PLAINTIFF'S EXHIBIT

MAC-24

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CHRIS N. KOLOS

July 17, 1997

David M. Lipman, Esq.
599 SW 74th Street
Suite 304
Miami, FL 33143

Re: ***Anne M. Tinker, Executrix of the Estate of Timothy W. Tinker, Deceased vs. A.E. Clevite, et al.*** **Ontario County Index No. 83778.**

Dear Mr. Lipman:

My letter of July 2, 1997 was not quite right. Enclosed please find what truly is the final production to be made by Mack Trucks, Inc. in response to paragraphs 7 and 11 of Plaintiff's Request for Production.

If you have any questions regarding the above, please do not hesitate to contact me.

Sincerely,

Chris N. Kolos

CNK:jo
Enclosures

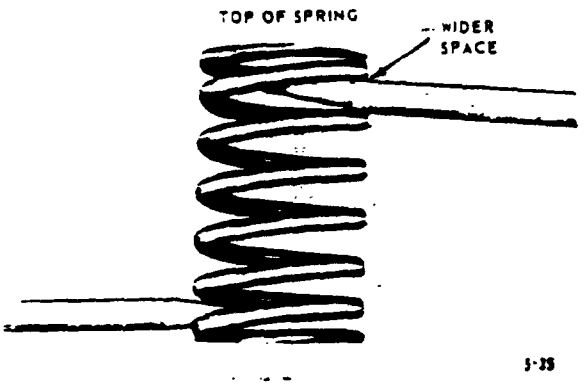


Figure 2-12. Valve Spring

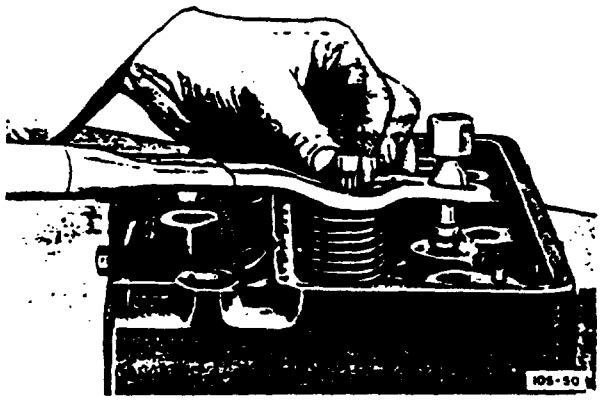


Figure 2-13. Installing Valve Keys

Installing Cylinder Heads

New cylinder head gaskets are installed on the cylinder block with "Top" mark up. Check cylinder head studs for secureness in the block; also threads for damage that may cause binding of the stud nuts. Fit cylinder heads over studs lowering on to cylinder head gasket carefully to avoid damage. Install cylinder head stud washers and nuts. Torque nuts in sequence shown with a calibrated torque wrench in progressive steps of 50, 100 and finally 140 lb. ft. (Stud threads oiled). See Figure 2-14.

Install the two water connection flanges, with gaskets, to cylinder head (connecting heads together to permit cooling water circulation through the three cylinder heads), and install thermostat housing (outlet) and gasket to the front head. A blank plate and gasket are used at the rear head.

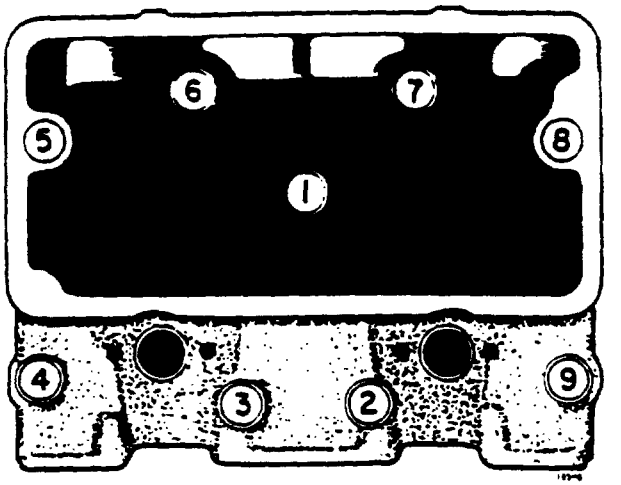


Figure 2-14. Torquing Sequence

Valve Rocker Arm and Shaft Assembly

The valve rocker arm features a bushing. When the bushing is installed, the split must locate on the horizontal plane and face the slipper side of the arm. See Figure 2-15.

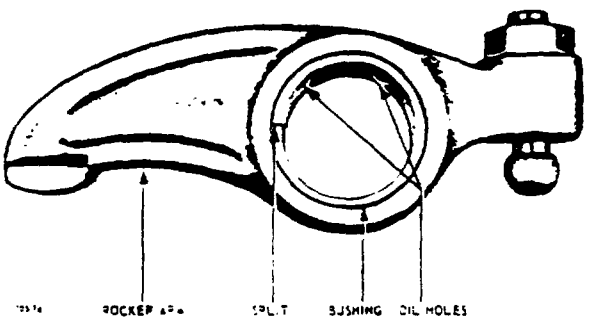


Figure 2-15. Rocker Arm Assembly

Press the bushing in so that it will come flush with the side of the hub which contacts the rocker arm shaft bracket. Two oil holes must be drilled in the bushing. They must be in alignment with the two oil holes provided on top of the arm to feed the slipper and the rocker arm to pushrod adjusting screw with lube oil. Ream bushing I. D. 0.8661 to 0.8669 in., to allow for proper running clearance with a new rocker arm shaft diameter. Check shaft O.D. at unworn area for size, before reaming new bushings to be used with old shaft. Running clearance, 0.0005 to 0.0015 in.

The valve rocker arm shaft is hollow. Two large holes are drilled through the shaft, vertically, at locations where the bracket-to-cylinder head screws are installed. Four positions on the shaft are drilled through the shaft from one side to the other, on a horizontal plane. This provides eight oil feed holes, two for each of four rocker arms. They feed the bushing with lube oil at the 3 and 9 o'clock positions.

The valve rocker arm and shaft assembly must be installed only after the cylinder heads have been properly torqued down.

The valve lifters must be installed with the camshaft in place. The pushrods must then be installed. See Figure 2-16.

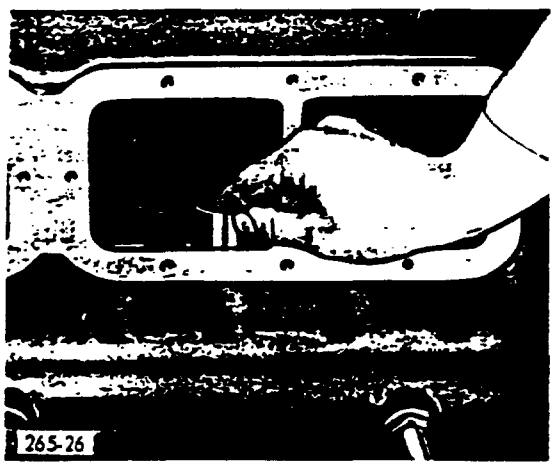


Figure 2-16. Installing Valve Lifter

The rocker arms, shaft, springs and brackets are assembled and secured at each end with large hex head type plugs. The two bracket-to-cylinder head bolts must also be in place before installing the assembly to the head. The bolts are drilled up through the center, and a feed hole drilled on side of the bolt locates inside the rocker arm shaft, on the assembly, to admit lube oil which originates (under pressure) from a passage directed to the bottom of the tapped hole (in the cylinder head) to feed the bracket bolt.

A heavy paper disc type gasket is used between the brackets and cylinder head to prevent oil leakage. Before installing new gaskets, remove any part of the old gaskets that may be adhering to the bracket or head to assure solid seating.

Tighten the bolts equally and finally torque to 40 lbs. ft. maximum. See Figure 2-17.

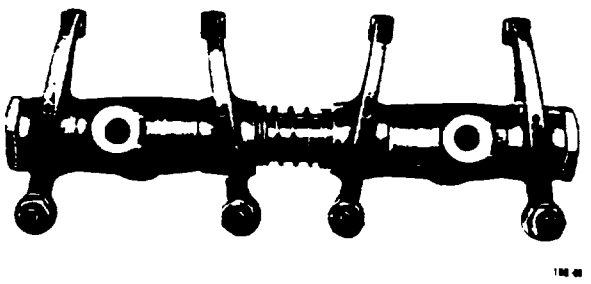


Figure 2-17. Rocker Arm and Shaft Assy.

When the rocker arm and shaft assembly is installed on the engine, carefully check outer rocker arms for possible binding between bracket and hex head plug. Rap opposite end of shaft with hammer to free.

Naturally Aspirated Diesel (END475)

Adjust valve clearance (cold engine setting); inlet valve, 0.014 in. and exhaust valve, 0.018 in.

Turbocharged Diesel (ENDT475)

Inlet valve, 0.014 in. and exhaust valve 0.028 in. Squirt engine oil over valve mechanism and at valve stems for initial protection.

NOTE

As soon as engine is running, observe to be sure lubricating oil is flowing from all rocker arms.

CYLINDER BLOCK

Description

The cylinder and upper crankcase is an integral casting of alloy cast iron. See Figure 2-18. It features replaceable wet-type cylinder sleeves flanged at the top to fit in the counterbores on the cylinder block deck. Three O-ring type seals are employed to seal the lower areas of the sleeve at the water jacket. The O-rings are resistant to oil and heat.

The standard cylinder sleeve I.D. is 4.527. This is the only size available. A worn or scored sleeve must be replaced with a new sleeve because the piston and piston rings are also only available in standard size. Cylinder sleeves may be removed by using puller J-21376 and sleeve puller shoe J-21587. See Figure 2-19.

to 1.457 inch (37mm) is 147.34 lbs. (660N). See Figure 2-19.

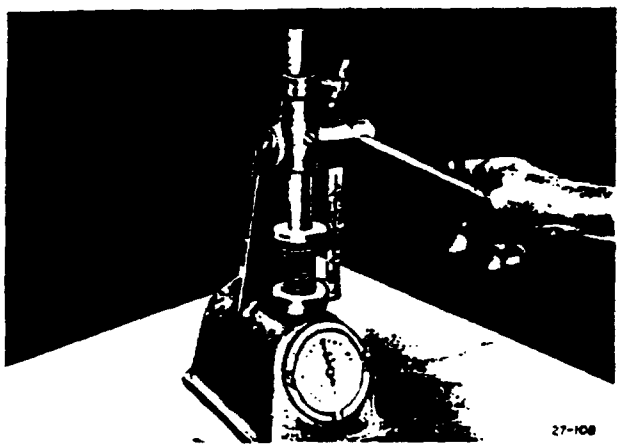


Figure 2-19.Checking Valve Springs

Position inner and outer valve springs over the inlet and exhaust valve stems and install washers, valve stem keys and caps using a suitable spring compressing tool. See Figure 2-20.

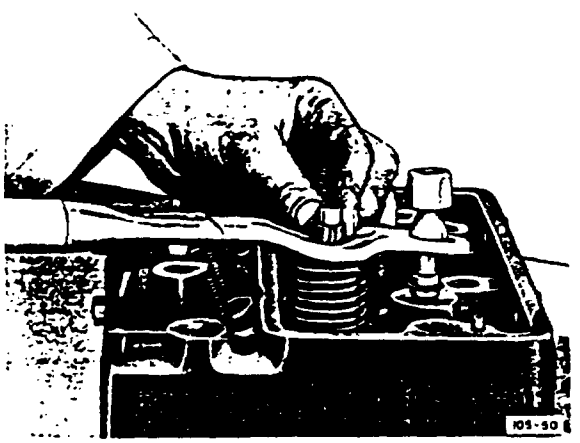


Figure 2-20.Installing Valve Keys

Installing Cylinder Heads

NOTE

A fire ring is formed in the cylinder head gasket when the cylinder head is torqued on the cylinder block: therefore, a new gasket must be used when installing the cylinder head. See Figure 2-21.

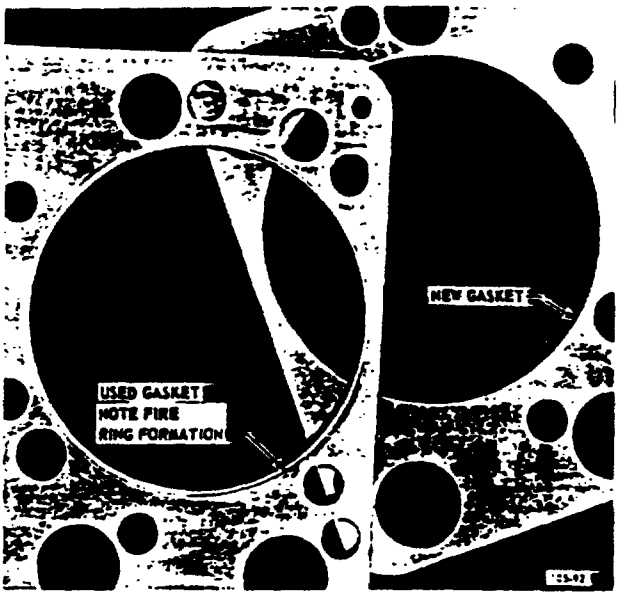


Figure 2-21.Cylinder Head Gasket
(Note: Fire Ring Formed in Left Gasket)

1. Clean the cylinder block deck thoroughly.

2. Check cylinder sleeve height above the deck. (See Figure 2-31.)Install new cylinder head gasket on deck.

NOTE

Do not use a sealing compound or soak cylinder head gasket.

3. Check gasket position. Be sure that all passages are open and not blocked by the gasket. See Figure 2-22.

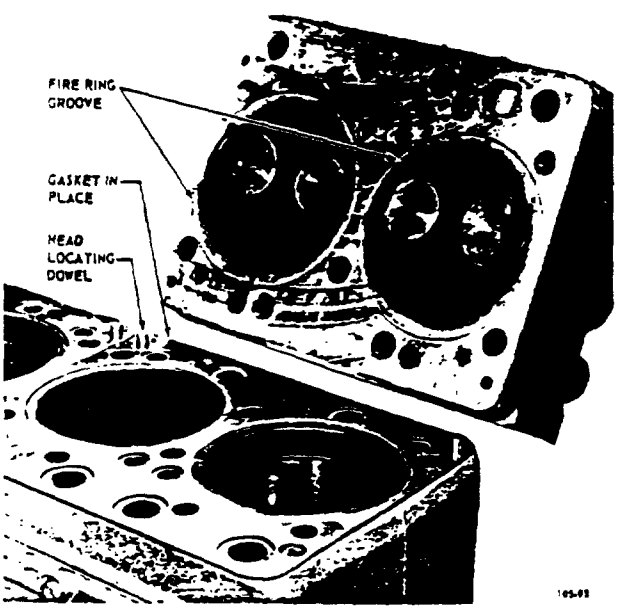


Figure 2-22.Gasket and Cylinder Head Over Cylinder Block

2. Install strainer (6) on bottom plate (4) and insert assembly in rotor cover.

3. Place washer (2) on top of rotor and firmly hand tighten rotor nut (1).

4. Install rotor assembly (Item 4, Figure 2-68) in filter housing. Check rotation - the rotor assembly must rotate easily.

5. Install new O-ring on body cover and attach to filter housing.

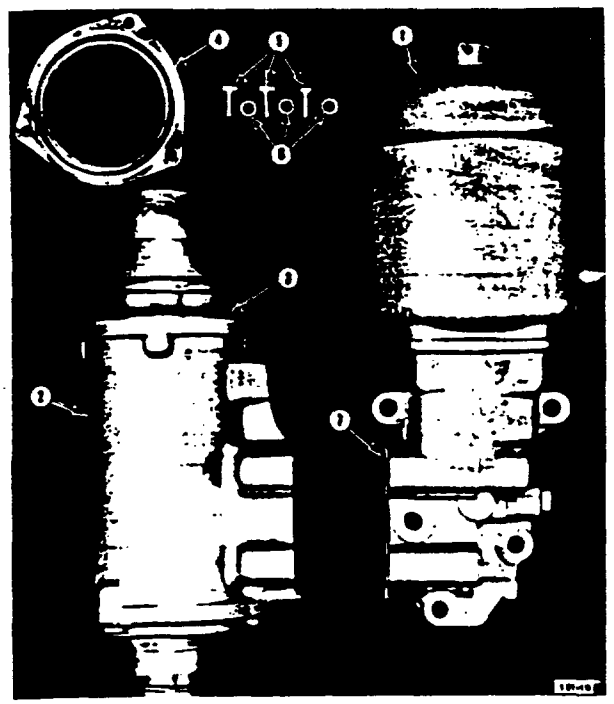
6. Firmly hand tighten top "T" handle locknut.

Oil Cooler

The oil cooler does not normally require any form of maintenance. If leakage is suspected, the cooler should be pressure tested. Water side 58 psi (399.9 kPa) oil side 145 psi (999.7 kPa). In case of possible water leakage past the O-ring seals, they must be replaced.

Replacing O-Ring Seals

1. Remove cooler assembly from oil filter (1). See Figure 2-72.



1. Oil Filter
2. Oil Cooler
3. O-Ring Seal
4. End Plate
5. Capscrews
6. Lockwashers
7. Oil Cooler Mounting Gasket

Figure 2-72. Removing Cooler Assembly from Oil Filter

NOTE

Numbers in ( ) refer to Figure 2-72.

2. Remove capscrews (5) and lockwashers (6).

3. Remove end plates (4).

4. Press element out of housing far enough to expose the O-ring seal (3).

5. Remove O-ring seal (3).

6. Reverse oil filter (1) and remove opposite O-ring seal (3).

7. Place the new O-ring seals (3) in oil for a few minutes.

8. Oil the O-ring seal groove and install new O-ring seal (3) in position.

9. Press core in cooler housing (2) far enough to expose the opposite O-ring seal (3) groove.

10. Lubricate groove and install opposite O-ring Seal (3).

11. Center core in housing and secure by installing end plates (4), capscrews (5), and washers (6).

Turbocharger Oil Filter

The turbocharger oil filter is provided to insure only filtered oil is directed to the turbocharger. See Figure 2-73.

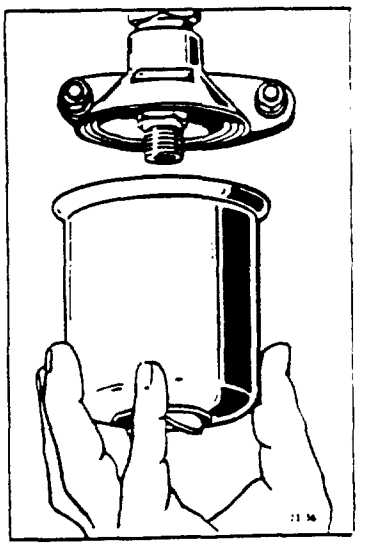


Figure 2-73. Turbocharger Oil Filter

This filter is a spin-on disposable unit. It has an adapter with internal oil passages into and from the filter element.

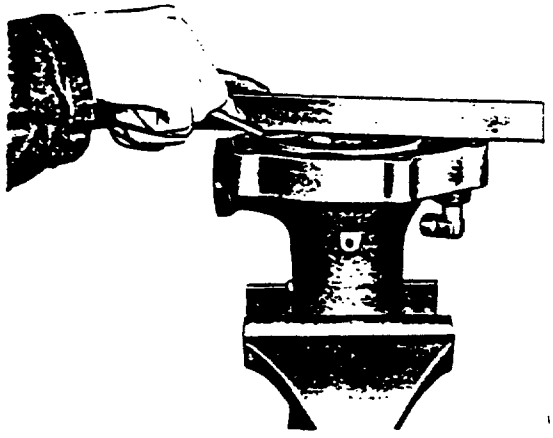


Figure 2-90. Checking Impeller Clearance

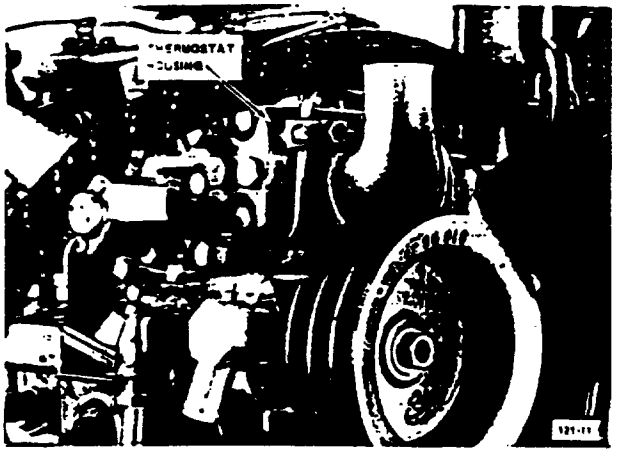


Figure 2-91. Thermostat Housing Location

9. Install impeller lockwasher and nut and secure.

THERMOSTAT

The thermostat is located above and to the right of the injection pump. See Figure 2-91.

Removal

To remove the thermostat, first drain the coolant and then remove the outlet housing. See Figure 2-92.

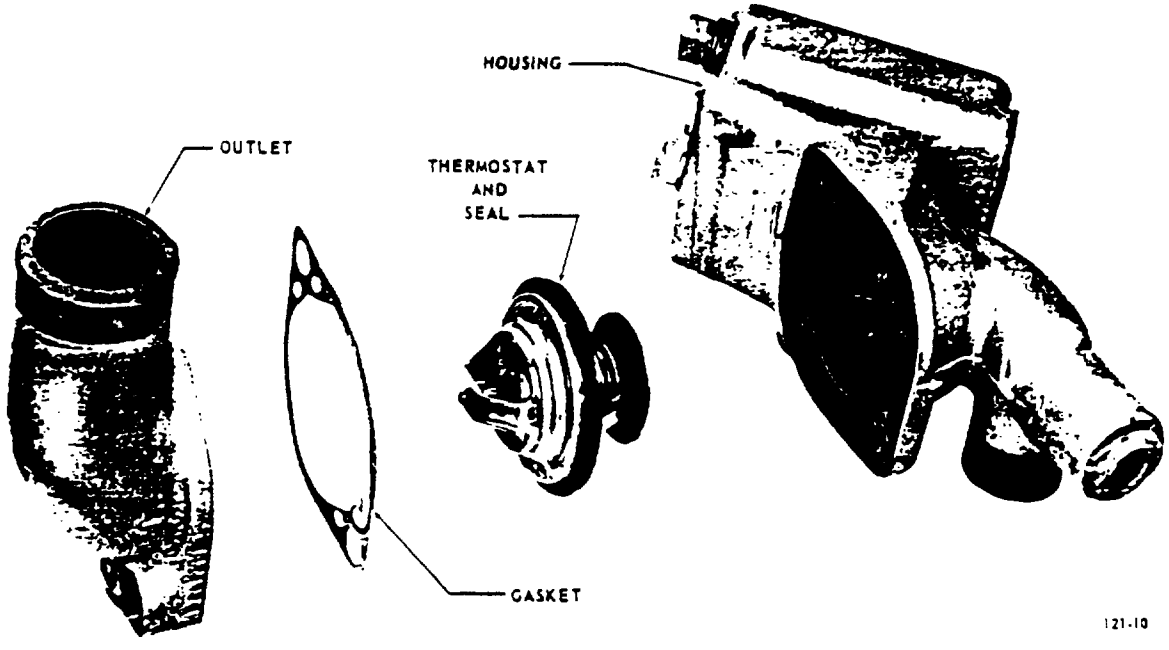


Figure 2-92. Thermostat Housing Exploded View

TURBOCHARGER

Preliminary

Inspect external and visible internal areas for contamination or damage before installing the unit on the engine. Check the condition of the turbine and exhaust manifold mating flanges for uneven surfaces. The smooth surface is required to assure good gasket clamping for dependable sealing and for longer gasket life.

Make certain that the air cleaner and air tubes are clean, to avoid restricted air flow. New hose connections and dependable clamps should be used and properly secured.

Insert the proper timing gear cover alignment sleeve in the cover, (J-26583 for 4.250 inch nominal O.D. oil seal, and J-24230, with handle J-8092, for 4.00 inch nominal O.D. seal). The sleeve also protects the seal when installing the timing gear cover.

Install two suitable guide studs and position the timing gear cover on the engine using a new gasket.

Install two timing gear cover screws, finger tight. Then tap the cover with a soft-faced hammer, using a straight edge to align the timing cover with the oil pan rail. See Figure 2-129.

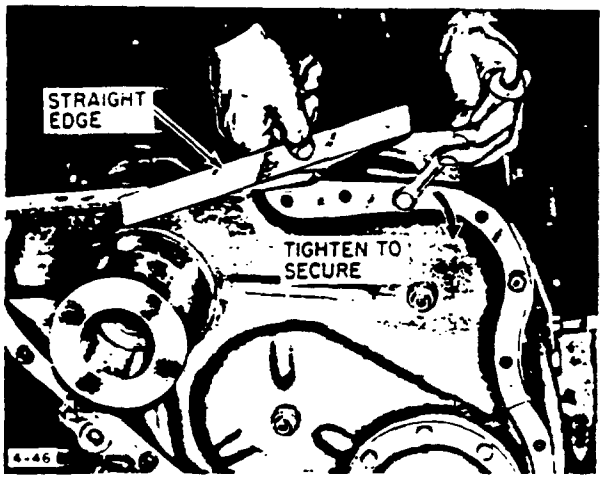


Figure 2-129. Aligning Timing Gear Cover

After timing gear cover has been aligned, remove the guide studs. Install the remaining capscrews and torque to specifications.

To adjust the thrust button, rotate the button clockwise until it is snug against the shaft, (camshaft and auxiliary shaft). Then back out the thrust button 1/4 turn and tighten jam nut. The resulting end-play will then be within specifications. See Figure 2-130.

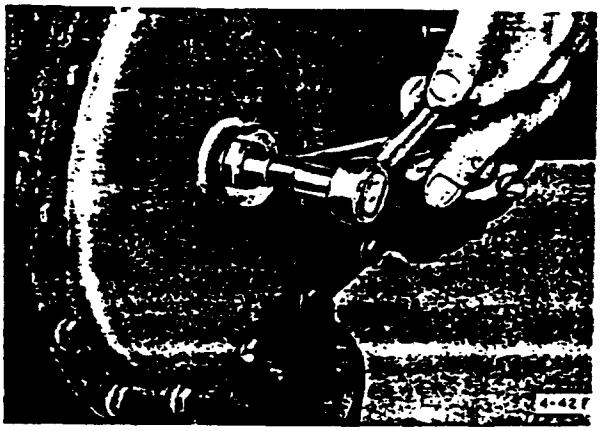


Figure 2-130. Positioning Thrust Button

After thrust buttons have been adjusted, remove the centering sleeve.

Lubricate oil pump drive and driven gears and mount the oil pump assembly to engine. See Figure 2-150.

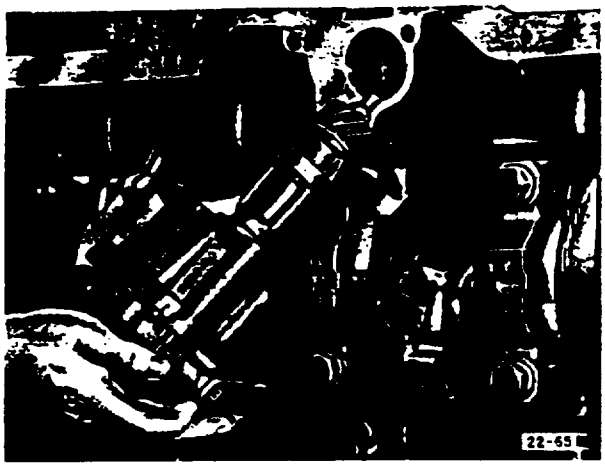


Figure 2-150. Assembly of Oil Pump to Engine

Assemble the oil pump mounting screws and torque to specifications. Check back lash between gears to make certain that gears are not tight.

Place new gasket on oil pump inlet tube flange and assemble to oil pump. See Figure 2-151.

Figure 2-151. Assembling Oil Pump Inlet Tube

To assist in readily identifying the different cap and spring combinations, refer to Table 4.

TABLE 4

OIL PRESSURE RELIEF VAVLE CAP AND SPRINGS
(In Oil Pump)

TYPE OF FILTERING SYSTEM	RELIEF VALVE CAP *	RELIEF VALVE SPRING	SPRING INSPECTION LIMITS
By-Pass Filter	226GB121	572GC11	25.0 lbs. ± 1.8 lbs. at 2-3/4 in.
Full-Flow By-Pass (Pre-ESI)	226GB122	572GC114	40.0 lbs. ± 4.0 lbs. at 3-5/64 in.
ESI (With 100 PSI Oil Pressure Gage in Cab)	226GB147	572GC114	40.0 lbs. ± 4.0 lbs. at 3-5/64 in.
ESI (With 150 PSI Oil Pressure Gage in Cab)	226GB122	572GC114	40.0 lbs. ± 4.0 lbs. at 3-5/64 in.
ESI Plus	226GB122	572GC114	40.0 lbs. ± 4.0 lbs. at 3-5/64 in.

* The last three digits of the part number (such as "121") are stamped on the end of the cap for identification.

Inspect oil pan mounting flange surface for flatness. Correct as required. See Figure 2-152.

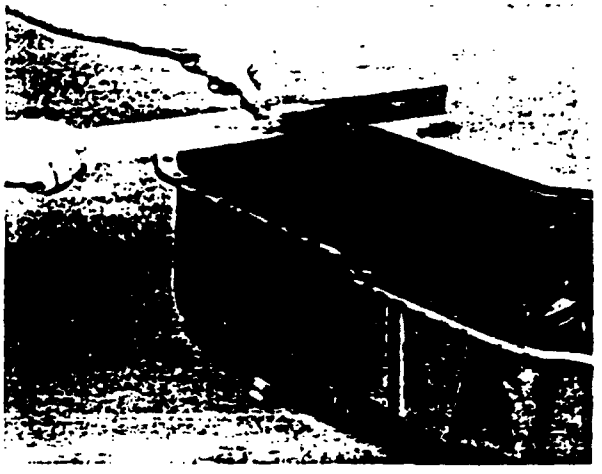


Figure 2-152. Checking Oil Pan Mounting Flange for Flatness

Install new gasket and assemble pan to engine. Assemble capscrews and torque to specifications.

There are three types of oil pans in use on Mack engines. Thse are "Original Production", "ESI Engines", and "ESI-Plus Engines."

Original Production

Original production engines were built with a 19 quart capacity oil pan. See Figure 2-153.

Figure 2-153. Original Production Oil Pan (19 Quart Capacity)

ESI Engines

The oil pan capacity was then increased to 28 quarts for use with the ESI (Extended Service Interval) engines. See Figure 2-154.

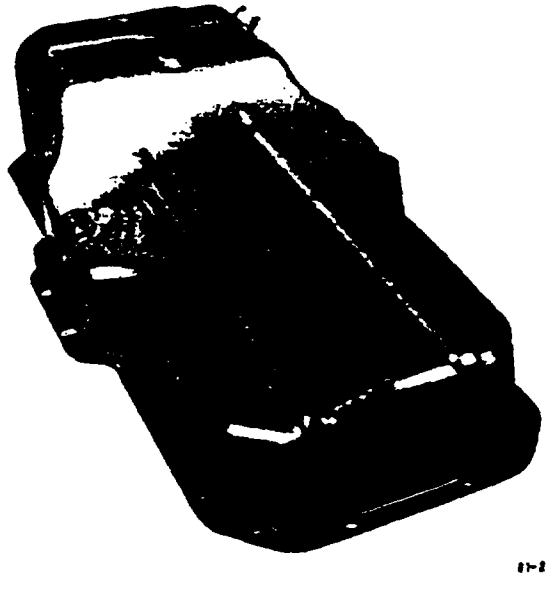


Figure 2-154. Oil Pan for ESI Engines (28 Quart Capacity)

ESI Plus Engines

Oil pans for ESI-Plus engines have been made deeper and have an additional increase in oil capacity to 51 quarts. See Figure 2-155.

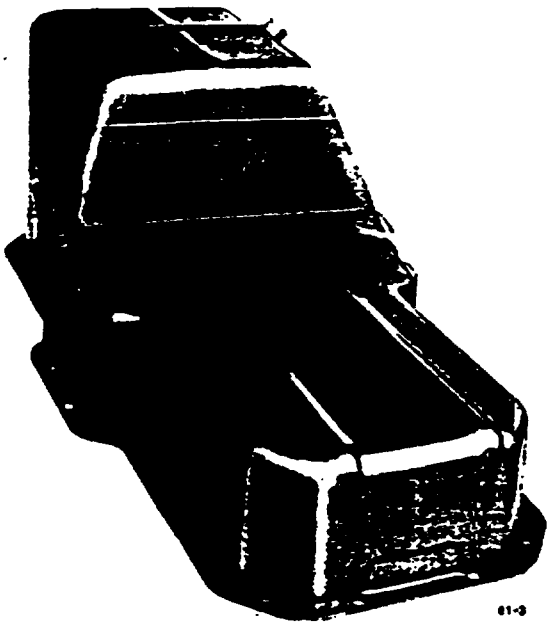


Figure 2-155. Oil Pan for ESI-Plus Engines (51 Quart Capacity)

NOTE

Because of the low mileage normally incurred with on and off highway type vehicles, and also because of ground clearance problems, the new "ESI-Plus" engines are not used in models such as the DM600 or 800, DMM, RD,RM and MB.

Basic Engine Assembly - Oil Pan Applications

Current Basic Engine Assemblies (for Service) are built with the 28 quart capacity oil pan which is required for ESI engines. When this assembly is used to replace an engine not having ESI features, it is recommended that the ESI retrofit kit be installed.

If the original oil filter arrangement is retained, there are two options:

1. Use the new oil pan and add 9 quarts of oil to provide proper oil level in the 28 quart pan.

2. Use oil pan from replaced engine, (19 quart capacity).

If an "ESI-Plus" engine is being replaced, the 28 quart capacity oil pan on the new assembly must be replaced by a 51 quart capacity oil pan.

Make certain that cylinder head assembly is in satisfactory condition. (Refer to "Cylinder Head Reconditioning Procedure" on Page 2-225 .)

Assemble the correct type of cylinder head gasket to engine. The "folded-steel" type gasket is used with the "flat-flange" type cylinder liner, and the "Maxidyne" type is used with the beaded-flange type liner. See Page 2-155.

All gaskets are pre-coated and do not require any type of sealing compound.

Assemble gasket in cylinder block locating gasket over guide pins. Make cerain that surface of gasket marked "Top" is on the top side. With the "Maxidyne" type gasket, carefully fit a new fire ring over the circular bead on each cylinder liner flange. See Figure 2-156.

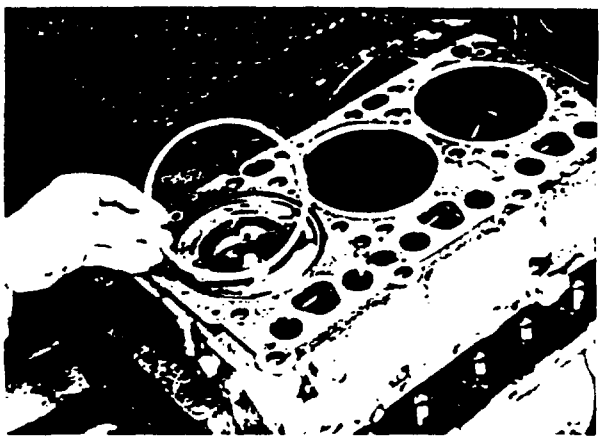


Figure 2-156. Installing Maxidyne Fire Ring

Position the cylinder heads (completely assembled) over the cylinder block, locating the guide holes in the head over the pins in the cylinder block. See Figure 2-157.

If engine has cylinder head studs, check for condition of threads and straightness of shank. Apply a light coat of lubricating oil to threads of studs and install them in cylinder block finger tight, then back off 1/3 turn. Apply a light coat of oil to cylinder head stud washers and nuts and install in position and hand tighten.

6. Continuing adjusting valve lash for the remaining cylinders, in firing order, placing each piston at TDC with respective turning of the engine crankshaft.

NOTE

Engines equipped with the Mack Dynatard® engine brake system will have hydraulic valve lash adjusters in the exhaust rocker arms. Adjust exhaust lash (cold static) using special exhaust valve adjusting tool MVT-36-6. When using tool press downward with hand on exhaust valve adjuster so that the internal clearance in the adjuster is eliminated. Failure to press down on the adjuster will result in unsatisfactory engine performance and unsatisfactory performance of the engine brake.

The MVT-36-6 Exhaust Valve Adjusting Tool is available from:

Automatic Aids
1618 Willow Avenue
La Mott, Philadelphia,
Pennsylvania 19126

For a detailed explanation of the engine brake operation, refer to "Dynatard Engine Brake" section.

CYLINDER HEAD COVER

Check cylinder head covers to make certain that mounting surfaces are flat and clean. Also make certain that gasket surfaces are dry and free from dust.

Apply a thin layer of "Scotch Grip" 3M Co., No. 1711, (or equivalent) contact-type cement to both cover mounting surface and gasket. Let stand for several minutes then assemble adhesive side of gasket to cover.

Allow several minutes for gasket to bond to cover, then assemble covers to engine. Torque capscrews to specifications. See Figure 2-167.

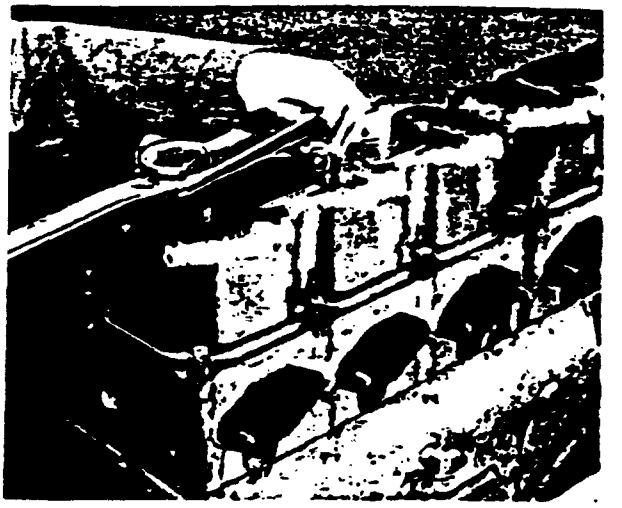


Figure 2-167. Torquing Cylinder Head Cover Capscrews

NOTE

Use of the adhesive between the cover and the gasket will prevent the gasket from squeezing out from under the cover.

Cylinder Head Cover (with Mack Dynatard Engine Brake)

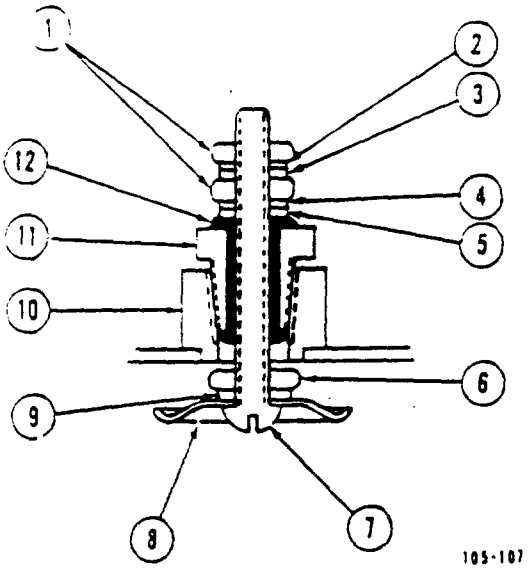
There are two types of terminals assembled to the cylinder head cover. Type No. 1 has a spring steel strip (approximately 3/8 inch wide) which contacts the terminal on the center valve rocker arm shaft bracket. Type No. 2 has a circular contactor spring (approximately 1-5/16 inch in diameter). The circular spring eliminates the need to position the contactor in the horizontal plane.

Type No. 1 Assembly (Non-Current)

1. Assemble insulating washers and/or insulating adapter in terminal hole in cylinder head. See Figure 2-168.

2. Position strip on terminal in cylinder head toward center of engine so that it will come in contact with terminal on center valve rocker arm shaft bracket. Use Loctite and torque nut as specified in Figure 2-168.

3. Loosen nuts holding center screw and adjust screw to obtain dimension shown in Figure 2-168.



1. Nut
2. Lock Washer
3. Terminal Blade
4. Lock Washer
5. Plain Washer
6. Nut
7. Screw
8. Contactor Spring
9. Lock Washer
10. Cylinder Head Cover Boss
11. Adapter(Brass)
12. Insulator (Nylon)

Figure 2-171. Engine Brake Terminal Parts Arrangement Current

To assemble terminal, proceed as follows:

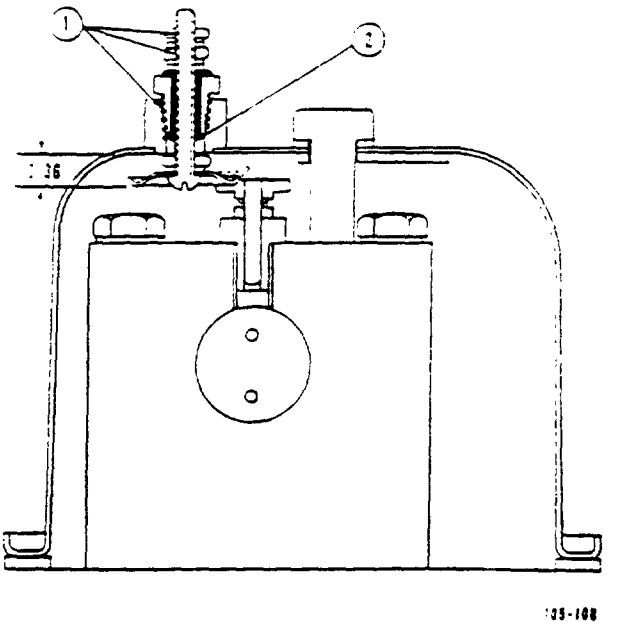
1. Assemble contactor spring to screw with lock washer and nut. Tighten nut.

2. Install the adapter into the cylinder head cover boss, using sealant as specified in Figure 2-172.

3. Assemble screw through the adapter insulator, using sealant. Adjust to dimension as shown in Figure 2-172.

4. Assemble flat washer, lock washer and nut (with sealant) on top side of screw to lock screw at dimension shown in Figure 2-172. Tighten nut.

5. Assemble terminal blade, lock washer, and nut (with sealant), as shown in Figure 2-172. Tighten nut.



1. Apply one drop of Loctite 290 in threads after assembly. (Three Places).
2. Apply Permatex No. 2 to joint between nylon insert and screw.

Figure 2-172. Engine Brake Terminal Assembly Arrangement (End View) Current

VALVE LIFTER COVER

Check valve lifter covers for flatness. Use new gaskets and assemble front and rear valve lifter covers. See Figure 2-173.

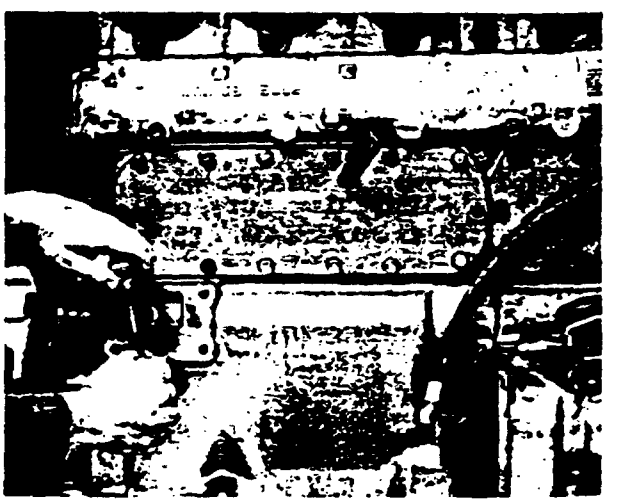


Figure 2-173. Assembling Valve Lifter Covers

NOTE

If any instruction plates are fastened to the original valve lifter cover, make certain that they are replaced when rebuilding engines.

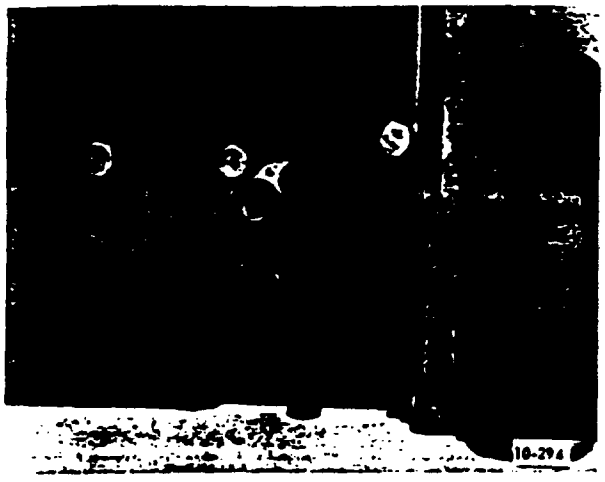


Figure 2-183. Fuel Transfer Pump Mounted to Injection Pump

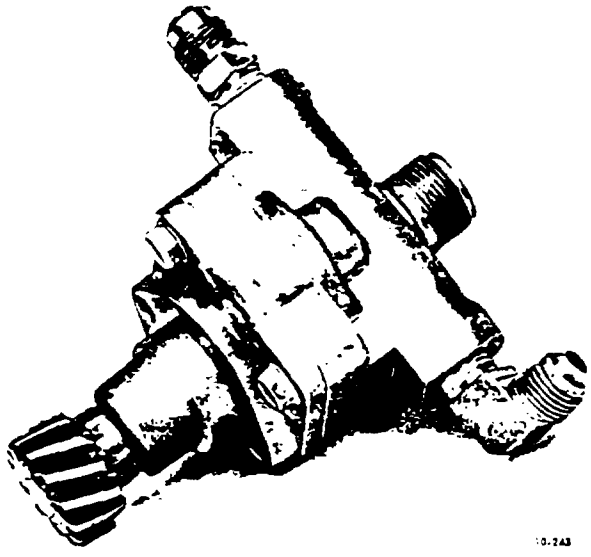


Figure 2-184. Combination Fuel Transfer Pump and Tachometer Drive

This unit is assembled at the tachometer drive hole location. Lubricate shaft and gear. Always use a new gasket when installing pump. Use flat washers and capscrews for securing pump to block. Tighten capscrews.

Assemble fuel inlet line to transfer pump inlet.

NOTE

For complete details on the two types of transfer pumps, refer to the "Fuel Section" in this manual.

TACHOMETER DRIVE ASSEMBLY

There are two types of tachometer drive assemblies in use. One assembly is used solely to drive the tachometer, while the other is a combination fuel transfer pump and tachometer drive. (The combination drive assembly is covered in the preceding section of this manual.)

Lubricate tachometer shaft and gear. Install tachometer drive assembly in cylinder block, using new gaskets and flat washers under mounting capscrews. Tighten capscrews. See Figure 2-185.

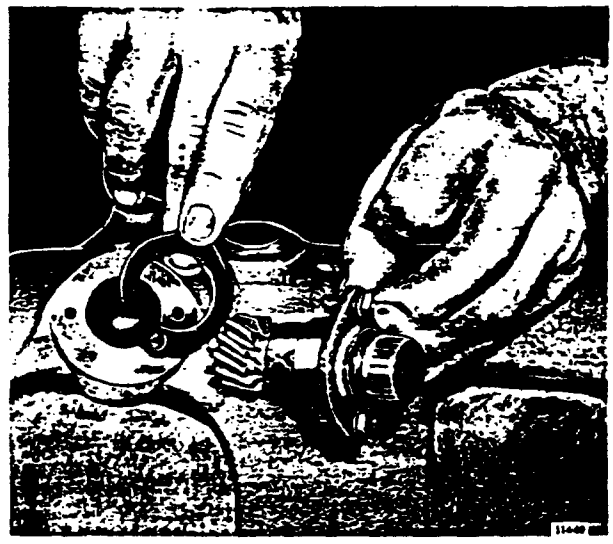


Figure 2-185. Installing Tachometer Drive Assembly

Exhaust Manifold

After checking exhaust manifold for restrictions, cracks or wear, assemble on cylinder head exhaust manifold mounting studs, using new gaskets. Position plain washer and nut locking tab over studs, and assemble nuts to studs. Torque nuts to specifications. See Figure 2-190.

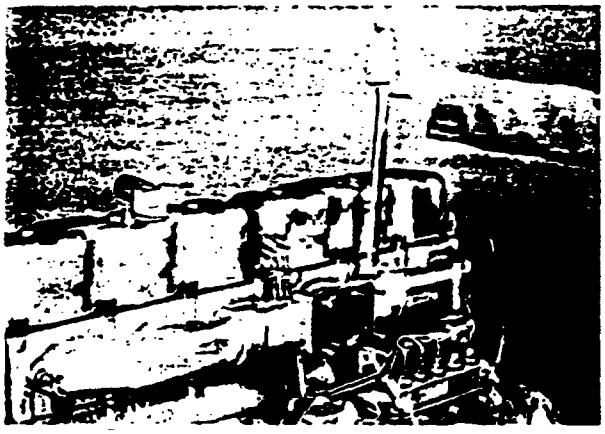


Figure 2-190. Torquing Exhaust Manifold Stud Nuts

After nuts are torqued, bend locking tab to secure nut. One-half of tab is bent against flat on nut and the other half is bent against side of manifold flange.

Inlet Manifold

Check inlet manifold to make certain flanges are flat and there are no cracks or foreign material in manifold.

NOTE

On engines equipped with turbochargers, assemble turbo oil feed line to oil filter adapter before assembling inlet manifold.

CAUTION

If turbocharger oil feed check valve is in system on ESI engines, it should be removed, since field tests indicate it is not required.

Position lockwasher on capscrew and insert in flange holes. Using new gaskets, assemble manifold to engine. Tighten capscrews to specifications.

NOTE

Some installations use a "Patch-Lock" capscrew for mounting the inlet manifolds. With these screws, lockwashers are not required.

On Charge Air Cooling engines, assemble rear half of inlet manifold after charge air cooler header is in position. Use new gaskets and rubber hose connection. Tighten capscrews to specifications. Tighten hose clamps.

Water Manifolds

Non-Charge Air Cooling

Inspect the water manifolds for restrictions, cracks, and flange wear. Assemble hose and clamps at center section of front inlet manifold. Using lockwashers, proper length capscrews, and new gaskets, assemble manifold to engine. Assemble rear water manifold to engine and tighten all capscrews. Position hose to suitable cover front and rear section for proper clamping area. Tighten hose clamps.

Charge Air Cooling

On these engines assemble rear section of water outlet manifold after charge air cooler manifold is in position. Use new gaskets and rubber hose connection. Tighten capscrews to specifications. Tighten hose clamps. See Figure 2-191.

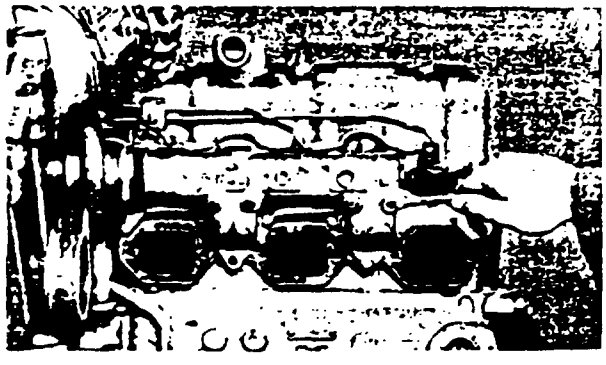


Figure 2-191. Installing Rear Water Outlet Manifold

OIL COOLER

Make certain that oil cooler is in satisfactory condition. (Refer to "Oil Cooler Rebuild" Sub-Heading.)

Assemble the oil cooler and oil filter lube oil fitting to the oil cooler, using a new O-ring gasket. Snug capscrews.

Assemble thermostat by-pass tube, hoses, and clamps, at the oil cooler water inlet fitting.

Assemble oil cooler to engine using new gasket between cooler inlet fitting and water pump. Snug capscrews. See Figure 2-192.

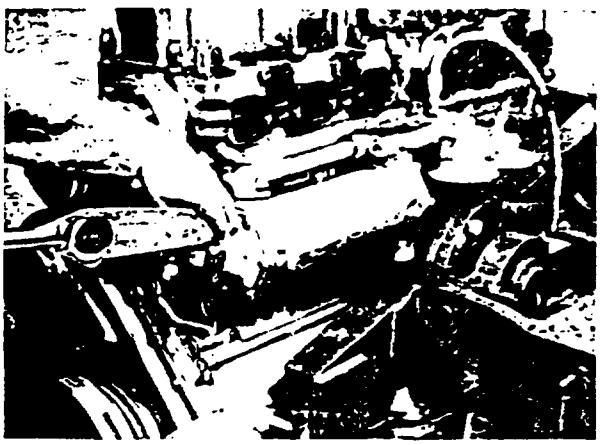


Figure 2-192. Assembling Oil Cooler to Engine

Assemble oil cooler oil inlet tube to cooler, using new O-ring. Before fastening inlet tube to cooler, lubricate O-ring in oil filter fitting and insert tube into fitting. Snug capscrews.

NOTE

The snugged capscrews are tightened when the oil pressure relief valve housing is assembled to the engine. This will permit alignment of all connecting parts.

WATER PUMP

Make certain that water pump is in satisfactory condition. (Refer to Sub-Heading "Water Pump Rebuild".)

Assemble water pump to cylinder block using new gasket. Install capscrews and lockwashers, and torque to specifications. See Figure 2-193.

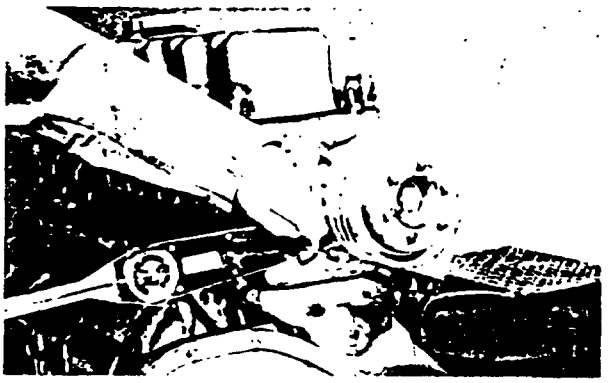


Figure 2-193. Water Pump Installation

OIL PRESSURE RELIEF VALVE

Refer to Sub-Heading "Lubrication System" for correct oil pressure relief valve housing.

Align gasket on mounting flange of relief housing to ensure that the proper gasket is used. See Figure 2-194.

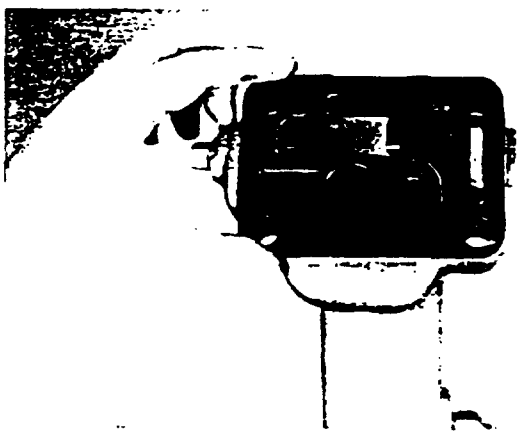


Figure 2-194. Checking Oil Pressure Relief Valve Housing Gasket

CAUTION

Failure to use proper gasket could result in insufficient oil pressure, and cause engine damage.

THERMOSTAT

Install new thermostat seal in water outlet fitting using tool J-26637. See Figure 2-205.

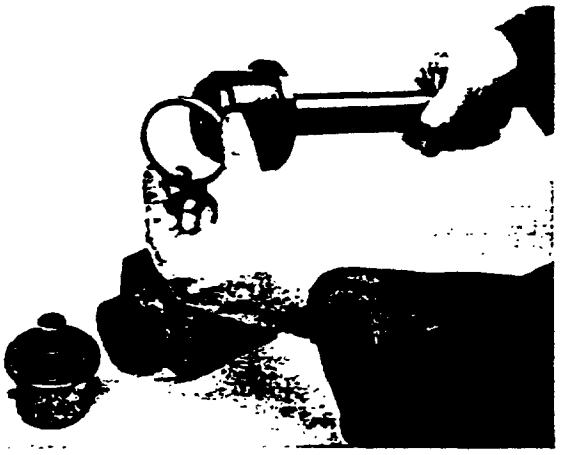


Figure 2-205. Installing Thermostat Seal

Using new thermostat and gasket, assemble fitting to water outlet manifold.

Attach hose from thermostat by-pass tube to water outlet fitting and tighten hose clamps.

COOLANT CONDITIONER

There are two basic types of coolant conditioner arrangements in use.

Type I. - Engines equipped with 150°F. (or 170°F.) thermostats having a higher opening temperature shutterstat.

Type II. - Engines equipped with a 170°F. thermostat and no shutterstat or a lower opening shutterstat.

Type I

With this arrangement, two ball check valves are assembled in the coolant conditioner adapter. The direction of the coolant flow into the adapter is indicated by cast arrows shown on top of the adapter. See Figure 2-206.

Take note of the direction of the arrows so that check valves can be properly installed. The open end of the valve should be located in the direction of the arrows. The ball checks are located so that they are unseated by the direction of coolant flow.

Figure 2-206. Coolant Conditioner Adapter

Type II

Engines equipped with the 170°F. thermostat and no shutterstat (or an optional shutterstat which operates at a lower temperature), have an external coolant feed line. This system eliminates the inlet check valve that was in the adapter. Instead, the inlet check valve is included with the water inlet fitting which is assembled into the adapter.

When assembling adapter to thermostat housing, always use new O-ring in check valve counterbore. See Figure 2-207.

Figure 2-207. Assembling Coolant Conditioner Adapter

Before assembling coolant conditioner to adapter, apply a film of oil to the sealing gasket. Tighten conditioner one full turn after gasket contacts adapter.

Oil Cooler Disassembly

1. Remove water inlet and outlet end caps. See Figures 2-287 and 2-288.

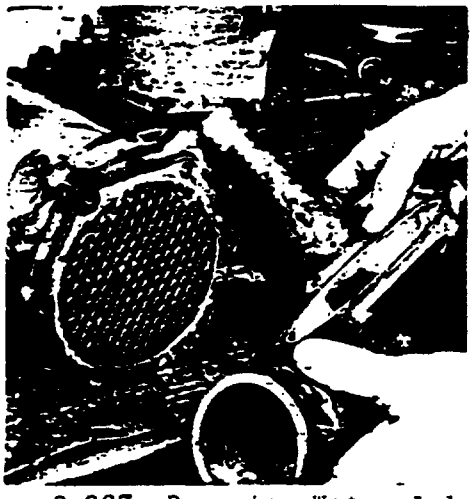


Figure 2-287. Removing Water Inlet End Cap

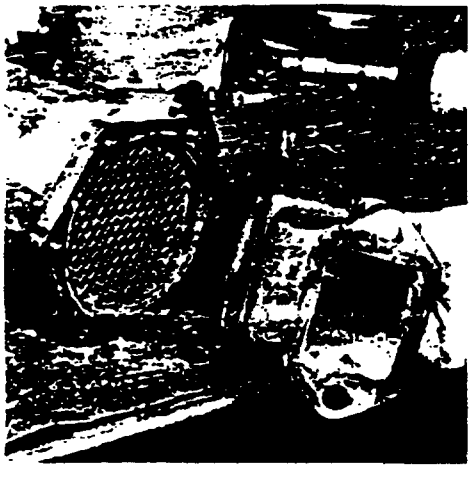


Figure 2-288. Removing Water Outlet End Cap

2. Remove bundle from housing. See Figure 2-289.

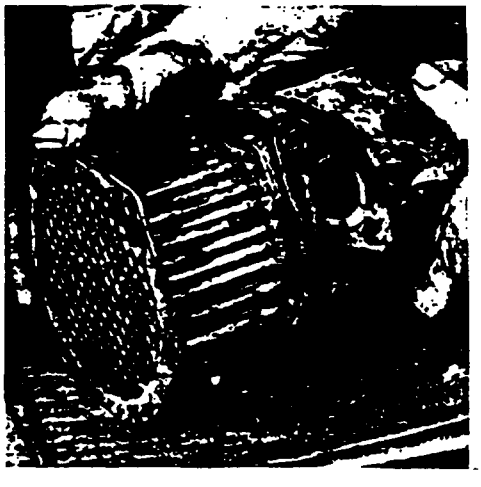


Figure 2-289. Removing Bundle

3. Scrape off end cover gaskets. See Figure 2-290.

Figure 2-290. Scraping End Cover Gasket

4. Remove oil supply line gasket. See Figure 2-291.

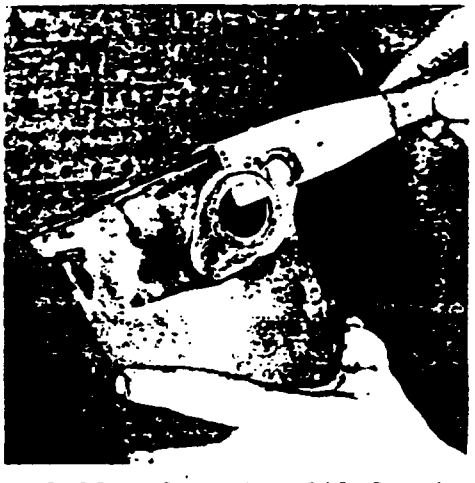


Figure 2-291. Scraping Oil Supply Line Gasket

5. Remove O-ring from housing. See Figure 2-292.

Figure 2-292. Removing O-Ring

NOTE

Visually inspect the housing for cracks which could lead to a leak. If the housing is damaged, replace with new.

6. The oil cooler bundle should be checked for leaks by pressurizing with 80 PSI air pressure and submerging in water. If leaks develop, replace bundle with new. See Figure 2-293.

Figure 2-293. Water Testing Bundle

Oil Cooler Assembly

1. Lubricate O-ring. See Figure 2-294.

Figure 2-294. Lubricating O-Ring

2. Install O-ring in groove at water outlet end of the oil cooler. See Figure 2-295.

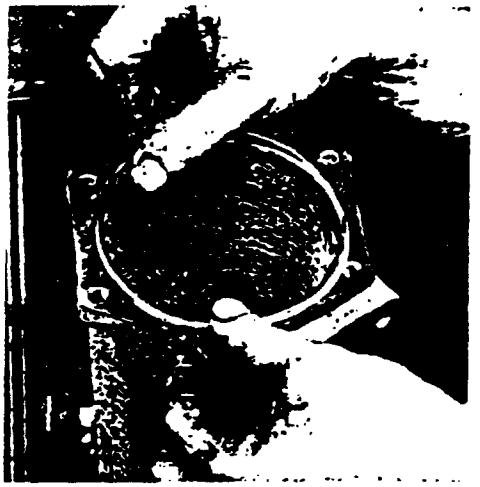


Figure 2-295. Installing O-Ring

3. Spread Perma-Tex gasket sealer on inlet water flange before installing gasket. See Figure 2-296.

Figure 2-296. Applying Gasket Sealer to Housing

4. Install gasket on water inlet end of housing. See Figure 2-297.

Figure 2-297. Installing Gasket

5. Spread Perma-Tex gasket sealer on top of gasket. See Figure 2-298.

Figure 2-298. Applying Gasket Sealer on Gasket

6. Install bundle. Tap last 1/2 inch with a soft-faced hammer to seat bundle past O-ring. See Figures 2-299 and 2-300.

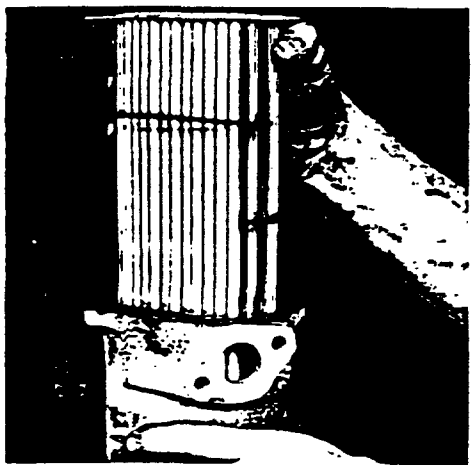


Figure 2-299. Installing Bundle

Figure 2-300. Tapping Bundle into Housing

7. Spread Perma-Tex gasket sealer on bundle end. See Figure 2-301.

Figure 2-301. Applying Gasket Sealer on Bundle

8. Place gasket on bundle end. See Figure 2-302.

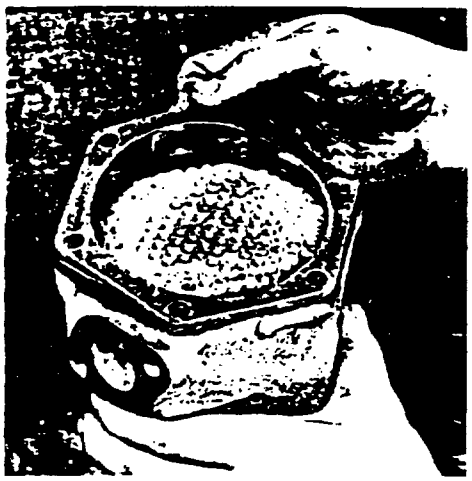


Figure 2-302. Placing Gasket on Bundle

9. Spread Perma-Tex gasket sealer on top of gasket before installing the end cap. See Figure 2-303.

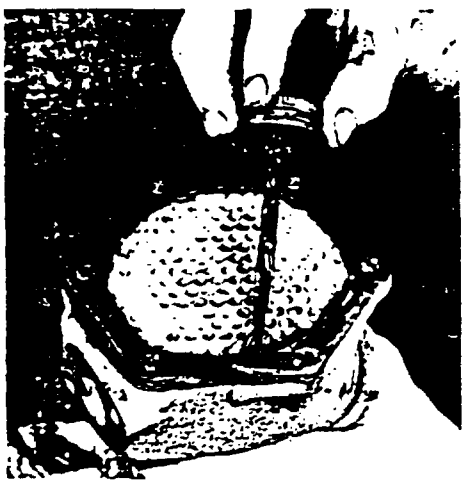


Figure 2-303. Applying Gasket Sealer on Gasket

10. Install water inlet end cap. See Figure 2-304.

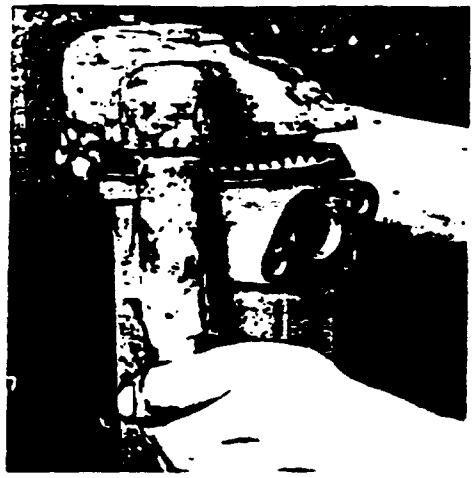


Figure 2-304. Installing Inlet End Cap

11. Torque inlet end cap capscrews to 13 lb.ft. See Figure 2-305.

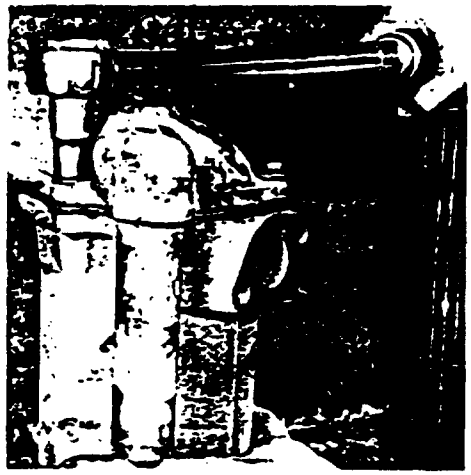


Figure 2-305. Torquing Inlet End Cap Capscrews

NOTE

To install the water outlet end cap, spread Perma-Tex gasket sealer on housing flange. Place the gasket on the sealer then put seal on top of the gasket. Install the end cap and torque capscrews to 13 lb. ft.

Pressure Test Oil Cooler Assembly

1. Install a steel plate with a rubber gasket and an air line fitting on the oil inlet opening. See Figure 2-306.

Figure 2-306. Installing Oil Inlet Plate

2. Install a steel plate with a rubber gasket on the oil outlet opening. See Figure 2-307.

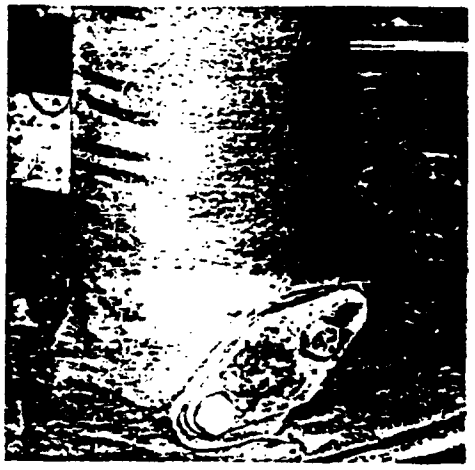


Figure 2-307. Installing Oil Outlet Plate

3. Connect air line and pressurize to 80 psi. Submerge in water to check for leaks. See Figure 2-308.

Figure 2-308. Pressure Testing Completed Assembly

18. Torque pulley nut to 100 lb.ft. See Figure 2-334.

Figure 2-334. Torquing Pulley Nut

NOTE

When torquing the pulley nut on the shaft, it is necessary to use a strap wrench to keep the pulley and shaft from turning while tightening the pulley nut.

19. Place gasket sealer on the gasket seating surface of the housing. See Figure 2-335.

Figure 2-335. Applying Gasket Sealer

20. Place gasket on sealer making sure to line up the holes. See Figure 2-336.

Figure 2-336. Applying Gasket

21. Position housing cover assembly over housing. See Figure 2-337.

Figure 2-337. Positioning Housing Cover

22. Coat housing cover capscrew threads with sealing compound and tighten. See Figure 2-338.

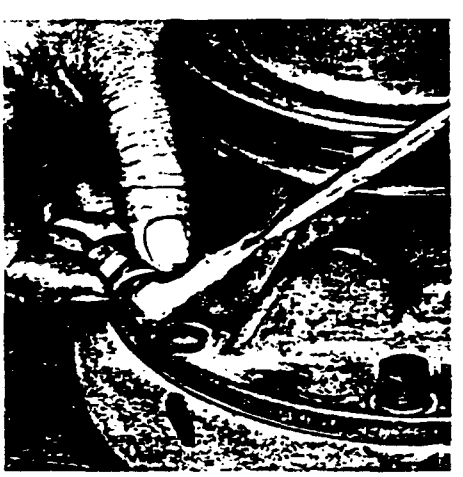
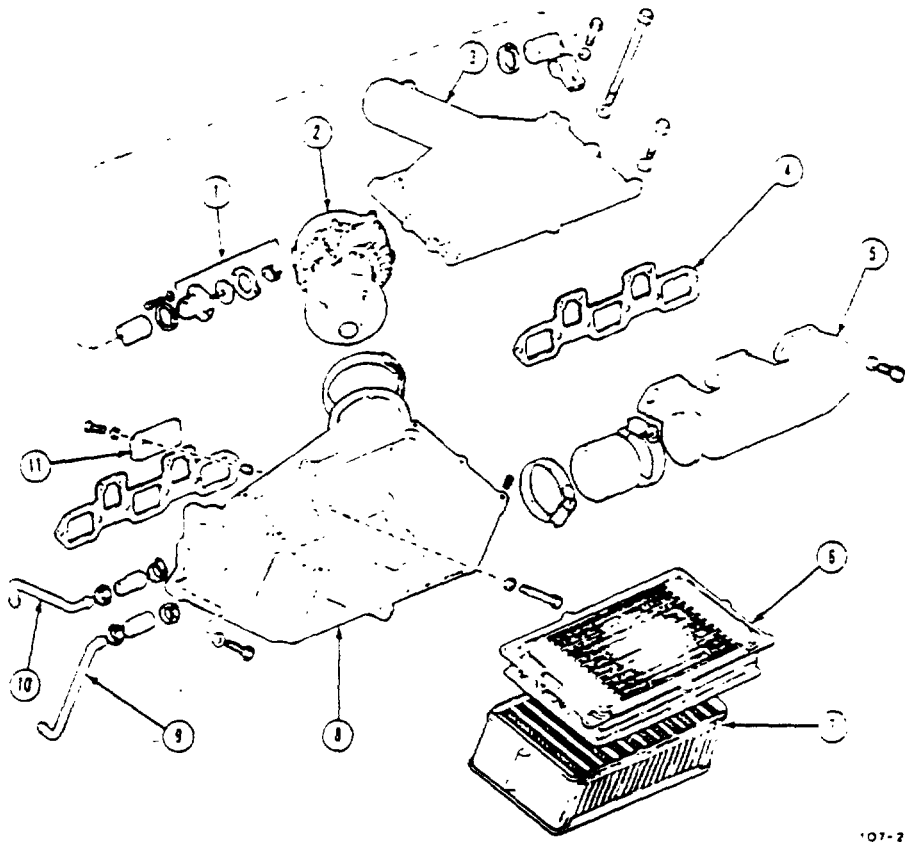


Figure 2-338. Applying Sealer to Capscrews



1. Air Valve Assembly
2. Tip Turbine Fan
3. Header Plate
4. Inlet Manifold Gasket
5. Rear Inlet Manifold
6. Water-to-Air Core
7. Air-to-Air Core
8. Housing
9. Water Outlet Tube
10. Water Inlet Tube
11. Housing Mounting Bracket

Figure 2-357. Exploded View of Series Charge Air Cooling Arrangement

Series Charge Air Cooling

The two stage, or series, charge air cooling arrangement combines a water-to-air heat exchanger with an air-to-air heat exchanger. The combination of these two units lowers the temperature of the air coming from the turbocharger to the inlet manifolds by about 180 degrees F. [100 degrees C.] See Figure 2-357.

The coolant for the water-to-air heat exchanger is drawn off the top of the water pump, circulated through the core and returned to the cooling system via the oil cooler end cap. See Figure 2-357.

Assembly Charge Air Cooling Arrangement

1. To install the charge air cooling housing and intake manifold, place two locating guide pins in the cylinder head to help in positioning the manifold. Assemble gasket over guide pins and position manifold over pins. Install mounting capscrews (patch-lock) and torque to 35-45 lb.ft.

2. Install the thermostat housing. See Figure 2-381.

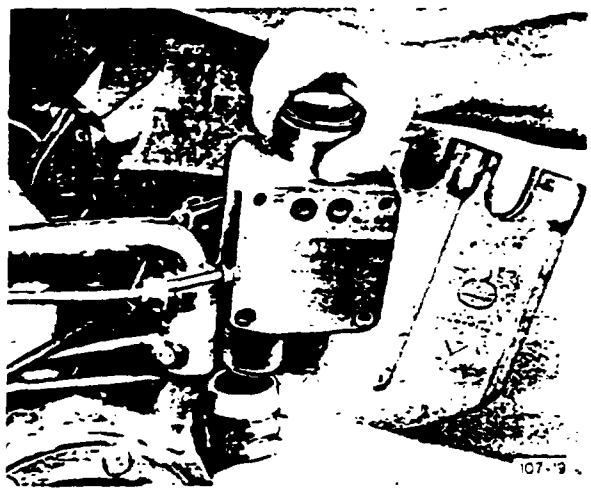


Figure 2-381. Installing Thermostat Housing

3. Install the lower two capscrews in the thermostat housing. Torque to 12-14 lb.ft. See Figure 2-382.

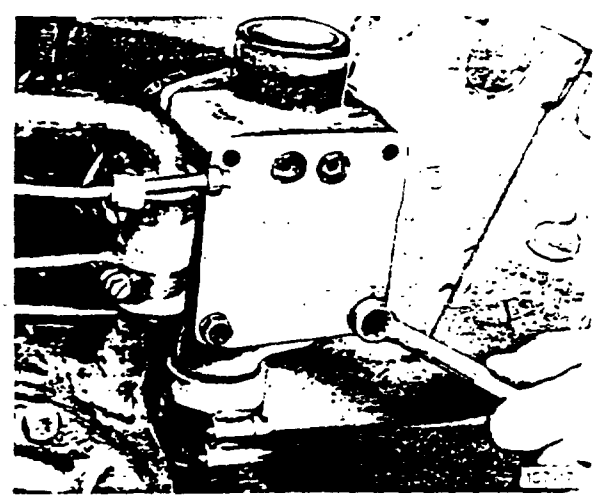


Figure 2-382. Lower Capscrews Location

4. Position the hose clamps and tighten. See Figure 2-383.

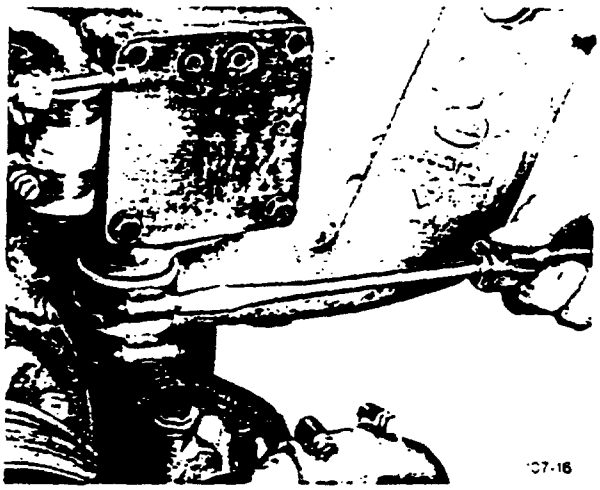


Figure 2-383. Clamps Locations

5. Install the coolant conditioner mounting plate and torque capscrews to 12-14 lb.ft. [8.85-10.32 Nm]. See Figure 2-384.

Figure 2-384. Installing Mounting Plate

6. Install coolant conditioner by hand. Tighten conditioner 3/4 turn after the gasket comes in contact with the mounting plate.

7. Install the coolant conditioner inlet line. See Figure 2-385.

12. Connect and tighten the turbocharger oil feed line. See Figure 2-390.

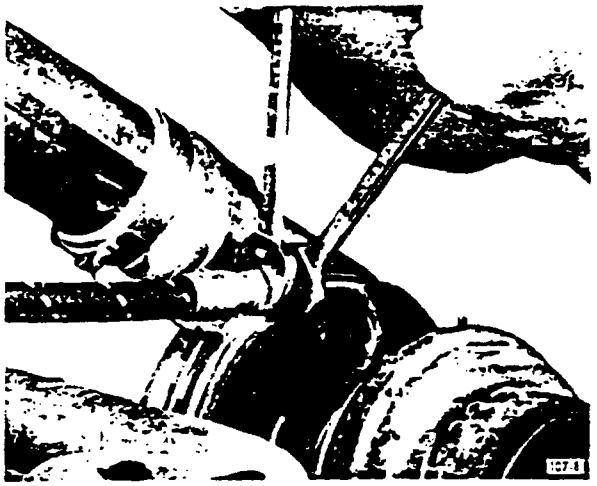


Figure 2-390. Connecting Oil Line

13. Install the air-to-air core in the housing. Then install the water-to-air core being careful not to damage the ends that extend through the housing.

NOTE

Wipe housing or gasket surfaces with talcum powder or Dow Corning 44 silicone grease before installing in housing to prevent gasket sticking.

14. Install the header plate and capscrews. Torque capscrews to 23 lb. ft. See Figure 2-391

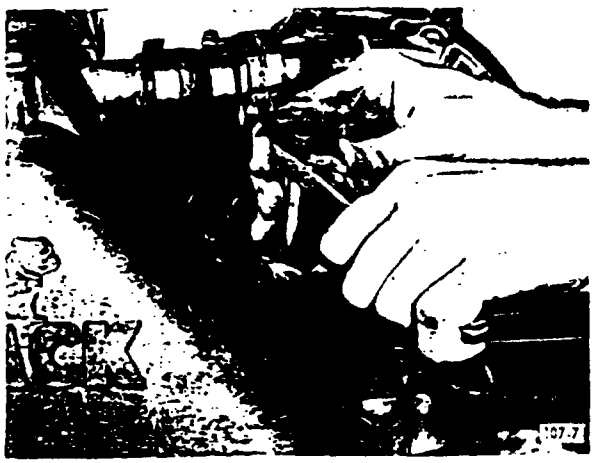


Figure 2-391. Installing Headplate Capscrews

15. Position and tighten the tip turbine fan bleed line clamps. See Figure 2-392.

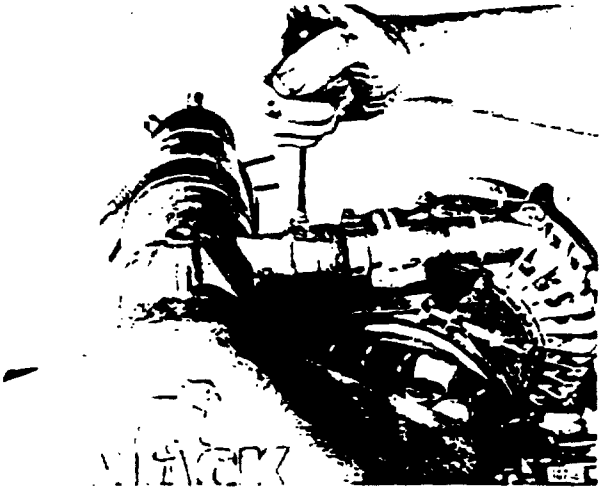


Figure 2-392. Clamp Locations

16. Series Charge Air Cooling Only - Place the water inlet and outlet tubes into the water-to-air core.

17. Series Charge Air Cooling Only - Tighten clamps at both ends of the water tubes. See Figure 2-393.

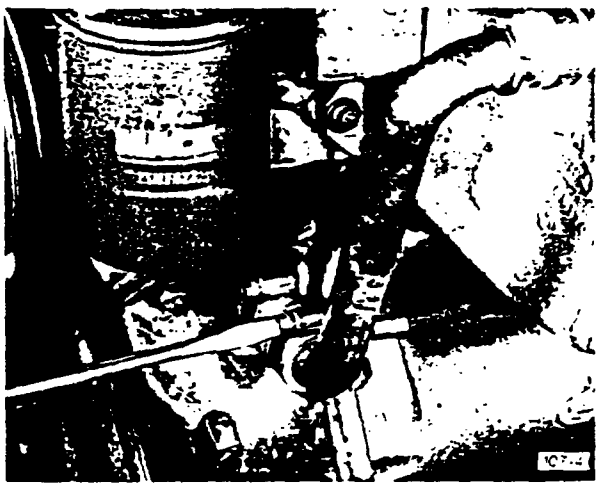


Figure 2-393. Clamp Locations

18. Position and tighten the turbocharger crossover tube connecting sleeve clamps. See Figure 2-394.

Cleaning the Air-to-Air Heat Exchanger

NOTE

The cleaning procedure and the gasket replacing procedure is the same for both the air-to-air heat exchanger and the air-to-air portion of the series heat exchanger. This can be done by either one of two methods.

1. Steam cleaning.

CAUTION

Steam pressure exceeding 40 psi and/or temperatures exceeding 400 degrees F. can damage core and gaskets.

2. Detergent cleaning.

Use a solution of household laundry detergent. Flush through the core several times followed by a rinse with warm water. Use low pressure air to blow dry.

CAUTION

Do NOT under any circumstances use strong caustic solutions such as "Oakite" or acids such as bowl cleaners, hydrochloric acid, etc. as they will corrode the core and damage the gaskets. Also, do NOT use shop solvents to clean the core as they will damage the gaskets.

Gasket Removal

1. Pull off old gaskets. See Figure 2-395.

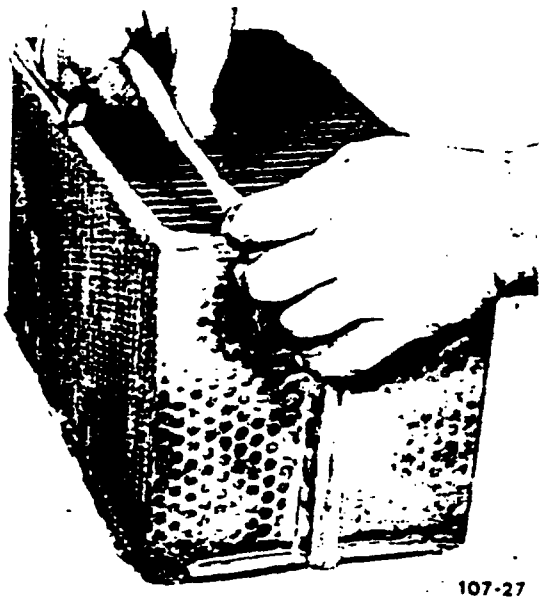


Figure 2-395. Pulling Gasket

2. Using a razor blade or a sharp knife, cut away the excessive bonding material. See Figure 2-396.

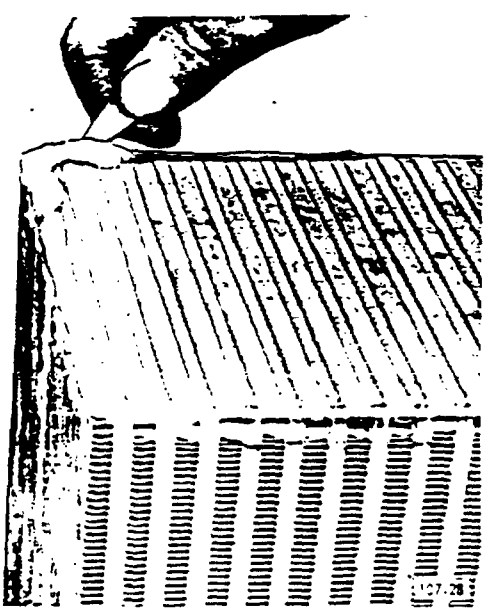


Figure 2-396. Cutting Material

NOTE

It is not necessary to remove all the bonding material out of the depressed areas since the new gasket will seal perfectly to the slightly uneven old gasket surface.

3. Remove all loose shavings and cuttings.

Gasket Installation

NOTE

The unit must be clean and dry before installing the new gaskets.

1. Place the unit on a flat workbench with the gasket surface up. (The turbocharger air flow arrow pointing up or down.)

2. Soak a clean rag with alcohol and wipe the old gasket surface and the new gasket to remove all oily residue.

3. Run a bead of silicone rubber bonding agent on the corners of the core. See Figure 2-397.

Figure 2-397. Applying Agent to Core

4. Run a bead of silicone rubber bonding agent on the four sides of the new gasket. See Figure 2-398.

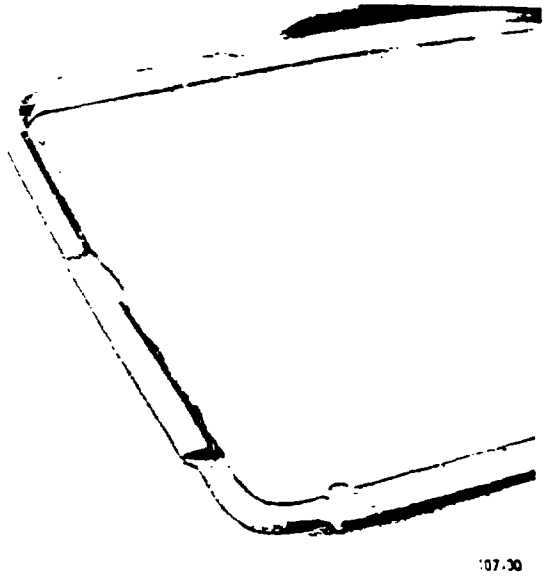


Figure 2-398. Applying Agent to Gasket

5. Place gasket on core and adjust into place. See Figure 2-399.

Figure 2-399. Placing Gasket

CAUTION

Refer to diagrams on gasket shipping container for proper installation position.

6. Invert the core and repeat steps 3 through 5 for the second gasket.

NOTE

If the end gaskets are damaged, proceed with steps 7 through 10; otherwise, omit these steps and proceed with step 11.

7. Remove the old end gasket. See Figure 2-400.

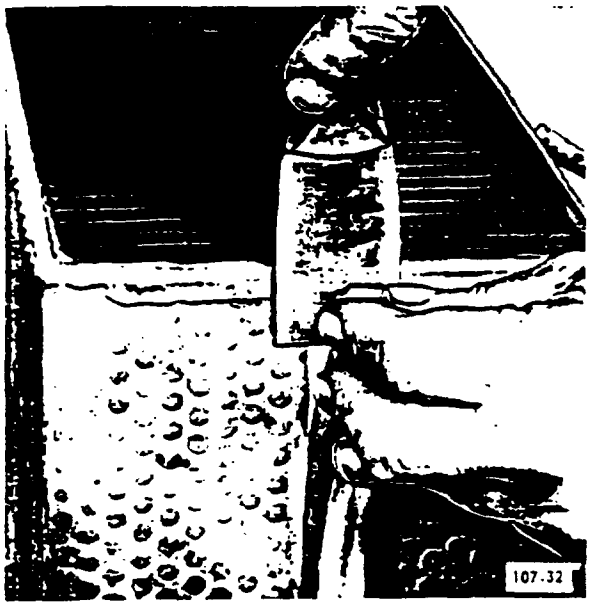


Figure 2-400. Removing End Gasket

8. Soak a clean rag with alcohol and wipe the old gasket surface and the new gasket to remove all oily residue.

9. Run a bead of silicone rubber bonding agent on the flat side of the new gasket. See Figure 2-401.

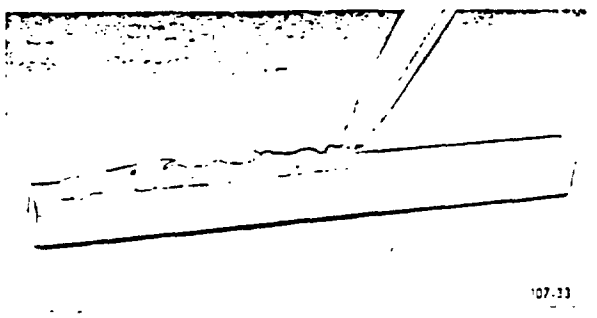


Figure 2-401. Applying Agent to End Gasket

10. Place new gasket into position. See Figure 2-402.

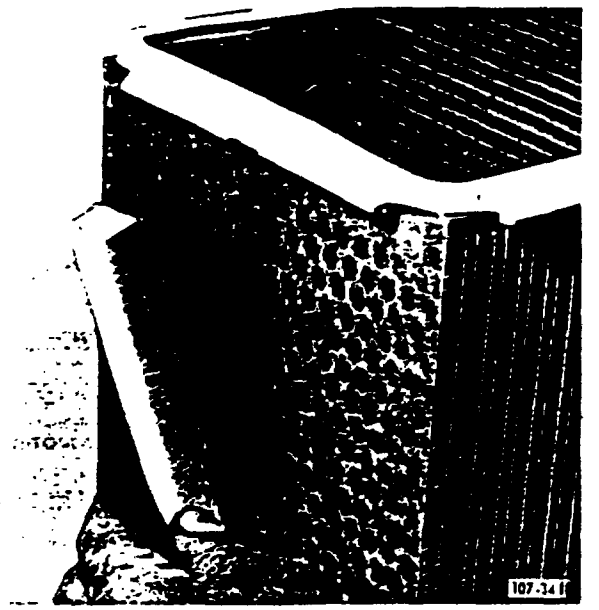


Figure 2-402. Placing Gasket

NOTE

Hold the end gaskets in position with string or tape wrapped around the entire unit until the bonding agent takes a set.

11. Check all the gaskets to make sure they have not shifted during handling.

NOTE

The gaskets may be adjusted during the first five minutes while the silicone rubber bonding agent is curing.

12. Let the entire unit stand undisturbed for 1 to 1-1/2 hours minimum before installing.

13. Visually inspect the bond after curing to make sure that the gasket is firmly attached all the way around. Gaps that are found should be filled with additional silicone rubber bonding agent. Let cure.

CYLINDER HEAD GASKETS

Two (2) types of cylinder head gaskets are currently being used during engine rebuild. The "folded-steel" type gasket (see Figure 11) is used with the "flat-flange" type cylinder liner (see Figure 12).

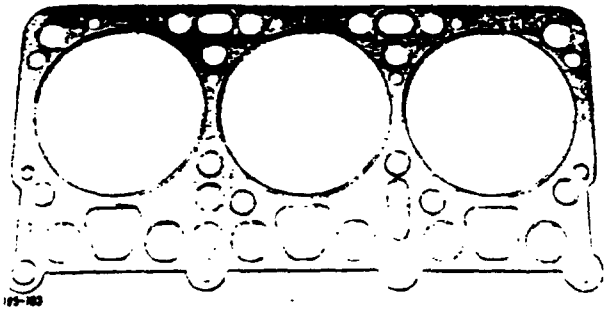


Figure 11. Folded-Steel Type Gasket

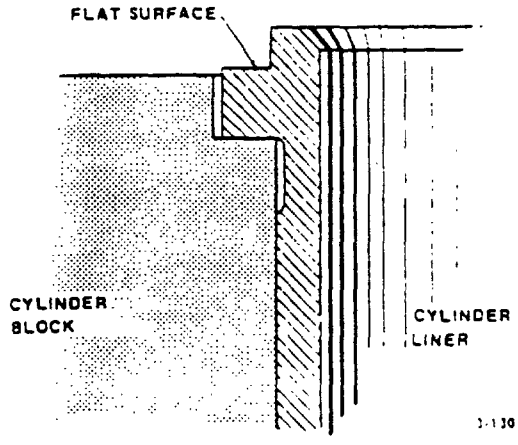


Figure 12. Flat-Flange Type Cylinder Liner

The "Maxidyne-Type" gasket (consisting of a one-piece composition gasket and three (3) fire rings as shown in Figure 13 must be used with the beaded-type liners as shown in Figures 14 and 15.

NOTE

Before assembly of cylinder head, always check the circular grooves in the head surface directly opposite the liner bead. They must be 0.008 in. deep and absolutely clean to assure a good fire ring seal.

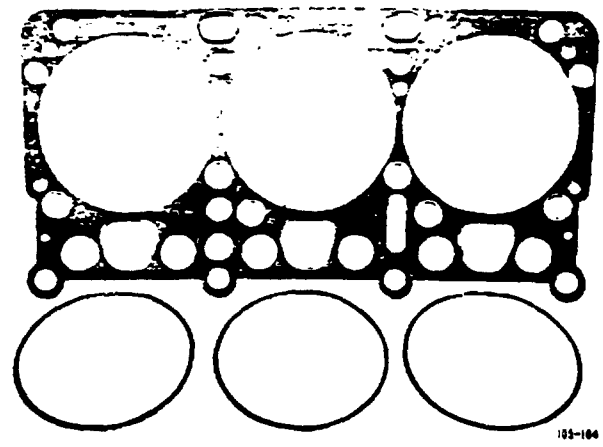


Figure 13. Maxidyne-Type Gasket (with Fire Rings)

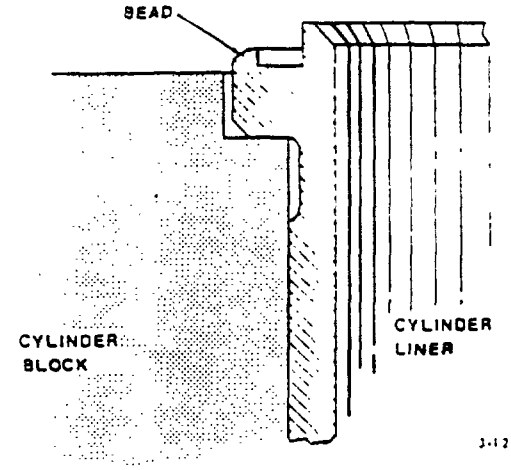


Figure 14. Beaded-Type Cylinder Liner (4-7/8 In. Bore)

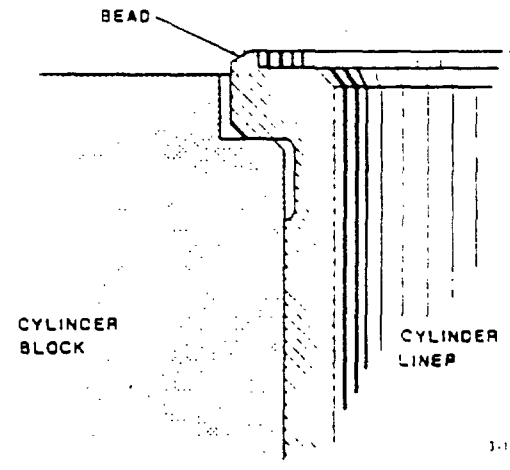
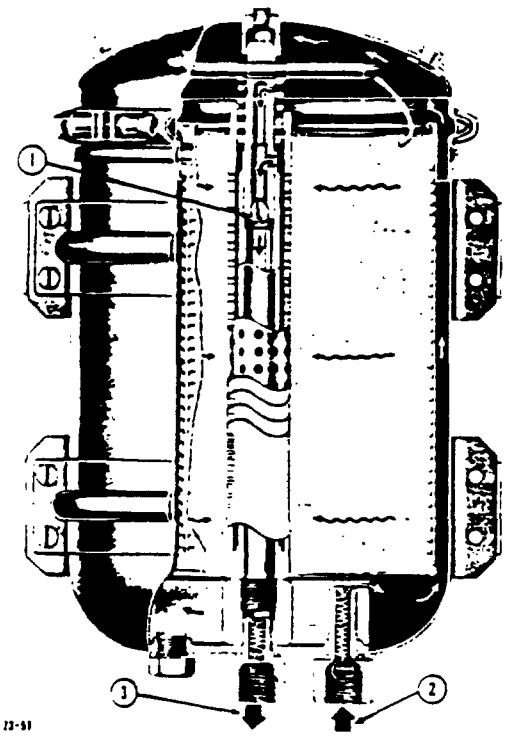


Figure 15. Beaded-Type Cylinder Liner (5 In. Bore-END707 and END711 Engines)

CAUTION

Always use new gaskets and fire rings when assembling engines.

Early engine mocels had by-pass type oil filters. The quantity of oil going through this type of filter is controlled by a metering orifice. See Figure 65.

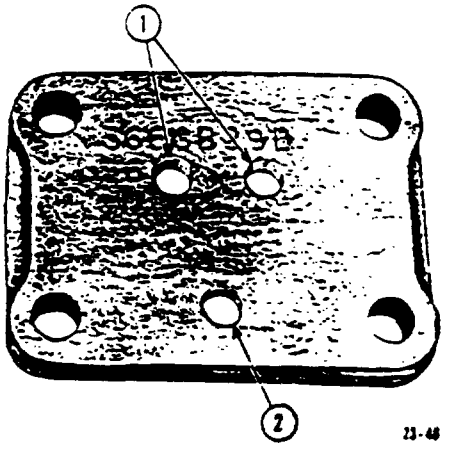


1. Metering Orifice
2. Oil Inlet
3. Oil Outlet

Figure 65. By-Pass Type Filter

This filter used flexible lines for oil supply to filter and oil return to engine. The oil lines are connected to a cover which is assembled to the oil filter pad on the left-hand side of the engine.

Because of revisions that have been made to the cast contours of the pad on the current cylinder blocks, oil filter pad cover, 368GB29D, and gasket, 590GB1152B, must be used with a by-pass filter installation. See Figures 66, 67, and 68.



1. Oil Pressure Feed Holes
2. Oil Drain Hole

Figure 66. Top View of Oil Filter Pad Cover

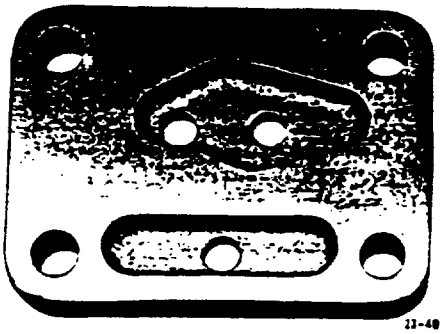


Figure 67. Bottom View of Oil Filter Pad Cover

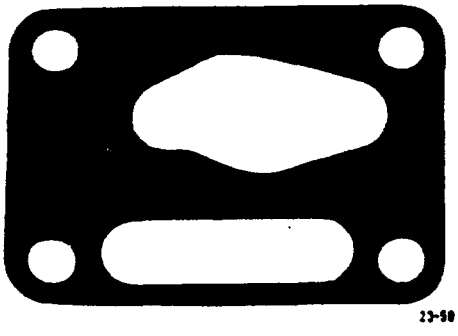


Figure 68. Oil Filter Pad Cover Gasket

CAUTION

Failure to use the correct cover and gasket, on current cylinder blocks, will result in low oil pressure and possible engine damage.

If the replaced engine has a full-flow by-pass type of filter, as shown in Figure 69 or a spin-on type filter, as shown in Figure 70, use the adapters or housings from the original engine.

OIL PRESSURE RELIEF VALVE HOUSING GASKET

Since service gasket kits include different types of gaskets to cover the various oil pressure relief valve housing designs, it is important that the correct gasket be used.

Although these gaskets are similar in appearance, they are not interchangeable. Identification of the correct gasket can be made by comparing with the following illustrations, which are full size. See Figures 73, 74, 75 and 76.

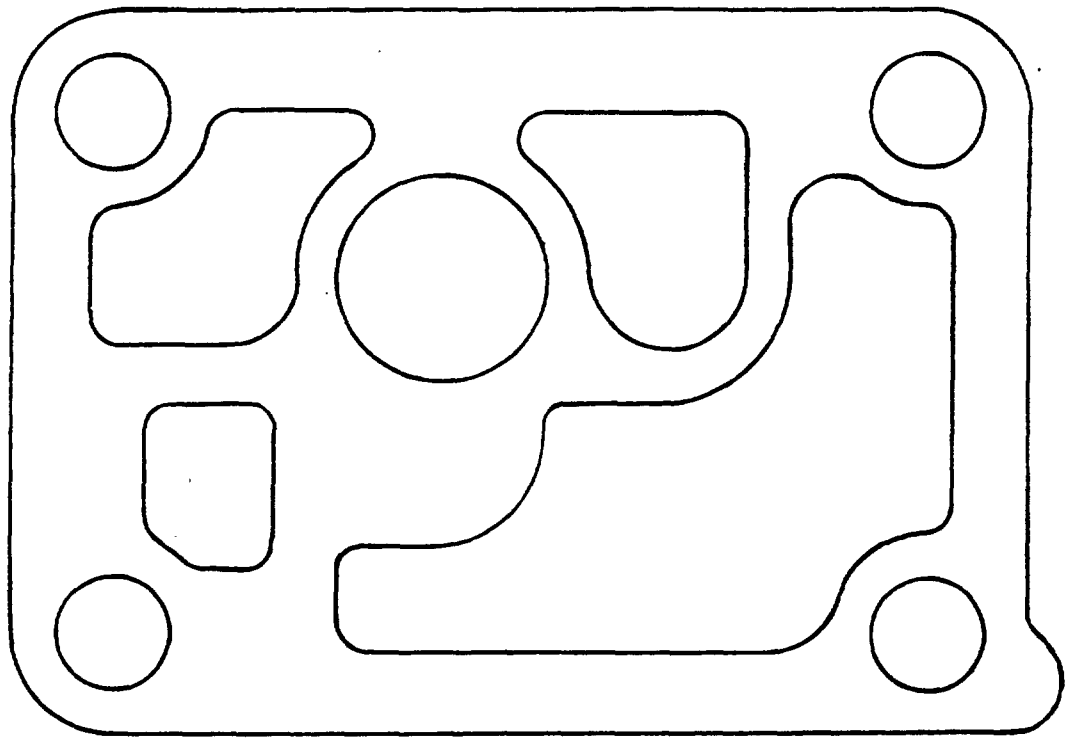


Figure 73. Oil Pressure Relief Valve Housing Gasket 590GB1298B

Gasket Part No.	Application	Oil Pressure Relief Valve Housing
590GB1298B (See Figure 73)	All ESI and ESI Plus Six Cylinder Engines. Piston Cooled and Non-Piston Cooled	766GB269-P1,P2.&P3 (Non-Piston Cooled Engines) 766GB51-P1,P2 & P3 (Piston Cooled Engines)

NOTE

The "B" version of the above gasket includes a tab at the bottom right corner, which will indicate at a glance whether the gasket is properly installed.

Provisions have been made on both sides of the case to install buttress screws which fit into the main bearing cap. The buttress screws are used on both sides of all main bearing caps. They must be removed in order to remove the main bearing caps.

Block Preparation

1. Check the cylinder block deck surface for warpage. If warpage is excessive be sure that the maximum amount of material removal limit is not exceeded.

CAUTION

The piston travel above the cylinder block deck is critical and must be checked during assembly to insure proper clearance of piston with cylinder head and valve.

2. Remove all core plugs and fittings from the cylinder block and remove any accumulation of rust and sludges.

3. Check block for cracks, the condition of threaded holes and the straightness of the mating flanges.

4. Thoroughly inspect the upper edge of the cylinder sleeve counterbore in the block for signs of pitting or errosion. Rework as required. Shims are available to obtain correct sleeve height at reassembly.

5. Blow all passages thoroughly with compressed air.

6. Coat new O-ring with sealant, place on core plugs and install plugs in block.

7. Install all oil gallery plugs and gaskets using Permatex sealant or equivalent to insure positive sealing.

Cylinder Sleeve

The cylinder sleeves are wet type, centrifugal cast iron and are available in standard size. A bead is provided around top of seating flange for using a fire ring type cylinder head gasket. Clean sleeve flanges using a brass wire rotary brush to be sure of effective fire ring sealing. Check cylinder sleeve for out-of-round and taper. Use tool J5347-01 and measure each sleeve I.D. See Figure 2-9. Take readings in two directions at each of three levels: top, center, and bottom.

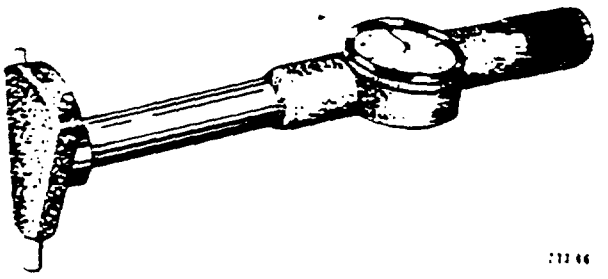


Figure 2-9 Cylinder Sleeve Bore Measuring Tool

Check the sleeve height above the cylinder block deck. Use gage J26948. See Figure 2-10.

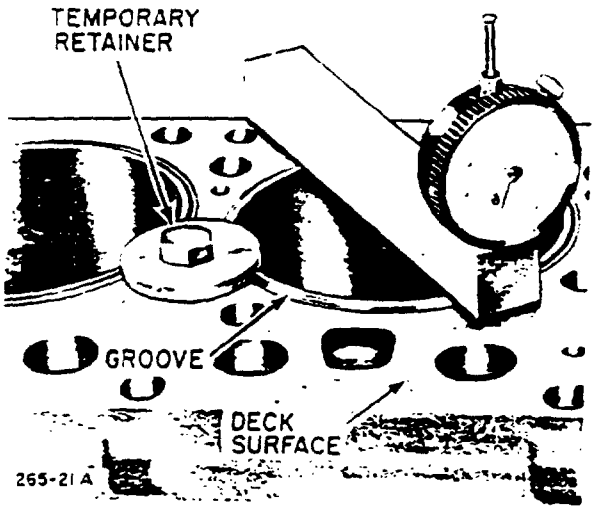


Figure 2-10. Checking Sleeve Height Above Block Deck

Honing

If sleeve bore when in place does not exceed out-of-round and taper limit, clean up I.D. with a suitable hone, 150 to 220 grit, to produce a diamond criss-cross pattern surface finish of 25 to 40 micro-inch rms.

Wash liner bore with a solution of household laundry detergent and air blow dry. Wipe liner bore with a clean oil soaked cloth.

Sleeve Rebore

If sleeve exceeds out-of-round and taper limit, the sleeve may be resized using boring bar equipment to receive the next applicable oversize piston. After re-sizing, hone 150 to 220 grit to produce a diamond criss-cross pattern surface finish of 25 to 40 micro-inch rms.

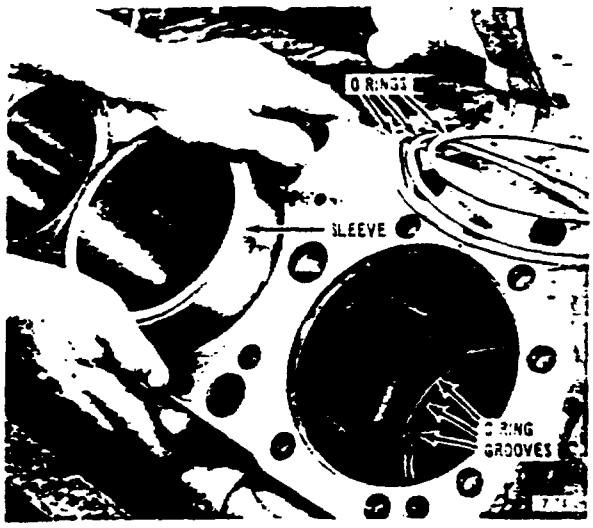


Figure 2-13. Installing Cylinder Sleeve

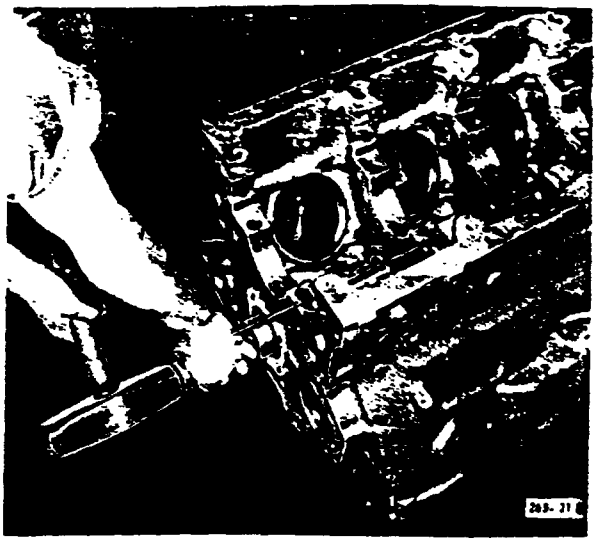


Figure 2-14. Installing Camshaft Bushing

CAUTION

If for any reason the sleeve is backed out even as little as 1/8 inch, it may roll the top seal over the relief edge damaging the seal. Remove sleeve and replace seals.

8. Secure cylinder sleeve in pairs using keeper washer and capscrew at center cylinder head capscrew hole until pistons, rings and cylinder heads are installed.

Camshaft Bushings

There are two camshaft bushing widths. The front camshaft bushing is the wider bushing; the remaining bushings are of a narrower width. All bushings are located at set distances measured from the forward machined surface of the camshaft thrust washer recess to the forward edge of subsequent bushings. Use special tool kit J-21428 to install or remove bushings. Coat outer surface of the bushings with engine oil before installation. The oil supply hole in the bushing should be located to the right as viewed from above and standing to the rear of the engine. The camshaft bushing interlocking split should be installed upward. See Figure 2-14.

NOTE

The rear camshaft bushing can be removed, using special tool J-21385, without removing the flywheel housing.

Expand the front oil gallery plug to offer resistance upon entering bore. The front oil gallery plug is further secured by installing the camshaft thrust washer which partially covers the plug. Patchlock countersunk Allenhead capscrews are used to secure the thrust washer in place. It is imperative that the mating surfaces be clean and new Patchlock screws are used. See Figure 2-15.

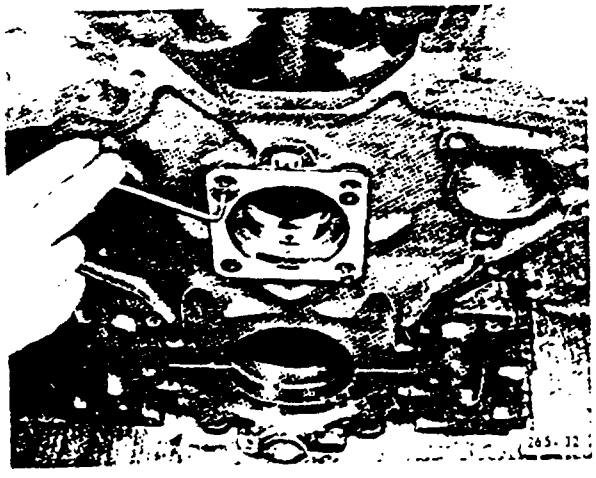


Figure 2-15. Installing Camshaft Thrust Washer

Apply a coat of Permatex to the rear oil gallery plug and gasket and install in rear oil gallery. See Figure 2-16.

4. Remove front bearing retainer and drive front bearing and spacer from housing out through the front.

5. Reverse housing and drive rear bearing from housing out through the rear.

Inspection

1. Inspect the water pump drive gear for wear pattern and condition of teeth.

2. Inspect and check shaft for journal wear and condition of internal spline.

3. Inspect and check condition of the bearings.

Assembly

1. Install front bearing (double row ball bearing) in housing from the front.

2. Install retaining ring, tapered side outward, in housing groove.

3. Start water pump drive gear and shaft assembly into the bearing bore. Do not completely install.

4. Rotate gear and tap with a soft face hammer until gear rotates concentric with the bearing.

5. Press gear and shaft assembly into bearing until it bottoms on shoulder on shaft.

6. Invert housing and gear and install spacer.

7. Install rear bearing with seal side outward in housing.

8. Clamp assembly in a suitable clamping fixture to hold gear and install water pump drive shaft screw. Tighten to recommended torque. 50 lb. ft.

9. Install O-ring in the groove on outer periphery of the housing.

10. Lubricate O-ring seal generously and install drive assembly in cylinder block recess with flat side of housing toward camshaft gear.

NOTE

It is important to generously lubricate O-ring seal before installing in block. This will prevent the O-ring from rolling on upper surface and restricting oil supply to the water pump bearings.

11. Install three water pump housing capscrews securing assembly in position. Tighten to recommended torque. 26 lb. ft.

TIMING GEAR COVER

Inspection

Inspect timing gear cover for dents, condition of threaded holes and straightness of flanges.

Installation

1. Install crankshaft front oil seal into the cover using tool J-21375.

2. Install the adjustable camshaft thrust button from the inside and position the washer and jam nut on the outside of the cover.

3. Adjust camshaft thrust button to its retracted position.

4. Install six guide studs. Two guide studs are used at the lowest point, highest point and one adjacent to the water pump drive and the final stud adjacent to the drive provision directly opposite the water pump drive.

5. Install the timing gear gasket over guide studs.

6. Install the timing gear cover over the guide studs and push cover into position.

7. Install all cover capscrews loosely.

8. Install water pump drive alignment tool J-21382 and crankshaft oil seal alignment tool J-21381. Torque all capscrews.

CRANKSHAFT VIBRATION DAMPER AND HUB

Inspection

1. Inspect crankshaft vibration damper hub for scoring, condition of flange, threaded holes and keyway.

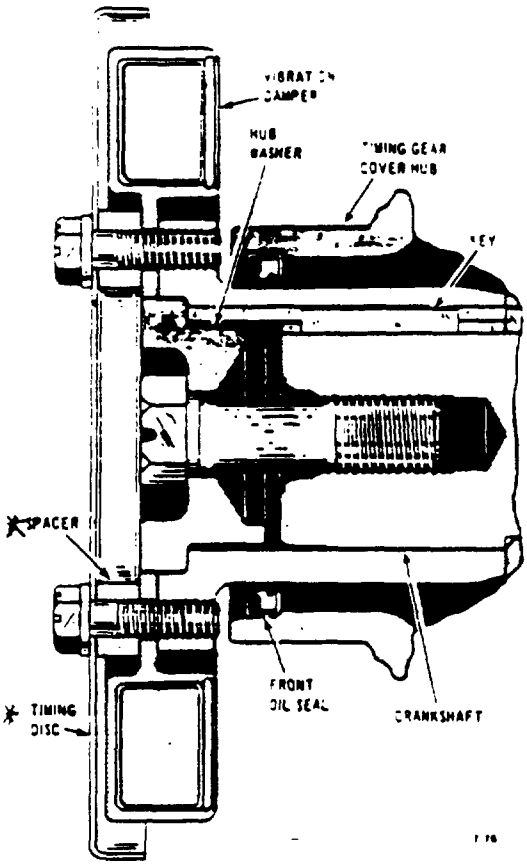
2. Inspect the vibration damper for general condition, mounting threaded holes and housing.

Installation

1. Position crankshaft keyway UP and install key.

2. Heat crankshaft vibration damper hub in hot oil to 250 degrees F.

3. Align crankshaft hub on key and install hub. See Figure 2-49.



*Not required on Current Production Engines

Figure 2-49. Vibration Damper and Hub Arrangement

4. Install hub washer and retaining screws. Torque screws.

5. Install vibration damper, spacer and timing disc on crankshaft hub: the holes will only line up one way.

6. Install retaining capscrews securing assembly.

NOTE

When all parts are assembled on the crankshaft, keyway up, the scribe mark on the damper rim must be up. The TDC mark must align with the timing indicator 30 degrees to the left of the engine centerline.

OIL PAN

Inspection

1. Inspect oil pan for dents, cracks and condition of flange.

2. Inspect and check the bolt holes for elongation and baffle for security.

3. Inspect and check drain hole for condition of threads.

Installation

1. Position gasket on oil pan and position oil pan on cylinder block.

2. Install and tighten oil pan retaining capscrews evenly to prevent oil leakage.

AUXILIARY DRIVE ASSEMBLY

NON-CURRENT (Figure 2-50) Prior to following:

Engine	Serial Number
ENDT(B)865	TB865 5F 9380
ENDT(B)865C	T865C 5M 5045
ENDT(B)866	T866 5F 8981
ENDT(B)866C	T866C 5M 4357

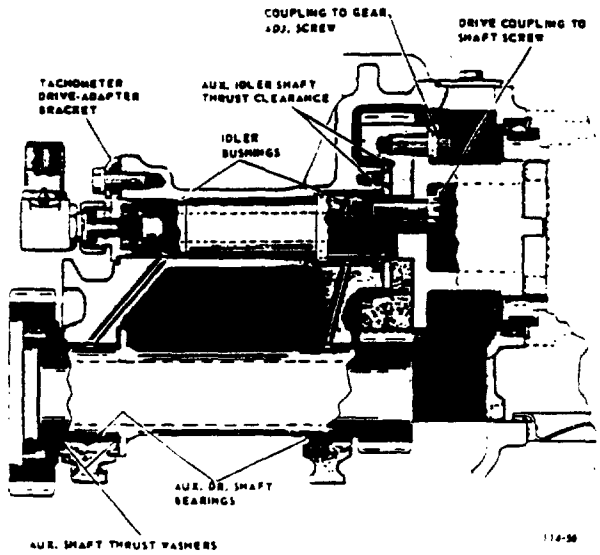


Figure 2-50. Auxiliary Drive Assembly

Description

The auxiliary drive is a complete unit sub-assembly located between the cylinder heads on the front of the engine. The auxiliary drive consists of a drive housing, idler shaft and gear assembly and drive shaft. It is gear driven from the camshaft.

DRIVE HOUSING

Description

The auxiliary drive housing is an alloy casting and supports the drives for the injection pump, air compressor, tachometer drive and hydraulic steering pump.

Installation

1. Time auxiliary drive to camshaft gear. Install both push rods in No. 6 cylinder location. Bar engine over until movement is felt in both push rods simultaneously and the timing indicator pointer indicates TDC for No. 1 and 6 cylinders. The single punch mark on the camshaft gear will be in the upright position.

2. Install O-ring in oil passage port at right hand front top edge of cylinder block.

3. Apply a bead of 243SX32 gasket compound or equivalent to mating surfaces of the auxiliary drive housing.

4. Place auxiliary housing assembly on top of the block carefully.

NOTE

Be sure timing gear cover gasket is properly positioned and the single timing mark on the camshaft gear alignes with the single timing mark on the auxiliary drive gear.

5. Install all nine capscrews and washers hand tight.

6. Torque the two lower timing gear cover to auxiliary housing capscrews.

7. Torque all auxiliary housing to cylinder block capscrews.

8. Release the torque on the two timing gear cover to auxiliary housing capscrews then retorque the same capscrews.

NOTE

This procedure will align auxiliary housing to front face of the cylinder block and permit block surface to butt fully to mating surface of auxiliary housing.

9. Check backlash between camshaft gear and auxiliary drive gear. If backlash is not within limits, loosen auxiliary housing capscrews and reposition housing by tapping with a soft faced mallet. Retorque capscrews and recheck backlash.

NOTE

Care must be taken at this time to have all pipe plugs in the auxiliary drive oil gallery passages. Access to these plugs becomes increasingly difficult at later assembly points.

VALVE LIFTER COVERS

The center valve lifter cover is a steel stamping and requires a new gasket at assembly. The rear valve lifter cover is cast aluminum. At assembly apply a bead of gasket compound 243SX32 to the cover and cylinder block mating area.

INJECTION PUMP

Installation

1. Bar engine over in the normal direction of rotation until the No. 1 cylinder piston is at TDC, as indicated by the timing indicator, and the timing marks on the auxiliary drive shaft gear aligns with the timing mark on the auxiliary drive idler. The pin hole location will be at the five o'clock position and the coupling tangs are at 12 degrees 36 minutes off the horizontal. See Figure 48.

2. Bar engine back approximately 40 degrees.

3. Bar engine over in the normal direction of rotation until timing indicator reads the B.T.C. setting as specified on the injection pump name plate. In this position the tangs on the drive coupling will be approximately horizontal and the drive coupling pin hole will be approximately at the 4:30 o'clock position. The gear marks will be approximately 15 degrees 30 minutes to the right. See Figure 2-55.

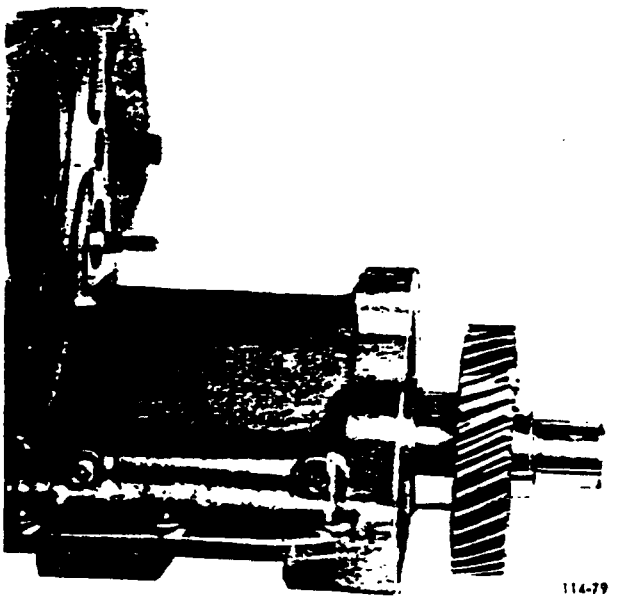


Figure 2-79. Auxiliary Drive Gear

13. Install auxiliary drive gear retaining ring. See Figure 2-80.

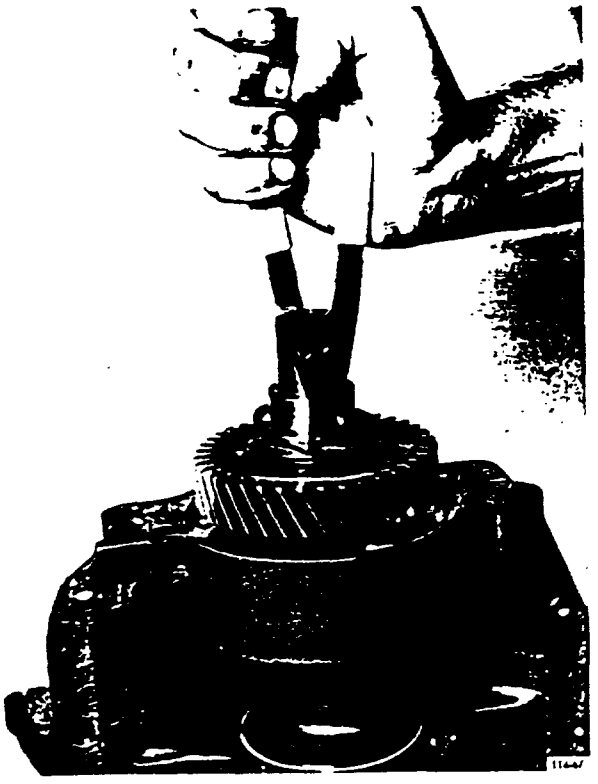


Figure 2-80. Installing Retaining Ring

14. Place the auxiliary housing on end and check end play with a dial indicator.

NOTE

End play is controlled by the drive shaft thrust washers. Check the following if the end play does not fall within the correct specification. Make corrections as required.

1. Worn thrust washers.
2. Worn thrust journals.
3. Shaft bushings not properly installed.

INSTALLATION

1. Thoroughly clean the auxiliary housing mounting surface on the engine block and remove the exposed portion of the timing gear cover gasket.

2. Carefully cut a new timing gear cover gasket to the exact size of the removed portion and install on the timing gear cover using a good grade gasket sealer.

NOTE

Apply an extra bead of gasket sealer where the new gasket meets the old gasket.

3. Install a new O-ring seal in the engine block to auxiliary oil supply port.

4. Apply a bead of Silastic to the mounting surface of the block. Use extreme care not to allow the Silastic to enter/block the oil supply port. See Figure 2-81.

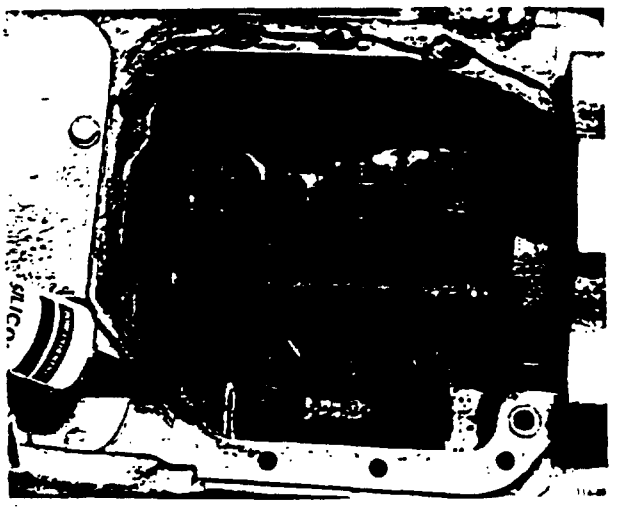


Figure 2-81. Applying Silastic

5. Install the auxiliary housing on the engine block.

CYLINDER HEAD INSTALLATION

NOTE

New cylinder head gaskets and fire rings must be installed each time cylinder heads are removed.

1. Clean the cylinder block deck thoroughly.

2. Install new cylinder head gasket on deck. Position of gasket is determined by guide pins in the upper deck.

NOTE

Do not use a sealing compound or soak cylinder head gaskets. They are all pre-coated.

3. Install new fire ring carefully fitted over circular bead on cylinder sleeve flange. See Figure 2-102.

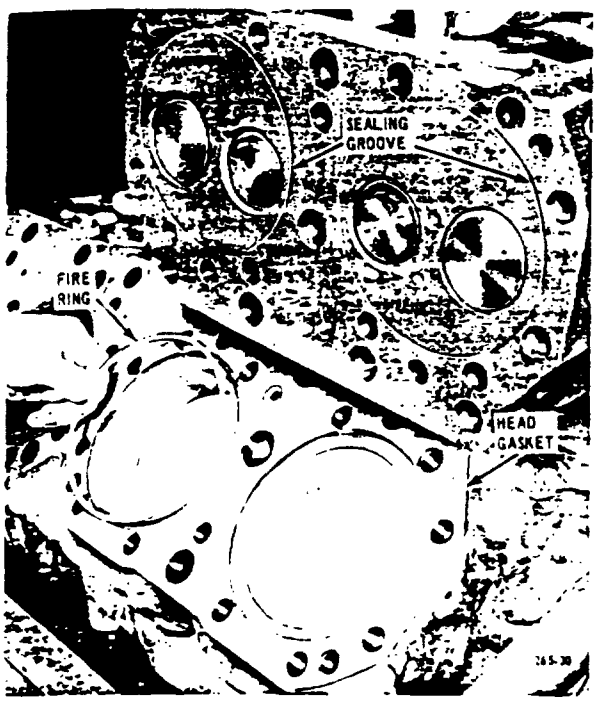


Figure 2-102. Cylinder Head Installation

4. Clean the surface of the cylinder head and ciruclar groove for the fire ring.

5. Carefully position the cylinder head assembly over the cylinder block deck aligning the guide pins in the block with the guide holes in cylinder head.

6. Install cylinder head on block.

7. Install fourteen cylinder head capscrews.

8. Torque capscrews on each head progressively in steps of 50 to 100 to 175, and finally to 225 lb. ft. in sequence as shown. See Figure 2-103.

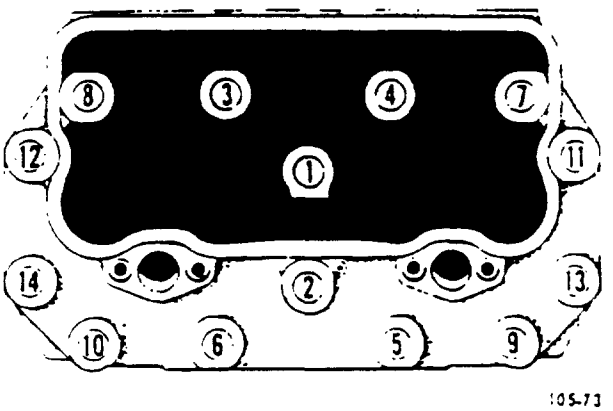


Figure 2-103. Cylinder Head Tightening Sequence

PUSH RODS

Description

The push rods for the intake and exhaust valve rocker arms are tubular steel with spherical ends. Engines not fitted with the Dynatard engine brake feature identical 1 2 inch O.D. x 14-17/64" push rods; however, when the engine is fitted with the Dynatard engine brake system the exhaust valve rocker arm push rod is a solid steel rod 5/8 inch O.D. x 14 inches long.

Inspection

1. Inspect and check the push rods for length and straightness. Replace any that are bent.

2. Inspect and check the spherical surfaces for wear and tightness to tube.

Installation

Apply a light coat of lubricating oil to the spherical ends and install the push rods in the valve lifters.

4. Continue adjusting valve lash for the remaining cylinder pistons in firing order placing each cylinder piston at TDC with respective 1/4 turns of the engine crankshaft.

5. Properly secure aduusting screw locknut after each cylinder piston valve lash adjustment.

INLET MANIFOLD

Inspection

1. Inspect and check the inlet manifolds for restrictions.

2. Inspect and check mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between the inlet manifold and cylinder head.

2. Install right and left hand inlet manifolds and lifting eyes. Secure to cylinder head by installing attaching capscrews and tighten to the recommended torque.

3. Place a new inlet manifold fitting gasket on the top of each inlet manifold and install inlet manifold inlet fitting.

4. Install tee fitting and complete inlet manifold assembly.

WATER OUTLET MANIFOLD

Inspection

1. Inspect water outlet manifold for restrictions.

2. Inspect and check mounting flanges for cracks and straightness.

Installation

1. Place new gasket between right bank and left bank water manifold and the mating cylinder heads.

2. Install and tighten attaching capscrews to the proper torque.

3. Install thermostats in the right and left bank water manifolds.

4. Install thermostat gaskets, water outlet fittings, thermostat seals and water outlet by-pass elbows.

5. Secure assembly to the water manifold by installing the attaching capscrews.

EXHAUST MANIFOLD

Inspection

1. Inspect and check the exhaust manifold for restrictions.

2. Inspect and check the mounting flanges for erosion, cracks and straightness.

Installation

1. Place new gaskets between exhaust manifold and cylinder head.

2. Install and tighten the attaching capscrews and washers to the proper torque.

CYLINDER HEAD COVERS

Inspection

1. Inspect and check the cylinder head covers for cleanliness, dents and straightness of flange.

2. Inspect and check breather in cover, if applicable, to be sure it is not plugged.

Installation

1. Cement a new gasket to the mounting flange of the cylinder head cover.

2. Position the cylinder head cover over rocker arms.

3. Install and torque cover retaining capscrews.

TURBOCHARGER

Description

The turbocharger is an exhaust gas driven air compressor. See Figure2-106The purpose of the turbocharger is to increase the supply of air to the cylinders and thus burn more fuel which in turn produces more power.

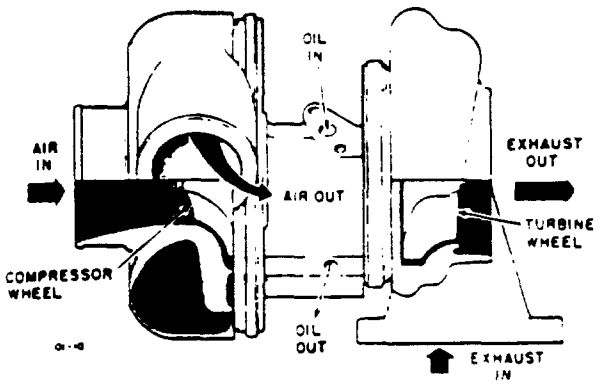


Figure 2-106. Exhaust Driven Turbocharger

The turbocharger consists of three main parts; the turbine housing, the bearing housing and the compressor housing. The turbine housing is located at one end of the bearing housing and the compressor housing is located at the other end. A common shaft connects the turbine wheel and compressor wheel.

The turbine end of the turbocharger uses exhaust gas energy normally discharged to the atmosphere. The exhaust gas enters the turbocharger through the flange connection on the exhaust manifold. The exhaust gas flows around the turbine housing and radially inward causing the turbine wheel to rotate. The exhaust gas is then discharged through the center of the turbine housing into the exhaust pipe.

The bearing housing contains the through-shaft, bearings, seals, and oil passages.

The bearings are of the floating sleeve type and are pressure lubricated from the engine oil supply system. Piston ring type oil seals are used at each end of the shaft to effectively seal off the oil.

The compressor housing contains the compressor wheel and air enters at the center of the compressor wheel and flows radially outward intothe compressor wheel and flows radially outward into the compressor housing. The air leaves through a tangential outlet on the outside of the compressor housing and is ducted to the inlet manifold.

Checks Before Removal

If turbocharger malfunction is suspected, make the following checks before removal of turbocharger from the engine.

1. Start engine and check for unusual noise or vibration from turbocharger. This will idicate out-of-balance, rubbing or damage to compressor or turbine wheels.

2. Check for leaks in the air system from turbocharger to intake manifold and from intake manifold to cylinder block. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

3. Check air cleaner and air intake system, from the air cleaner to turbocharger, for restrictions to air flow or leaks.

4. Check exhaust system from cylinder block to turbocharger for exhaust leaks. Be sure all bolts, clamps and connections are tight and gaskets are not blown and are in proper location.

5. Check exhaust system from turbocharger to outlet for restrictions.

Reassembly

Install oil seal ring in groove in housing and position bearing and shaft assembly in housing. Place housing assembly on a suitable press, using a bucking bar through the plug hole to back up shaft and bearing assembly, and press fan pulley on shaft. See Figure 2-107. Install bearing retainer using suitable pliers. Be sure retainer is properly seated in groove. Pack grease compartment 1/3 full with Alvania No. 3 water insoluble lithium soap petroleum grease or equivalent. Install plug.

Installation

1. Press a new oil seal in support housing.

2. Install a new gasket and position support housing over auxiliary shaft extension and secure with capscrews. Be sure oil seal is properly positioned over shaft before tightening capscrews.

3. Place key in slot of auxiliary shaft extension and align and install driving pulley.

4. Secure with bolt and washer.

5. Position fan pulley housing in support housing and secure loosely with capscrews and washers. Install adjustment nut "D" loosely on stud. See Figure 2-107.

6. Install the two fan belts. Make adjustment with nut "D" until the fan belts are properly tensioned. Refer to Fan Belts for procedure. Tighten lock plate screws.

Extension Driven Type Disassembly

Remove fan belt and fan. Remove housing retaining capscrews and remove housing.

NOTE

One capscrew cannot be completely removed due to interference with pulley hub.

Place housing on a suitable adapter (scrap auxiliary drive extension) in vise and remove fan hub retaining lock nut and washer. Remove fan hub using a suitable puller in threaded holes of inner hub. Remove key from shaft. Remove bearing retainer snap ring using pliers.

Place housing, rear side down, on adapter and press shaft from housing. Invert housing and press front bearing from housing. Remove grease compartment vent. Wash parts in suitable solvent and air blow dry.

Inspect all parts and replace as required.

Reassembly

1. Install front (large) bearing in housing, shielded side of bearing facing outward.

2. Install Tru-arc bearing retainer ring with taper facing out. Bottom retainer ring in groove.

3. Install short key at flange end of fan driveshaft.

4. Install fiber coupling on shaft with face inside of coupling seating against shaft flange. Install coupling spacer washer against coupling.

5. Install rear (small) bearing on shaft against coupling with sealed side toward coupling.

6. Install bearing spacer on shaft.

7. Pack housing 1/3 full with Alvania No. 3 water insoluble lithium soap petroleum grease or equivalent.

8. Place fan drive housing nose down on press base and install shaft with coupling, bearing and spacer in housing and through large bearing. Press shaft assembly into housing using suitable plug. See Figure 2-109.

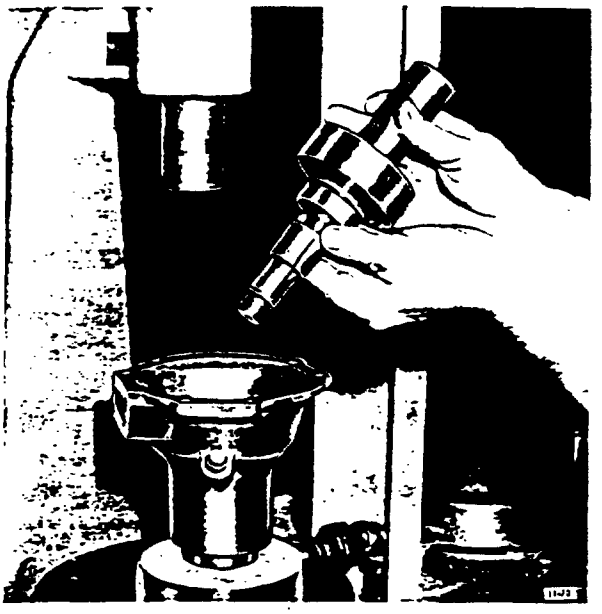


Figure 2-109. Installing Fan Drive Shaft V-8 Series

9. Invert housing on press stand and support coupling end of shaft on press base. Install long housing capscrew and lockwasher before installing fan drive pulley.

10. Install long key in shaft, align, and using a suitable tool to engage inner part of hub, press hub on shaft. See Figure 2-110.

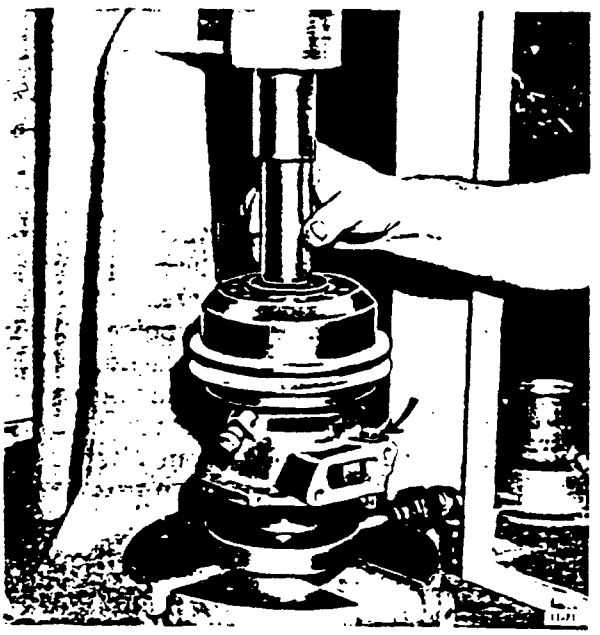


Figure 2-110. Installing Fan Drive Hub

11. Place housing assembly on a suitable adaptor in vise and install hub retaining washer and locknut. See Figure 2-111.

12. Install grease vent. (Install auxiliary drivesnaft extension, if removed).

Figure 2-111. Installing Hub Retaining Washer and Locknut

Installation

1. Place new gasket on housing and install housing, grease vent at top, aligning coupling with auxiliary driveshaft extension.

2. Assemble fan to hub. Be sure bolts are proper length, 3/8-16 x 7/8 inch.

CAUTION

Longer bolts will engage inner member and cancel out vibration absorbing effect of elastic insulator and shorten service life of fan drive assembly.

3. Install fan belt. Refer to Fan Belts for proper tensioning.

Oil Pump Inlet Tube

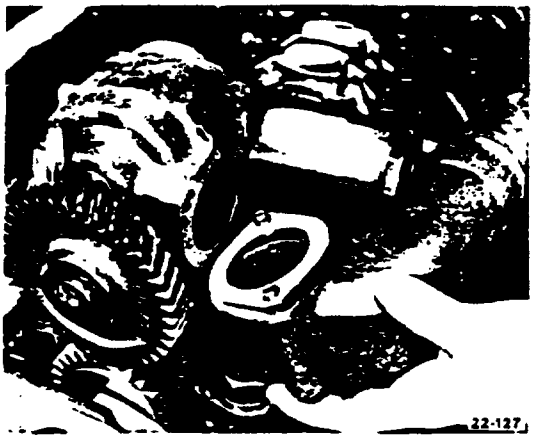


Figure 119. Installing Oil Pump Inlet Tube

Assemble gaskets, capscrews, and washers to oil pump inlet tube fitting flange and mount to oil pump. See Figure 119.

Oil Pump Outlet Tube

Figure 120. Installing Oil Pump Outlet Tube

Assemble oil pump outlet tube fitting at cylinder block and hold in position by installing capscrews and washers. Do not tighten until complete assembly is completed. Assemble "O"-ring to oil pump outlet tube. See Figure 120. Lubricate "O"-ring and insert tube into fitting at cylinder block. Mount to oil pump using capscrews and washers. Torque all screws to specifications.

NOTE

Gaskets are not used between fitting and block and between fitting and oil pump.

Piston Cooling Tubes

Figure 121. Piston Cooling Cross-Over Tube (Front)

Assemble "O"-ring over end of tube and into flange counterbore. See Figure 121. Lubricate "O"-rings. (Coating "O"-ring which fits in counterbore with a little grease will aid in holding it in place.)

Assemble screw and washer in flange end and mount to cylinder block. Tighten screws to specifications.

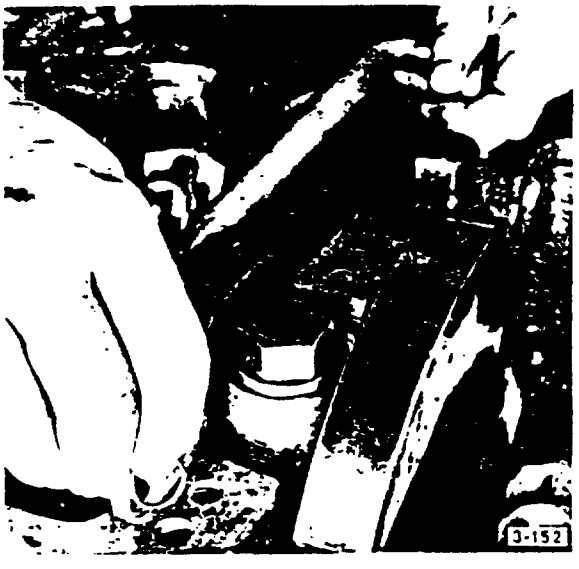


Figure 122. Piston Cooling Cross-Over Tube (Rear)

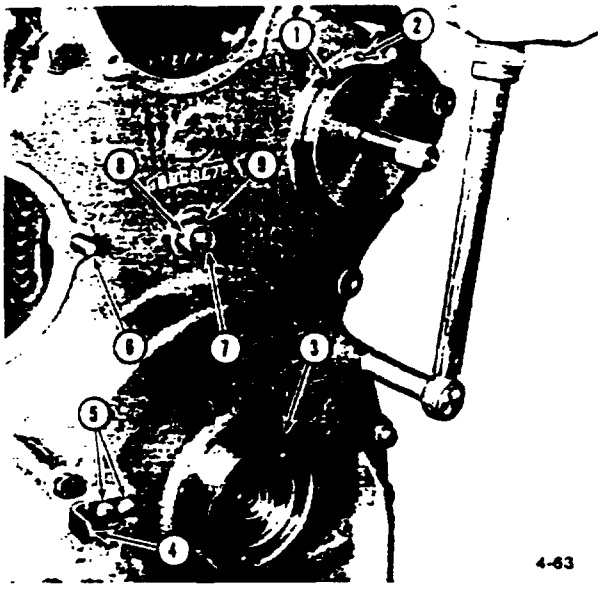
Assemble "O"-rings into flange counterbore at both ends of tube. See Figure 122. Use a light coating of grease in "O"-rings to aid in holding them in place.

Position cross-over tube on cylinder block.

Inspection

Inspect the timing gear cover mounting surface for flatness of flanges and condition of threaded holes.

Timing Gear Cover Installation



1. Timing Gear Cover Alignment Tool (at Water Pump Location
2. Water Pump Locating Pin
3. Timing Gear Cover Alignment Tool (at Crankshaft Location)
4. Timing Indicator
5. Timing Indicator Mounting Pins
6. Alternator Drive Cover Stud
7. Camshaft Thrust Screw
8. Camshaft Thrust Screw Nut
9. Camshaft Thrust Screw Nut Washer

Figure 124. Timing Gear Cover Installation

Install the adjustable camshaft thrust screw from the inside of the timing cover. Position washer and nut on outside of cover and adjust thrust screw to the retracted position. See Items 7, 8 and 9 in Figure 124.

Thread alternator drive cover stud into timing gear cover. Apply Loctite 271 before installing stud. See Item 6 in Figure 124. Then install gasket, cover and tighten capscrews and nut.

Install water pump locating pin in cover. Height of pin above mounting surface should be 0.250 - 0.200 inches. See Item 2 in Figure 124.

Place timing indicator over locating holes in timing gear cover and drive pins into holes to secure indicator. See Items 4 and 5 in Figure 124.

Install six guide studs in the cylinder block. Two guide studs are used at the lowest point, two at the highest point, and one adjacent to the water pump drive location and the final stud on the side opposite the water pump drive location.

Install the timing gear cover gasket over the guide studs.

Install timing gear cover over guide studs and push cover into position.

Install all cover capscrews loosely.

Install timing gear cover alignment tool J-29287, at water pump location. See Item 1 in Figure 124.

Install timing gear cover alignment tool J-29288, over crankshaft stub end. See Item 3 in Figure 124.

Make certain that timing gear cover lower edge is aligned with the oil pan mounting surface on the cylinder block.

After timing gear cover is properly aligned, remove the guide studs. Install the remaining capscrews and torque to 42 lb. ft.

The timing gear cover gasket will extend below the cover and the block by approximately 1/8 inch. This excess gasket material should be trimmed flush with the cover and block.

Check capscrew holes for elongation.

Check drain hole for condition of threads.

If oil pan is satisfactory, position new gasket on oil pan and assemble to cylinder block.

Install and tighten oil pan retaining capscrews evenly and to specifications. This will prevent distortion of mounting flange and possible leakage problems.

NOTE

If the auxiliary housing is being installed on a block that does not have a new timing gear cover gasket, proceed as follows:

1. Before installing auxiliary housing on the engine block, remove the exposed portion of the timing gear cover gasket.

2. Carefully cut a new timing gear cover gasket to the exact size as the removed portion and install on the timing gear cover using a good grade gasket sealer.

3. Apply an extra bead of gasket sealer where the new gasket meets the old gasket.

Install the auxiliary housing on the cylinder block. Assemble the auxiliary housing to cylinder block capscrews and lockwashers. Make certain that the front face of the auxiliary drive housing is in line with the front face of the cylinder block within 0.005 inches. Snug capscrews, but do not tighten.

Assemble capscrews through timing gear cover and into auxiliary drive housing. Tighten capscrews to specifications. Then tighten auxiliary drive housing mounting capscrews.

NOTE

Disregard timing marks that appear on the auxiliary drive shaft gear. Timing of the auxiliary drive shaft gear to the camshaft is not required for assembly of this short drive auxiliary housing.

Check the backlash between the auxiliary drive shaft gear to camshaft gear. Should be 0.0037 to 0.0088 inches.

Engine Breather

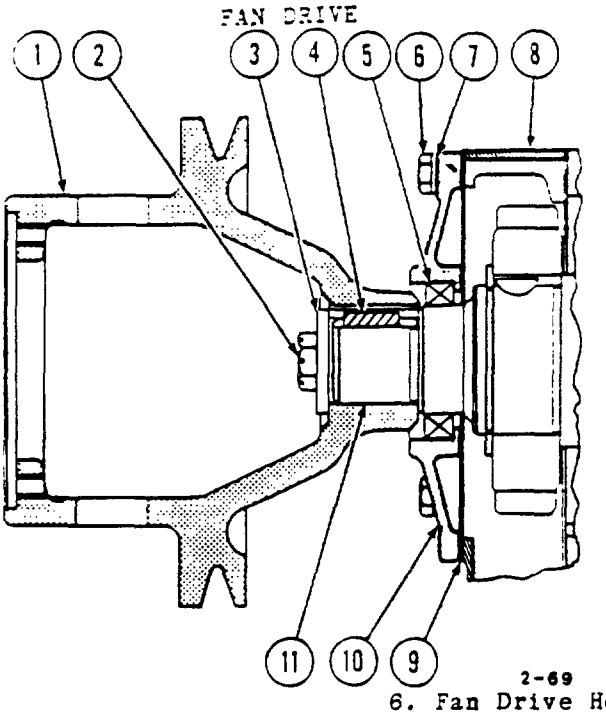
Assemble four breather tube studs to valve lifter cover using Loctite 271. See Figure 185, Items 3 and 12.

Assemble breather cover and filter in valve lifter cover. See Figure 185, Items 10 and 11.

Assemble new gasket over studs, and fasten breather tube with plain washers and nuts. See Figure 185. Items 1, 2, 4, and 5.

Oil Filler Tube (or Cover Plate)

Thread oil filler tube flange stud (or cover plate stud) to valve lifter cover, using Loctite 271. Apply FIPG compound to mounting surface on cover. Assemble flange (or cover) to valve lifter cover and tighten the mounting stud nut and capscrew.



1. Fan Pulley
2. Fan Pulley Screw
3. Fan Pulley Screw Washer
4. Fan Pulley Key
5. Auxiliary Drive Shaft Seal (at Fan Drive Housing)
6. Fan Drive Housing Screw
7. Fan Drive Housing Screw Washer
8. Timing Gear Cover
9. Fan Drive Housing Gasket
10. Fan Drive Housing
11. Auxiliary Drive Shaft

Figure 186. Fan Drive Arrangement

The fan drive is mounted on the front end of the auxiliary drive shaft. See Figure 186.

Inspection

Inspect fan drive housing to make certain that mounting flange is flat and free of defects.

Installation

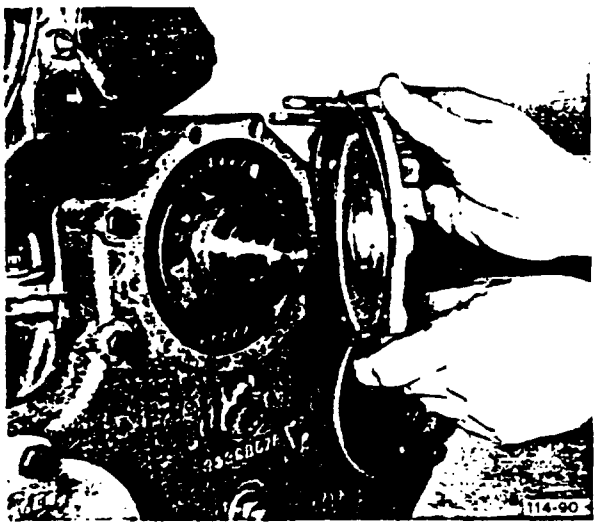


Figure 187. Installing Fan Drive Housing

Using new gasket assemble fan drive housing to timing gear cover with capscrews and washers. See Figure 187.

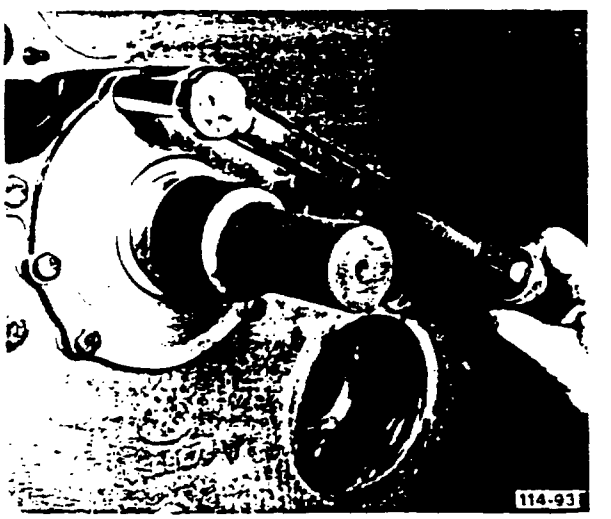


Figure 188. Aligning Fan Drive Housing

Before tightening fan drive housing screws, install alignment tool J29304 in seal counterbore. See Figure 188.

Cylinder Head Gasket Installation

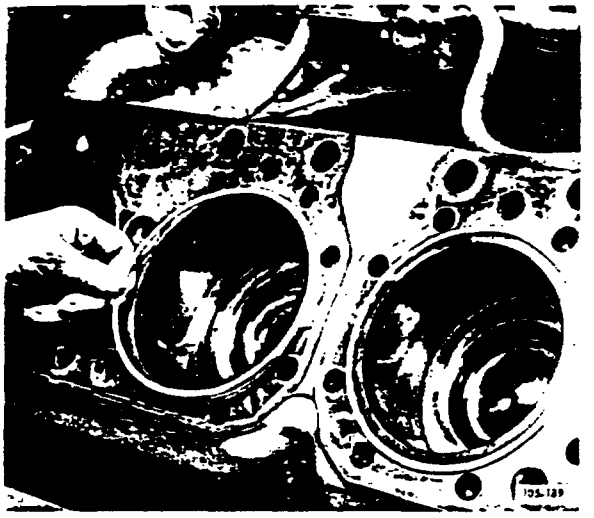


Figure 256. Assembling Fire Ring

Assemble fire ring over shoulder on cylinder sleeve. See Figure 256.

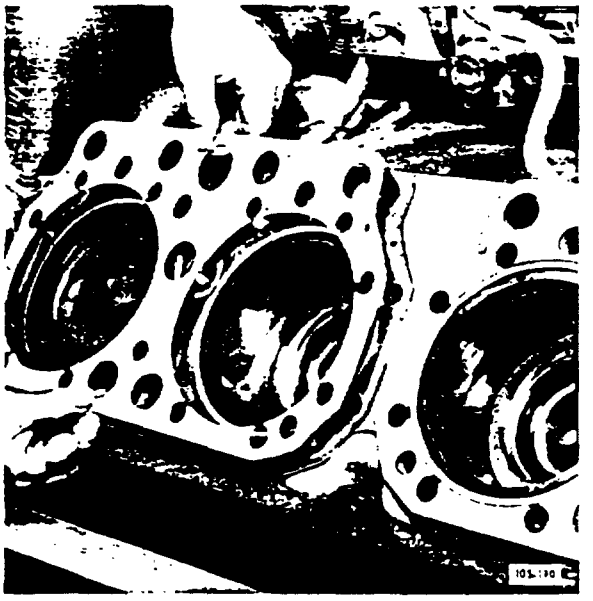


Figure 257. Assembling Cylinder Head Gasket

Assemble gasket on cylinder block. Locating gasket over guide pins and making certain that fire ring is within gasket opening. Surface of gasket marked "TOP" should be on the top side. See Figure 257.

All gaskets are pre-coated and do not require any type of sealing compound.

Cylinder Head Installation

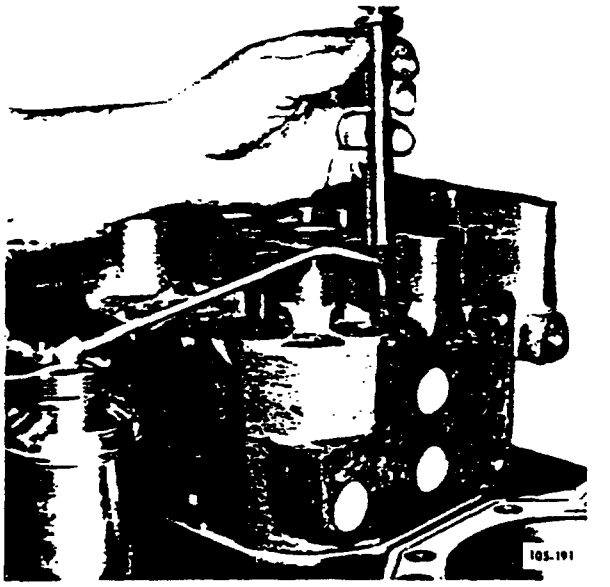


Figure 258. Lubricating Cylinder Head Capscrew Threads

Position cylinder heads over cylinder block, locating guide holes in head over pins in block. Lubricate capscrew threads. See Figure 258.

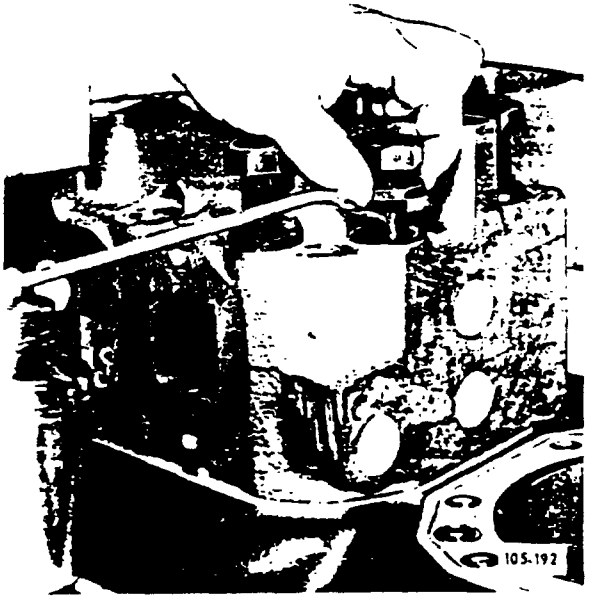
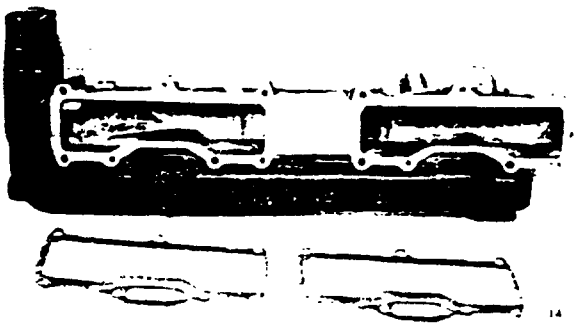


Figure 259. Lubricating Underside of Capscrew Head and Washer

Lubricate underside of capscrew and washer. See Figure 259.

Assemble all capscrews in cylinder head.

Snug capscrews lightly.



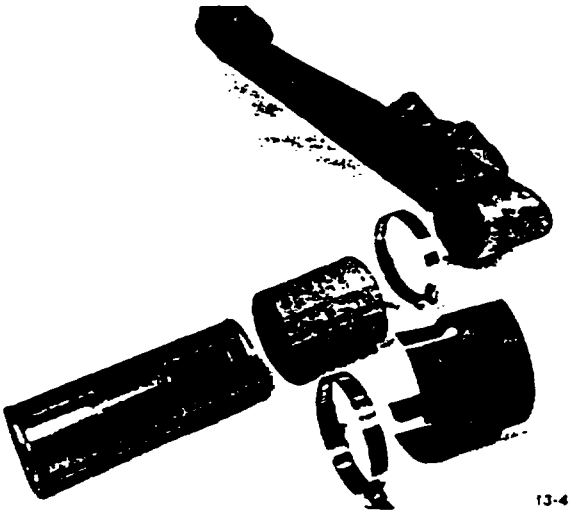
1. Inlet Manifold
2. Water Outlet Manifold

Figure 269. Inlet and Water Manifolds

An integral gasket is used for the water and air manifold. See Figure 269.

Assemble screws and washers to the inlet, and the water outlet manifold. Position gasket over screws and assemble manifolds to cylinder head. Tighten all screws.

Water Manifold Crossover Tube



1. Crossover Tube Shield
2. Crossover Tube Hose Clamp
3. Crossover Hose
4. Crossover Tube
5. Water Manifold

Figure 270. Water Manifold Crossover Tube

Slide hoses and clamps over crossover tube. See Figure 270.

Place crossover tube between water manifold and slide hose over water manifold. Tighten hose clamp at water manifold.

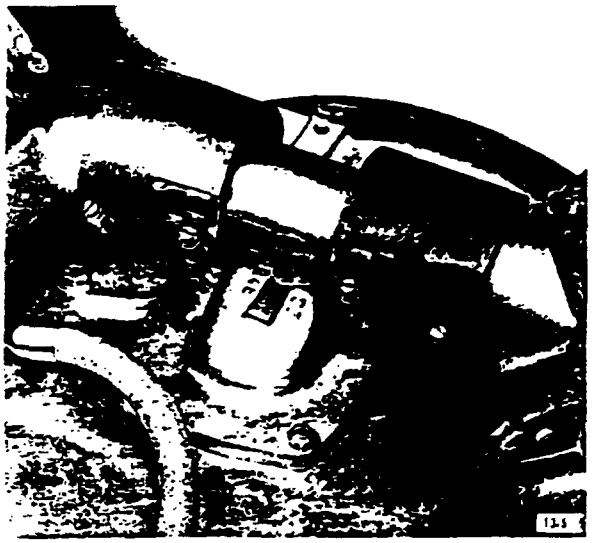


Figure 271. Assembly of Crossover Tube Shield

Assemble shields over hoses with slots in shields pointing towards middle of engine. See Figure 271. Assemble inner hose clamps over shields, clamping the hoses and the shield to crossover tube.

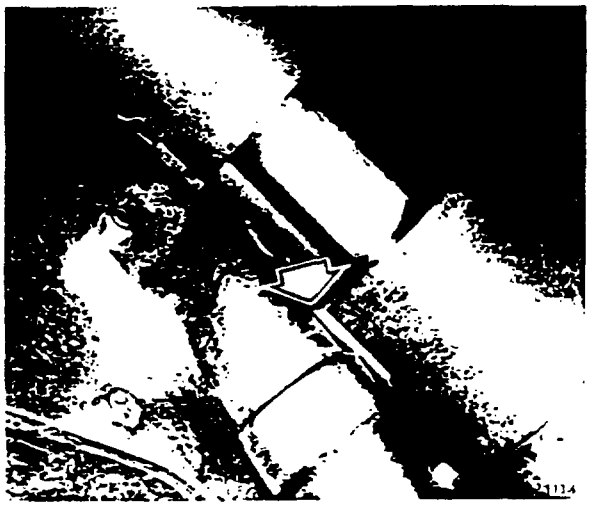


Figure 272. Positioning Crossover Tube Shield

Shields are used over the crossover tube hoses to protect them from the heat given off by the turbocharger. Position shields to provide maximum hose coverage. Cut out in shield should be as close to engine as possible, and still not interfering with adjacent parts. See Figure 272.

When the check valve is properly installed, the open end will be at the mounting surface, and the ball check will be towards the center of the adapter. See Figure 279.

CAUTION

If check valve is improperly assembled, no coolant will flow through the conditioner.

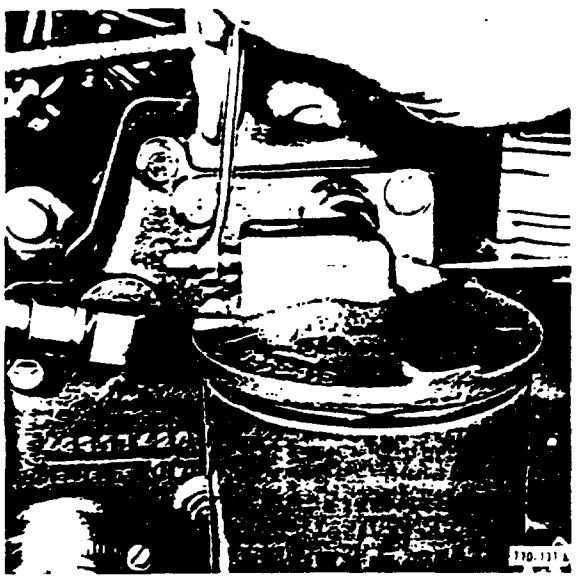


Figure 280. Installing Inlet Check Valve Fitting

Install the inlet check valve in the adapter. See Figure 280. This valve can only be assembled one way since one side has a 1/8 NDT thread which is assembled to the adapter. The other end has a 1/2 - 24 straight thread.

Install feed line from water pump to inlet check valve fitting.

Conditioner Installation and Removal

Apply film of oil to sealing gasket. Install conditioner and turn one full turn after gasket contacts base. (check for leaks when engine is started) To remove, use tool J24783 or equivalent.

EXHAUST MANIFOLD

Figure 281. Assembling Rear Exhaust Manifold

Position new gaskets in place, and assemble exhaust manifolds to engine using capscrews, washers and locks.

NOTE

When assembling the rear exhaust manifolds, the long boss should be on the upper side. See Figure 281.

Assemble exhaust manifold to turbocharger tee fitting on flywheel housing. Assemble exhaust fittings and sleeves at rear of engine. Use new gasket between fitting and rear exhaust manifold.

After manifold, fittings, and sleeves are aligned at the rear of the engine, tighten the capscrews at the turbocharger fitting on the flywheel housing.

Assemble drain tube to turbocharger, using new gasket. Assemble screws and lock washers. Tighten screws to specifications.

CAUTION

The flange on the drain tube is mounted at an angle to provide clearance between the bellows and the turbocharger mounting flange. See Figure 333. Failure to mount the tube properly will result in an interference between the bellows and flange, causing bellows to wear and possibly result in oil leakage.

Assemble from turbocharger mounting studs to tee fitting. See Figure 331, Item 4.

Position new gasket over mounting studs. See Figure 331, Item 5.

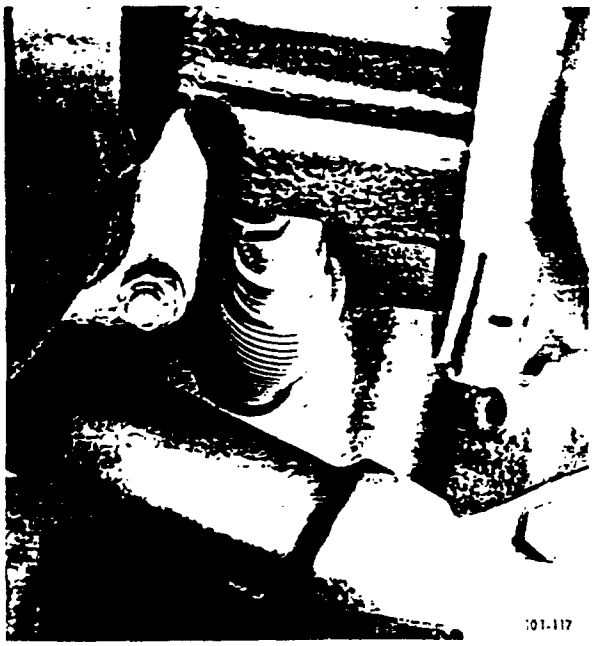


Figure 334. Assembling Turbo Oil Drain Hose Into Cylinder Block

Assemble O-Ring seal to turbo drain tube. See Figure 332, Item 4. At the same time position turbocharger mounting flange over studs in tee fittings. See Figure 331. Assemble washers and nuts to studs, and tighten to specifications.

Assemble flexible hose to oil feed fitting at cylinder head. Assemble turbocharger oil inlet tube to turbocharger using new gasket. Install washers and screws and tighten to specifications. Assemble 90 degree elbow fitting to inlet tube. See Figure 331, Item 9. Assemble flexible hose to fitting. See Figure , Item 1. Tighten all connections.

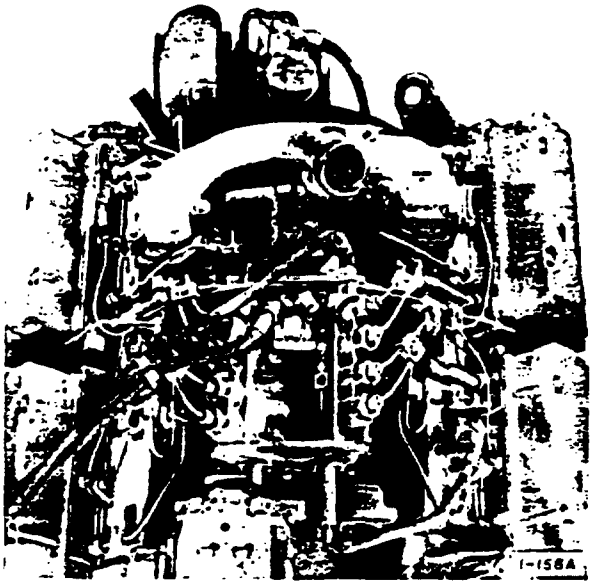
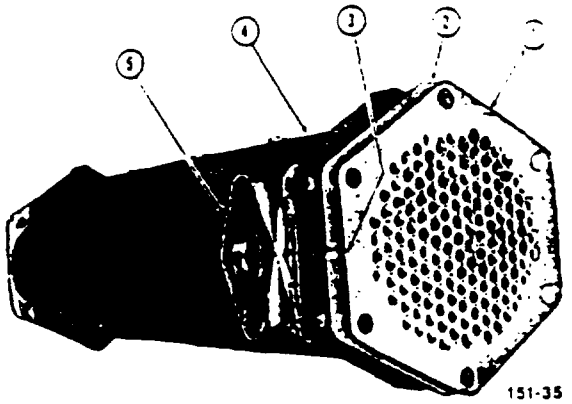


Figure 335. Inlet Manifold Crossover Fitting.

After turbocharger is assembled, position crossover fitting between inlet manifolds. See Figure 335. Assemble fitting with new gaskets. Install capscrews and washers and tighten to specifications.

Install new O-ring seal at rear side of housing. See Figure 337. Lubricate surface of O-ring with clean lubricating oil.



1. Oil Inlet Port
2. Notch in Bundle Flange

Figure 338. Installation of Bundle into Housing

Assemble new gasket to flanged end of bundle and insert bundle into oil cooler housing. The notch in the bundle flange must be assembled in line with the oil inlet in oil cooler. See Figure 338.

NOTE

Use correct gasket between bundle flange and housing. This is an elastomer coated gasket, and is black in color. Failure to use correct gasket could result in oil leakage in this area.

After gasket and bundle are in position, push bundle into housing, past O-ring.

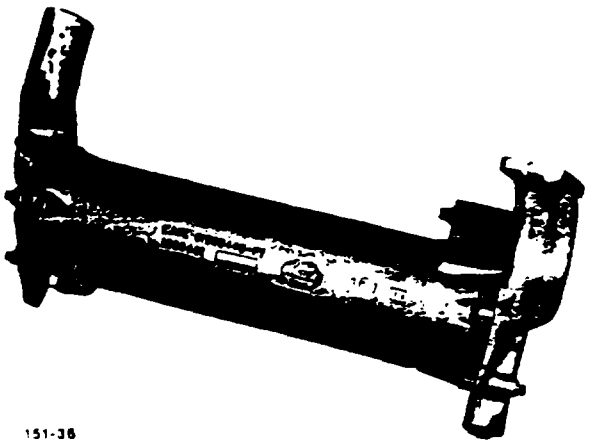
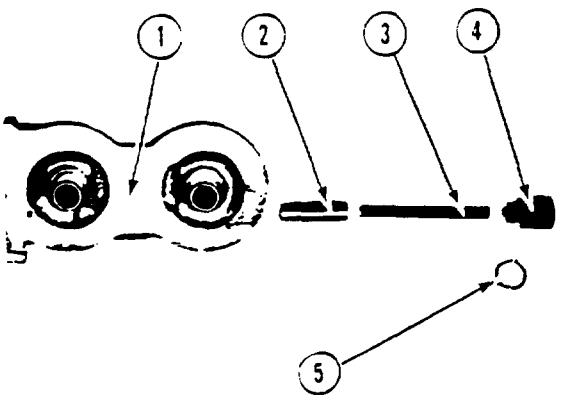


Figure 339. Oil Cooler Assembly with Water Inlet Fitting and Rear Bracket

Assemble gaskets and water inlet fitting and rear bracket to oil cooler assembly. Assemble screws and tighten to specifications. See Figure 339.

Oil Filter Pressure Relief Valve



1. Oil Filter Adapter (Rear)
2. Oil Filter Adapter Pressure Relief Plunger
3. Oil Filter Adapter Pressure Relief Plunger Spring
4. Oil Filter Adapter Pressure Relief Cap
5. Oil Filter Adapter Pressure Relief Cap Washer

Figure 340. Oil Pressure Relief Valve Arrangement

Check plunger and spring to make certain they are in satisfactory condition. Install plunger, spring, washer, and cap, in adapter. See Figure 340. Torque cap to 100 lb. ft.

NOTE

The oil filter pressure relief valve opens when the pressure restriction across the element exceeds 42 to 50 psi. Oil then by-passes the filters and goes directly into the main oil gallery.

CLUTCH REMOVAL

1. Mark clutch cover and flywheel with a center-punch before removing clutch to facilitate reinstalling clutch in same position.

2. Use three spring retention tools (J26450 for CL-28, 40 and 50 series, J26451 for CL-47 series) or retaining cups as shown in Figure 4-1, when removing a clutch assembly from the flywheel.

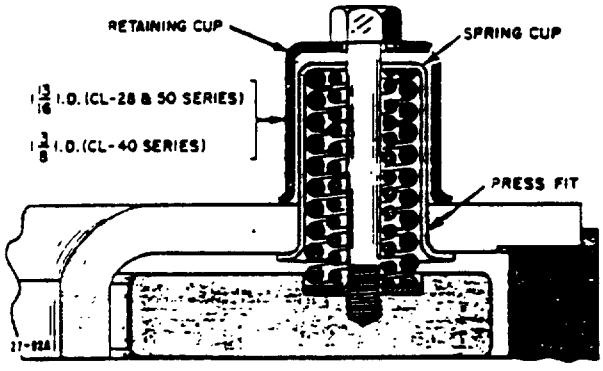


Figure 4-1. Retaining Cups

To use spring retention tools, bottom screws in tapped holes in pressure plate. Set tool nuts up snugly against tool bracket. Tighten tool nuts evenly to relieve spring tension on pressure plate. Not used on CL-58 Series.

3. Remove two clutch-to-flywheel capscrews with lockwashers at the ten o'clock and two o'clock positions of the flywheel and install two long headless guide studs to support the clutch assembly during removal of the remaining attaching capscrews.

4. After removal of all capscrew fasteners, carefully remove heavy clutch and disc assembly from flywheel counterbore and place on bench. Be careful not to drop driven disc assembly which is now free. Also remove the temporary guide studs from flywheel.

CLUTCH INSTALLATION

1. Using spring retention tools, bottom screws in tapped holes in pressure plate. Set tool nuts up snugly against tool bracket. Not used on CL-58 Series.

NOTE

Three retaining cups and screws are used to hold a new clutch assembly together until it is installed on the flywheel. Spring cups are pressed into the clutch cover hence the retaining cups are necessary to prevent spring cups loosening and slipping out of the cover during handling. Retaining cups and screws must be removed after the clutch is assembled to the flywheel. A tag is attached to new clutches (CL-28, 40 and 50 Series) calling attention to this fact and cups and screws are painted red for ready identification.

2. Engage splined end of clutch disc aligning mandrel or a spare main driving pinion with hub splines of driven disc from rear of long hub side. Then position driven disc assembly in flywheel so that spigot end of shaft engages inner race of clutch pilot bearing mounted in flywheel. This arrangement positions the disc assembly in proper alignment until clutch is completely assembled and secured in flywheel.

3. Install two long guide studs in the ten and two o'clock positions in flywheel rim. Mount clutch assembly on guide studs and push unit into flywheel bore until clutch cover flange enters counterbored pilot provided. Be careful not to disturb disc aligning mandrel.

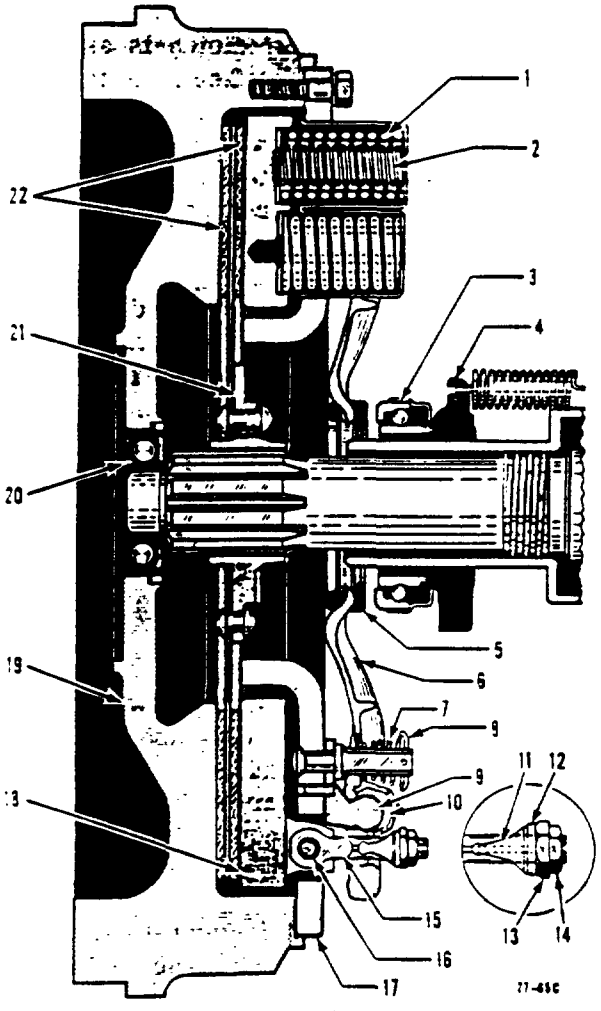
4. Lubricate and install cover-to-flywheel capscrews with their lockwashers. Tighten capscrews a few turns at a time so that cover will not be misaligned and forced into flywheel pilot by the tightening of the capscrews. Remove the two guide studs and replace with capscrews and their lock washers. Remove aligning mandrel.

CL-28 and 40 SERIES

Description

CL-28, -40 Series assemblies are single plate, dry disc pusher type clutches. They consist of a pressure plate, a cover, and a driven disc which is splined to the transmission main driving pinion shaft. When

engaged. the driven disc is clamped between the pressure plate and the flywheel by the pressure of coil springs which are mounted in cups on the cover. Drive is transmitted to the pressure plate by pressure plate lugs which fit in the cover openings. Six release levers have ball pivots and are linked to the pressure plate by eyebolts. The inner ends of the levers are held by the notched release thrust washer. See Figure 4-2.



1. Clutch Spring (outer)
2. Clutch Spring (inner, where used)
3. Release Bearing
4. Release Collar
5. Thrust Washer
6. Release Lever
7. Lever Spring
8. Spring Washer
9. Lever Pivot
10. Lever Bushing
11. Eyebolt Fulcrum
12. Washer
13. Fulcrum Adjustment Nut
14. Lock Nut
15. Eyebolt
16. Eyebolt Pin
17. Cover Plate
18. Pressure Plate
19. Flywheel
20. Pilot Bearing
21. Driven Disc Assembly
22. Driven Disc Facings

Figure 4-2. Sectional View of CL-28, 40 Series Clutch

Disassembly

1. Before disassembly of the various parts, mark these parts with a center-punch, so that at reassembly, they can be reassembled in their original positions. This is necessary in order not to disturb the dynamic balance of the clutch.

2. Before removing the three spring retention tools, compress clutch release lever springs, remove washer pins, then remove washers and release lever springs. Pry off snap ring from thrust washer. Remove eyebolt nuts, fulcrums, and clutch release levers.

CAUTION

If retaining cups are used instead of tool (J26450), clamp the cover in a press before removing the cups. This is necessary because the screw used does not have sufficient thread length to completely release the spring load before coming out of the pressure plate.

3. While holding spring retention tool screws, back off tool nuts alternately making one turn at a time. When spring is entirely relieved. back out the three tool screws.

4. Remove clutch cover and springs. If heat-insulating washers are removed from pressure plate spring pockets, retain them for reassembly. The eyebolts need not be removed unless inspection reveals distortion or loose fit on pins.

Inspection and Repair

1. Remove all traces of dirt and oil with a suitable safety solvent. Inspect parts carefully for cracks, distortion or excessive wear as described in the following steps.

2. If cover is cracked or distorted, replace. Tack-weld loose spring cups (on covers having this construction) replace worn or loose ball-fulcrums. Replace loose or bent pin rivets.

2. Equally space three steel blocks 3/8 inch thick, on bed of arbor or drill press.

3. Place clutch with pressure plate side down, on blocks. (This is done in order to raise clutch to permit disassembly).

4. Place a block of wood, such as a two by four, across cover plate in a position that does not interfere with tips of release levers, as shown in Figure 4-10. Compress clutch assembly slightly, removing lever adjusting screw locknuts.

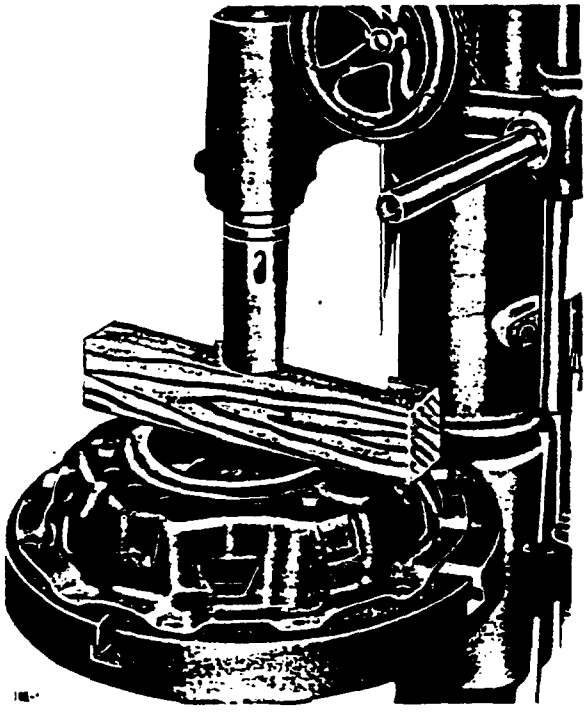


Figure 4-10. Compressing Clutch

5. Turn each lever adjusting screw down (clockwise), a few turns with a screwdriver, releasing spring tension a small amount. Repeat operation until all lever adjusting screws are entirely free of cover plate. Release remaining spring tension, and lift cover plate off pressure springs.

6. Pressure springs may now be removed. After extracting cotter pins and lever pins, remove release levers.

Inspection and Repair

1. Clean all parts thoroughly with a suitable safety solvent. Inspect carefully for excessive wear, distortion, or cracks as described in the following steps.

2. Check cover plate for distortion, excessive wear at indentations which register between drive bosses on pressure plate, and for stripped threads in holes accommodating release lever adjusting screws. If the above mentioned conditions are apparent, replacement of cover plate is required.

3. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

4. Replace release levers that are badly worn on tips (this is an indication of a sticking release bearing), worn threads on lever adjusting screws and nuts, or where binding appears to be present, which retards free back and forth movement.

NOTE

Release levers are serviced as a subassembly only, and consist of lever, adjusting screw, roller, roller block, lever spring and spring retaining pin.

5. If pressure plate shows signs of scoring, excessive wear at lever pin holes, inside of drive bosses, heat checking, or if warped more than 0.020 inch, plate must be refaced or replaced. (When refacing pressure plate, remove only sufficient metal to obtain a smooth flat surface.) When pressure plate thickness becomes less than 1.141 inch, replacement is necessary.

6. If flywheel is warped or heat checked and surface is refinished, maintain the 1.188 inch dimension between disc surface and bolting face for proper release lever adjustment. No more than 0.070 inch maximum may be removed by grinding.

7. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly.

If facings are worn down nearly even with countersunk, facing-retaining rivet heads and provided assembly is in otherwise good condition, it may be rebuilt.

3. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with clutch pilot bearing grease and install bearing in flywheel. Tap into place with shielded side toward clutch.

Use only the recommended pilot bearings specified. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

After bearing is properly installed, pack the entire cavity in back of the bearing with the same specified clutch pilot grease.

CAUTION

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 4-11.

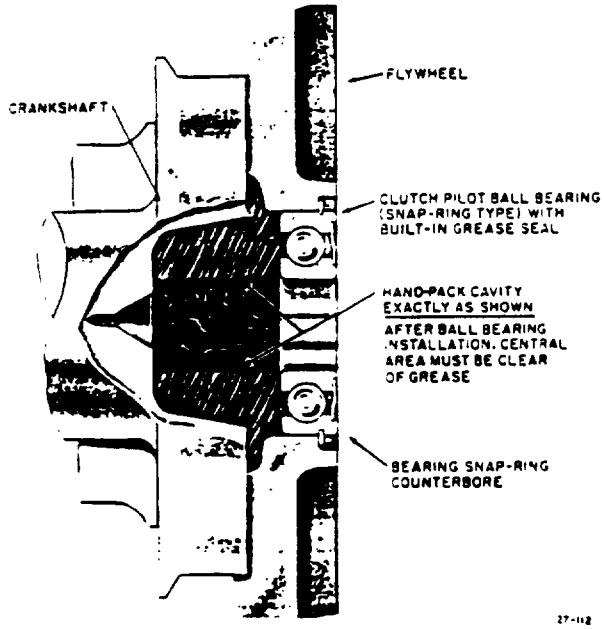


Figure 4-11. Cut-away View of Clutch Pilot Bearing Grease Reservoir Correctly Packed

Reassembly

1. Mount release lever assemblies on pressure plate. Set pressure plate assembly on three equally spaced steel blocks 3/8 inch thick, on bed of arbor or drill press, plate side down.

2. Place pressure springs in position on pressure plate, as shown in Figure 4-12.

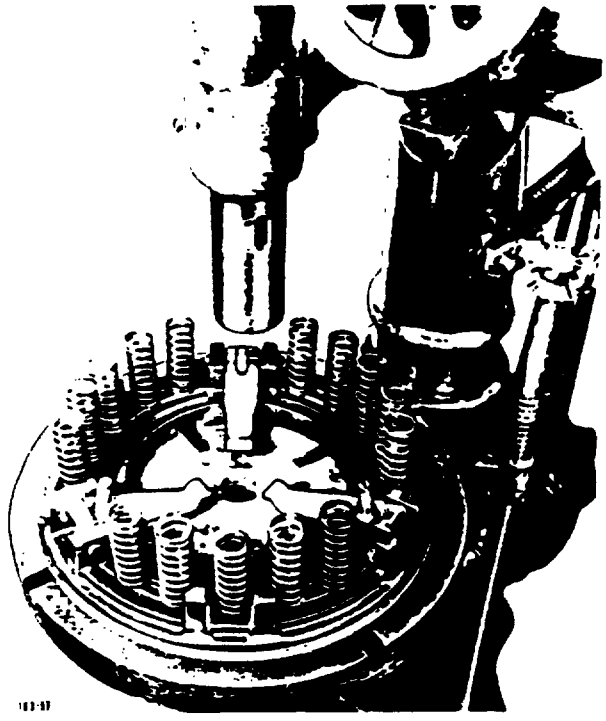


Figure 4-12. Assembling Clutch

3. Lay cover plate over springs, being sure that all springs are seated on bosses of pressure plate, and around indentations on inside of cover.

4. If pressure plate was refaced, it will be necessary at assembly, to add shims under each pressure spring equal to total metal removed.

5. Compress assembly slowly, aligning lever adjusting screws with threaded holes in cover plate. (The indentations inside cover, should enter the spaces between drive bosses on pressure plate freely.) With screwdriver, thread ends of adjusting screws into cover evenly, until screws protrude about 1/2 inch. Hold assembly compressed, while placing locknuts in position, but do not tighten.

6. To facilitate installation on flywheel, place wood blocks approximately 3/8 inch thick, between the tops of release levers and inner rim of cover plate. (Be sure these stay in position as all tension is released).

7. Insert the three spring retention tools (J26451), through cover and bottom in tapped holes in pressure plate (center hole of each five series in cover). With pres-

3. While holding spring retention tool screws, back off tool nuts alternately, making one turn at a time. When spring is entirely relieved, back out the three tool screws.

4. Remove clutch cover and springs. If heat-insulating washers are removed from pressure plate spring pockets, retain them for reassembly. The eyebolts need not be removed, unless inspection reveals distortion or loose fit on pins.

Inspection and Repair

1. Remove all traces of dirt and oil with a suitable safety solvent. Inspect parts carefully for cracks, distortion or excessive wear as described in the following steps.

2. If cover is cracked or distorted, replace. Tack-weld loose spring cups (on covers having this construction) replace worn or loose ball-fulcrums. Replace loose or bent release lever spring pins.

3. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

4. Replace thrust washer if worn, bent or defective.

5. Replace worn release levers, springs and ball seats. Check levers with a straightedge and 11/16 inch ball (J26453) as illustrated, in Figure 4-14 and if bent so that dimension (1) is more 11/32 inch when measured at a point where distance (2) is 2-1/2 inch, replace the lever.

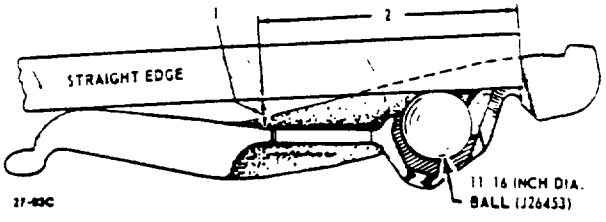


Figure 4-14. Checking Release Lever for Bend

6. If pressure and intermediate plates are scored, heat checked, or warped more than 0.020 inch, they must be replaced or refaced. Remove only enough metal to obtain a smooth flat surface. Finish with a light cut and polish with emery cloth. When thickness (1) becomes less than the worn limit given in specifications, the plate must be replaced. Measure at outer spring pocket as shown in Figure 4-15. Measuring at inner pocket is not accurate if pressure plate is dished. If cleft lugs are worn, cracked or distorted, replace the plate. The intermediate plate features a double set of drive slots for increased service life. At clutch installations after rebuild, it is recommended that the set with less wear be used. Replace eyebolts if they are distorted, have worn threads or keyways.

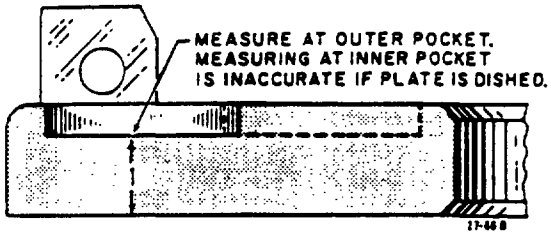


Figure 4-15. Pressure Plate Thickness Dimension

7. If flywheel is warped or heat checked and surface is refinished, maintain the 2.797 inch dimension between disc surface and bolting face for proper release lever adjustment. See Figure 4-16. No more than 0.070 inch maximum may be removed by grinding.

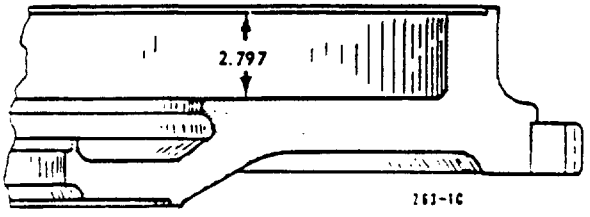


Figure 4-16. Flywheel Rubbing Surface-to-Clutch Cover Bolting Surface Dimension

Intermediate plate drive pins should be inspected for abnormal wear.

When pins have been removed to permit flywheel machining, or require replacement, squareness between flywheel friction and pin drive faces must be maintained at installation. A positioning tool will assist in establishing necessary alignment.

Suitable for this purpose, will be a slotted steel block 4 inches long, 2-1/2 inches wide and 1-1/2 inches thick. One 2-1/2 inches x 4 inches face should be ground for maximum flatness, as it will constitute the major working surface. A 3/16 inch x 45 degree chamfer along all edges of this face will tend to prevent burrs that would affect accuracy. See Figure 4-17.

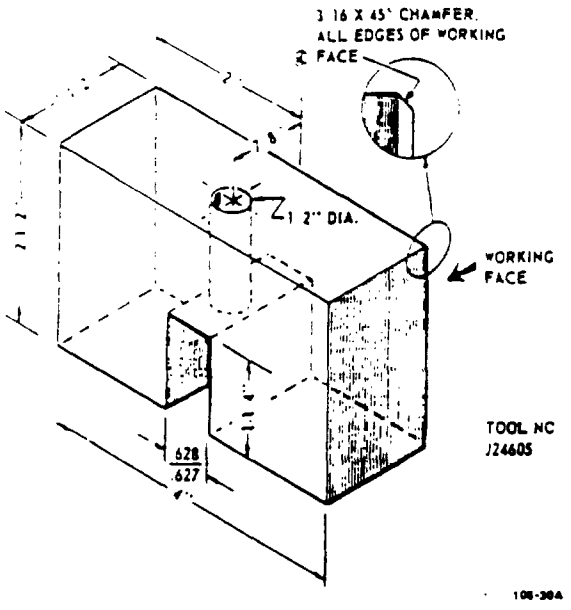


Figure 4-17. Drive Pin Positioning Tool

Midway between ends of the 4 inch length, a 0.627 to 0.628 inch wide slot 1-$\frac{1}{4}$ inch deep should be machined through the 1-1/2 inch thickness. The slot must be exactly square with the ground face for it will determine flywheel to drive pin head alignment. A half -inch drift pin clearance hole, drilled from the side opposite, and intersecting with, the slot will complete the tool. Hole centerline should be 7/8 inch from the ground face, so that driving force will be centered over the head. Magnetizing the block will minimize movement during driving and lessen possibility of marring flywheel face.

In use, the threaded portion of the pin is inserted in the flywheel hole. The positioning tool slot is placed over the drive head. with the ground surface held flat against the flywheel friction face. The pin is then driven until fully seated.

8. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly. If facings are worn down nearly even with countersunk facing-retaining rivet heads and assembly is in otherwise good condition, it may be rebuilt.

9. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with clutch pilot bearing grease and install bearing in flywheel. Tap into place with shielded side toward clutch and snap ring seated in counterbore.

All current Mack-made engine flywheels have been manufactured by boring the clutch pilot bearing hole straight-through and counterboring a recess to provide proper positioning for the snap ring type pilot bearings now in use. Old bearings without a snap ring cannot be used in new through-bored flywheels.

CAUTION

Do not install a new snap ring bearing in an old flywheel without removing the snap ring and discarding. In old flywheels without the counterbore, the snap ring would position the bearing too far rearward. which would result in early bearing failure and considerable damage to costly components. Use only the recommended snap ring type bearings specified. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

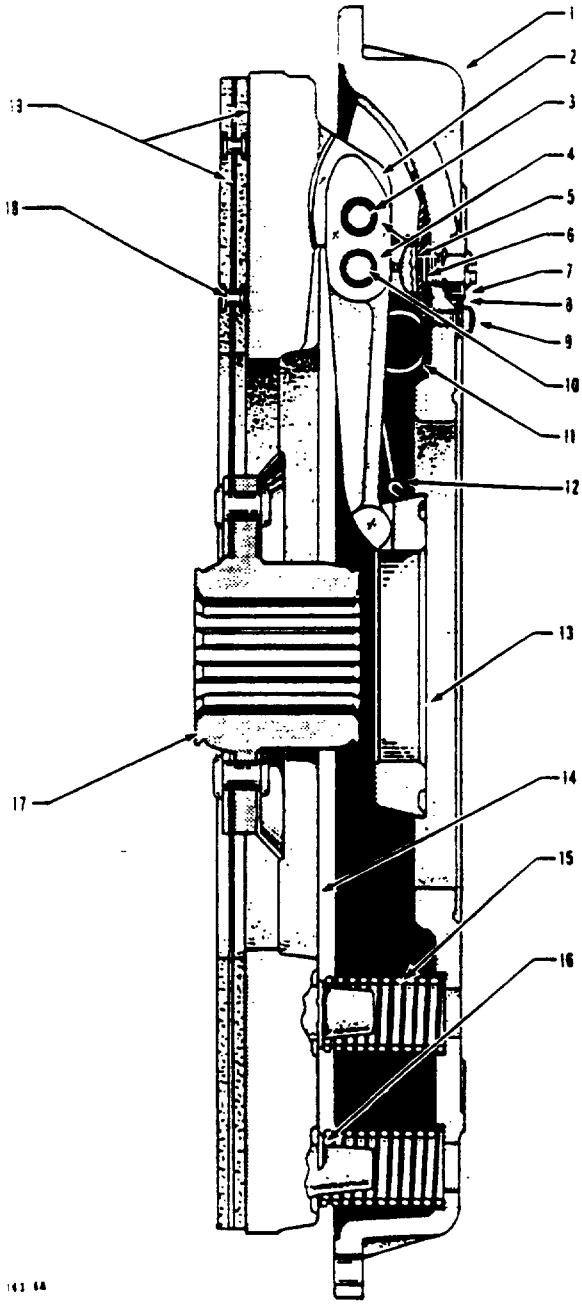
After bearing is properly installed, pack the entire cavity in back of the bearing with the same specified clutch pilot grease.

CAUTION

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 4-18.

Before assembling the clutch, a positive wear check should be made to insure that it will provide maximum disc wear. This check will uncover any interference that might prevent full release lever travel and allow corrections to be made before the clutch is assembled.

Place the pressure plate assembly and cover (without springs) into position as shown in Figure 4-19, making sure that shims of the correct thickness (0.250) are inserted



1. Clutch Cover
2. Release Cover
3. Release Lever Pin
4. Needle Bearings
5. Release Lever Yoke
6. Yoke Leaf Spring
7. Lever Adjusting Nut
8. Adjusting Nut Lock Plate
9. Lock Plate Lock Screw
10. Yoke Clevis Pin
11. Double Torsion Anti-Rattle Spring
12. Thrust Washer Clamp
13. Lever Thrust Washer Ring
14. Pressure Plate
15. Helical, Main Spring
16. Heat Insulator Ring
17. Driven Disc Assembly
18. Facing Rivet
19. Driven Disc Facings

Figure 4-21. Sectional View of CL-58 Series Clutch

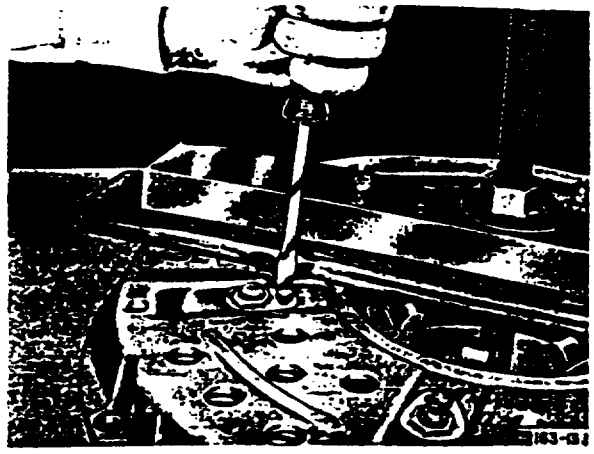


Figure 4-22. Removing Lever Adjusting Nut Lock Plates

main spring insulator washers from pressure plate bosses.

NOTE

Do not remove the six lever anti-rattle springs from the cover unless replacement is necessary.

4. Lay pressure plate on bench and with a soft metal drift, drive hardened lever pins out of pressure plate drive lugs to free release levers. With a pair of pliers, remove cotter pin from each lever yoke clevis pin and then press out each yoke clevis pin by hand.

CAUTION

When removing levers from pressure plate drive lugs and lever yoke, be very careful not to lose any of the small uncaged needle rollers.

Inspection and Repair

Remove all traces of dirt and oil with a suitable safety solvent. Inspect parts carefully for cracks, distortion or excessive wear as described in the following steps.

1. Replace springs if cracked or defective. Check all springs on a spring tester. Replace all that do not meet specifications.

2. If pressure plate is scored, heat checked, or warped more than 0.025 inch, it must be replaced or refaced. Remove only enough metal to obtain a smooth flat surface. No more than 0.070 inch maximum may be removed by grinding.

3. Inspect clutch release lever tips and clevis pin holes for excessive wear. Make sure levers are not bent. Replace where necessary.

4. Inspect release lever yokes for condition of threads. Slight thread damage may be cleaned up with a three-cornered Swiss file. Replace lever yokes if clevis pin holes are elongated.

5. Check clevis pins and lever pins for wear. Replace if wear is excessive. Check lever slotted thrust washer ring for excessive wear. Replace if slots are excessively worn.

6. Check lever needle roller bearings for wear. If flats are such that rollers slide rather than roll, replace rollers.

7. Inspect driven disc assembly for cracks, loose rivets, worn splines, warped or dished condition. If cracked, or hub splines are worn excessively, replace disc assembly.

If facings are worn down nearly even with countersunk facing-retaining rivet heads and provided assembly is in otherwise good condition, it may be rebuilt.

8. If flywheel is warped or heat checked and surface is refinished, maintain dimensions shown in Figure 4-23 between disc surface and bolting face for proper release lever adjustment. No more than 0.070 inch maximum may be removed by grinding.

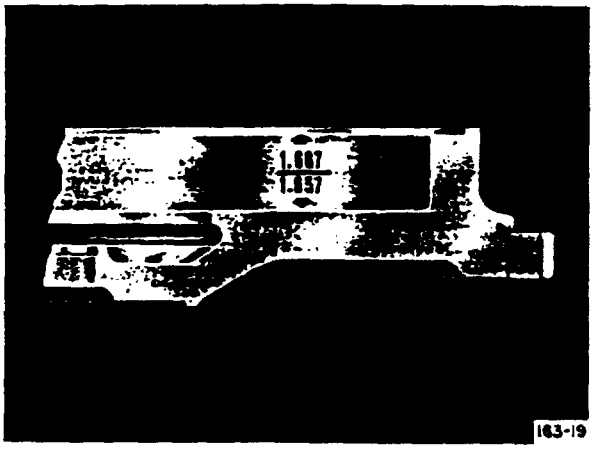


Figure 4-23. Flywheel Rubbing Surface-to-Clutch Cover Bolting Surface Dimension

9. Pilot bearing should be removed, cleaned and checked each time clutch or engine is removed. Discard bearing if balls or races are chipped or scored. After inspection, hand-pack bearing with clutch pilot bearing grease specified and install bearing in flywheel. Tap into place with shielded side toward clutch and snap ring seated in counterbore.

Use only the recommended snap ring type bearings. These bearings will function without premature failure where slight misalignment exists between engine and transmission.

After bearing is properly installed, pack the entire cavity in back of the bearing with the same specified clutch pilot grease.

CAUTION

To prevent damage to the bearing seal when the transmission is assembled to the engine, the space occupied by the main driving pinion pilot must not be filled with grease. See Figure 4-24.

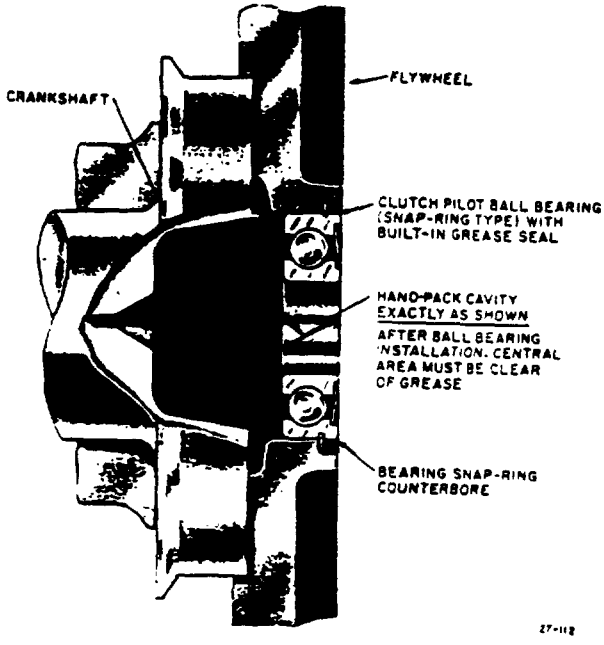
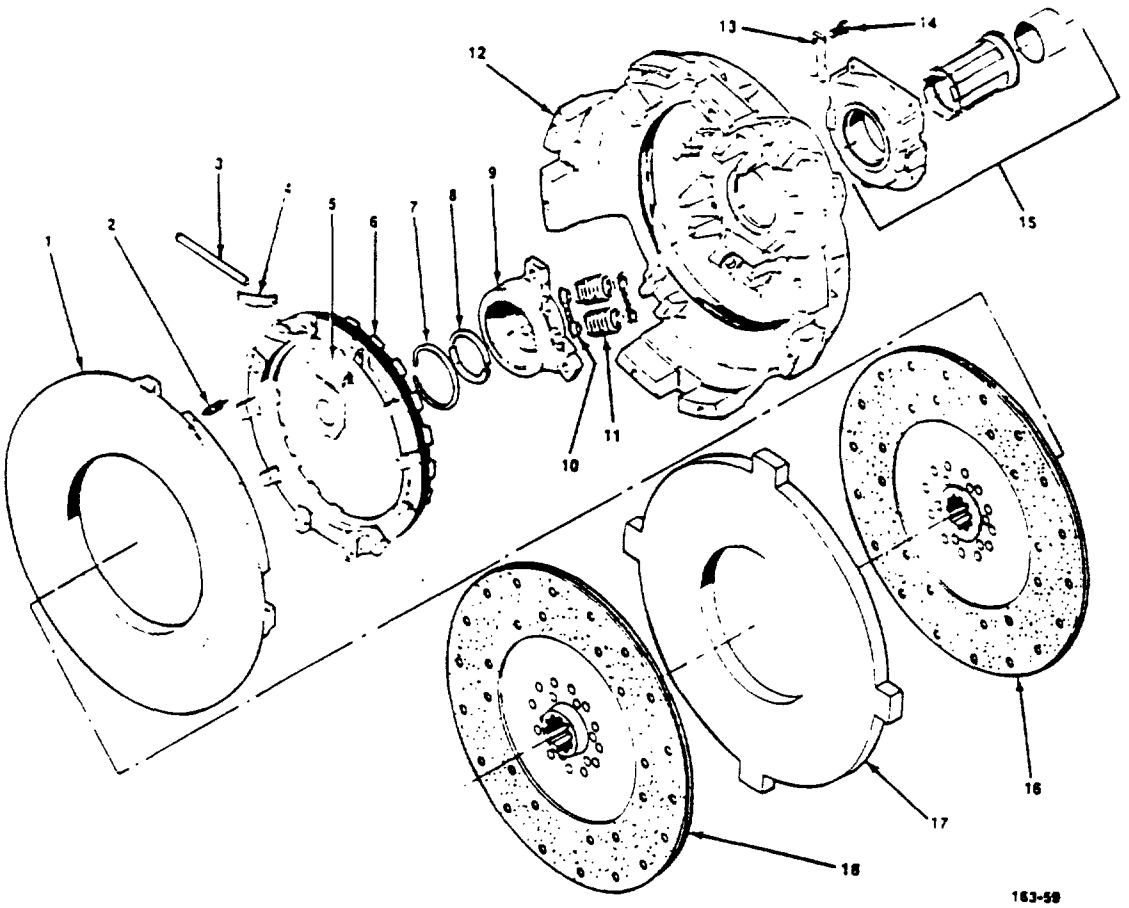


Figure 4-24. Cut-away View of Clutch Pilot Bearing Grease Reservoir Correctly Packed

Reassembly

1. Apply a light coat of clutch lever grease on the loose needle bearings and install rollers in each pin hole of levers. When bearings are installed, apply additional grease to each assembled bearing group.

2. Spread a thin coat of lever grease on the two rubbing flats of each lever and on all yoke rubbing surfaces. Center lever



1. Pressure Plate
2. Return Spring
3. Pivot Pin
4. Spring Clip
5. Lever
6. Adjusting Ring
7. Snap Ring
8. Release Sleeve Ring
9. Release Sleeve Retainer
10. Spring Pivot
11. Pressure Spring
12. Flywheel Ring
13. Adjusting Ring Lock
14. Bolt & Lock Washer Assy
15. Release Bearing & Bearing Assy
16. Driven Rear Disc
17. Intermediate Plate
18. Driven Front Disc

Figure 4-33. Exploded View AS-1550 Series Clutch Assembly

Removal and Disassembly

A suitable "sling" or transmission jack should be used to properly support and maintain the engine/transmission alignment when removing or installing a transmission on an engine. DO NOT let the rear end of the transmission drop down and hang unsupported in the splined hubs of the clutch discs to avoid bending or distorting the friction discs. Disconnect the external linkage from the clutch release arm to permit the release yoke to turn up and pull free of the release bearing thrust pads.

1. Prior to actual clutch removal, assemble a clutch disc aligning tool to the driven disc and release bearing assembly.

It is important that two 3/4 inch blocks of wood as shown in Figures 4-34 and 4-35 be inserted between the clutch release bearing housing and clutch flywheel ring as the clutch mounting bolts are loosened around the flywheel. These blocks will relieve the heavy internal spring load, preventing cocking and bending within the clutch and insure easy removal of remaining mounting bolts.

2. When all bolts have been removed, slide clutch assembly back and off using caution to keep aligning tool in place to retain discs and intermediate plate.

3. Carefully remove aligning tool, rear disc, intermediate plate and front disc.

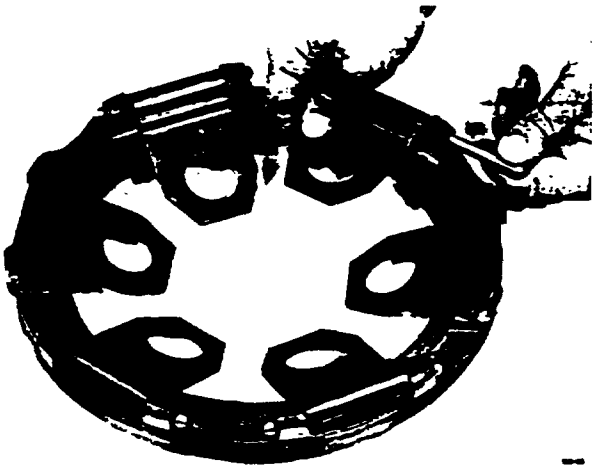
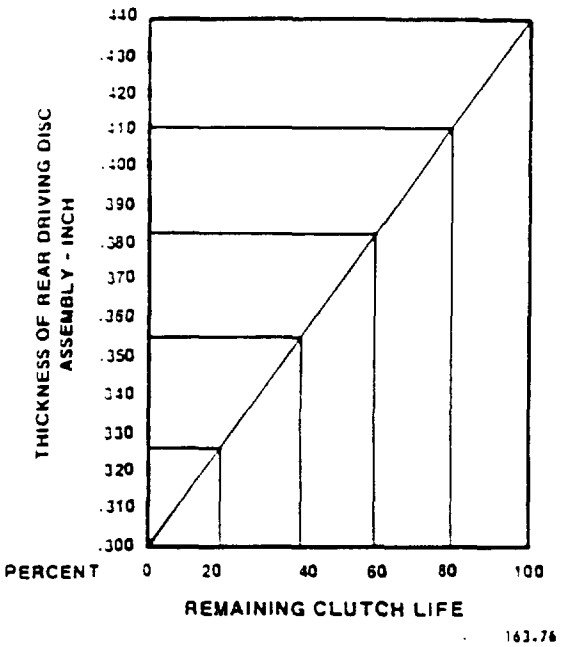


Figure 4-43. Removing Retainer Clip

Remaining Clutch Life Chart -



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Inspection and Repair

Clean all parts thoroughly with a suitable safety solvent.

Many clutches are replaced as a preventative maintenance item at low mileage during repairs of the transmission or engine. Before the Clutch Assembly is replaced, the unit should be inspected for the following items:

1. Heat cracks in the pressure plate.
2. Excessive wear in all drive slots.
3. Broken springs.
4. Dry or damaged release bearing.
5. Broken intermediate plate.
6. Excessive driven disc hub spline wear.
7. Burned facings.
8. Excessive wear on drive pins or intermediate plate slots.

If the preceding inspection shows clutch parts to be in good condition, use the following chart to determine the approximate remaining clutch life (by measuring the thickness of the rear driven disc assembly).

Find thickness of rear disc on column to left; follow curve on right, then drop this point down to read percent of clutch life remaining.

Driven Discs

Inspect disc assembly for cracks, loose rivets, worn splines, warped or dished condition. Re-straighten if dished or warped beyond 0.015 inch maximum runout. Replace if hub is cracked, or splines are worn excessively.

Replace facings if they are glazed, scored, worn down to rivet heads, burned, or if contaminated with grease or oil.

The driven discs use high-quality asbestos facings riveted to the steel disc. They may be furnished as rigid type disc or damper type. Used discs can be reworked in the field by drilling out the rivets to remove old facings. Use the correct size drill when removing old rivets to avoid enlarging holes in disc. Use proper facings and a star set anvil to reline used discs.

Ceramic friction material, a combination of metal and ceramic, is used in producing round or trapezoidal buttons which are riveted to steel discs. These clutch

discs, available with either rigid or damper hubs, offer many advantages for heavy-duty applications. Reworking these discs in the field is not recommended because the ceramic buttons must be assembled and ground to hold thickness as well as squareness with splines.

Super-duty discs have six trapezoidal ceramic buttons and are available with rigid or damper hubs. These discs are thinner than standard discs while the intermediate plate is thicker. This combination of more ceramic buttons and thicker intermediate plate provides longer life and increased torque capacity.

A super-duty kit consisting of two driven discs and an intermediate plate is available for converting a standard Angle-Spring clutch into a super-duty clutch. It is very important that the kit be installed as a unit and that its components never be intermixed with standard components.

Flywheel Ring

Inspect the flywheel ring for cracks. Replace if cracks are visible. Check slots for indentation caused by wear of pressure plate driving lugs. See Specification Chart for slot limits.

Inspect bolt circle face and pilot for nicks and burrs due to removal or handling. Remove burrs with file to insure proper seating and squareness when clutch is mounted to flywheel.

Adjusting Ring

Check pivot pin holes for wear. Clearance may not exceed 0.010 inch between pin and hole. Inspect for cracks; replace if cracks are visible.

Pressure Plate

Inspect fulcrum for wear. If wear exceeds 0.015 inch, remachine. See Specification Chart for maximum rework.

Inspect friction surface of pressure plate for scoring, burning, heat checking or distortion. If friction surface is badly scored, heat checked, warped or dished in excess of 0.010 inch, resurface or replace with new pressure plate. Smooth and flat pressure plate surfaces must be used for satisfactory clutch life.

Check drive lugs for wear per Specification Chart.

Intermediate Plate

Inspect friction surfaces of intermediate plate for heat checks, scoring or distortion. If friction surface is badly scored, heat checked, warped or dished in excess of 0.010 inch, resurface or replace with new intermediate plate. Smooth and flat intermediate plate surfaces must be used for satisfactory clutch life. Inspect driving slots of intermediate plate for wear per Specification Chart.

Release Levers

Inspect levers for excessive wear at points of contact with pressure plate, release sleeve retainer, and pivot pin. If levers are bent or worn, replace with new levers. It is good preventive maintenance to replace levers during clutch rebuild.

Release Sleeve Retainer

Inspect for wear in lever groove and internal splines. Refer to specifications for driving slot clearance between flywheel ring drive slots and release sleeve retainer drive lugs.

Spring Pivots

Inspect for cracks; if visible, replace.

Release Sleeve Sub-Assembly

Check bushing for excessive wear. Check bearing diameter for tight fit. Refer to Specifications Chart and replace if necessary.

Release Bearing and Sleeve Assembly

It is recommended that the release bearing and sleeve assembly be replaced as a unit at the time of clutch rebuild. Assemblies are available as service replacement items.

Disc Brakes

No manual adjustment required. Brakes adjust automatically during braking operation. The square-cut piston seal is distorted when pressure is applied to piston. When braking pressure is released. the seal returns to its normal condition and pulls the piston away from the lining. This action, plus some slight rotor lateral runout ("wobble"), considerednormal, provides adequate running clearance.

Disassembly and Assembly

When brakes are relined or disassembled for other repairs, all parts should be inspected for wear and worn parts should be replaced as required.

Cam Brakes - (See Figure 8-37)

Disassembly

1. Remove shoe return spring.

2. Remove lock rings, retainers, and felts from brake shoe anchor pins.

3. Cut lock wire and remove anchor pin lock screws.

4. Remove anchor pins and shoe assemblies.

5. Remove brake shoe roller retaining clip (or screw) and remove roller.

6. Remove slack adjuster lock ring and spacing washers.

7. Remove camshaft. washer. and felt seal (if used).

8. Remove nylon bushings if replacement is necessary. Use suitable tool for both removal and installation of bushing. See Figure 8-44.

NOTE

On brakes where lip type seals are used. these will have to be removed and replaced if nylon bushings are replaced.

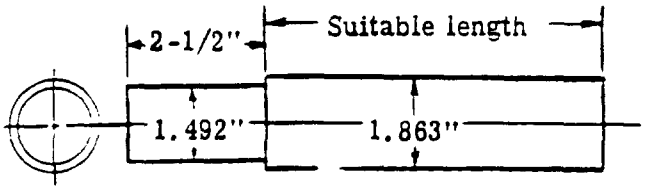

Figure 8-44. Bushing Removal and Installation Tool

Assembly

1. Install new nylon bushings. if required. using suitable tool. (Install new lip type seal if used.)

2. Install brake shoe rollers and retainers. Make certain rollers are of proper size. See instructions relative to brake shoe "Cam Roll-Over."

3. Install camshaft. washer. and felt seals. (if used.)

4. Position brake shoe assembly over spider and tap anchor pin into position with brass punch. "flat" in line with lock screw hole.

5. Install lock screws, tighten securely and thread with lockwire.

6. Position felts, retainers. and lock rings on anchor pins.

7. Install shoe return spring. New springs should be used with each brake reline. Tension loss occurs from normal use and heat build up. New springs will ensure that shoes are returned to fully relaxed position, and not in contact with drum, which would cause premature wear.

8. Assemble slack adjuster on splined end of camshaft; using spacers and washers on each side of adjuster to obtain . 030-. 060 end play.

Wedge Brakes - (See Figure 8-39)

Disassembly

1. Remove shoe return springs. Use brake spring pliers. (Do Not use screwdriver.)

2. Remove brake shoe assembly.

3. Remove plunger guide screws and gaskets from plunger housing. If brake is automatic adjusting, remove hollow capscrew. gaskets, spring and adjusting pawl. It may be necessary to use a magnet to remove the adjusting pawl.

4. Using a suitable screwdriver. pry the seals loose and remove anchor (solid) plungers. adjusting plungers. adjusting sleeves (actuators) and adjusting bolts.

5. Thoroughly inspect and clean all parts including the housing plunger and seal bores and shoe rest pads. DO NOT solvent clean any rubber parts (plunger seals or gaskets).

4. Lift the caliper off the hub and rotor. See Figure 8-50.

Figure 8-50. Removing Caliper

NOTE

It is not necessary to remove the hydraulic line when replacing shoe and lining assemblies. However, do not let the caliper hang on the hydraulic line. Lay the caliper on the suspension.

Removing Shoe and Lining Assembly

1. Remove the inner shoe and lining assembly from the anchor plate.

2. Remove outer shoe and lining hold-down spring, pin and cup. See Figure 8-51.

Figure 8-51. Removing Spring, Pin, and Cup.

3. Remove outer shoe and lining assembly. See Figure 8-52.

Figure 8-52. Remove Outer Shoe and Lining Assembly.

Inspecting Caliper

1. Check the inside of caliper for hydraulic fluid leak. If evidence of fluid leak is noted, the caliper should be overhauled.

2. Wipe the inside of the caliper, clean and check the dust boots for cuts, cracks or other damage. If damage is noted the caliper should be overhauled. See Figure 8-53.

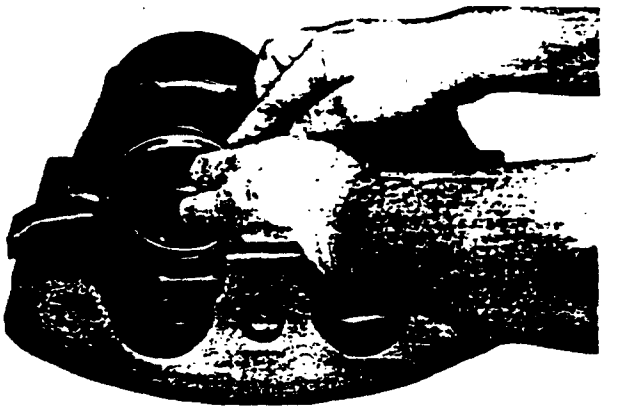

Figure 8-53. Inspecting Boots for Cracks and Cuts.

Assembly

Installing Shoe and Lining Assemblies

1. Install new inner shoe and lining assembly into anchor plate.

2. Push the pistons to the bottom of the piston bore. This is done by taking a small block of wood and placing it over the pistons and boots. With a "C" clamp, push the pistons to the bottom of the piston bores.

3. This will provide clearance for the caliper to fit over the hub and rotor when new shoe and linings are installed. See Figure 8-54.

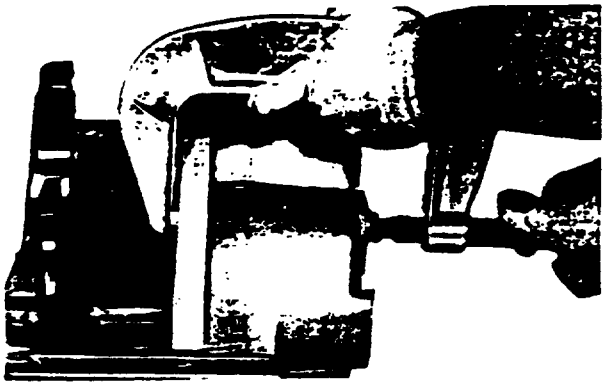

Figure 8-54. Pushing Pistons back into Caliper.

4. Install outer shoe and lining into caliper and install shoe hold-down spring and pin. See Figure 8-55.

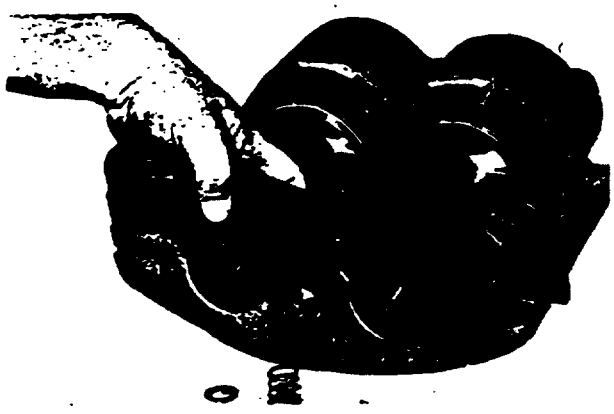

Figure 8-55. Installing Outer Shoe and Lining Assembly.

5. Install caliper assembly over the hub and rotor and position into grooves in anchor plate.

6. Install the caliper hold-down assemblies and tighten bolts to 40 lb. ft. torque. See Figure 8-49.

7. Add brake fluid to bring level to 1/4 inch from top of reservoir.

8. If any hydraulic fluid lines have been disconnected, bleed the hydraulic brake system. Pump the brake pedal several times to make sure brake shoes are adjusted.

9. Install the front wheels and lower vehicle.

Caliper Overhaul

Always use denatured alcohol or brake fluid to clean caliper parts.

CAUTION

Do not use mineral base cleaning solvents such as gasoline, kerosene, carbon tetrachloride, acetone or paint thinner to clean the caliper. It will cause rubber parts to become soft and swollen in extremely short time.

1. Remove caliper assembly as previously described in this section.

2. Disconnect the hydraulic hose and cap or tape the fitting to prevent dirt from entering the hydraulic line.

3. Check the brake hose for worn spots, cracks or other signs of deterioration. Discard the hose if damaged.

4. Drain brake fluid from caliper.

5. Thoroughly clean the exterior of caliper.

6. Place a small block of wood under caliper piston. (Approximately 2 inches thick) Pad the exterior of the caliper with a clean shop towel. Remove the piston by directing air into the caliper fluid inlet. See Figure 8-56.

CAUTION

Use just enough air pressure to ease the pistons out of bore. If the pistons are blown out, even with padding provided, it may be damaged.

WARNING

Do not place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

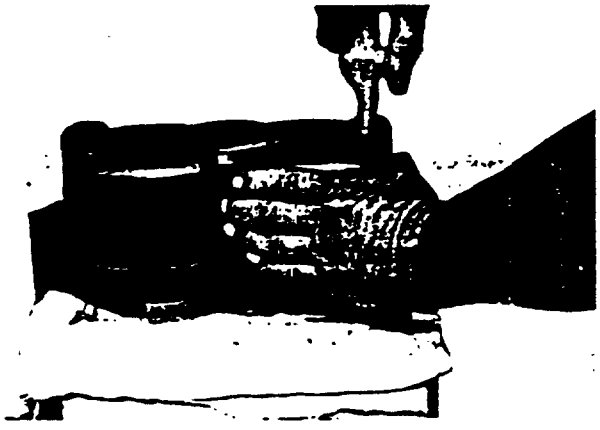

Figure 8-56. Removing Pistons from Caliper Bore.

7. Remove and discard the piston boots.

19. Install new shoe and lining assemblies, and caliper as previously described.

20. Connect the brake hose to the caliper.

21. Bleed the system. Allow the caliper to fill with brake fluid. After all air bubbles have escaped and fluid runs clear from bleeder, close the bleeder screw. Replenish the brake fluid in the hydraulic fluid reservoir.

22. "Pump" the brake pedal several times to actuate the piston seals and position the shoe and lining assemblies.

23. Check for fluid leakage at all connections under maximum pressure. Refill fluid reservoir as necessary.

24. Install front wheels and lower vehicle.

25. Always check the hub and rotor braking surface for deep scores, cracks, and heat checks. See Figure 8-61.

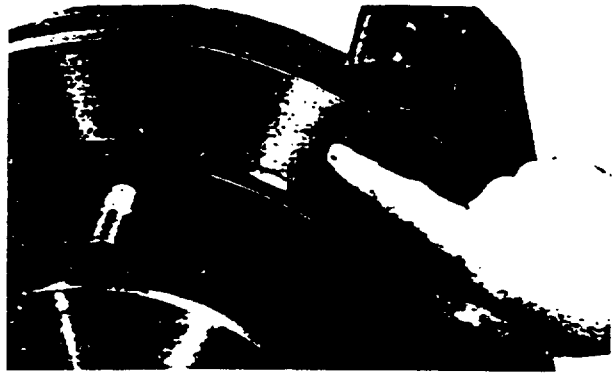

Figure 8-61. Checking Rotor Surface

26. Always check hub and rotor lateral runout ("wobble"). Lateral runout must not exceed 0.008 inch.

leading to the bottom of the container. The air then rises through the alcohol and passes into the line to the compressor, carrying alcohol in the form of vapor with it. The alcohol, thus introduced into the air system acts as an anti-freeze.

Figure 8-82. Alcohol Evaporator

Preventive Maintenance

Every 1,000 Miles or as Determined by Actual Usage

Check alcohol level and if necessary replenish with 188 proof methanol alcohol. In cold weather, alcohol level should be at least 2/3 full.

NOTE

If alcohol is not being consumed, it indicates the evaporator is inoperative and should be inspected.

Every Mack C and D Inspection

Remove strainer if present in bottom of evaporator body and clean thoroughly in solvent.

Every Mack C and D Inspection

Disassembly evaporator unit and clean thoroughly. Inspect all parts for cracks and be sure evaporator tube is not clogged with dirt. Replace all gaskets and rubber parts.

Inspection

When the compressor is compressing air, air bubbles should be passing through the alcohol. If air bubbles are not present when the compressor is compressing air, then the alcohol evaporator is not functioning properly. Check to be sure all connections are tight. Check condition of filler cap gasket and cover gasket.

RELINING & RECONDITIONING

Drum-Type Brakes

After supporting the axle on stands, cage the springs in the spring brake chambers. Remove the tires, wheels, and drums as an assembly, and inspection drums for heat checks, cracks, distortion or other damage.

Close inspection of all worn brake parts may lead to clues for corrective action to improve lining life and future drum damage.

Scored Drum

Only the tops of the ridges will contact brake lining. Since a small percentage of the brake lining is required to do all the work, hard pedal and fade will result. A scored drum must be reconditioned in a lathe. See Figure 8-83.

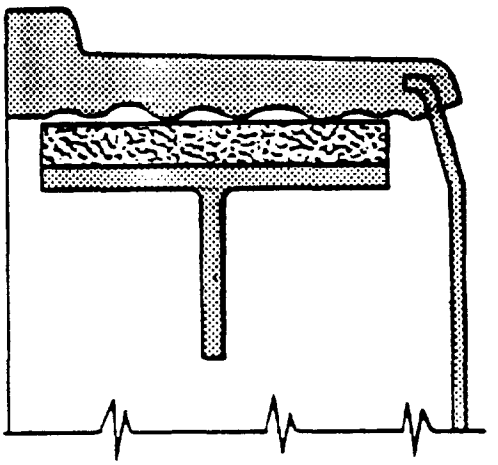

Figure 8-83. Scored Drum

Hard Spots

Hard spots are "islands" of steel in the cast iron surface. They result from a change in metallurgy caused by the heat of braking. Hard spots must be ground out or brake performance will be poor and erratic. See Figure 8-84.

Bell-Mouthed Drum

If a drum is bell-mouthed or flared, full lining to drum contact cannot be achieved. Fade and noise can be expected. A bell-mouthed drum must be trued in a lathe in order to procure full lining to drum contact. See Figure 8-85.

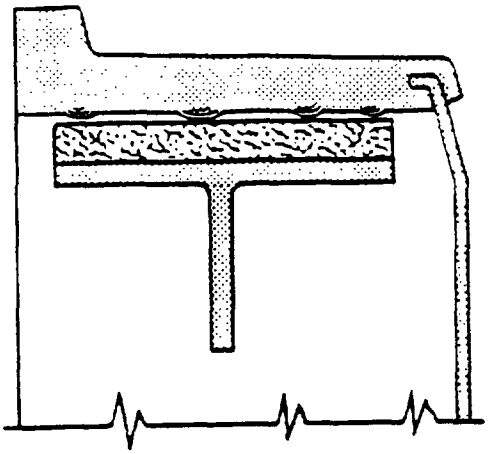

Figure 8-84. Hard Spots

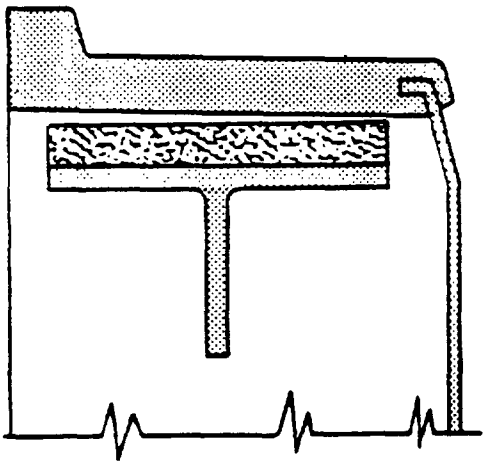

Figure 8-85. Bell Mouthed Drum.

Heat checking and discoloration, if only superficial, can be corrected by resurfacing the drum, otherwise replace drum.

Drums having more than .010" out of round, or any of the conditions described above should be resurfaced. Use only those drums which produce a satisfactory surface finish.

CAUTION

Drum manufacturer and state vehicle inspection laws (where applicable) govern the amount of drum diameter increase allowed when resurfacing. Most drums are stamped by manufacturers as to maximum oversize allowable.

Excessive removal of drum material could result in drum failure or unsatisfactory brake performance and is illegal in some states.

NOTE

When reconditioning brakes, it is important that the brake assemblies on each side of the same axle be serviced in exactly the same manner. This will avoid unequal braking performance. (Drums on the same axle should be resurfaced within .010 of each other.

Cam Roll-Over

Increasing the drum diameter will permit the cam to rotate beyond its maximum lift when the lining becomes worn. To prevent cam "Roll-Over," oversize roller cam followers are available.

Standard (1.250" O.D.)

Standard rollers are used when installing standard linings with standard drums. "X" lining (1/16 oversize) with 1/16 oversize drums, and "XX" lining (1/8 oversize) with 1/8 overside drums.

1/8" Oversize (1.375")

1/8" oversize rollers are to be used with the installation of standard linings with worn or trued drums which are 1/32" oversize. 1/8" oversize rollers should be installed and the liners circle ground a few thousandths less than drum diameter.

1/4" Oversize (1.500")

Where "X" linings have been installed with 1/16" oversize drums and standard rollers, these rollers should be removed and 1/4" oversize installed before the lining becomes worn to a point where the brake cam is no longer effective with the standard rollers.

1/2" Oversize (1.750")

Where "XX" linings and 1/8" oversize drums have been used, the standard rollers should be removed when the linings become approximately 50% worn and 1/2" oversize rollers installed.

Brake Linings

Linings must be the correct material for a specific application, and the same type lining should be used for each wheel on the same axle.

Handle lining carefully to prevent grease, oil, or any other type of contamination to come in contact with lining surface.