin to the bleed blower assembly. Raise the rubber hose so that the hose is free of the filter assembly.
3. From the outside of the locomotive, remove ten 1/2"-13 hex head bolts and split lockwashers holding the inertial air filter inlet screen to the filter opening. Remove the screen. Fig. 4-5 shows a cross sectional view of the area where filter and screen are attached to the locomotive hood.
4. Thread several lifting eyes into the holes for the 1/2"-13 bolts, and attach a suitable lifting device to the filter assembly. Each filter assembly weighs approximately 600 pounds.
5. From inside the central air compartment, loosen the flare nuts that connect drain piping to the underside of the filter assemblies. Bend the tubing slightly away from the fittings.
6. With a pipe wrench, remove the pipe nipples and attached elbows from the filter assemblies. This is done to allow easy removal of the filter assemblies and avoid damage to the pipe fittings. To avoid loss, the elbows and nipples may be temporarily fastened to the flare nuts.
7. Remove the 16 hex head 1/2"-13 bolts that hold the filter assembly in place, and remove the filter assembly from the carbody.
8. Remove and discard the pressure sensitive backed tape-type gasket material from the filter flange.
9. Place the entire filter assembly in a hot caustic or detergent bath until clean. The time required for cleaning

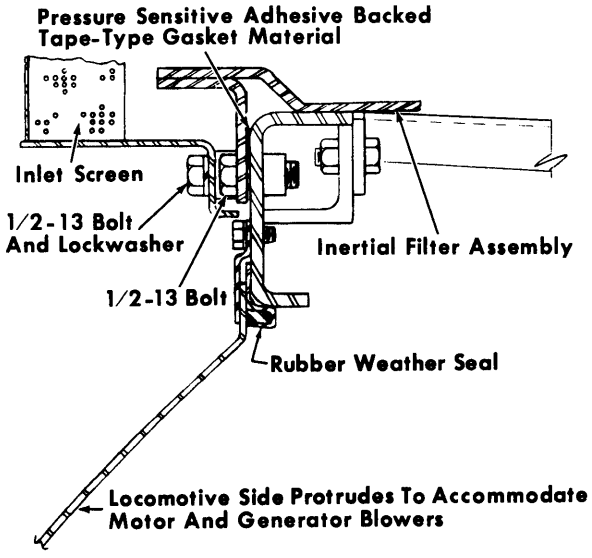


Fig. 4-5 — Inertial Filter And Filter Screen Attachment Cross Sectional View

will depend upon the type of bath used, its temperature, and the condition of the filter.

10. When the filter is removed from the caustic bath it should be given a clear cold wash.

11. Dry the filter flange and apply new pressure sensitive backed tape-type gasket.

12. Reinstall the filters and filter screens, reconnect water drain piping, and reconnect the hose between the dust bin and blower assembly.

13. Tighten the hose clamps, then after inspecting the gasket material on the access cover, replace the access plate and reapply the screws.

CAUTION: Make certain that the hoses are correctly mated to the dust bin openings before tightening the hose clamps.

14. Check all connections to see that no leaks exist. Check the filter compartment depression.

ENGINE AIR FILTER

GENERAL DESCRIPTION

The engine air filter, Fig. 4-6, is mounted within the central air compartment and on top of the main generator. It is an oil bath filter that relies upon oil-wetted media to remove dirt particles from the air that is drawn through it. The filtering media is both wetted and washed by filter oil that is drawn by the force of air from an oil sump and up to the filtering media.

FILTER OPERATION

Incoming air enters the front, side, and back of the filter housing through openings formed by structural iron legs that separate the drip pan and oil sump from the main body of the filter assembly. The air passes through a perforated plate, each perforation of which is covered by a disc that is elevated by the force of incoming air. The openings in the perforated plate are calibrated to increase the velocity of air through them just the proper amount to pick up oil as it tends to spill over the edges of the holes. At the same time, the movable discs (variflow valves) act to distribute air flow uniformly over the filter pad area.

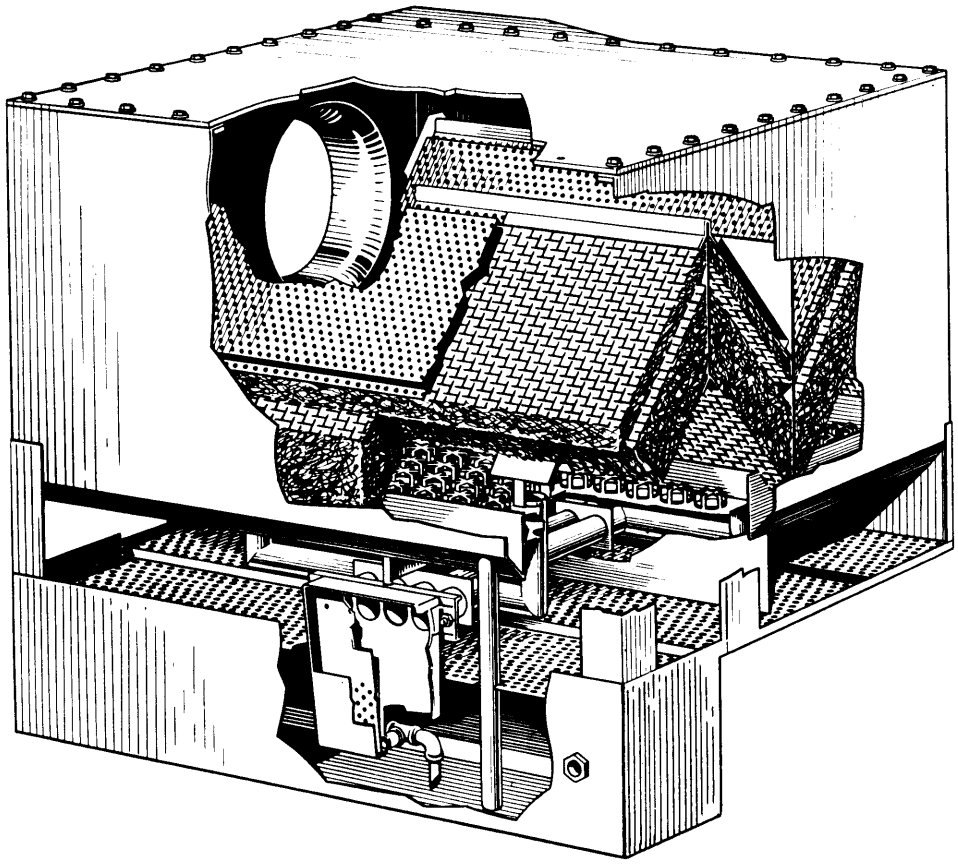
Oil and dirty air are carried upward from the perforated plate and into the primary filter pad. Dirt is collected by the pad, and clean air passes through the pad. The collected dirt is washed out by oil as it drains to the low edges of the pads and into channels and piping that returns the dirty oil to the sump. The accumulated sludge settles to the bottom of the sump.

A secondary pad catches oil that did not adhere to the primary pad. However, if air velocity through the filter becomes too great, oil will pass through the secondary pad and into the engine. The manner in which this is prevented is shown following the explanation of how oil is drawn up to the perforated plate and filter pads.

OPERATION OF THE PNEUMATIC OIL LIFT

The restriction in air flow caused by the perforated plate and variflow valves develops a pressure drop across the perforated plate. Because of this pressure drop, oil is pulled in droplet form from the aspirator cup and into the lift tubes. A flow of oil is therefore supplied from the oil sump to the filtering media and top of the perforated plate. This occurs in the following manner.

The pressure inside the lift tubes is less than the atmospheric pressure on the surface of the oil in the sump. Oil therefore starts to rise in the aspirator cup.



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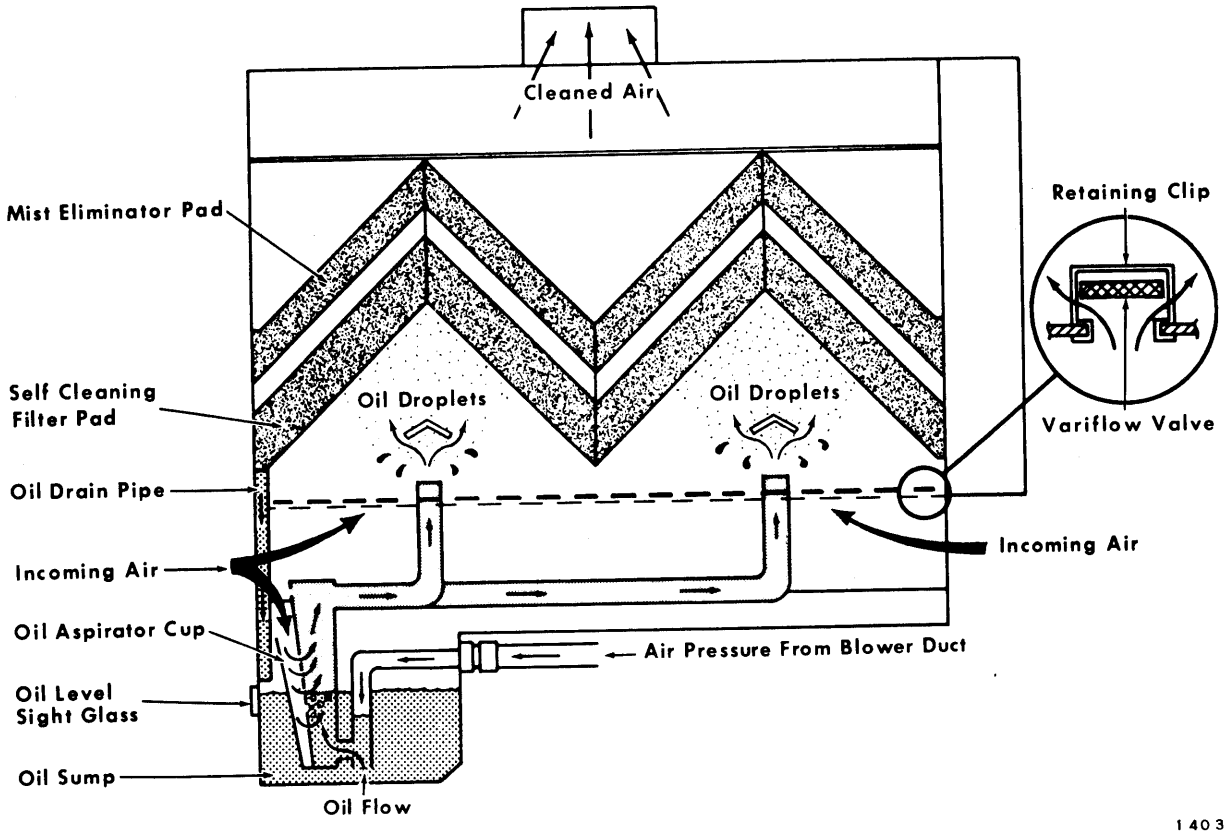

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Fig. 4-6 — Engine Air Filter Schematic Diagram

See detail on Fig. 4-6. The pressure differential also causes air to enter aspirator holes in the cup, some of it below the level of the oil standing in the cup. The jets of air through the aspirator holes are of sufficient velocity to break oil surface tension and create oil droplets. The air-oil mixture combines with the air entering the aspirator holes above the oil level. This provides sufficient lift to deliver the oil to the area above the perforated plate. The small oil particles are carried to filtering pad; the larger drops fall to the perforated plate and form a film that is picked up and carried to the filtering pad by the force of incoming air through the variflow valves.

ASPIRATOR CUTOFF

The sump details on Fig. 4-6 show that traction motor blower pressure is used to influence the flow of oil to the aspirator cup. This is required because space restrictions limit the size of the oil bath filter, and the velocity of intake air at higher engine speeds would cause oil to be drawn through the mist eliminator pad and into the engine. The method used to prevent filter oil from being drawn into the engine is to cut off aspiration when engine speed reaches a specific throttle position. This is done by taking the pressure (proportional to engine speed) in the traction motor blower duct and directing it to the aspirator assembly. The details on Fig. 4-6 show that air pressure as calibrated by an orifice in the line will prevent oil from rising in the aspirator cup when pressure becomes great enough.

After aspirator cutoff, the filter acts as an oil wetted impingement filter of sufficient capacity to operate continuously at high throttle for over a day without plugging the filter. Since a locomotive does not operate continuously at high throttle for such long periods, filtering media plugging will not occur. The media will be cleaned adequately and re-oiled when the engine is operated at idle or low throttle position for about 15 minutes every few hours.

MAINTENANCE

Operation of the engine oil bath filter should be checked at intervals stipulated in the Scheduled Maintenance Program. Filter oil should be changed and the filter cleaned at stated intervals or at shorter intervals if operating conditions warrant. Filter oil must be of the type indicated on the Service Data page.

OIL LEVEL

A sight glass is located on the side of the oil sump. The oil level should be checked after the engine has been idling for at least 5 minutes to allow the system to balance. The oil level should be at the center of the sight glass. If oil level is checked immediately after engine shutdown it will also be at the center of the glass, but will rise to the top of the glass in about 20 minutes.

If frequent addition of oil is necessary, an investigation should be made to determine where the oil is being lost. If no external leak is found, the aspirator cutoff may be faulty and oil is being drawn into the engine.

Under normal conditions, there should be no need to add oil between scheduled oil changes.

CHECKING ASPIRATOR CUTOFF

Aspirator cutoff can be checked by looking with a flashlight up through the variflow valves toward the filtering pad while the locomotive is running in various throttle positions. When oil is being aspirated, tiny droplets can be seen being carried toward the filtering pad. Aspirator cutoff should occur at the throttle

position listed on the Service Data page. Close the central air compartment door while making the check.

If the aspirator cutoff is not working, check the following:

1. The hose connecting the traction motor blower duct with the filter sump should be intact and secure.
2. Aspirator cutoff orifice plugged.
3. Air pressure line inside the sump leaking.
4. Additive type oil used instead of recommended oil.

CAUTION: Additive type oils tend to keep dirt particles in suspension, which increases its tendency to "mist."

5. While checking aspirator cutoff, check that all variflow valves operate properly and that the valve retaining clips are in good condition.

PROCEDURE FOR CHECKING ASPIRATOR CUTOFF

1. With engine at idle
   a. Check oil level. The oil level should be at the center of the sight glass.
   b. Check oil level in the delivery cup with a dipstick. Oil level should be at a minimum of 1" deep.
2. Increase engine speed to 8th throttle. Within 3 minutes after reaching eighth throttle, the delivery cup should be empty.
3. Reduce throttle to Run 6 and allow the engine to run at that speed for 3 minutes. If the aspirator cutoff is operating properly there will be no oil in the delivery cup.
4. Return engine to idle. Within 3 minutes the oil level in the delivery cup should be at a minimum of 1" deep.

CHECKING FILTER OIL WASH

A periodic check should be made to verify that the aspirator is working properly and the filtering media is being washed with oil. If the filter air intake area is coated with dry dirt, proper aspiration is not taking place. The following items should be checked.

1. Check for proper filter oil level.
2. Check that the oil level in the aspirating cup is at least 1-1/2 inches. A piece of metal can be used as a dip stick.
3. Verify that the proper type of oil is being used in the filter.

CLEANING THE FILTER

A drain plug is provided at the bottom of the oil sump. After the oil is drained, replace the plug temporarily and use a kerosene spray to clean the vari-flow valves and the oil drip pan surfaces. Drain out the kerosene, then with a scraping tool, clean the sludge from the sump. When the bulk of the sludge has been removed a further kerosene spray may be used to wash down the remaining sludge. With a brush or some pointed object, check that the holes in the aspirator cup are clear. Wipe out the sump with shop towels.

Add the type oil specified on the Service Data page. Oil level should be at the center of the sight glass.

The filtering and mist eliminator pads need no servicing and should not be disturbed unless there is definite indication of malfunction. Should some rare condition make it necessary to clean the filtering and mist eliminator pads, it is first necessary to remove the inertial filters and roof hatch from the locomotive, then unbolt and remove the filter top plate. Lift out the pads and clean them with kerosene or hot water.

SERVICE DATA

CENTRAL AIR SYSTEM

ROUTINE MAINTENANCE PARTS AND EQUIPMENT

	Part No.
Pressure Sensitive Backed Tape-Type Gasket	
1/16" × 3/4" Rubber Cork	8135382
100 ft. length	8133198
1/16" × 1-7/8" Rubber Cork	8135383
100 ft. length	8133199
Rubber Weather Seal	8324100

SPECIFICATIONS

Engine Air Filter - Oil Type

No. 10 Weight, Non-Detergent, Low-Additive Mineral Oil (Air Compressor Oil) ..... Flat Sump 11-1/2 Gallons
"V" Sump 15-1/2 Gallons

Aspirator Cutoff Point Maximum Position ..... 6th Throttle

Engine Air Filter - Pleated Paper Type 12 Required Per Assembly

Filter Element (Length 45" - Weight 19.5 Lbs.) 8377042

Electrical Cabinet Air Filter

Pleated Cotton-Paper Elements (2 per housing) ..... 8345482 or 8398833

FILTER INTERCHANGEABILITY

SD45 Inertial Filters And Inlet Screens Are Interchangeable With SD40 Filters And Screens, But With No Other Models.

SERVICE DATA (CONT'D)

Minimum Allowable Central Air Compartment Depression . . . . . 2 inches H_2O

Maximum Allowable Depressions:

		Maximum Depression Inches Of Water	Pressure Reading Location At Run 8, Load Or No Load
Units Equipped With Oil-Type Engine Air Filters	Carbody Inertial Filter	5	Between fitting in electrical cabinet and outside of filter compartment.
	Combined Oil-Type And Inertial Filters	16	Between oil-type filter top front (toward electrical cabinet) bolt hole and outside of filter compartment with door closed.
	Aftercooler Core	10	At bolt holes (5th from top) across aftercooler core. Apply and disconnect hoses with engine down or at idle speed. CAUTION: Do not remove hoses with engine at high speed. Do not apply or remove hoses singly.
		Maximum Depression Inches Of Water	Pressure Reading Location At Run 8, Load Or No Load
Unit Equipped With Pleated Paper Engine Air Filters	Carbody Inertial Filter	5	Between fitting in electrical cabinet and outside of filter compartment.
	Combined Pleated Paper And Inertial Filters	14	Between vacuum switch piping (Engine side of partition) and outside of filter compartment.
	Aftercooler Core		No check required. Cores are not subject to soot loading.

RECOMMENDATIONS — INERTIAL FILTER CLEANING

It is recommended that carbody inertial filters by thoroughly cleaned every 12 months, regardless of depression readings. This is to avoid the possiblity of inefficient filtration due to uneven distribution of dirt on the filter cells.

It is recommended that filter compartment depression readings be taken periodically. However, if readings are taken only yearly, a reading of 3 inches of water indicates that the maximum allowable depression of 5 inches probably will be reached before the next yearly inspection.

RECOMMENDATIONS — OIL-TYPE FILTER CLEANING AND OIL CHANGE

On units with flat bottom sumps, change oil every 3 months. Clean the sump and the valve distribution plate every 6 months. On units with "V" bottom sumps, change oil every 6 months. Clean the sump and valve distribution plate every 12 months.

Monitor the combined inertial and oil-type filter depression at annual inspections. Also check the inertial filter depression independently. These readings will provide indication whether the inertial filter alone, or both the inertial and the oil-type filters should be removed and cleaned.

The oil-type filter should be removed and cleaned when the pressure reading cannot be brought into tolerance by cleaning the inertial filter alone; or if with a clean inertial filter it is expected that the pressure limitation will be exceeded before the next annual inspection.

If the condemning pressure is not reached, the oil-type filter should be removed and cleaned only at the rebuild interval (5 years).

RECOMMENDATION — AFTERCOOLER CORE CLEANING

On units equipped with oil-type engine air filters, the aftercooler cores should be cleaned every 12 months.

RECOMMENDATION — PAPER FILTER CHANGEOUT

When a tripped engine air filter service indicator is noted, the indicator should be reset with the engine at idle speed. Speed should then be increased to Run 8 for 1 minute, then returned to idle. If the indicator is tripped, check the combined paper and inertial filter depression with a manommeter, then check the inertial filter depression independently. These readings may indicate whether inertial filter cleaning will significantly increase the usable life of the paper filters.

Ideally, to obtain full use of the paper filters, the times of inertial filter cleaning and paper filter changeout should be staggered.

COMPRESSED AIR SYSTEM

DESCRIPTION

Compressed air is used for operating the locomotive air brakes and auxiliary devices such as sanders, shutter operating cylinders, horn, bell and windshield wipers. Air is also required for atomizing the fuel oil supplied to the steam generator (if so equipped).

AIR COMPRESSOR

DESCRIPTION

Compressed air is received from a deep crankcase water cooled, three cylinder (six cylinder optional), two stage air compressor, Fig. 5-1. The compressor is driven through flexible couplings from the front end of the engine crankshaft.

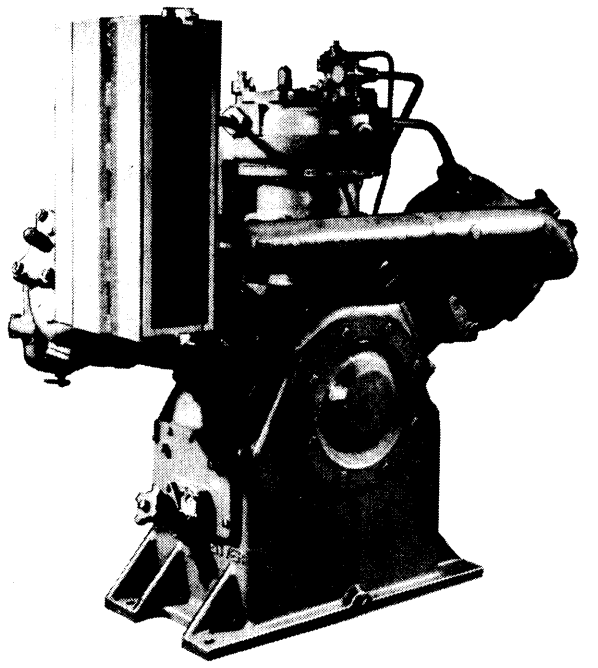

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Fig. 5-1 — Air Compressor

The compressor has its own oil pump and pressure lubricating system. With the engine running, the oil level in the compressor crankcase can be checked on the float type indicator. At idle speed with the lubricating oil at operating temperature, the oil pressure should be approximately 15 to 20 psi. A plugged opening in the relief valve block is provided for an oil pressure gauge.

The compressor has two low pressure and one high pressure cylinders. The pistons of all three cylinders are driven by a common crankshaft. Two low pressure cylinders are set at an angle to the one vertical high pressure cylinder. Air from the low pressure cylinders goes to a water cooled intercooler to be cooled before entering the high pressure cylinder. The intercooler is provided with a relief valve and a plugged opening for a pressure gauge.

The compressor is equipped with either of two dry type air inlet filters, Fig. 5-2, containing replaceable elements.

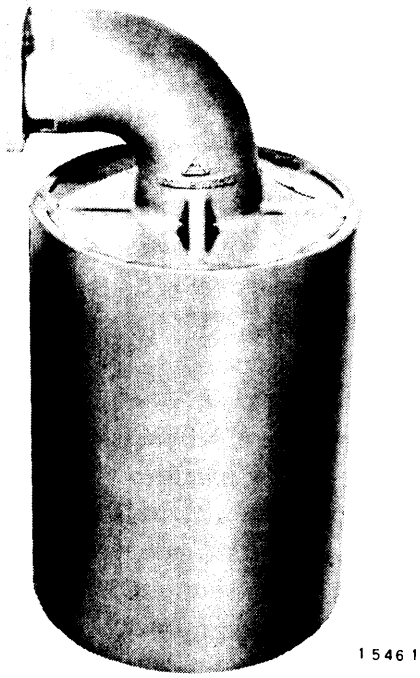

Fig. 5-2 — Compressor Air Filter

MAINTENANCE

The air compressor should be periodically checked to see that the lube oil level indicator needle is in the RUN zone on the sight gauge. If the gauge shows the oil level to be in the ADD zone, a sufficient amount of EMD approved lube oil should be added at the oil fill pipe. The oil should be changed at intervals stated in the applicable Scheduled Maintenance Program. The capacity of the deep crankcase compressor should be sufficient to make it unnecessary to add oil between oil changes.

When it is necessary to install a pressure gauge to check intercooler or lube oil pressures be sure the gauge is removed and replaced with a plug and the plug tightened sufficiently to prevent loosening from vibration.

The air inlet filter element should be changed at intervals specified in the applicable Scheduled Maintenance Program. Consult the Service Data page at the end of this section for the correct replacement filter element.

An alternate method of judging the proper filter element change point is to measure the pressure drop across the filter using a water manometer. One of the four bolts used to attach the filter to the manifold should be removed and the manometer tube inserted through the hole.

The filter element should be replaced when the pressure drop indicated by the manometer is 10" of water or higher.

To remove the element from the rectangular shaped filter, remove the nut, lockwasher, and retainer hook at the top and bottom of the filter, Fig. 5-3. The impingement screen can then be removed and the element pulled out of the housing.

To remove the element from the cylindrical shaped filter, remove the elastic stop nut and the retainer at the bottom of the filter. The element is then free to drop out of the filter body so a new element can be installed.

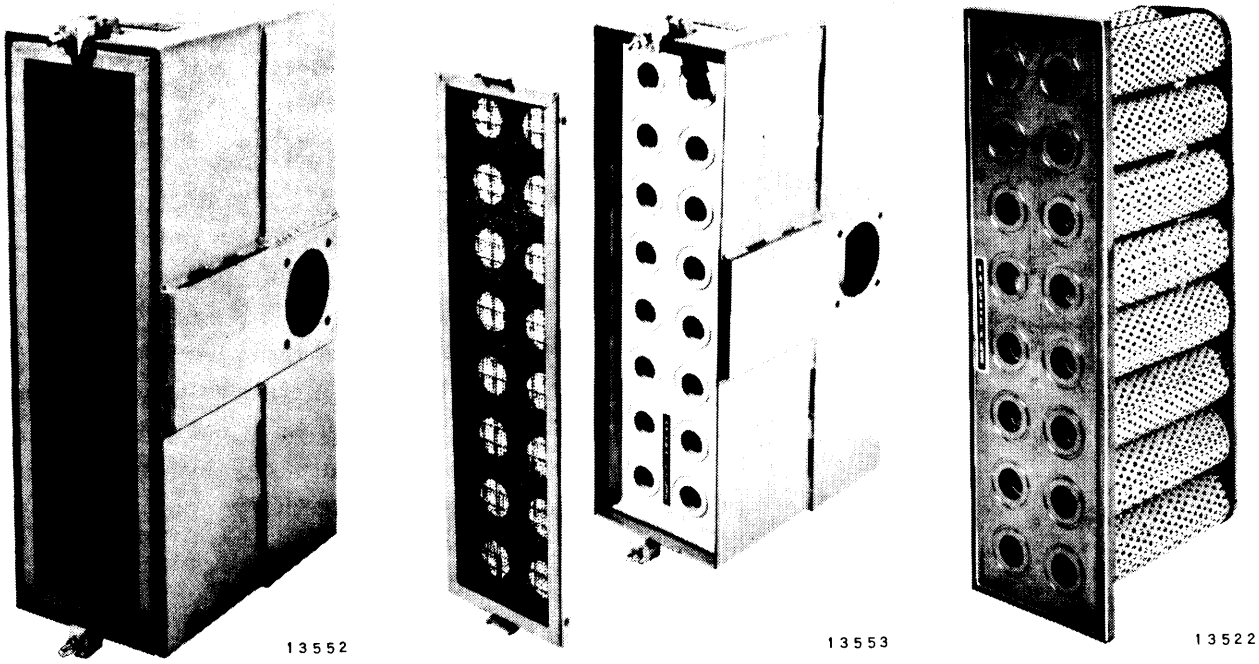

Fig. 5-3 — Replacing Compressor Air Filter Element

COMPRESSOR CONTROL EQUIPMENT

COMPRESSOR CONTROL SWITCH — CCS

DESCRIPTION

Since the air compressor is directly connected to the engine, the compressor is in operation (although not always pumping air) whenever the engine is running. An unloader piston that cuts out the compressing action when actuated by air pressure from the compressor control switch, Fig. 5-4, is provided in the head of each high and low pressure cylinder. The unloader accomplishes this by blocking open the intake valves in the high and low pressure cylinders. When the air operating the unloader is cut off, the unloader releases the intake valves and the compressor resumes pumping. Main reservoir air pressure is used to actuate the unloader valves.

When the locomotive is furnished with the optional extra compressor synchronization, each locomotive unit is equipped with

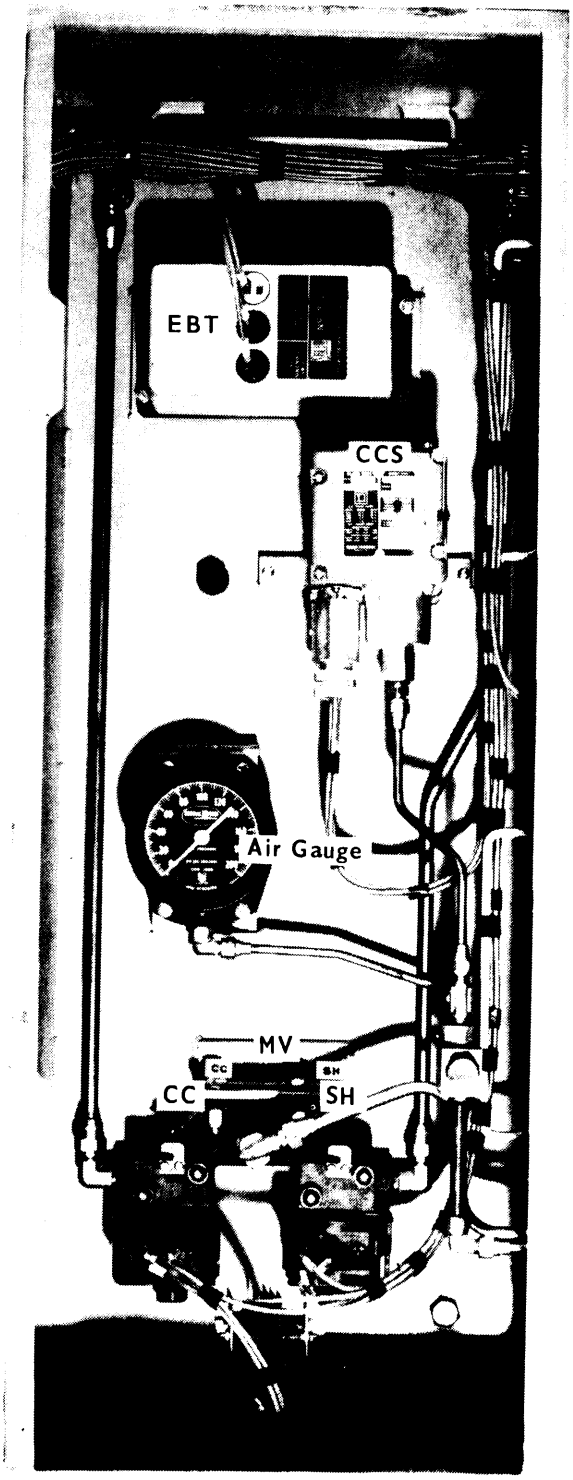

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Fig. 5-4 — Compressor Control Equipment In AC Cabinet

an electro-pneumatic system for compressor governor control. The electrical arrangement is such that the compressor in each unit of a consist pumps air to its own main reservoirs whenever the main reservoir pressure in any single unit drops to 130 psi, Fig. 5-5. All units will continue to pump until main reservoir pressure in each and every unit reaches 140 psi.

Another available option is a dual compressor control switch which acts to unload the compressor on an individual unit when the main reservoir pressure for that unit reaches 145 psi. This prevents individual compressors from working against the main reservoir safety valve when other units in the consist have not yet accumulated sufficient main reservoir pressure to signal unloading of the compressors.

MAINTENANCE

The compressor control switch, Fig. 5-6, is manufactured to close tolerances and therefore inspections should be limited to intervals specified in the applicable Scheduled Maintenance Program. If air compressor difficulties arise, all other sources of possible trouble should be investigated before any attempt is made to disturb the settings of the compressor control switch.

During periodic inspections of the compressor control switch or when faulty operation is suspected, the switch should be removed from the locomotive and replaced with a qualified switch. The faulty switch should be taken to a bench for any further testing or setting.

COMPRESSOR CONTROL MAGNET VALVE — MV-CC

DESCRIPTION

When the compressor control magnet valve, Fig. 5-4, is de-energized, the air compressor unloader piston lifts and the compressor begins to pump. The magnet valve is de-energized when the compressor relay is energized, and the compressor relay responds to the compressor control switch in the individual unit or to

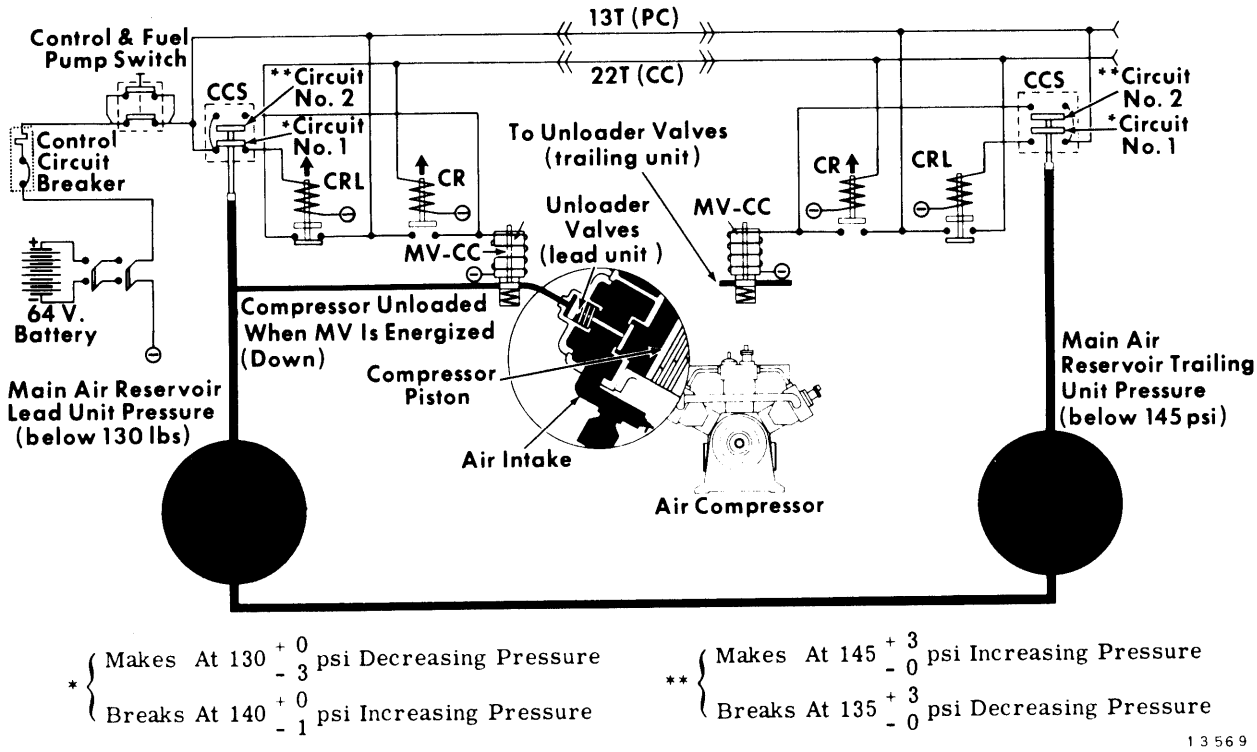


Fig. 5-5 — Electro-Pneumatic Compressor Control

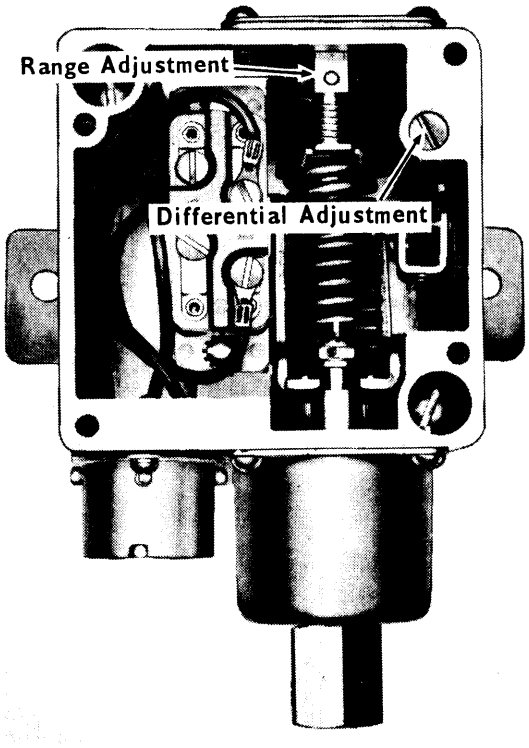


Fig. 5-6 — Compressor Control Switch

the compressor control switch in each or any unit of a consist equipped with synchronization.

A manual means is also provided for keeping the air compressor unloaded. To do this hold the compressor magnet valve, MV-CC, open by a manual override handle, which holds the magnet valve in energized position.

MAINTENANCE

If faulty operation of the valve is suspected, check the magnet valve by turning the small "tee" handle on top of the valve while the compressor is running. The unloader valve should open causing the compressor to pump. Check the magnet valve and air line to the compressor unloader valve for leaks. Also check the electrical connections on the valve to see that they are tight. If repair is required, remove the magnet valve and replace it with a qualified valve.

COMPRESSED AIR PRESSURE GAUGE

DESCRIPTION

A pressure gauge, Fig. 5-4, is provided in the compressor control section of the AC

cabinet to check the operation of the compressed air system. The gauge is connected to the air system in the line from the main reservoir to the compressor control switch and consequently will reflect No. 1 main reservoir pressure.

MAINTENANCE

If faulty operation of the gauge is suspected replace it with a tested gauge and take the faulty gauge to a bench for testing.

COMPRESSED AIR FILTERS

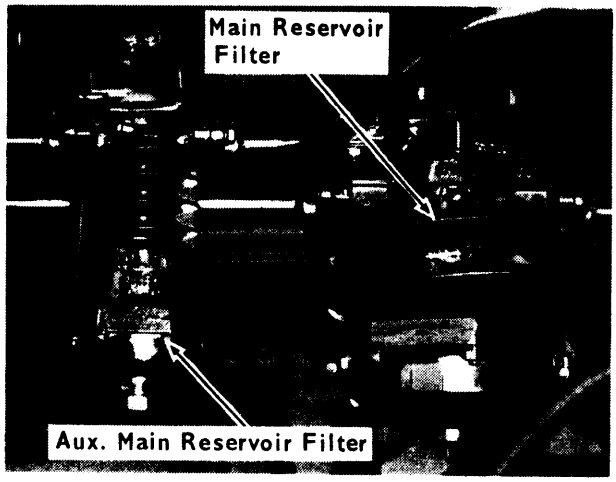
DESCRIPTION

The compressed air system has three centrifugal type filters, the main reservoir and auxiliary main reservoir filters, and the compressor control strainer, Fig. 5-7, to prevent moisture and contaminants from being carried into the air brake and other air systems. Both the main reservoir and auxiliary main reservoir filters are equipped with an automatic electric drain valve which operates on a signal from the compressor control switch each time the compressor unloader valve is actuated. The compressor control strainer drain valve opens each time reservoir pressure drops below 20 psi such as during monthly inspections of the locomotive. The main reservoir centrifugal filter contains a replaceable paper filter element.

The main reservoir and auxiliary main reservoir filters can be equipped with an optional electro-thermo timer to control the interval between blowdowns of the automatic drain.

MAINTENANCE

The main reservoir centrifugal filter contains a replaceable type filter element which should be changed at intervals



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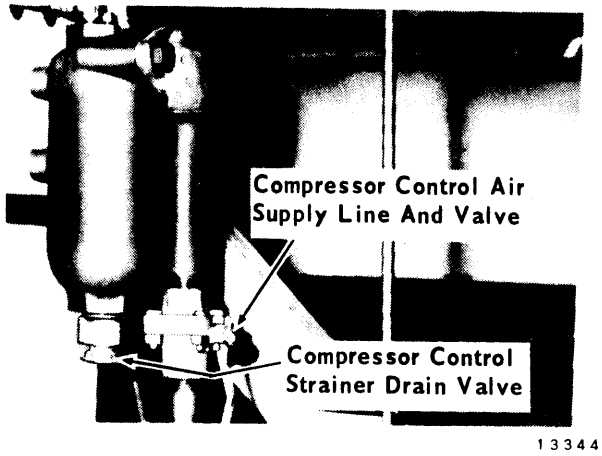

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Fig. 5-7 — Compessed Air Filters

stated in the applicable Scheduled Maintenance Program. See Service Data for correct filter element.

Before removing the sump bowl on the bottom of the filter be sure the cutout located between the main reservoir and the filter is shut off. Once the sump bowl is removed, the element can be removed by unscrewing the wing nut that holds the element in place.

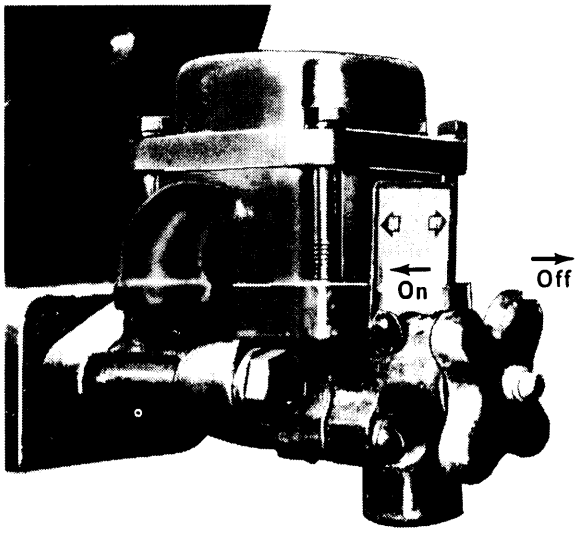
The sump bowl on both the centrifugal filters may be cleaned out if necessary by removing the bowl.

The magnet valves should be cleaned and inspected when maintenance is performed on the filters as stated in the applicable Scheduled Maintenance Program.

MAIN RESERVOIR DRAIN VALVES

DESCRIPTION

Both main reservoirs are equipped with a manual drain valve to allow moisture to be drained from the reservoir before it is carried into the air system. The No. 1 main reservoir is also an automatic drain valve which operates automatically when the compressor loads or unloads. The No. 2 main reservoir can be equipped with an automatic drain as an option.



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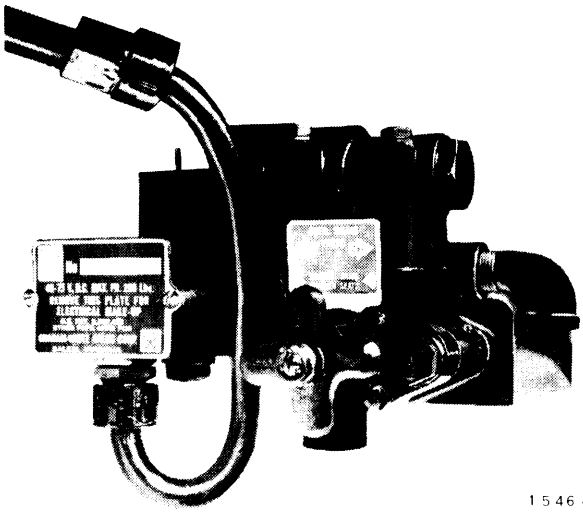
Manual Drain Valve



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Solenoid Operated
Automatic Drain Valve

Fig. 5-8 — Main Reservoir Drain

The electro-thermo timer to control blow-downs of the automatic drains, mentioned earlier under Compressed Air Filters, can be supplied as an option at extra cost.

An additional option which is frequently used with the electro-thermo timer is the solenoid operated automatic drain valve which has the solenoid attached directly to it, Fig. 5-8.

MAINTENANCE

The drain valves should be checked periodically to see that they are seating properly and no air is leaking. The seals and piston should be lubricated at regular intervals with a good grade of air brake grease.

ELECTRO-THERMO TIMER

DESCRIPTION

The electro-thermo timer, EBT, Fig. 5-9, used to control the interval between blow-downs on the automatic drain valves consists of a bi-metal switch, a resistor, and

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Fig. 5-9 — Electro-Thermo Timer

a relay which is connected to the coil leads on the filter and reservoir drain valves. When the coil is energized by closing the battery circuit, the resistor in the electro-thermo timer is energized and starts to heat up. This also heats the bi-metal switch until it opens the circuit to the relay, which will energize the solenoid on the drain valves. When the bi-metal switch cools off, the procedure is repeated.

MAINTENANCE

If faulty operation of the electro-thermo timer is suspected, first check to see that all connections are tight at the timer and at the drain valves. If this does not produce satisfactory results replace the thermo switch by removing the electro-thermo timer cover and pulling the tape tab on the switch. Plug in a new switch and replace cover.

DRAINING THE AIR SYSTEM

The compressed air system air filters and main reservoir automatic drains should be operated manually at least once a day to ensure operation of the automatic feature.

The drain valves are located at the following locations:

1. Auxiliary main reservoir centrifugal filter drain valve, Figs. 5-10 and 5-11.

2. Main reservoir centrifugal filter drain valve, Figs. 5-10 and 5-11.

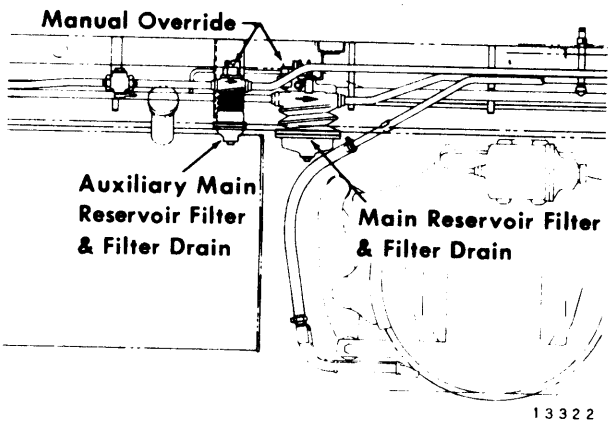
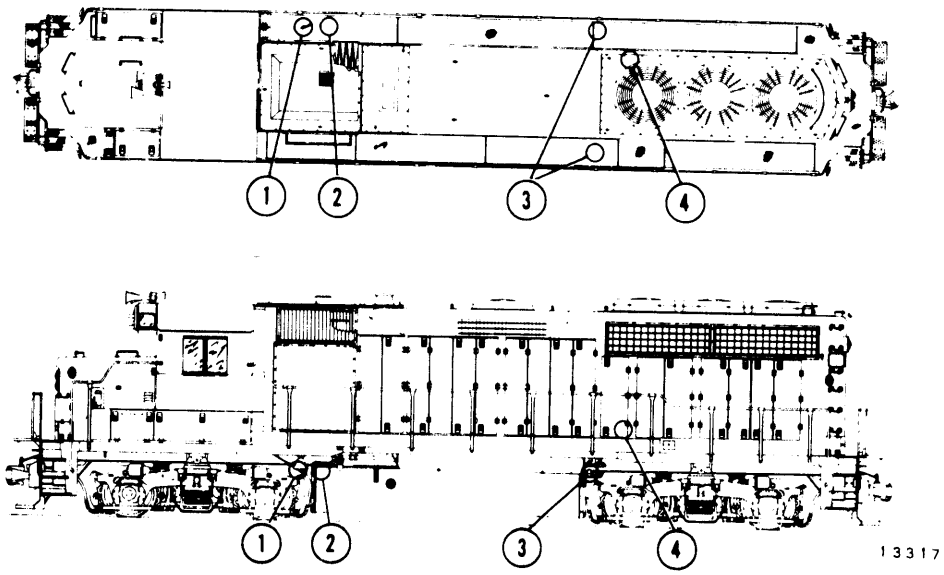


Fig. 5-10 — Main And Auxiliary Main Reservoir Centrifugal Filters



1. Main Reservoir Centrifugal Filter And Drain
2. Auxiliary Main Reservoir Centrifugal Filter And Drain
3. Main Reservoir Drain Valve Location
4. Compressor Control Strainer Drain Valve Location

Fig. 5-11 — Compressed Air System Drain Valve Locations

3. Main reservoir drain valves, Fig. 5-11.

4. Compressor control strainer drain valve, Fig. 5-11.

RADIATOR SHUTTER CONTROL

SHUTTER OPERATING PISTON

DESCRIPTION

The radiator shutters are opened and closed by the action of an air operated piston, Fig. 5-12, which is mounted to the carbody structure at the front of the shutter assembly on each side of the carbody. The cylinder is actuated when the shutter control magnet valve, MV-SH, is energized.

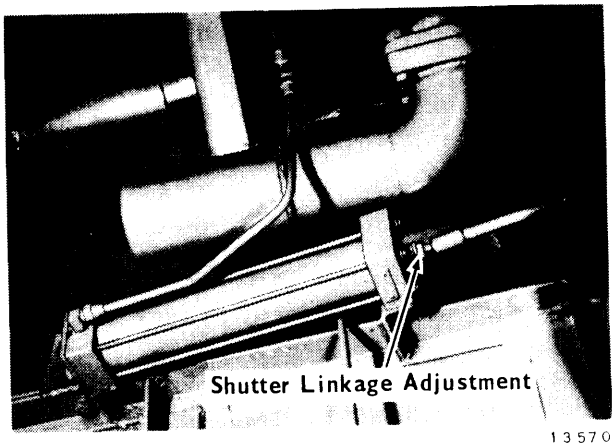


Fig. 5-12 — Shutter Operating Piston

MAINTENANCE

Operate the shutters manually by tripping the temperature switch or by manually operating the shutter control magnet valve, MV-SH. Check for fast, snappy action when opening or closing, and for interference which might be caused by bent linkage or shutter blades. If shutters do not open or close to their full extent, the shutter operating rod may be adjusted by loosening the locknut on the operating rod at the front head of the cylinder, Fig. 5-12, and turning the rod until the desired length is obtained.

SHUTTER MAGNET VALVE — MV-SH

DESCRIPTION

When the No. 2 cooling fan contactor is energized, interlocks of the cooling fan contactor pick up to energize the shutter magnet valve, MV-SH, Fig. 5-4, and compressed air is admitted to the shutter operating piston. See Fig. 3-2 for the shutter control circuit.

MAINTENANCE

If faulty operation of the valve is suspected, check the magnet valve by depressing the small "tee" handle on top of the valve while the locomotive engine is running. The shutter operating piston should open the shutters. Check the magnet valve and air line to the operating piston for leaks. Also check the electrical connections on the valve to see that they are tight. If repair is required, remove the magnet valve and replace it with a qualified valve.

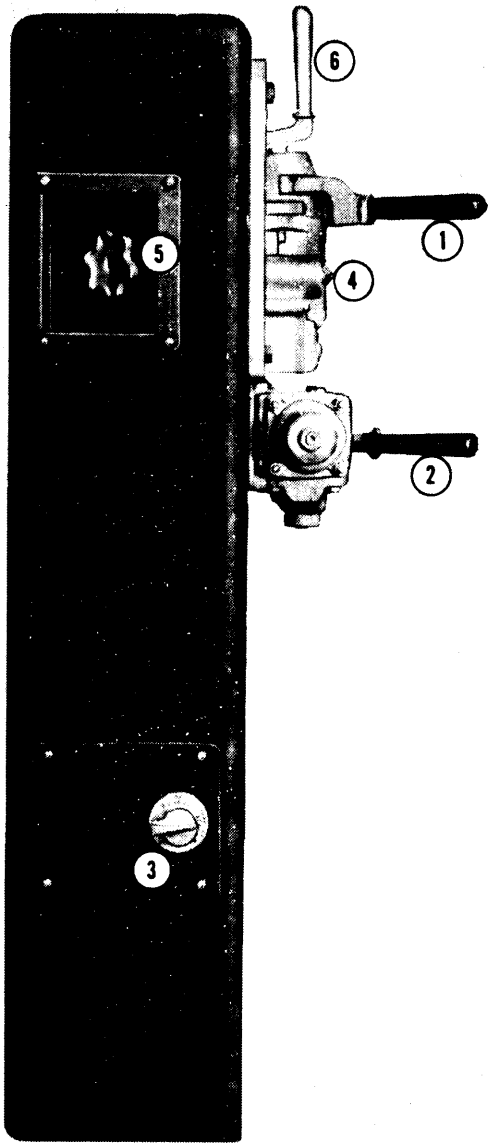
AIR BRAKE EQUIPMENT

DESCRIPTION

Basic locomotives are equipped with type 26L air brakes. The 26L air brake control equipment is located to the left of the controller. As shown in Fig. 5-13, this equipment consists of an automatic brake, independent brake, multiple unit valve (when MU control is installed), cutoff valve and a trainline air pressure adjustment device. The dead engine feature, a part of the 26L equipment, is shown in Fig. 5-15.

AUTOMATIC BRAKE VALVE

The automatic brake valve handle, which controls the air to the locomotive and train brake systems, may be placed in



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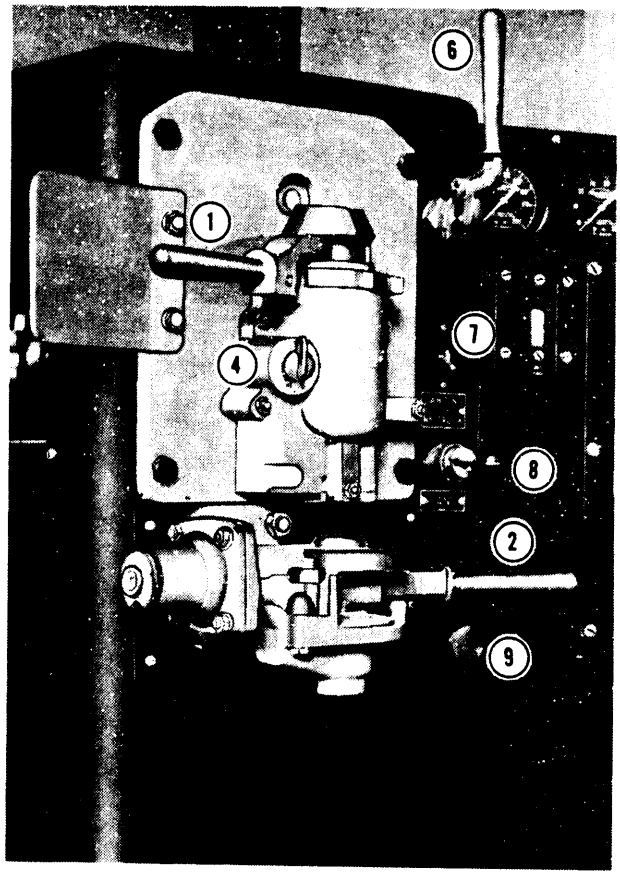

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1. Automatic Air Brake Handle
2. Independent Brake Handle
3. Multiple Unit Valve
4. Cut-off Valve
5. Trainline Air Pressure Knob
6. Air Horn Valve
7. No. 1 Truck Sanding Switch
8. Manual Sanding Lever
9. Bell Ringer

Fig. 5-13 — Air Brake Equipment

any of six operating positions as shown in Fig. 5-14.

INDEPENDENT AIR BRAKE

The independent air brake handle is located directly below the automatic brake handle. It has two positions; namely, RELEASE and FULL APPLICATION. Between these two positions is the application zone. Since this is a self-lapping brake, it automatically laps off the flow of air and maintains brake cylinder pressure corresponding to the position of the handle in the application zone.

Depression of the independent brake valve handle when in the RELEASE position causes release of any automatic brake application on the locomotive.

MULTIPLE UNIT VALVE

The universal multiple unit (MU-2A) valve is located on the left hand side of the control stand as shown in Fig. 5-13. Its purpose is to pilot the F1 selector valve which is a device that enables the air brake equipment of one locomotive unit to be controlled by that of another unit.

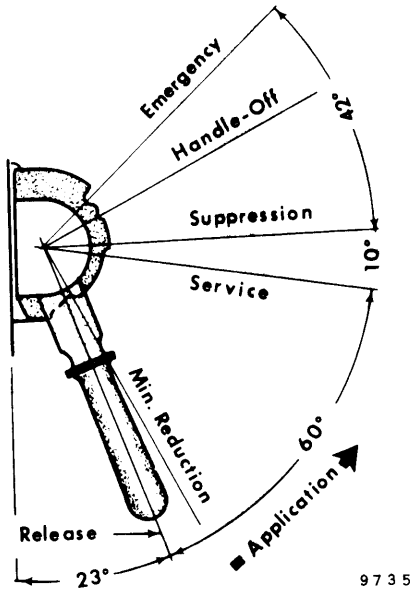

Fig. 5-14 — Automatic Brake Handle Positions

The MU-2A valve has three positions which are:

1. LEAD or DEAD
2. TRAIL 6 or 26*
3. TRAIL 24

The valve is positioned by pushing in and turning to the desired setting.

*Whenever the MU-2A valve is in the TRAIL 6 or 26 position, and if actuating trainline is not used, then the actuating end connection cutout cock must be opened to atmosphere. This is necessary to prevent the inadvertent loss of air brakes due to possible pressure buildup in the actuating line.

CUTOFF VALVE

The cut-off valve, Fig. 5-13, is located on the automatic brake valve housing directly beneath the automatic brake valve handle. This valve has the following three positions:

1. CUT-OUT
2. FRT (Freight)
3. PASS (Passenger)

TRAINLINE PRESSURE ADJUSTMENT

The trainline air pressure adjusting knob, Fig. 5-13, is located behind the automatic brake valve at the upper portion of the brake pedestal.

DEAD ENGINE CUTOUT COCK

A dead engine cutout cock, Fig. 5-15, is provided as part of the 26L braking equipment. When a locomotive is to be shipped dead in a train the cutout cock handle should be in a closed position.

PRESSURE REGULATOR

The pressure regulator, Fig. 5-15, is provided to regulate the air pressure

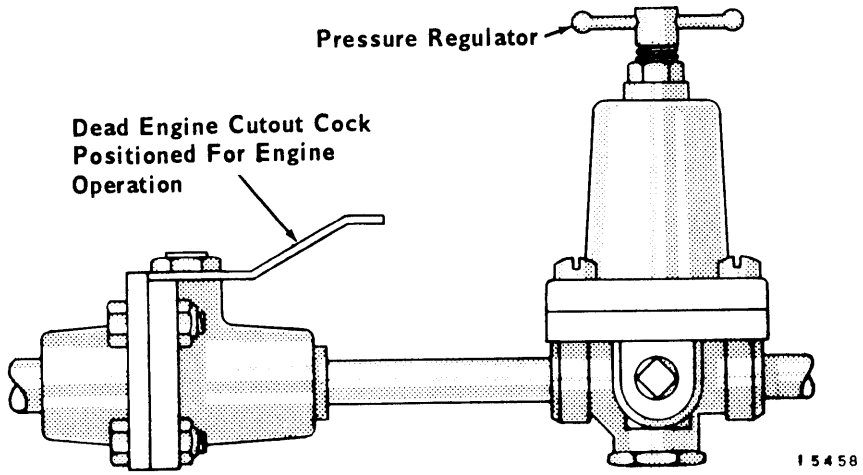

Fig. 5-15 — Dead Engine Cutout Cock And Pressure Regulator

available for braking a locomotive being shipped dead in a train.

The pressure regulator is pre-set at the value given in the Service Data. At any time the regulator must be reset, loosen the locknut and turn the adjusting handle on top of the regulator until the desired pressure is registered on the brake cylinder gauge when the brake is applied.

The pressure regulator should be cleaned out periodically by unscrewing the cleanout plug in the bottom of the regulator and removing and cleaning the screen.

QUICK RELEASE VALVE

Some SD trucks with single-shoe brakes are equipped with a quick release valve, Fig. 5-16. When the handbrake is applied, this valve bleeds off any resisting air pressure from the brake cylinder that applies the stopping force to the handbrake brake shoe.

The valve is actuated by linkage connected to the handbrake lever. The truck interchangeability is not affected by this installation because the truck applied to the No. 2 end of the locomotive is equipped with the proper hose and mounting pad for the quick release valve. When a truck is switched from one end of the locomotive to the other, the only requirement is that the quick release valve and linkage be applied at the correct location.

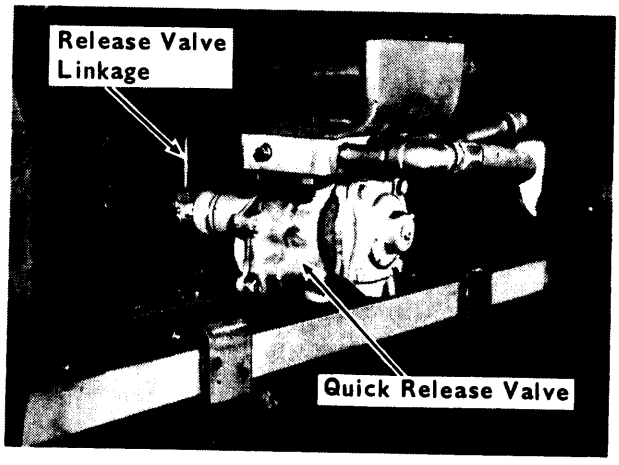

Fig. 5-16 — Quick Release Valve

Quick Release Valve Cable Adjustment

Proper adjustment of the quick release (QR) valve to handbrake cable assembly is essential for correct handbrake operation. Before adjusting the cable assembly,

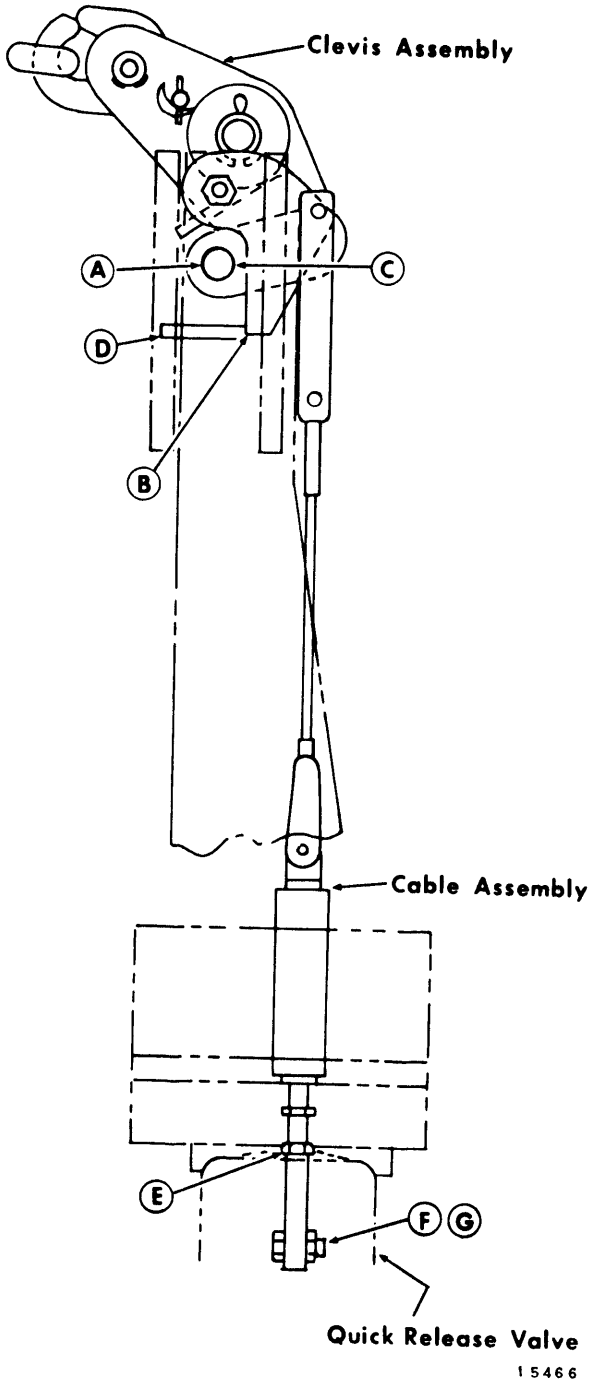

Fig. 5-17 — QR Valve Cable Adjustment

a new brake shoe should be installed in the associated brake shoe position. The adjustment is then made using the following procedure and referring to Fig. 5-17.

1. Release the handbrake.
2. Apply air brakes so the brake shoe is against the wheel and the handbrake lever is against the bracket stop on the truck. If air pressure is not available, place a pry bar between the adjacent wheel and brake shoe and force the brake shoe at the handbrake lever location against the associated wheel. Be sure to exert enough force to ensure that the handbrake lever is against the bracket stop on the truck.
3. Check the clearance between trip lever (B) and striker rod (A) at point (C) with the trip lever butted against stop (D). If the wheel at the handbrake lever location is new, this clearance should be 5/16", if the wheel is half worn, the clearance should be 3/16", and if the wheel is fully worn, the clearance should be 1/16". If this clearance is not correct, stop (D) will have to be removed and relocated to provide the correct clearance with the trip lever butted against it.
4. After the clearance has been established, loosen locknut (E) on the lower end of cable assembly and adjust cable length so when the cable assembly is pulled down taut and the release valve handle is in a normal horizontal position, the eye (F) in the cable assembly lines up with the pin hole (G) in the release valve handle.
5. Install the cable assembly pin through eye (F) of the cable assembly and hole (G) in the handle of the quick release (QR) valve and tighten locknut (E). Be sure to install the cotter pin to hold the cable assembly pin in place.

BRAKE EQUIPMENT POSITIONS

When operating locomotives equipped with 26L air brakes, the brake equipment should be positioned according to the information given in Fig. 5-18.

Type Of Service	Automatic Brake Valve	Independent Brake Valve	Cutoff Valve	Dead Engine Cutout Cock	26D Control Valve	26F Control Valve	MU2 Valve	Overspeed Cutout Cock	Deadman Cutout Cock
SINGLE LOCOMOTIVE EQUIPMENT									
Lead	Release	Release	Passenger Freight	Closed		Graduated Direct	Lead	Open	Open
Double Heading	Suppression	Release	Cutout	Closed		Graduated Direct	Lead	Open	Open
Shipping Dead In Train	Handle Off Position	Release	Cutout	Open	Relief Valve At Control Reservoir 73 ± 2#	Direct	Dead	Closed	Closed
MULTIPLE LOCOMOTIVE EQUIPMENT AND EXTRAS									
Lead	Release	Release	Passenger Freight	Closed		Graduated Direct	Lead	Open	Open
Trail	Handle Off Position	Release	Cutout	Closed		Graduated Direct	*Trail 6 or 26 Trail 24	Open	Open
Shipping Dead In Train	Handle Off Position	Release	Cutout	Open	Relief Valve At Control Reservoir 73 ± 2#	Direct Release	Dead	Closed	Closed
Double Heading	Suppression	Release	Cutout	Closed		Graduated Direct	Lead	Open	Open
Dual Control:									
Operative Station	Release	Release	Passenger Freight	Closed		Graduated Direct	Lead	Open	Open
Non-Operative Station	Handle Off Position	Release	Cutout						

*Whenever the MU2A valve is in "Trial 6 or 26" position and if the actuating train line is not used, then the actuating end connection cutout cock must be open to atmosphere; so as to prevent the inadvertant loss of air brakes due to possible pressure buildup in the actuating line.

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Fig. 5-18 — Air Brake Equipment Positions

MAINTENANCE

For maintenance information consult the manufacturer of the specific air brake equipment provided.

SANDING SYSTEM

DESCRIPTION

The basic sanding system for the locomotive is an electrical system that eliminates the need for relay valves and trainlined sanding actuating air pipes. However, if the locomotive is to be used with older locomotives equipped with only pneumatic sanding control, an optional extra pneumatic sanding system, Fig. 5-19, is superimposed upon the electrical sanding system. The two systems operate in parallel, therefore air actuating pipes should be connected whenever a consist contains any units equipped for only pneumatic sanding control.

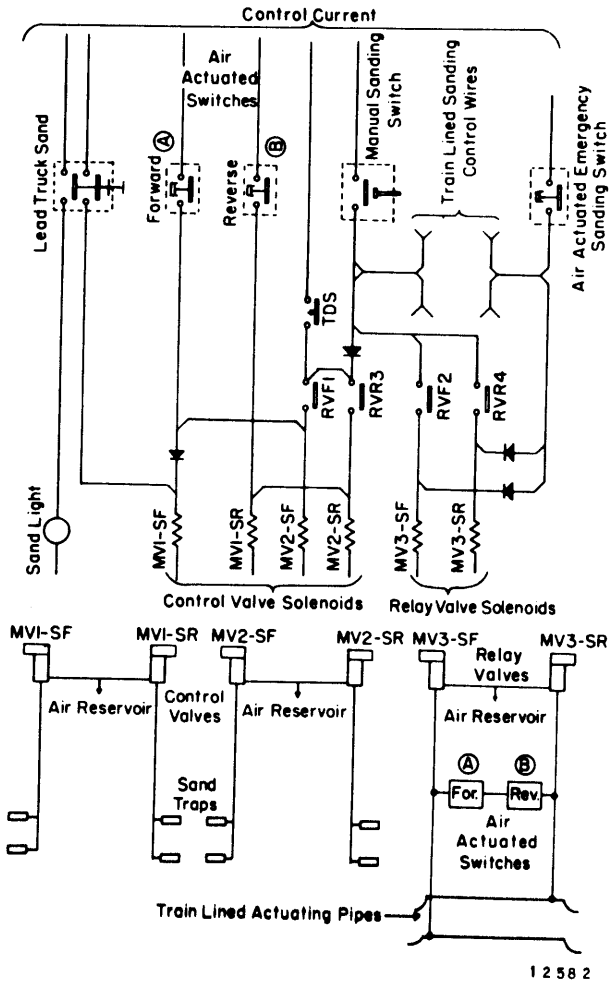

Fig. 5-19 — Sanding Circuit And Air Schematic Including Pneumatic Sanding Option

Movement of the manual sanding lever connects control current through the proper reverser interlock to the sanding control valve solenoids, and on locomotives equipped with the pneumatic sanding extra, to the relay valve solenoids. If the locomotive is trailing a pneumatic unit, air actuated switch A or B, Fig. 5-19, closes to provide sanding on the trailing unit.

Manual sanding at the No. 1 axle of the lead unit only is provided by operation of a toggle switch identified as SANDING No. 1 TRUCK. The SAND light comes on when the switch is closed.

During wheel slip action, time delay relay TDS is energized to provide sanding on only the slipping unit. Delayed dropout of TDS causes sanding to continue for a timed period after the slip is corrected.

Sanding during an emergency application of the brakes is provided automatically from all sand traps through action of an air operated emergency sanding switch. The circuits from the switch are so arranged that emergency sanding from all traps will continue even though the motors are "plugged" (reverse lever placed to oppose direction of travel). On the basic locomotive, emergency sanding is accomplished electrically. If the locomotive is fitted with the pneumatic option, relay valves and air actuated switches ensure proper sanding even with the motors "plugged."

MAINTENANCE

Before each trip check operation of the sanders by placing the reverser handle in the direction to be sanded. Close the

throttle and move the manual sanding switch to the sand position. Check the sanding nozzles at the rail to make sure they are aligned correctly and that the sand is being delivered to the rail.

Extreme care should be taken that the proper grade of clean dry sand is used. Damp or dirty sand or sand with foreign material in it is likely to clog the traps.

SANDING CONTROL VALVE

DESCRIPTION

Two sanding control valves in each end of the locomotive, Fig. 5-20, one for forward and one for reverse sanding. provide metered main reservoir air to their respective forward and reverse sand traps. When an electrical signal is received, the magnet valve section is energized to open an air valve which allows the main reservoir air to be admitted to the sand traps. The electrical signal can be initiated by the manual sanding switch, a wheel slip or an emergency brake application.

MAINTENANCE

If faulty operation is suspected, inspect the electrical connections for tightness and inspect the air connections for leaks.

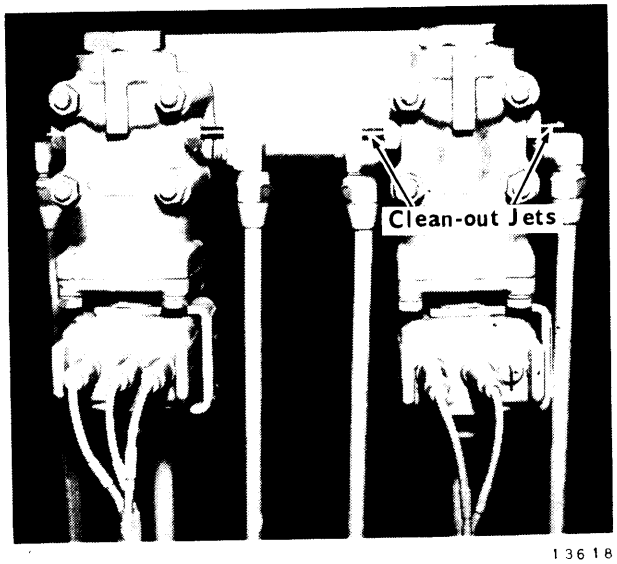

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Fig. 5-20 — Sanding Control Valves

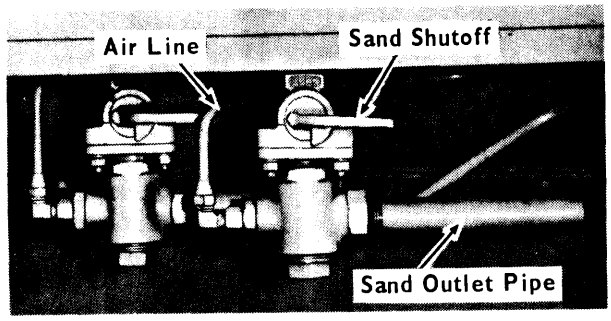
The control valve is equipped with automatic cleanout jets to clean out the orifice. To operate the cleanout jets push in the plungers on each side of the valve, Fig. 5-20. The plunger will automatically reset at the beginning of the next sanding cycle from the high pressure cleanout blast of air.

If further repair is required on the valve, remove it from the locomotive and replace with a qualified mechanism.

SAND TRAP

DESCRIPTION

Sand is fed to the trap, Fig. 5-21, by gravity through an inlet at the top of the trap. Actuating air enters the trap through the air nozzle. The nozzle is always covered by sand and therefore the air moves the sand that lies ahead of the discharge end of the nozzle. Sand entering at the trap inlet replaces the sand in front of the



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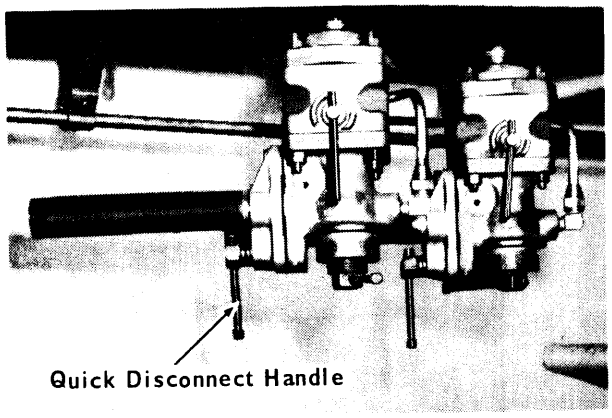

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Fig. 5-21 Sand Trap

nozzle, thus a uniform flow of sand is delivered to the rail through the trap outlet.

A sand shutoff assembly is mounted to the top of the trap at the sand inlet. The valve is in the open position when the hand lever on the side is set at OPEN or is parallel to the sand inlet line. The shutoff can be used when it is desirable to have a particular sanding line inoperative or if work is to be performed on the sand trap.

MAINTENANCE

Before any work is performed on a sand trap, the shutoff valve mounted to the top of the trap should be closed by turning the shutoff valve handle perpendicular to the inlet pipe.

Due to condensation there is always the possibility of getting moisture in the sand trap. To clean out the trap remove the pipe plug at the bottom of the trap. On special order a trap equipped with a quick disconnect delivery tube can be furnished.

The sand trap is set at the time of installation to deliver approximately 20 to 24 oz. of sand per minute. To change the rate of delivery, screw the adjusting nut, Fig. 5-22, in or out depending on whether more or less sand is desired. On the quick disconnect type sand trap use a 7/32" allen wrench to turn the sand control paddle to increase or decrease the rate of delivery.

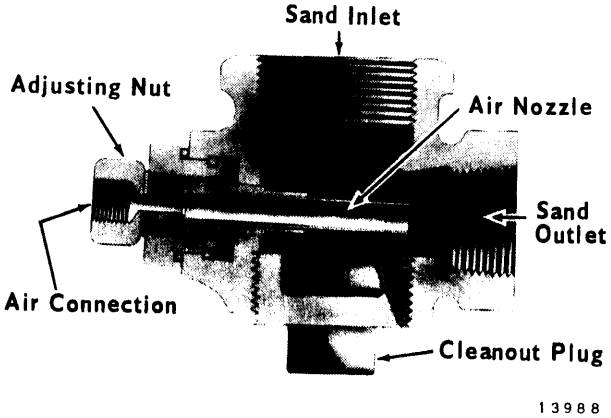

Fig. 5-22 — Sand Trap, Cross-Section

AIR SYSTEM ACCESSORY EQUIPMENT

WINDSHIELD WIPER ASSEMBLY

DESCRIPTION

A separate wiper assembly is provided for each window in front and behind the engineer's and rider's side of the locomotive cab and for the center windshield on the low nose cabs. The air motor, Fig. 5-23, used for the center windshield is identical to the other motors but is set for a longer degree of sweep.

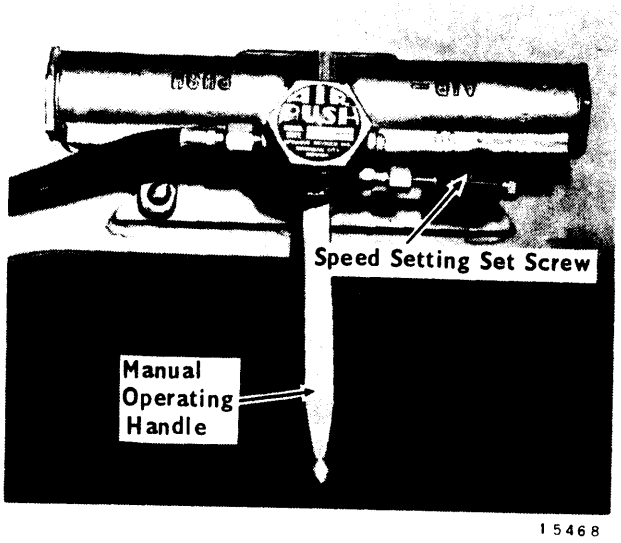

Fig. 5-23 — Windshield Wiper Air Motor

Each air motor is controlled by its own hand operated air valve which is located just above the side windows on each side of the cab. Each motor is equipped with a hand operated lever which can be used to operate the wipers in an emergency.

MAINTENANCE

If a windshield wiper air motor is not operating correctly check to see that the air connections at the motor and the manual control valve are tight and free from leaks.

With the air turned on, operate the air motor with the hand lever attached to the air motor shaft. If this fails, turn the air off and again try to operate the motor by hand. In most cases this will clean the valve seat of any foreign particles that may have been forced in through the air line.

Remove exhaust fitting, Fig. 5-23, and check for dirty filter or plugged hole. Remove reverser ball housing and check for broken or jammed ball spring.

Check the internal air flow by removing the cylinder end caps and blowing out the holes in the valve chamber. Also blow into the exhaust outlet to make sure the hole is not plugged.

If the air motor still does not operate properly, it will have to be replaced with a qualified motor and taken to the bench to be repaired.

If the wiper connecting arm must be removed from the air motor shaft, remove the acorn nut on the end of the shaft and pull the connecting arm off the splined shaft. When replacing the connecting arm on the shaft, be careful not to tighten the acorn nut too tight. The wiper motor and wiper mechanism is designed to operate at a maximum speed of 60-65 cycles per minute.

The speed of the wiper motor is adjusted by a set screw, Fig. 5-23, located in the exhaust restrictor. The following procedure should be used in making the adjustment:

1. Place a piece of paper between the wiper blade and the glass to simulate a wet glass condition which reduces frictional drag on the blades.
2. Make sure main reservoir air pressure is 130 to 140 psi. Turn operating valve in cab to the fully open position.
3. Turn the adjusting screw in the exhaust restrictor until the wiper motor is running at 60-65 cycles (120-130 strokes) per minute.

AIR HORN

DESCRIPTION

The basic air horn is a front facing, three chime, low profile type, Fig. 5-24. The lever to actuate the air horn is located on the brake stand at the locomotive control station. When the air horn operating lever is pulled down, air is released to the air horn. Other types of air horns are available on special order including five chime and rear facing horns.

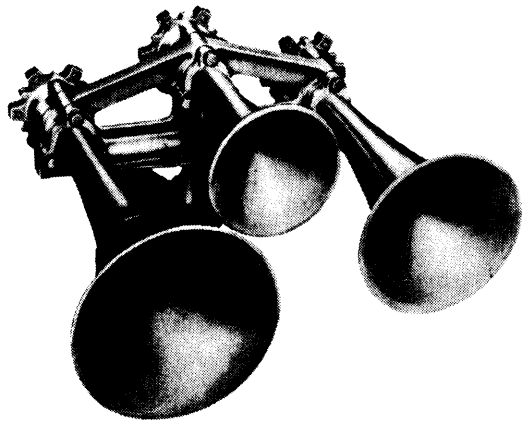

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Fig. 5-24 — Air Horn

A shutoff valve is located in the air brake stand if it is necessary at any time to have the air shut off to the horn operating lever.

MAINTENANCE

To inspect and clean the air horn diaphragm, remove back cover bolts and back cover. The diaphragm ring and diaphragm can be removed by taking out the diaphragm ring screws.

Whenever a back cover is removed, it is good practice to blow out the air lines by

opening the air horn operating valve wide with full reservoir pressure on the line. This will also clean out the orifice dowel pin.

BELL

DESCRIPTION

The basic locomotive bell is located under the underframe on the left side of the locomotive. A positive action air valve, which activates the bell, is located on the air brake stand at the operator's control station. When the valve is opened, compressed air forces the plunger in the bell ringer assembly down, which causes the clapper to strike the side of the bell.

When the plunger reaches the extended position, the compressed air then returns the plunger to its original position.

To shut off the air supply to the bell operating valve at the control stand, remove the upper panel on the back of the air brake stand and close the valve in the bell ringer air line.

MAINTENANCE

If the bell does not operate when the bell ringer operating valve at the control stand is opened, check to see that the clapper is free to swing and that no air leaks are present in the air lines.

If a new bell ringer cartridge, Fig. 5-25, is needed, remove the old cartridge by loosening the locknut on the side of the bell ringer assembly and unscrewing the set screw three or four turns. Using the clapper as a lever, unscrew the clevis from the assembly and pull the cartridge out with a pair of pliers. Before installing the new cartridge, actuate the bell ringer operating valve a few turns to blow out any dirt or scale which may have accumulated. After installing the new bell ringer cartridge, be sure the "O" rings are in place before applying the clevis. Once the clevis is applied, tighten the set screw and locknut.

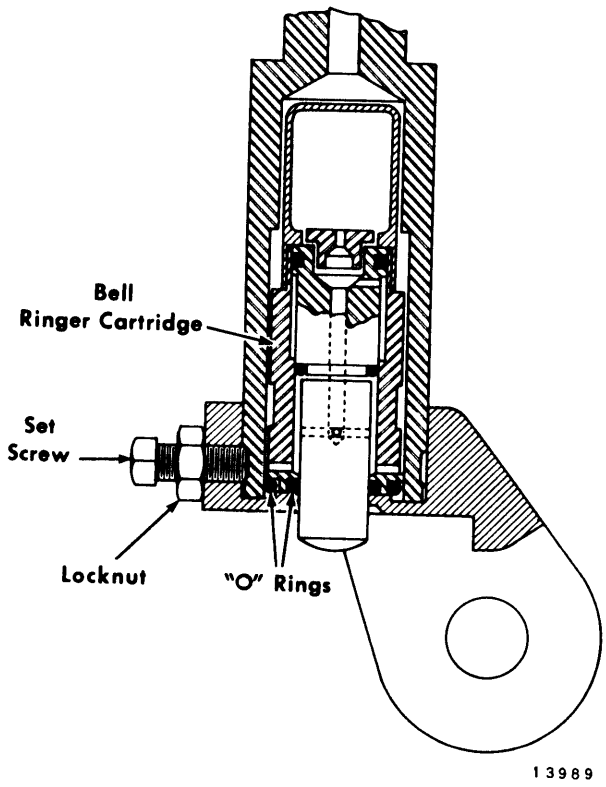

Fig. 5-25 — Bell Ringer, Cross-Section

COMPRESSED AIR SYSTEM

REFERENCES

Air Compressor Maintenance	M.I. 1110
Sanding Equipment Maintenance	M.I. 1926
Air Horn Maintenance	M.I. 2926

ROUTINE MAINTENANCE PARTS AND EQUIPMENT

FILTERS	Part No.
Inlet Compressor Air Filter Element (Rectangular Filter)	8347199
(Cylindrical Filter)	8402068
Main Reservoir Air Filter Element	8363343

AIR COMPRESSORS	
Lube Oil Pressure Gauge	8127030
Intercooler Air Pressure Gauge	8337561

SPECIFICATIONS

AIR COMPRESSOR

Type	2 Stage
Number of Cylinders (Basic)	3
Number of Cylinders (Optional)	6
Displacement at 900 RPM (3 cylinder)	254 Cu. Ft./Min.
Displacement at 900 RPM (6 cylinder)	401 Cu. Ft./Min.
Lube Oil Capacity (3 cylinder)	10-1/2 Gal.
Lube Oil Capacity (6 cylinder)	18 Gal.
Cooling	Water

Lube Oil

Compressor lube oil must be SAE 10 weight turbine type oil containing anti-rust, anti-oxidation and anti-foam inhibitors and should contain the following properties:

Viscosity-Saybolt Universal (ASTM D88 or D2161)	
@ 100° F. seconds	130 to 180
@ 210° F. seconds	42 to 45
Pour Point (ASTM D97° F. - minimum)	0
Rust-Distilled Water (ASTM D665)	No Rust

DEAD ENGINE PRESSURE REGULATOR SETTING

SD - Single Shoe (Composition Shoe)	25 $\pm$ 1-1/2 psi
GP And SD - Clasp Brake (Iron Shoe)	25 $\pm$ 1-1/2 psi
GP And SD - Clasp Brake (Composition Shoe)	13 $\pm$ 1-1/2 psi
DD -	35 $\pm$ 1-1/2 psi