Cummins

CBRKE By Jacobs™

Installation Manual For N14 Engines

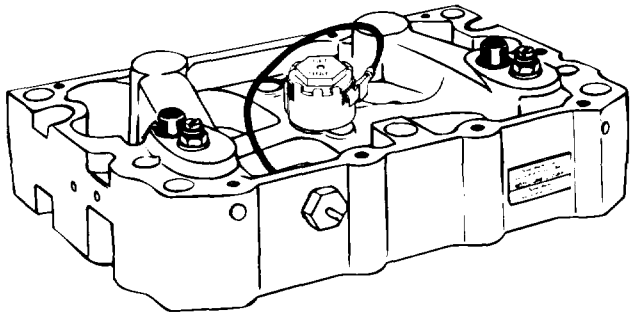


Table of Contents

The following symbols in this manual signal potentially dangerous conditions to the mechanic or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.

Safety Precautions

⚠ WARNING

THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.

⚠ CAUTION

THIS SYMBOL REFERS TO POSSIBLE EQUIPMENT DAMAGE.

NOTE:
INDICATES AN OPERATION, PROCEDURE OR INSTRUCTION THAT IS IMPORTANT FOR CORRECT SERVICE.

Fuels, electrical equipment, exhaust gases and moving engine parts present potential hazards that could result in personal injury. Take care when installing an engine brake. Always use correct tools and proper procedures as outlined in this manual.

⚠ WARNING

SEE DRIVER'S MANUAL FOR PROPER ENGINE BRAKE DRIVER TECHNIQUES.

THE CBRAKE BY JACOBS™ ENGINE RETARDER IS A VEHICLE SLOWING DEVICE, NOT A VEHICLE STOPPING DEVICE. IT IS NOT A SUBSTITUTE FOR THE SERVICE BRAKING SYSTEM. THE VEHICLE'S SERVICE BRAKES MUST BE USED TO BRING THE VEHICLE TO A COMPLETE STOP.

Section 1: Introduction

Tools Required

1. 7/16" 12 point socket for housing mounting screws
2. 0.023" feeler gage, Cummins P/N 3871534, Jacobs P/N 017685
3. 3/4" socket for solenoid
4. 5/8" crowfoot wrench for Auto-Lash® adjusting screw nut
5. 3/8" hex socket or open-end wrench for Auto-Lash® adjusting screw
6. 7/16" hex socket for master piston capscrew

NOTE:
NO ENGINE CONVERSION PARTS ARE REQUIRED FOR MODEL 450A/450B INSTALLATIONS ON 1994 N14 CUMMINS CELECT™ ENGINES.

Applications

⚠ CAUTION

THE CBRAKE BY JACOBS™ MODELS 450A AND 450B ARE FOR USE ON CUMMINS N14 ENGINES **ONLY**. CONSULT YOUR LOCAL CUMMINS DISTRIBUTOR OR DEALER TO VERIFY YOUR ENGINE CPL IS AN N14 ENGINE. MISAPPLICATION COULD RESULT IN ENGINE AND/OR ENGINE BRAKE DAMAGE.

Engine	Model Year	Horsepower Rating	CBrake by Jacobs™ Model
N14	1994	310E - 370E	450A
N14	1994	410E - 500E	450B

Section 2: Engine Preparation

Remove the three rocker lever covers and gaskets (see Fig. 1). Save the gaskets.

Remove the pipe plug from the center web of each rocker lever housing (Fig. 2). This is the oil supply for the engine brake housing.

Place the gasket included in the kit on each of the three rocker lever housings (Fig. 3).

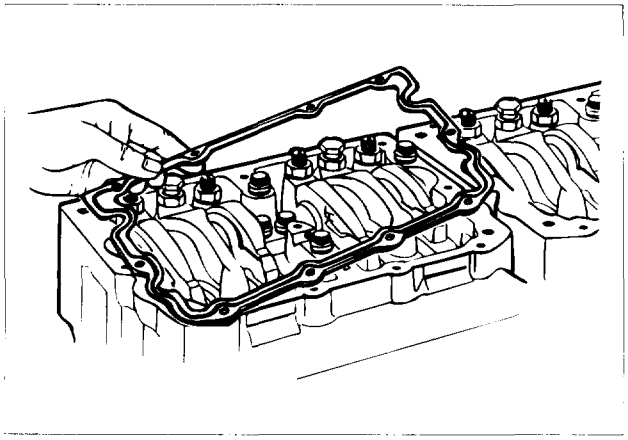


FIG. 1

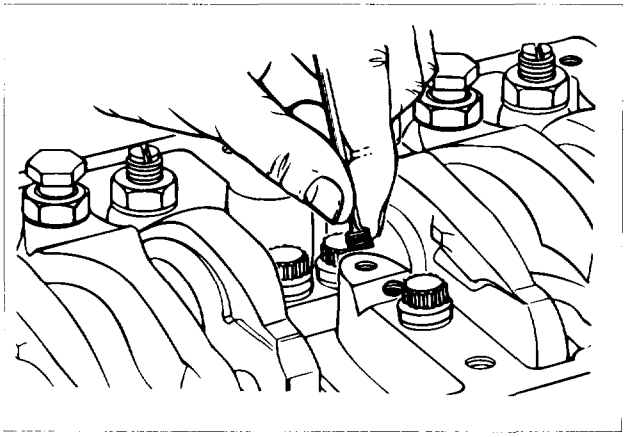


FIG. 2

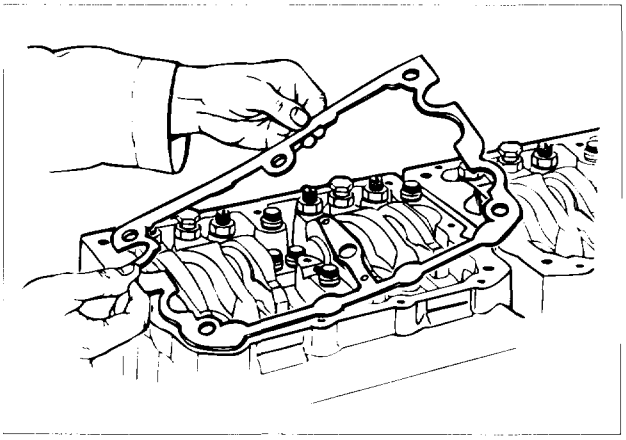


FIG. 3

Section 3: Housing Installation

Before installing the housings, back out the slave piston adjusting screws (Auto-Lash®) until the slave piston bottoms in the housing bore (screw is loose).

Install the three engine brake housings on the rocker lever housings. Install the six mounting screws into each housing (Fig. 4). Tighten the capscrews in steps, following the pattern illustrated in Fig. 5. First tighten to 35 lb.-ft. (48 N•m), then to 70 lb.-ft. (95 N•m).

⚠ CAUTION

DO NOT USE POWER TOOLS. USE OF POWER TOOLS MAY RESULT IN OVERTORQUING OF MOUNTING SCREWS. ENGINE BRAKE HOUSING FAILURE MAY RESULT.

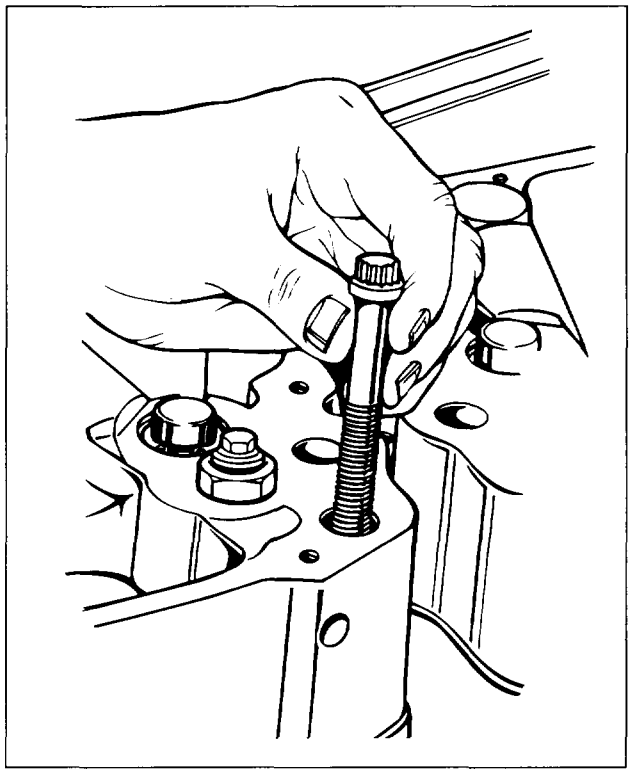


FIG. 4

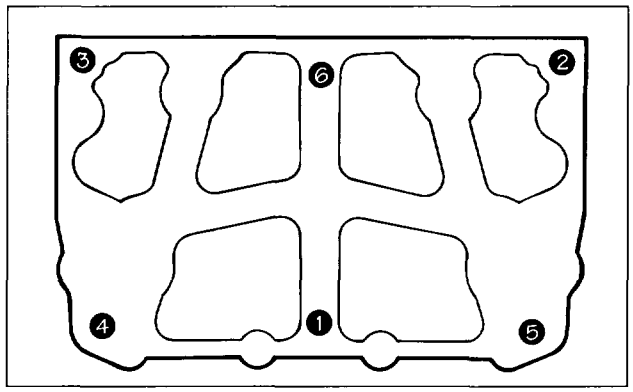


FIG. 5

Slave Piston Adjustment

Adjust the slave piston clearance with the engine stopped and cold, stabilized water temperature of 140° (60° C) or below. Exhaust valves on the cylinder to be adjusted must be in the closed position.

The feeler gage has 0.023" feeler stock on both ends (Fig. 6). One end can be used on cylinders 1, 3 and 5; the other end can be used for cylinders 2, 4 and 6 (see Fig. 7).

⚠ CAUTION

SLAVE PISTON ADJUSTMENT MUST BE MADE WITH THE FEELER GAGE POSITIONED UNDER BOTH FEET OF THE SLAVE PISTON. INCORRECT ADJUSTMENT CAN CAUSE ENGINE DAMAGE.

On cylinders with the exhaust valves closed (crossheads loose), install one end of the feeler gage under both feet of the slave piston. Turn slave piston adjusting screw (Auto-Lash®) in a clockwise direction until a slight drag is felt on the feeler gage. Hold the adjusting screw and tighten the locknut to 25 lb.-ft. (35 N•m).

NOTE:
UNLESS OTHERWISE SPECIFIED, THE TORQUE VALUES LISTED HERE AND IN THE TEXT ARE DIRECT VALUES USING NO TORQUE WRENCH ADAPTERS OR EXTENSIONS. WHEN ADAPTERS OR EXTENSIONS ARE USED WITH A TORQUE WRENCH, THE TORQUE VALUES MUST BE ADJUSTED FOR THE SPECIFIC TOOLS BEING USED. FOLLOW THE MANUFACTURER'S RECOMMENDED PROCEDURES FOR THE TORQUE WRENCH AND ADAPTER BEING USED.

Continue adjusting the remaining slave pistons where the exhaust valves are closed. Rotate the engine crankshaft about 180° to adjust the remaining slave pistons.

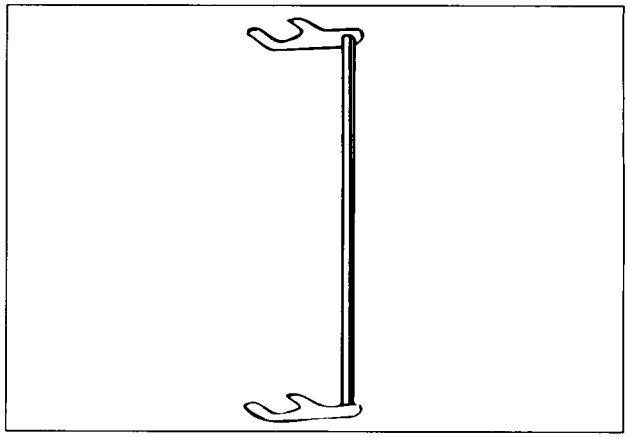


FIG. 6

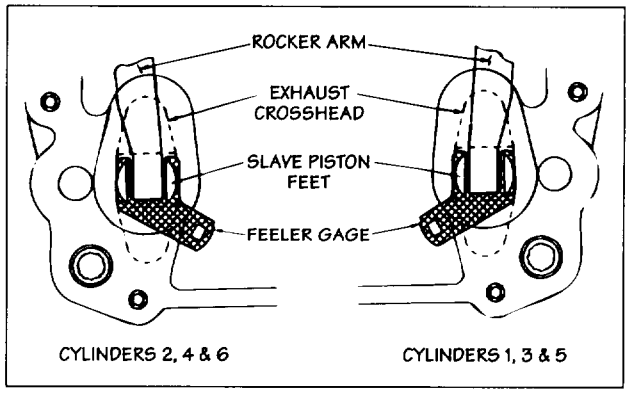


FIG. 7

Section 4: Electrical Installation

CELECT™ style engines require an ON/OFF dash switch (Fig. 8) that has gold-plated contacts. A relay is also required for these applications. Install the dash switches in a convenient location on the dashboard. The fuel pump switch or clutch switch is not required for application to CELECT engines.

Connect the wiring as shown in the diagram below (Fig. 9).

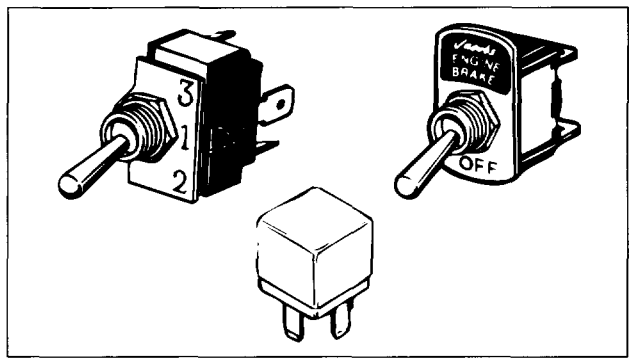


FIG. 8

ELECTRICAL CONTROL SYSTEM
ENGINE BRAKE MODELS 450A/B FOR 1994 N14 CELECT™ ENGINES

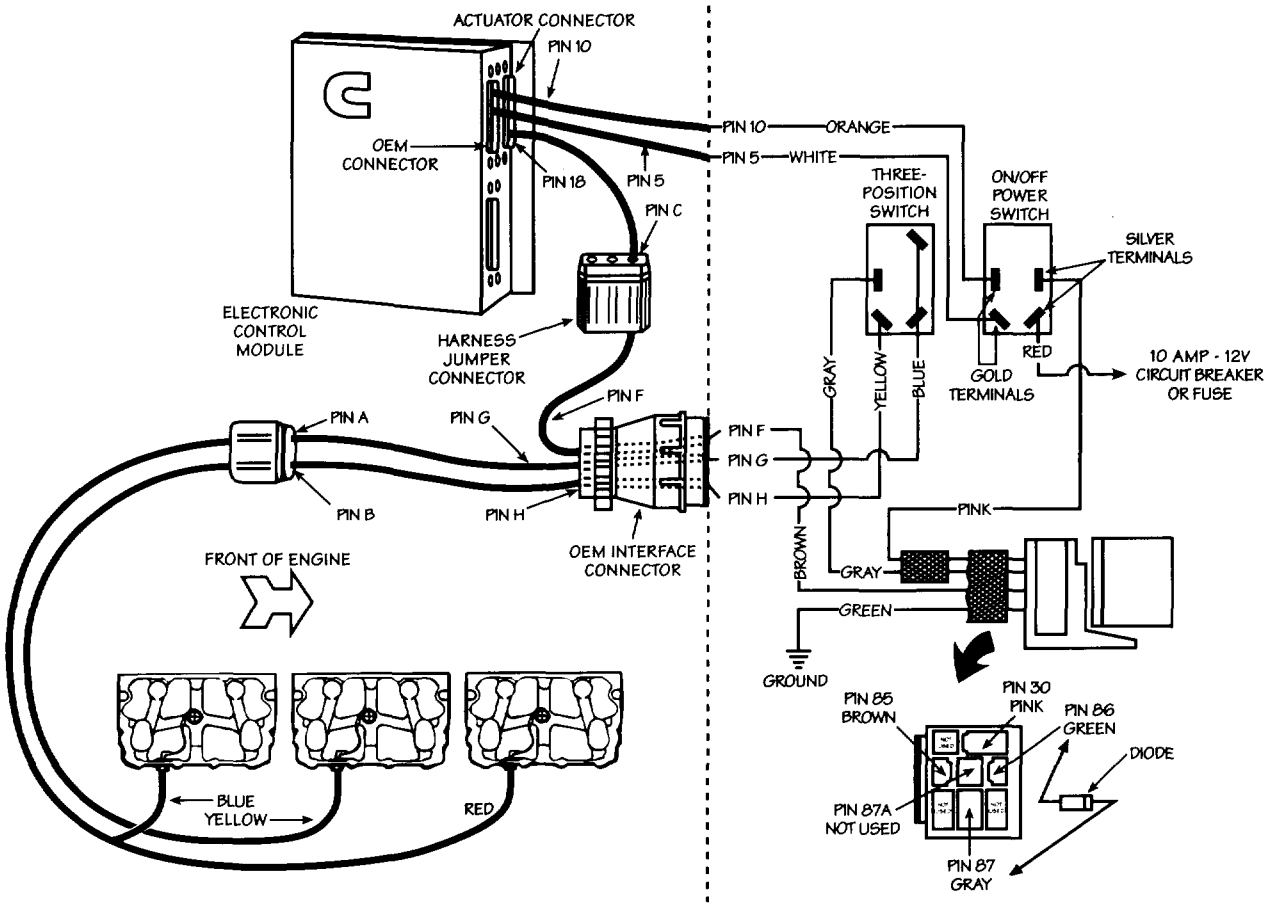


FIG. 9

Section 5: Operational Check

That completes the CBrake by Jacobs™ engine retarder installation. The following procedures should now be followed.

Connect the control wires to the electrical connector in the engine brake housings (Fig. 10).

⚠ WARNING

WEAR EYE PROTECTION; DO NOT EXPOSE YOUR FACE OVER ENGINE AREA. TAKE PRECAUTIONS TO PREVENT OIL LEAKAGE ONTO THE ENGINE. WHEN ENGINE IS RUNNING AND VALVE COVERS ARE REMOVED, OIL SPLASHING IN THE ENGINE BRAKE AREA COULD CAUSE PERSONAL INJURY.

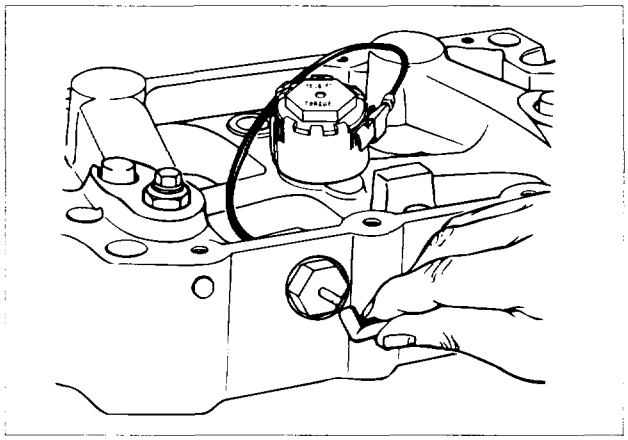


FIG. 10

To bleed the brake units and check their operation, start the engine and allow to run 5 to 10 minutes. With the engine brake switch off, accelerate the engine to approximately 1800 RPM. Release the throttle and manually depress each solenoid armature (Fig. 11). Repeat this procedure five or six times to permit engine oil to fill the brake housings.

NOTE:
PLACE A RAG OVER THE CONTROL VALVE COVERS TO REDUCE OIL SPRAY.

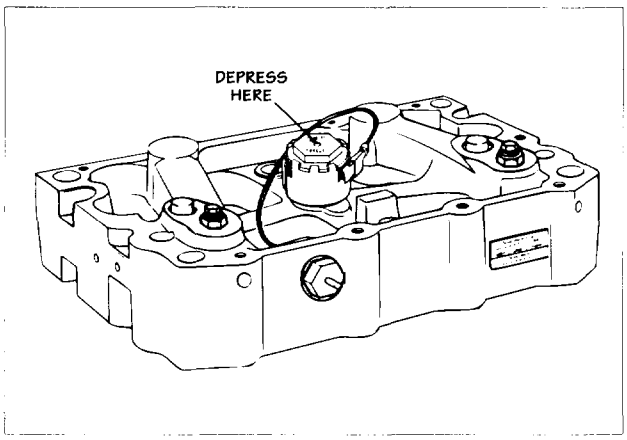


FIG. 11

To check the electrical system on CELECT™ engines, leave the engine running. Put the selector switch in position 1 and turn the ON/OFF switch to ON. The CELECT™ low-speed shut off prevents the engine brake from coming on at idle. Accelerate the engine to approximately 1800 RPM and release the throttle. In position 1, the center solenoid should operate. Repeat this procedure for positions 2 and 3. In position 2, the front and rear solenoids should operate; in position 3, all three solenoids should operate. Shut down the engine.

Reinstall the Cummins rocker lever cover gaskets, making sure the word "top" is facing up (Fig. 12). Replace the rocker covers and all previously removed parts. Torque the capscrews to 9 lb.-ft. (12 N•m).

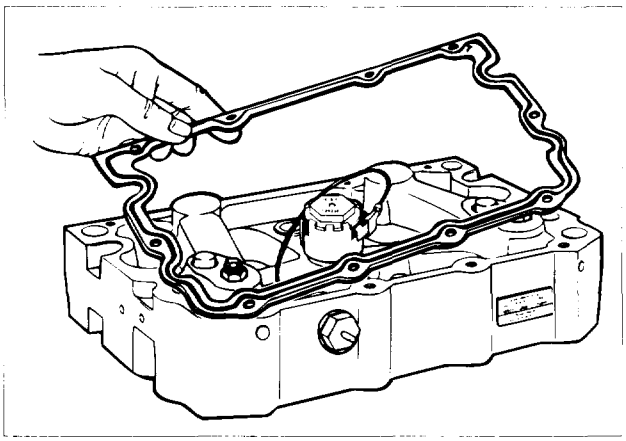


FIG. 12

Section 6: Engine Brake Maintenance

Theory of Operation

Energizing the engine brake effectively converts a power-producing diesel engine into a power-absorbing air compressor. This is accomplished through motion transfer using a master/slave piston arrangement which opens cylinder exhaust valves near the top of the normal compression stroke, releasing the compressed cylinder charge to exhaust.

The blowdown of compressed air to atmospheric pressure prevents the return of energy to the engine piston on the expansion stroke. The effect is a net energy loss, since the work done in compressing the cylinder charge is not returned during the expansion process.

Exhaust Blowdown

Referring to the schematic drawing below, exhaust blowdown occurs as follows:

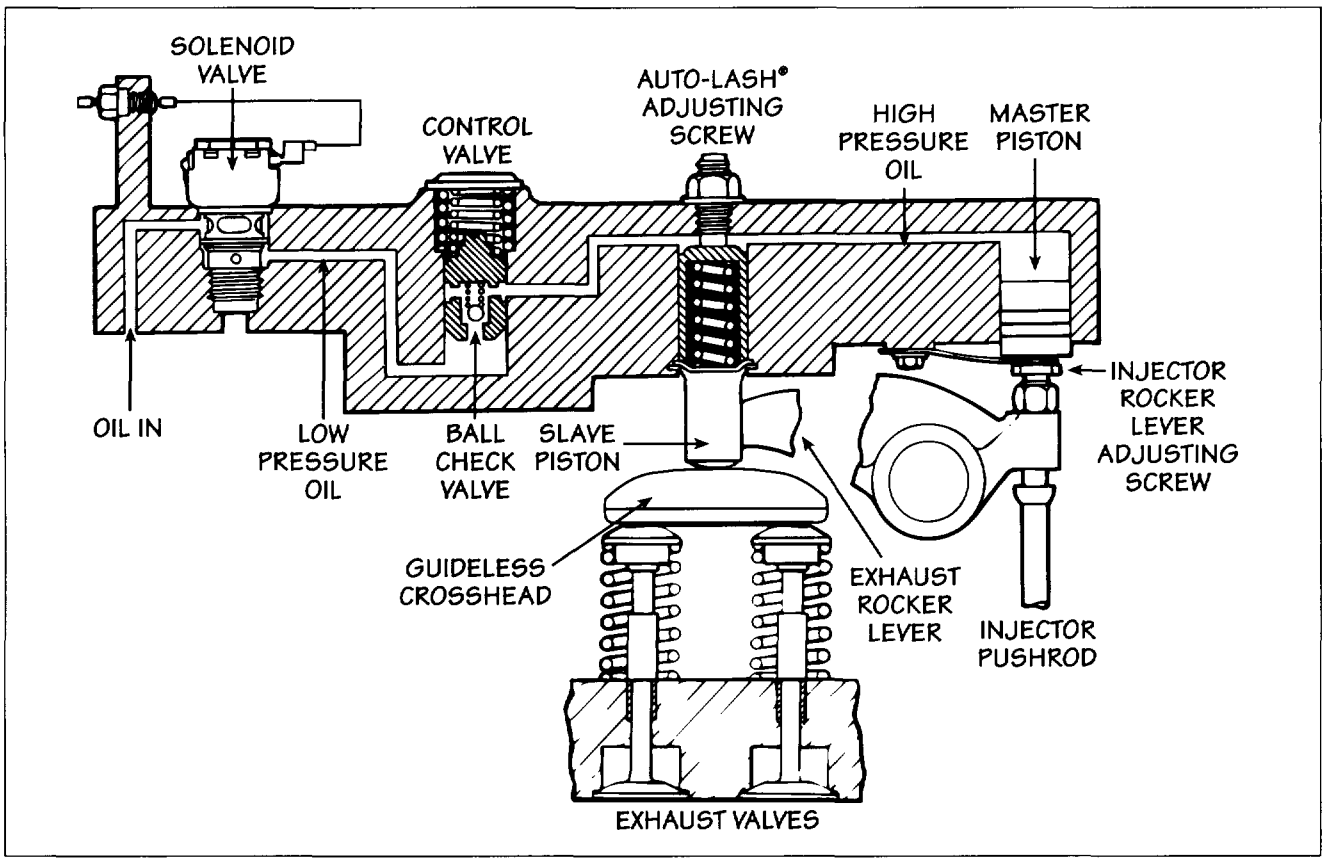
1. The energized solenoid valve permits engine lube oil to flow under pressure through the control valve to both the master piston and the slave piston.

2. Oil pressure causes the master piston to move down, coming to rest on the injector rocker arm adjusting screw.

3. The injector rocker arm adjusting screw begins upward travel (as in normal exhaust cycle), forcing the master piston upward and directing high pressure oil to the slave piston. The ball check valve in the control valve imprisons high-pressure oil in the master/slave piston system.

4. The slave piston, under the influence of the high-pressure oil moves down, momentarily opens the exhaust valve while the engine piston is near its top dead-center position, releasing compressed cylinder air to the exhaust manifold.

5. Compressed air escapes out to the atmosphere, completing a compression braking cycle.



SCHEMATIC DRAWING

The CBrake by Jacobs™ is a relatively trouble-free device. However, inspections and part replacements will need to be made from time to time. Use the following procedures to keep the engine brake in top condition.

⚠ WARNING

NEVER REMOVE ANY ENGINE BRAKE COMPONENT WITH ENGINE RUNNING. PERSONAL INJURY MAY RESULT.

This section will cover how to properly remove, clean and reinstall engine brake components. Use an OSHA-approved cleaning solvent when washing parts. Be sure to coat parts with clean engine oil when reinstalling them.

Control Valve

⚠ WARNING

REMOVE CONTROL VALVE COVERS CAREFULLY. CONTROL VALVE COVERS ARE UNDER LOAD FROM THE CONTROL VALVE SPRINGS. REMOVE WITH CARE TO AVOID PERSONAL INJURY.

1. Press down on control valve cover to relieve spring pressure.
2. Remove retaining ring using retaining ring pliers (see Fig. 14).
3. Slowly remove the cover until spring pressure ceases, then remove the two control valve springs and collar.

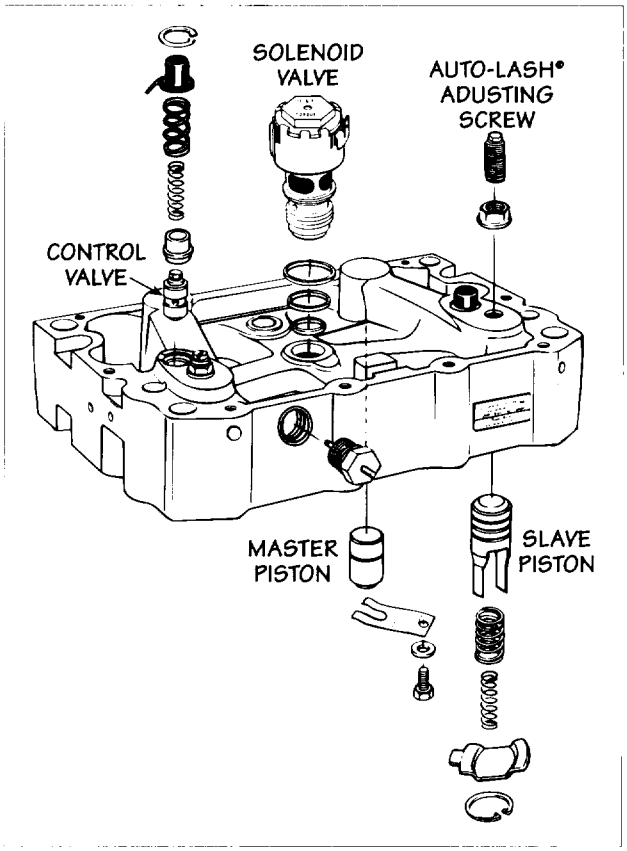


FIG. 13

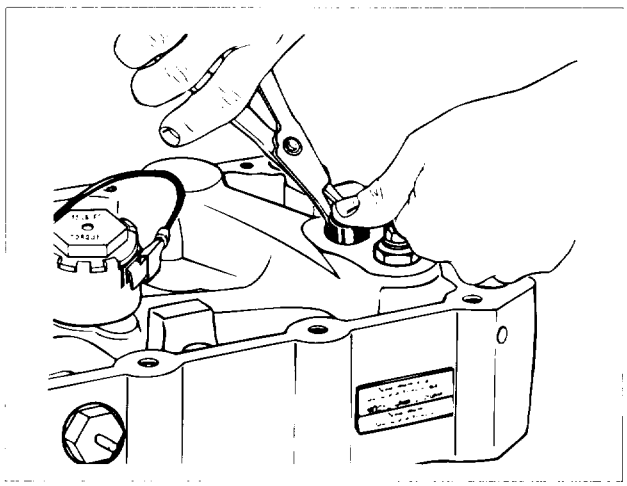


FIG. 14

4. Using needle-nose pliers, remove the control valve (Fig. 15).

5. Wash the control valves with an approved cleaning solvent. Push a wire through the hole in the base of the valve to the distance required to insure that the ball check is free. The ball should lift with light pressure on the wire. If the ball is stuck, replace the control valve. Dry the valve with compressed air and wipe clean with a paper towel.

6. Thoroughly clean the control valve bore in the housing using clean paper towels. Dip the control valves in clean lube oil and repalce the valve into its bore. If binding occurs, replace the control valve.

7. Reassemble in reverse order the springs, collar (note the proper direction from Fig. 16), cover and retaining ring. Rotate the retaining ring at least 90° from the slot in the housing.

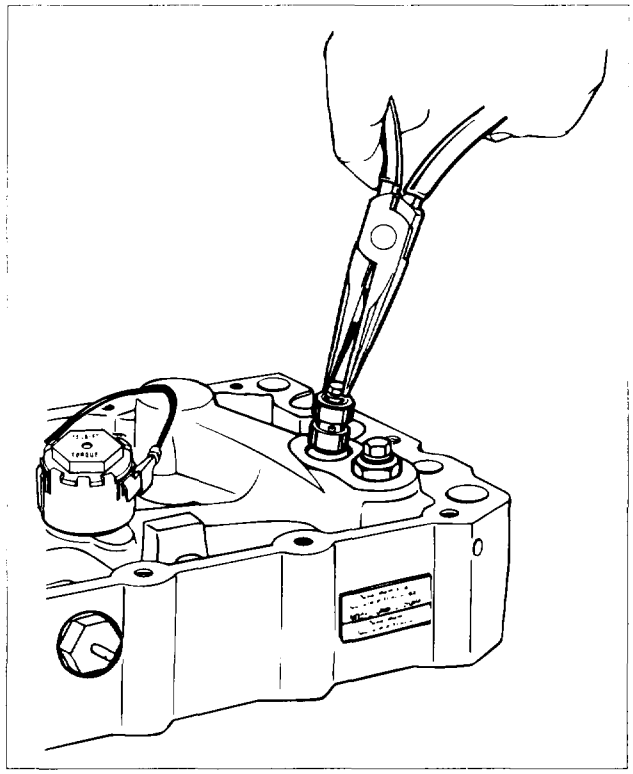


FIG. 15

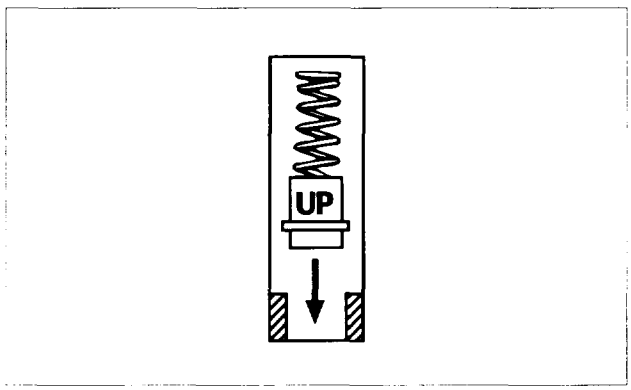


FIG. 16

Solenoid Valve

⚠ WARNING

DO NOT DISASSEMBLE OR TAMPER WITH THE SOLENOID VALVE. ENGINE DAMAGE COULD RESULT.

1. Disconnect solenoid harness. Using 3/4" socket, unscrew solenoid valve (Fig. 17).
2. Remove and discard the three rubber seal rings (Fig. 18). If the lower ring stays in the bottom of the housing solenoid bore, remove with a seal pick.
3. Wash out the solenoid valve with approved cleaning solvent. Use a brush to clean the oil screen. When clean, dry the valve with compressed air.
4. Clean out the solenoid valve bore in the housing. Use clean paper towels. Never use rags, as they may leave lint and residue which can plug the oil passageways.
5. Using new solenoid seal rings, coat them with clean lube oil. Install the upper and center seal ring on the solenoid body and the lower seal ring into the bottom of the solenoid bore in the housing.
6. Be sure the seals are seated properly and carefully screw the solenoid into the housing without unseating the seals. Torque the valve to 15 lb.-ft. (20 N•m). Be careful not to twist the seals while installing (Fig. 19).
7. Reconnect the solenoid wire harness.

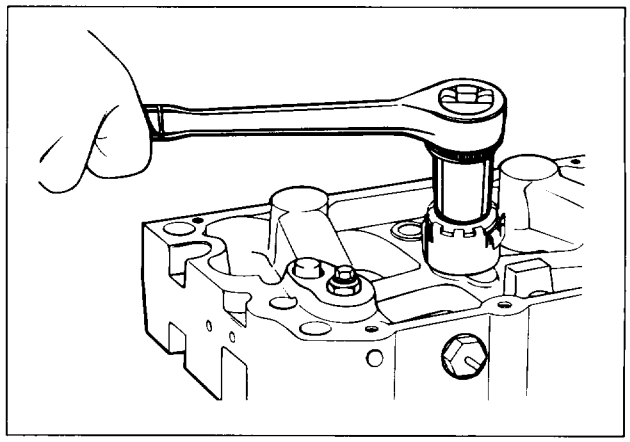


FIG. 17

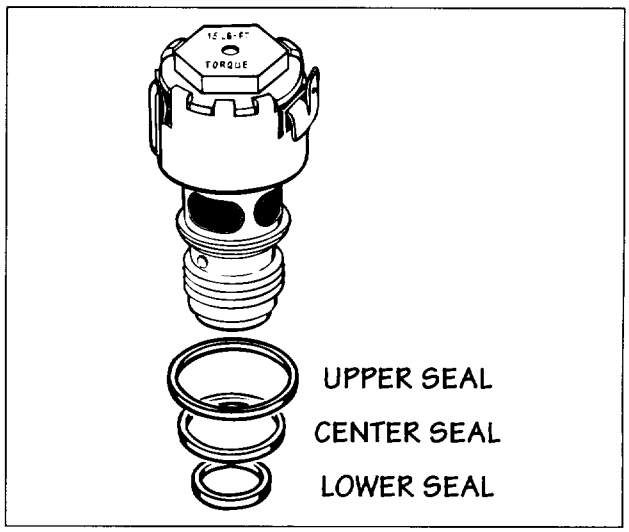


FIG. 18

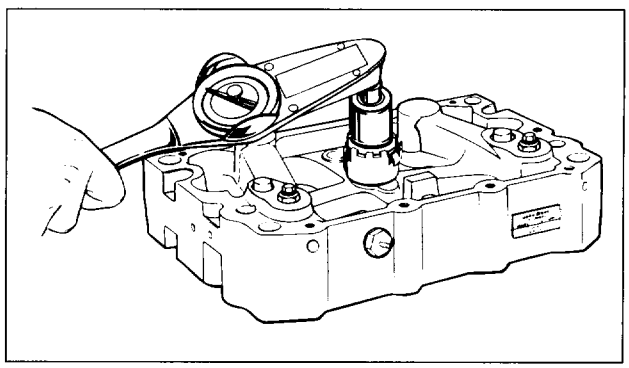


FIG. 19

Auto-Lash® Adjusting Screw

⚠ CAUTION

DO NOT DISASSEMBLE OR TAMPER WITH THE ADJUSTING SCREW. ENGINE DAMAGE COULD RESULT.

1. Loosen the slave piston adjusting screw locknut and remove the slave piston adjusting screw (Auto-Lash) from the housing.

2. Inspect the adjusting screw. The plunger should protrude from the bottom of the screw (Fig. 20). Approximately 10 lbs. (45 N) of force is required to move the plunger.

3. Clean in an approved cleaning solvent or replace the entire screw, as necessary. The screw assembly is not to be serviced in the field.

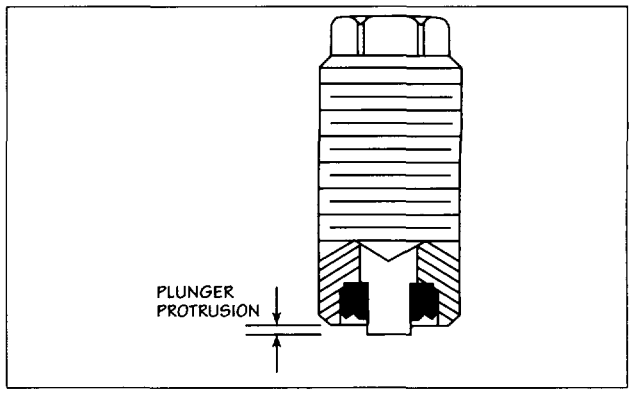


FIG. 20

Master Piston

1. Remove the screw, washer and master piston spring from the bottom of housing.

NOTE:
DO NOT ATTEMPT TO REMOVE THE MASTER PISTON WITHOUT REMOVING THE FLAT SPRING.

2. Remove the master piston from its bore (Fig. 21) using needle-nose pliers to initially pull the piston out, if necessary. If binding occurs, check for burrs or contaminants in lube oil.

3. Clean in an approved solvent. Inspect the hard face surface. Pitted, chipped, cracked or galled pistons should be replaced.

NOTE:
IF THE HARD FACING IS DAMAGED, INSPECT THE CORRESPONDING ROCKER ARM ADJUSTING SCREWS FOR EXCESSIVE WEAR OR PITTING. REPLACE IF DAMAGED.

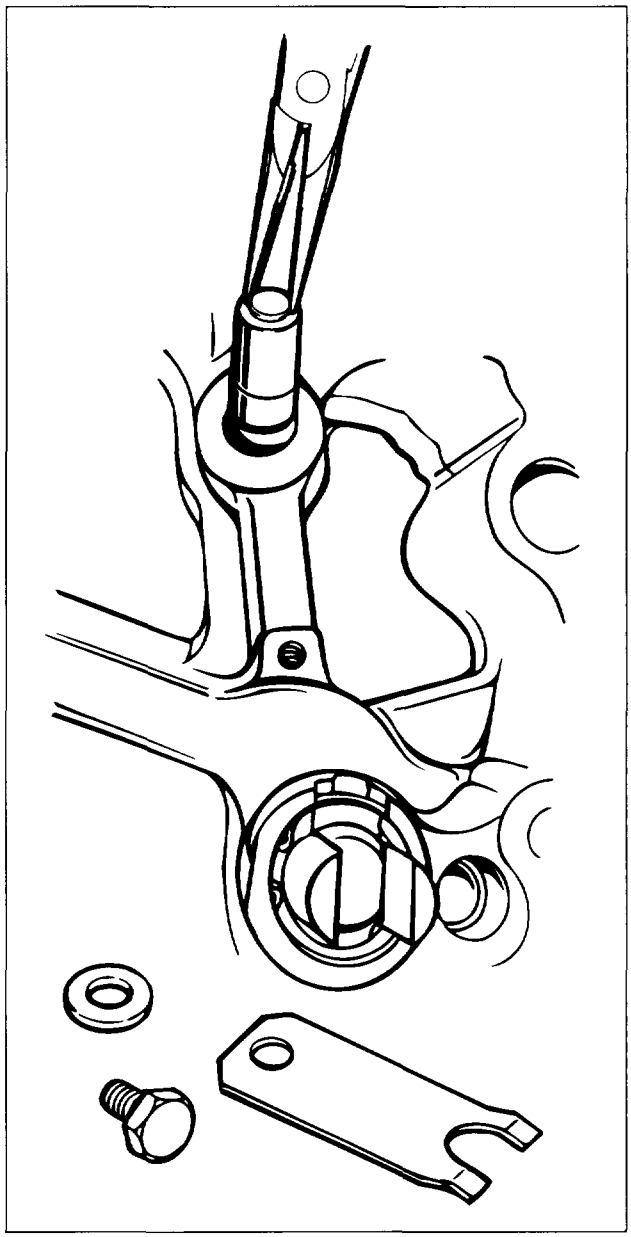


FIG. 21

4. Reassemble in reverse order. When tightening the capscrew, make certain the two spring tabs do not interfere with the sides of the master piston center raised portion (see Fig. 22). Torque the capscrew to 8 lb.-ft. (11N•m).

NOTE:
THE TABS SHOULD BE EQUALLY SPACED FROM THE RAISED PISTON AREA.

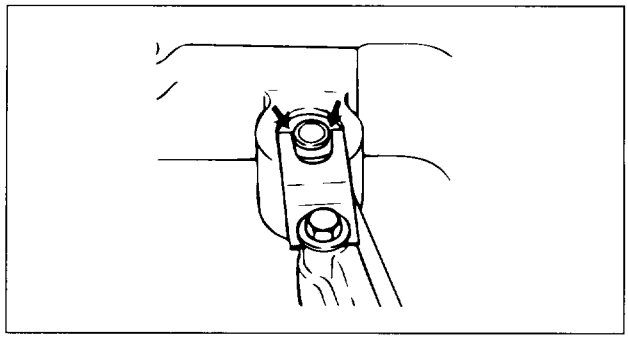


FIG. 22

Slave Piston

⚠ WARNING

WEAR SAFETY GLASSES.

REMOVE SLAVE PISTON CAREFULLY. THE SLAVE PISTON IS RETAINED BY SPRINGS THAT ARE UNDER HEAVY COMPRESSION. IF THESE INSTRUCTIONS ARE NOT FOLLOWED AND PROPER TOOLS NOT USED, THE SPRING COULD BE DISCHARGED WITH ENOUGH FORCE TO CAUSE PERSONAL INJURY.

1. Remove the locknut from the slave piston adjusting screw (Auto-Lash®). Back out the adjusting screw until the slave piston is fully retracted (screw is loose).

2. Place the hole in the slave piston removal tool bracket over the slave piston adjusting screw and center the holder between the slave piston legs (Fig. 23).

3. Turn the handle slowly until the retainer is depressed about 0.040" (1 mm) relieving pressure against the retaining ring.

4. Remove the retaining ring with retaining ring pliers (Fig. 23). Back out the holder until the springs are loose. Remove the tool.

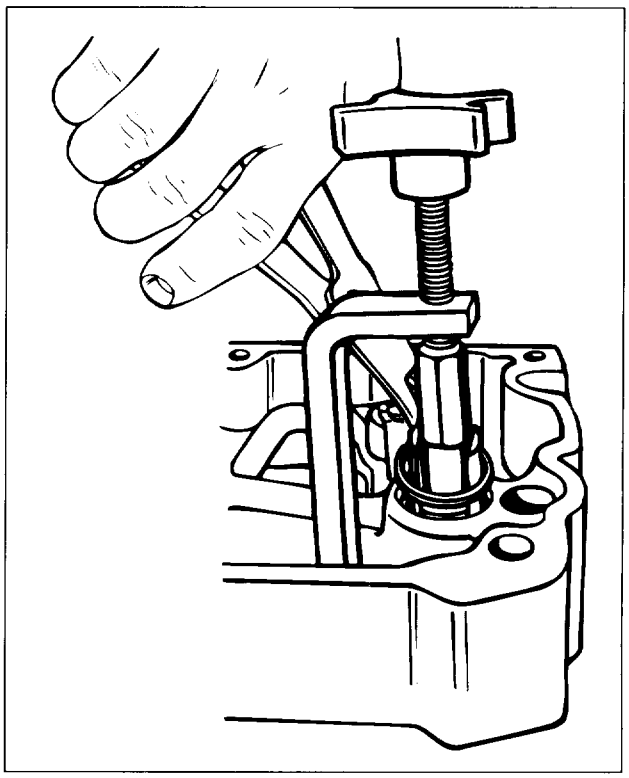


FIG. 23

5. Remove all components. Check for nicks or burrs that could cause binding. Clean in an approved cleaning solvent, or replace as necessary. Replace the piston if the grind surface on the outsie diameter is scratched or scored.

   NOTE:
   BE SURE COMPONENTS ARE REASSEMBLED IN PROPER ORDER (FIG. 24).

6. Install the slave piston into the bore. Install the springs and retainer inside the slave piston.

7. Use the slave piston removal tool to reinstall piston and springs. Be sure retaining ring is placed on the retainer before screwing the removal tool down over the slave piston.

8. Compress the slave piston springs down until the retainer is about 0.040" (1 mm) below the retaining ring groove. Reinstall the retaining ring. Be sure the retaining ring is fully seated in the groove. Rotate retaining ring about 90° away from slot in housing (Fig. 25).

   ⚠ CAUTION

   DO NOT LEAVE OPEN PORTION OF RETAINING RING ALIGNED WITH OPENING IN HOUSING AS THIS WILL PERMIT THE SPRING RETAINER TO BECOME LOOSE DURING ENGINE BRAKE OPERATION. SERIOUS ENGINE DAMAGE WILL RESULT.

9. Remove the tool slowly to insure proper seating of retaining ring.

10. Assemble the locknut; do not tighten.

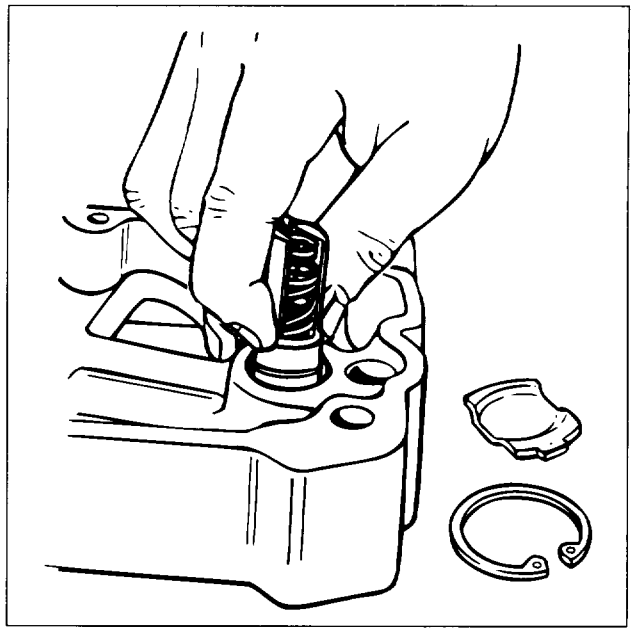


FIG. 24

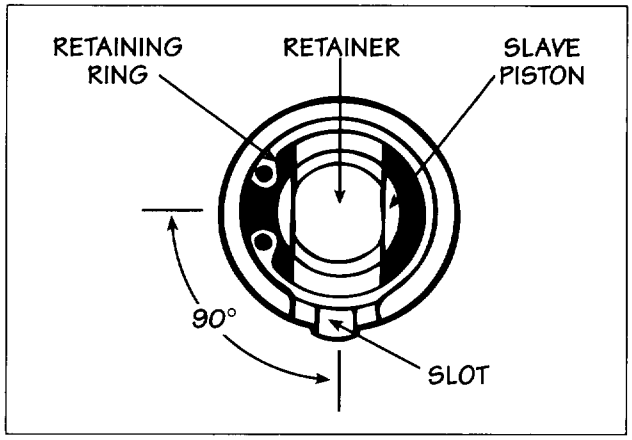


FIG. 25

Cummins Engine Company, Inc.
Box 3005
Columbus, IN 47202-3005
U.S.A.

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