



Installation Manual For N14 Plus Engines



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Safety Precautions

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.



THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.



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.



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

THE C BRAKE 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
3. 3/4" socket for solenoid
4. 7/8" crowfoot wrench for Robo-Lash™ adjusting screw nut
5. 3/8" hex socket or open-end wrench for Robo-Lash™ adjusting screw
6. 7/16" hex socket for master piston capscrew

NOTE:

NO ENGINE CONVERSION PARTS ARE REQUIRED FOR MODEL 455B AND 455C INSTALLATIONS ON N14 PLUS CUMMINS ENGINES.

Application Notes



THE C BRAKE BY JACOBS™ MODEL 455B AND 455C ENGINE BRAKES ARE FOR USE ON CUMMINS N14 PLUS ENGINES **ONLY**. CONSULT YOUR LOCAL CUMMINS DISTRIBUTOR OR DEALER TO VERIFY YOUR ENGINE CPL IS AN N14 PLUS ENGINE. MISAPPLICATION COULD RESULT IN ENGINE AND/OR ENGINE BRAKE DAMAGE. REFER TO CUMMINS BULLETINS AND INSTRUCTIONAL LITERATURE FOR SPECIFIC APPLICATION INFORMATION.

NOTE:

MODEL 455A WAS FORMERLY USED ON 1995 AND LATER N14 PLUS 310E - 370E ESP I & ESP II ENGINES. MODEL 455A HAS BEEN DISCONTINUED AND SUPERCEDED BY MODEL 455B. MODEL 455A ENGINE BRAKES CAN BE UPGRADED TO MODEL 455B BY CHANGING THE ROBO-LASH™ TO CUMMINS P/N 3871699 AND MARKING THE NAMEPLATE TO INDICATE THE CHANGE TO MODEL 455B.

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 a CBrake by Jacobs™ gasket on each of the three rocker lever housings (Fig. 3).

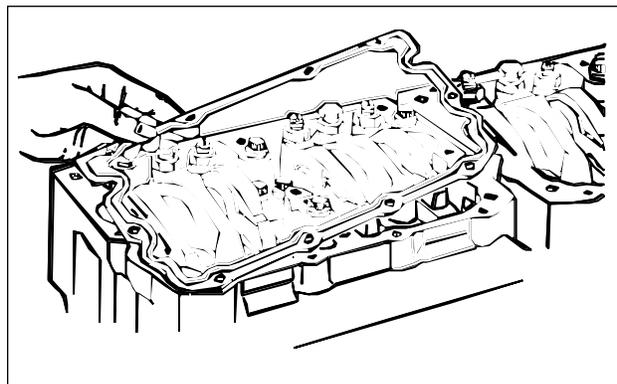


FIG. 1

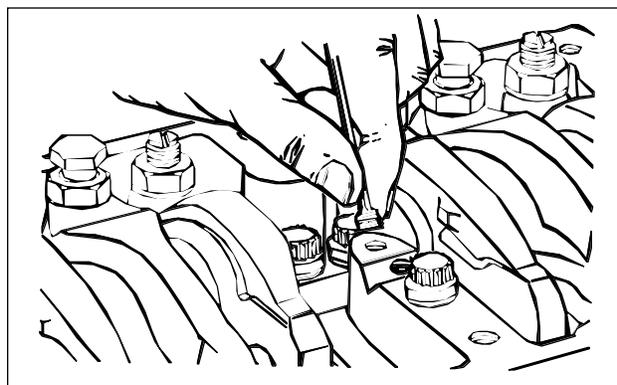


FIG. 2

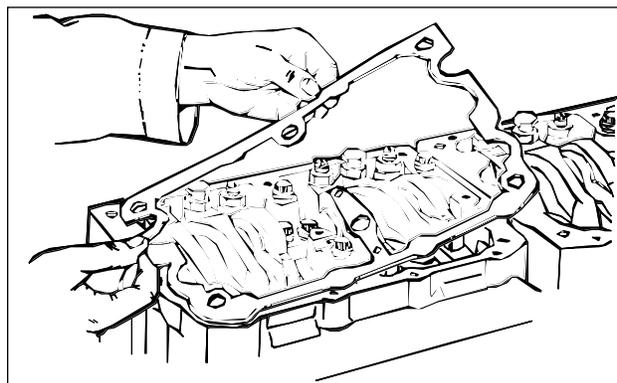


FIG. 3

Section 3: Housing Installation

Before installing the housings, back out the slave piston adjusting screws (Robo-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 mounting screws in steps, following the sequence illustrated in Fig. 5. First tighten to 35 lb.-ft. (48 N•m), then to 70 lb.-ft. (95 N•m).



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

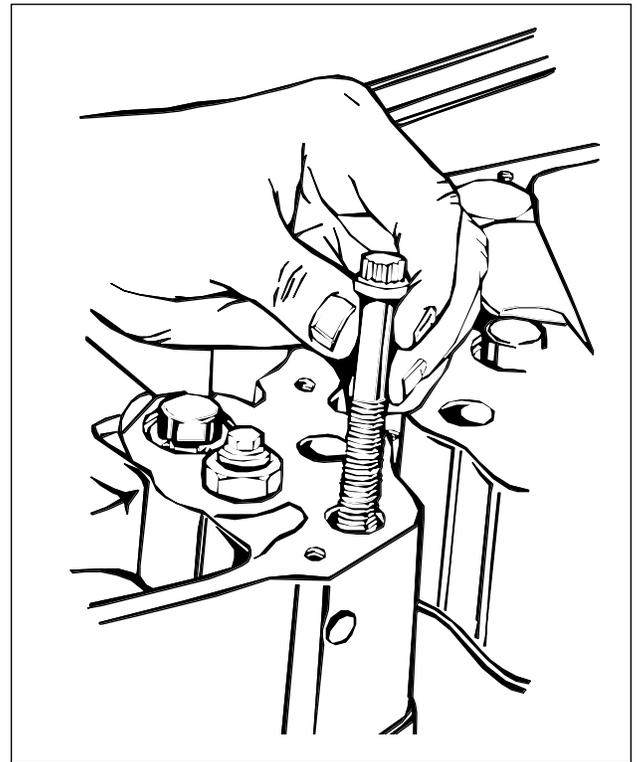


FIG. 4

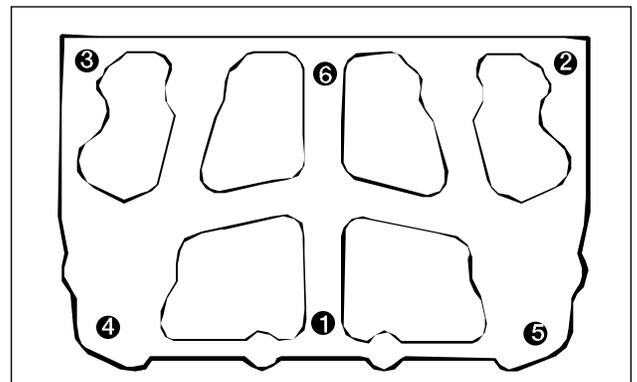


FIG. 5

Slave Piston Adjustment

Feeler Gage Method

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

The feeler gage, Cummins P/N 3871534, has 0.023" feeler stock on both ends. One end can be used on cylinders 1, 3 and 5; the other end can be used for cylinders 2, 4 and 6 (see Figs. 6 and 7).



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 (Robo-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. (34 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.

Dial Indicator Method

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

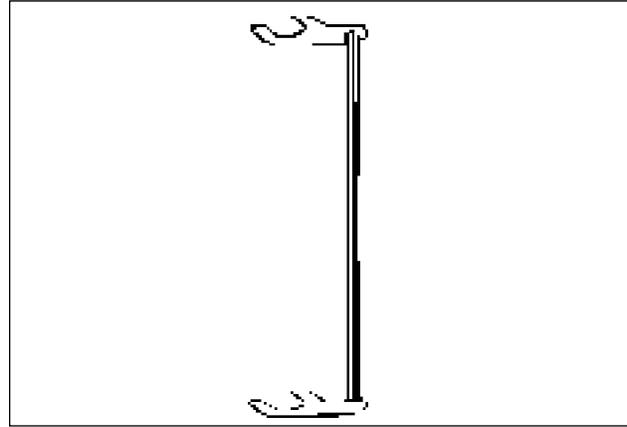


FIG. 6

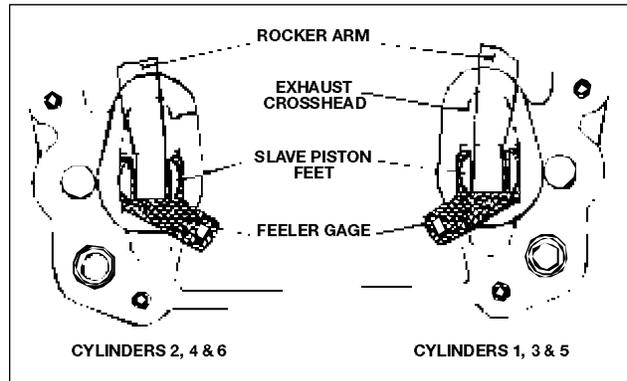


FIG. 7

Use a standard dial indicator with a magnetic base. Follow the steps below for proper slave piston adjustment:

1. Using a standard 3/8" hex wrench, turn the adjusting screw (Robo-Lash™) clockwise until the slave piston hits the crosshead.
2. Position the dial indicator stem centered over the hex on the adjusting screw. Zero out the dial indicator.
3. Using an open-end wrench, turn the adjusting screw counterclockwise until 0.023" is indicated on the dial.
4. Using a crowfoot wrench, tighten the hex nut to 25 lb.-ft. (34 N•m) (see NOTE in Feeler Gage Method Adjustment).

Continue adjusting the remaining slave pistons where the exhaust valves are closed.

Section 4: Electrical Installation

N14 Plus engines require an ON/OFF dash switch (with gold-plated contacts) and a 3-position dash switch (with gold-plated contacts) (Fig. 8). Install the dash switches in a convenient location on the dashboard.

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

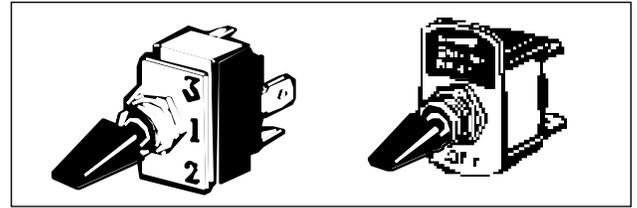


FIG. 8

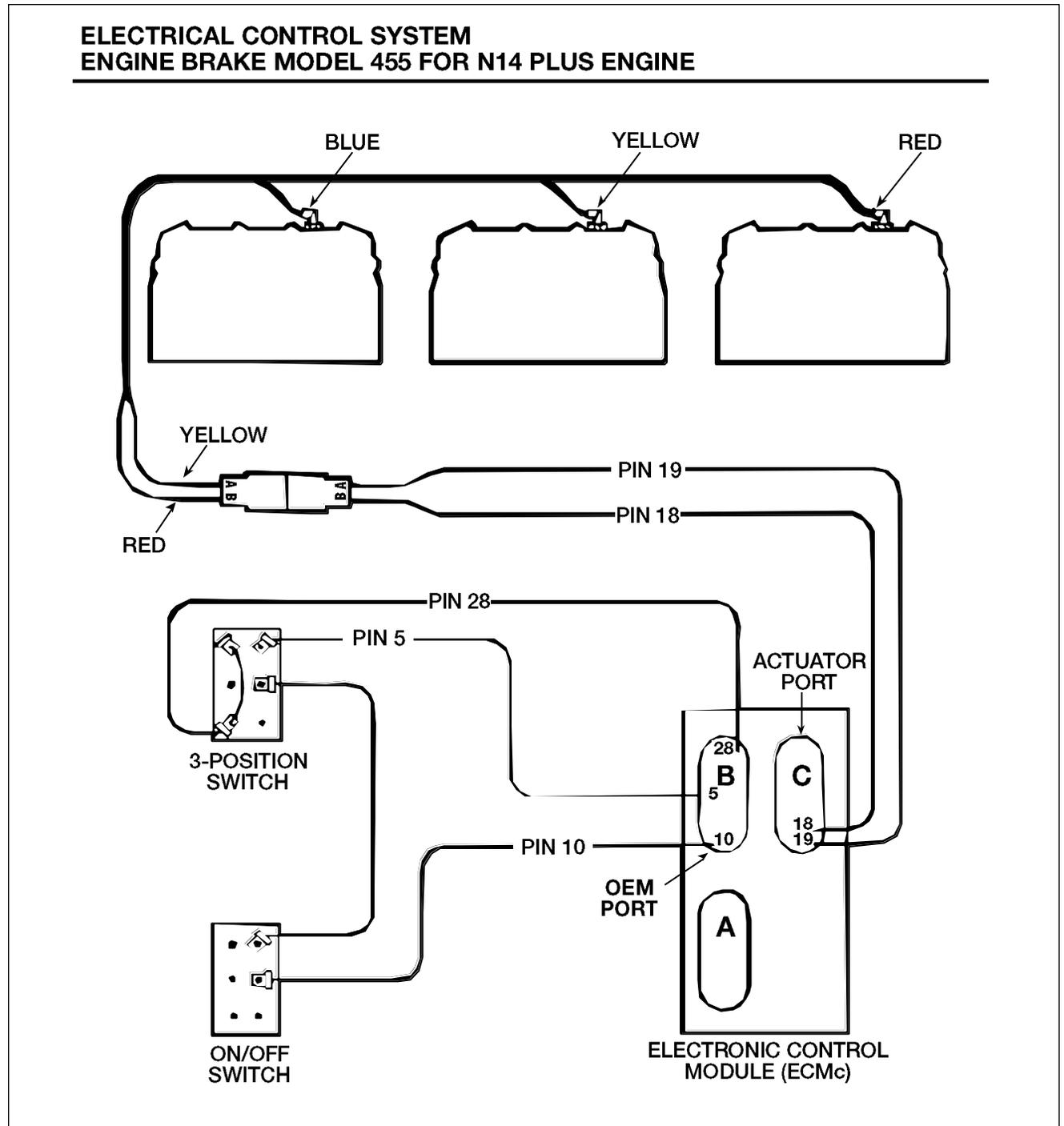


FIG. 9

Section 5: Brake Operation Check

Bleed Brake Housings



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.

1. Assure that the control wires are connected to the electrical connector in the engine brake housings (Fig. 10).
2. To bleed the brake us and check their operation, start the engine and allow to run 5 to 10 minutes. With the engine brake switch off, accelerate engine to approximately 1800 RPM. Release 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 RAG OVER THE CONTROL VALVE COVERS TO REDUCE OIL SPRAY.

3. To check the electrical system on N14 Plus engines, leave engine running. Put selector switch in position 1 and turn the ON/OFF switch to ON. The N14 Plus low-speed shut off prevents the engine brake from coming on at idle. Accelerate engine to approximately 1800 RPM and release the throttle. In position 1, the center brake housing solenoid should operate. Repeat this procedure for positions 2 and 3. In position 2, the front and rear brake housing solenoids should operate; in position 3, all three brake housing solenoids should operate. Shut down engine.
4. Reinstall the Cummins rocker lever cover gaskets, making sure the word "top" is facing up (Fig. 12). Replace rocker covers and all previously removed parts. Torque rocker lever cover screws to 9 lb.-ft. (12 N•m).

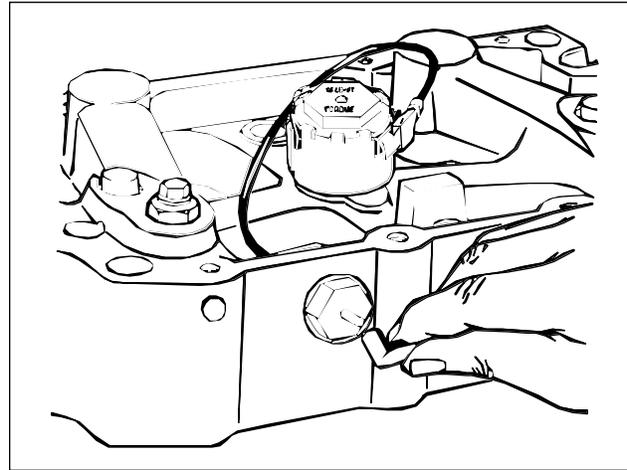


FIG. 10

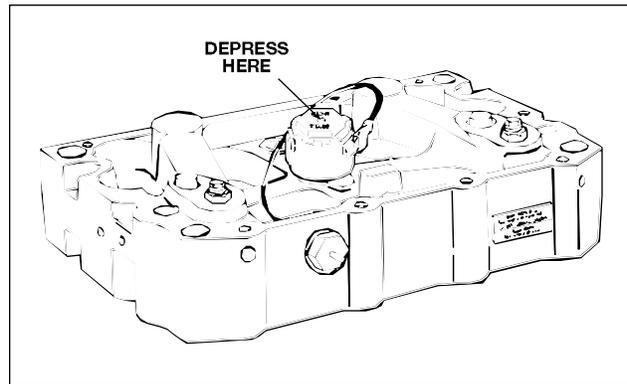


FIG. 11

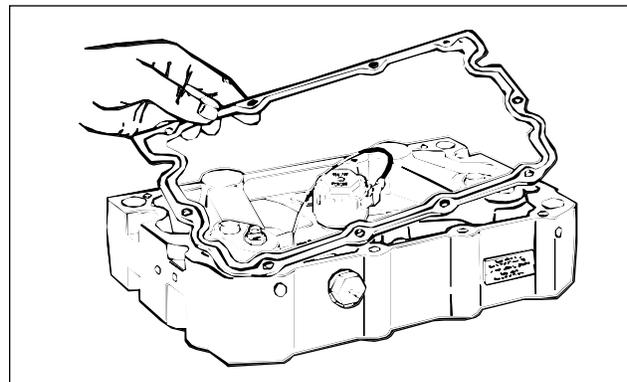


FIG. 12

Section 6: Brake Maintenance

Theory of Operation

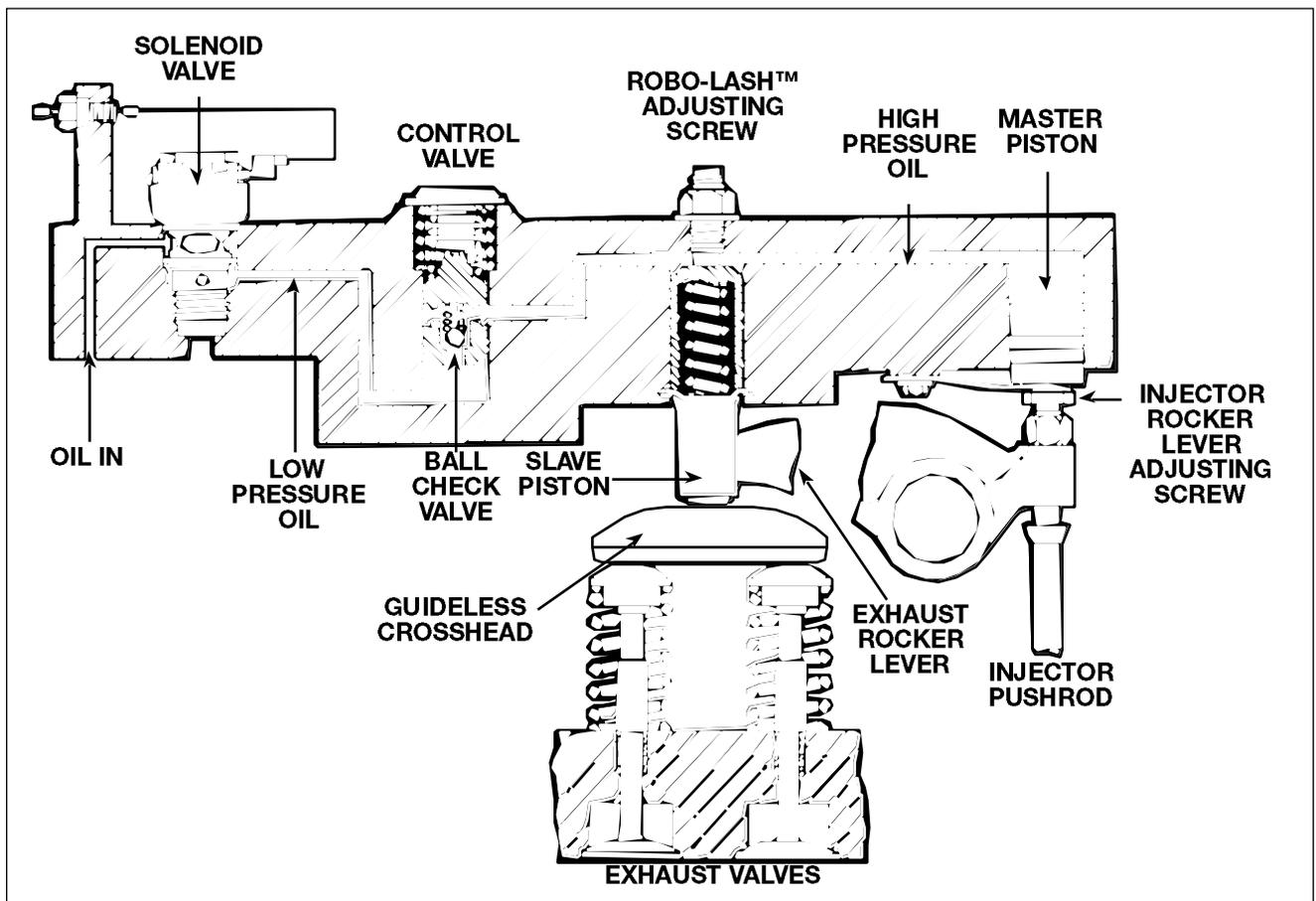
Energizing the engine brake effectively converts a power-producing diesel engine into a power-absorbing air compressor. This is accomplished through motion transfer using a master/slave piston arrangement which opens cylinder exhaust valves near the top of the normal compression stroke, releasing the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

Use the following procedures to keep the engine brake in top condition.



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



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 (see Fig. 14). Remove retaining ring using retaining ring pliers.
2. Slowly remove the control valve cover until spring pressures ceases; then, remove the control valve springs and collar.

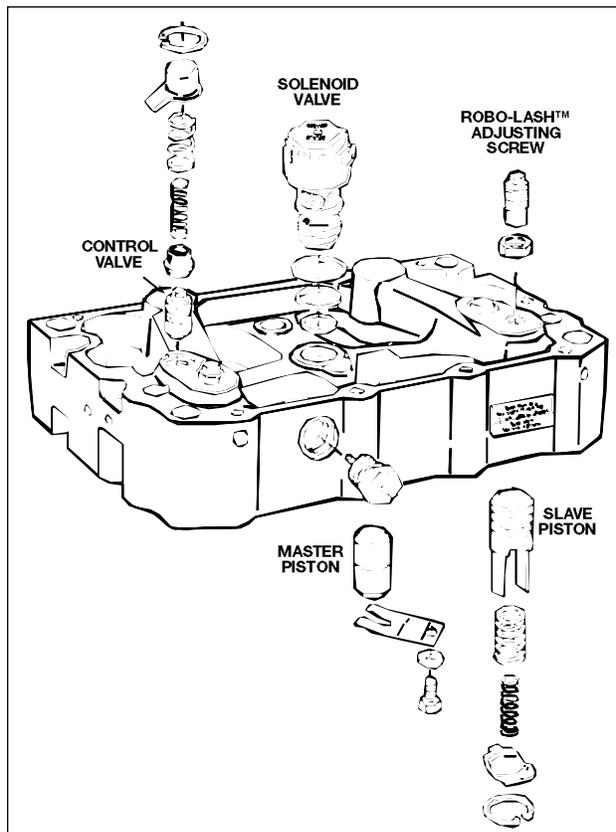


FIG. 13

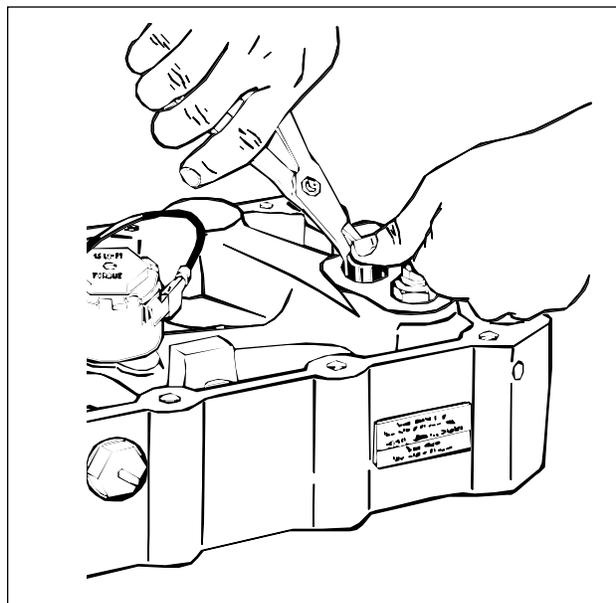


FIG. 14

3. Using needle-nose pliers, remove the control valve (see Fig. 15).
4. 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.
5. Thoroughly clean the control valve bore in the housing using clean paper towels. Dip the control valves in clean lube oil and replace the valve into its bore. If binding occurs, replace the control valve.
6. Reassemble in reverse order the springs, collar (note the proper direction from Fig. 16), cover and retaining ring. Rotate retaining ring at least 90° from slot in the housing.

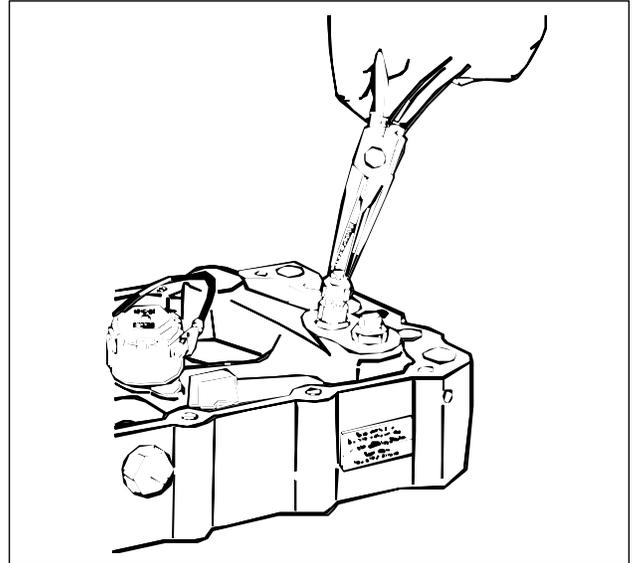


FIG. 15

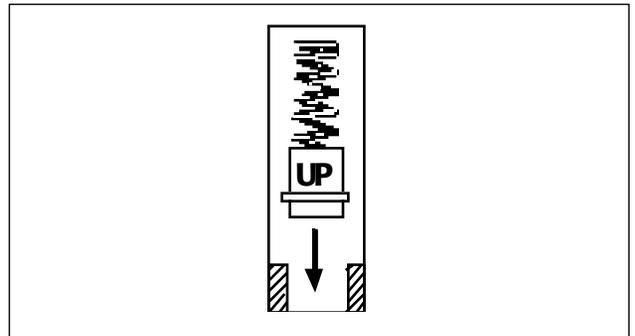


FIG. 16

Solenoid Valve



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

1. Disconnect the solenoid harness. Using 3/4" socket, unscrew solenoid valve.
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) (Fig. 19). Be careful not to twist the seals while installing.
7. Reconnect the solenoid wire harness.

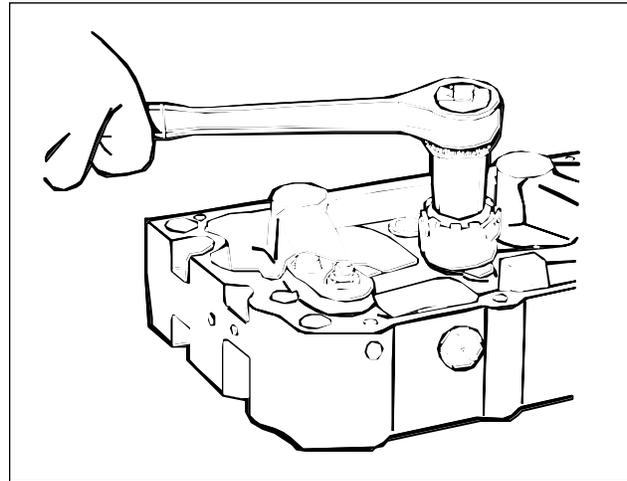


FIG. 17

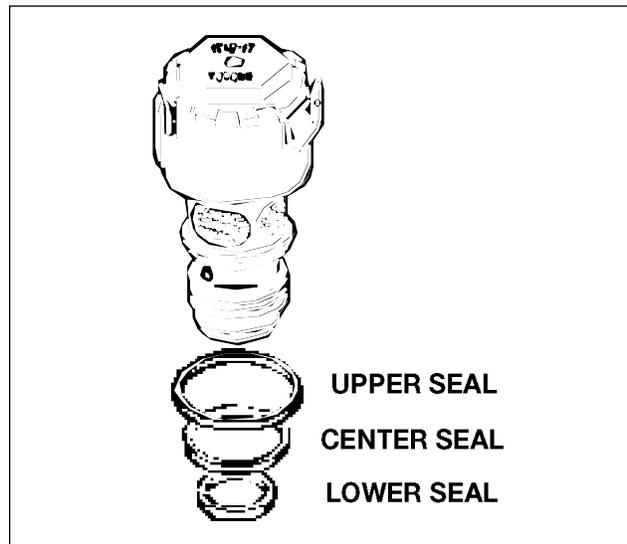


FIG. 18

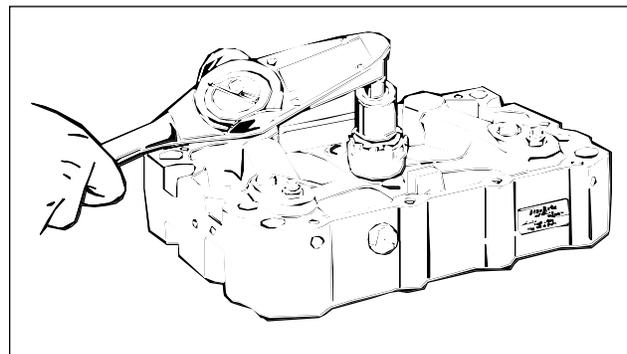


FIG. 19

Robo-Lash™ Adjusting Screw



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

1. Loosen the adjusting screw locknut and remove the adjusting screw (Robo-Lash™) from the housing.
2. Inspect the adjusting screw. The cup should move freely (Fig. 20). Approximately 10 lbs. (45 N) force is required to move the cup. The bottom center area on the cup should be free of nicks. Check the hole in the bottom of the cup to see that it is not plugged.
3. The top of the slave piston (within 0.50" of center) should be smooth and free of nicks (this is a sealing surface.)
4. Clean in an approved cleaning solvent or replace the entire adjusting screw, if necessary. The adjusting screw assembly is not to be serviced in the field.

Master Piston

1. Remove the hex-head capscrew, washer and master piston flat 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 assembly with ceramic insert from its bore (see Fig. 21). If binding occurs, check for burrs or contaminants in the lube oil. Be careful not to chip the ceramic insert edges.
3. Clean in an approved solvent. Inspect the master piston. Pitted, chipped, cracked ceramic inserts and/or galled pistons should be replaced.

NOTE:

THE CERAMIC INSERT IS NOT REPLACEABLE. IF CERAMIC IS DAMAGED, INSPECT THE CORRESPONDING ROCKER ARM ADJUSTING SCREWS FOR EXCESSIVE WEAR OR PITTING. REPLACE IF DAMAGED.

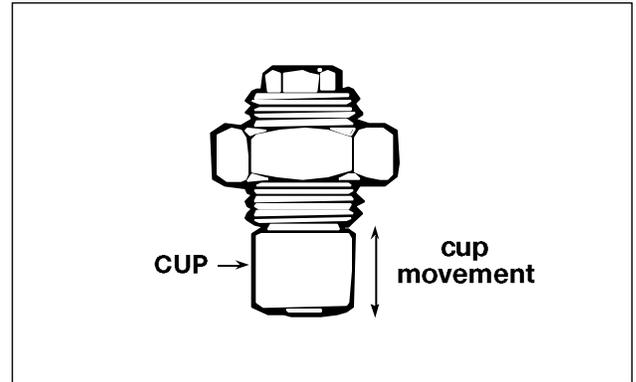


FIG. 20

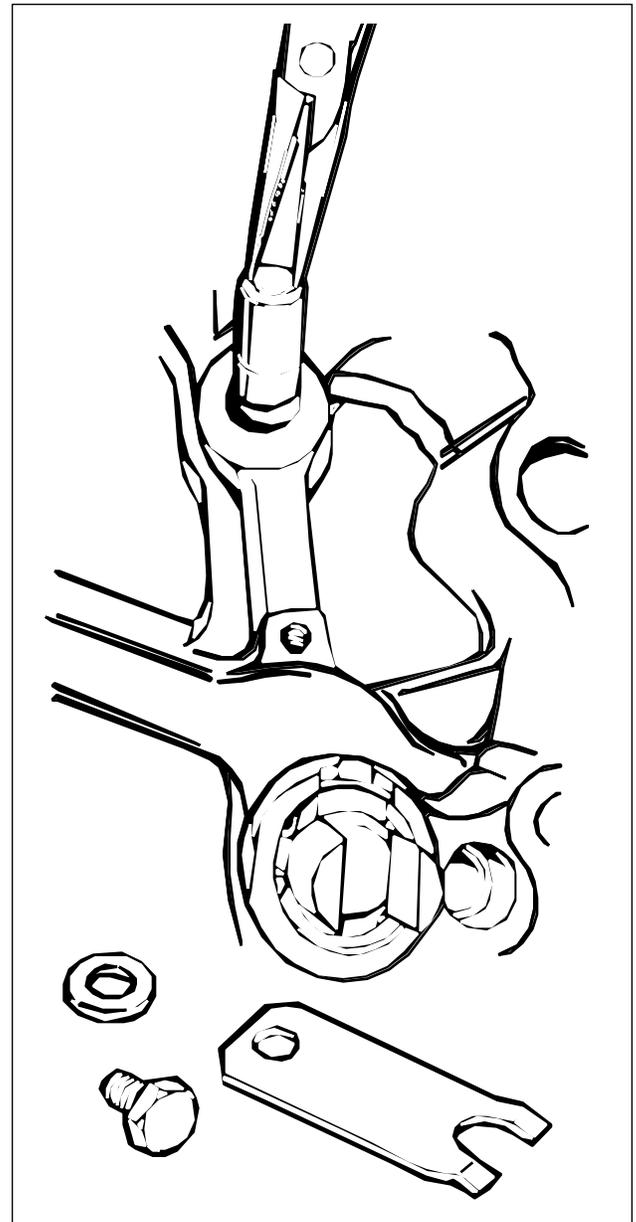


FIG. 21

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

NOTE:

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

Slave Piston



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.

Loosen and remove the adjusting screw locknut. Back out the adjusting screw until the slave piston is fully retracted (screw is loose) (Fig. 23).

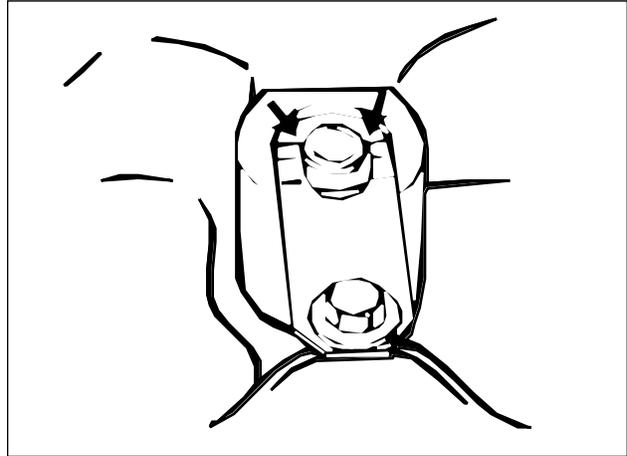


FIG. 22

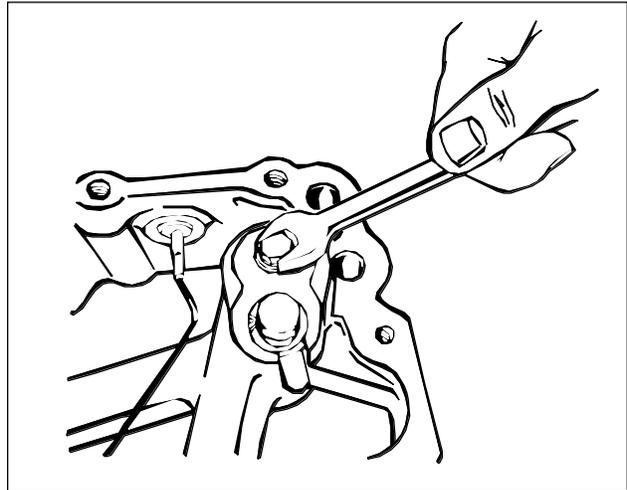


FIG. 23

Use the slave piston removal tool with the following procedure to remove and replace the slave piston.

1. Place the hole in the removal tool bracket over the adjusting screw. Place the screw end between the slave piston legs (Fig. 24).
2. Turn the handle slowly until the retainer is depressed about 0.040" (1 mm), relieving the pressure against the retaining ring.
3. Remove the retaining ring with retaining ring pliers (Fig. 24). Back out the removal tool until the springs are loose. Remove the tool.
4. Remove the retainer, springs (2) and slave piston. Check for nicks or burrs that could cause binding.
5. Clean the piston in an approved cleaning solvent. Replace the piston if the ground surface on the outside diameter is scratched or scored.

NOTE:

BE SURE COMPONENTS ARE REASSEMBLED IN PROPER ORDER (FIG. 25).

6. Install the slave piston into the bore. Install the springs and retainer inside the slave piston.
7. Use the removal tool to reinstall the piston and springs. Be sure the 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 the retaining ring about 90° away from the slot in the housing (Fig. 26).



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

9. Remove the removal tool slowly to insure proper seating of retaining ring.
10. Assemble the locknut. Do not tighten.

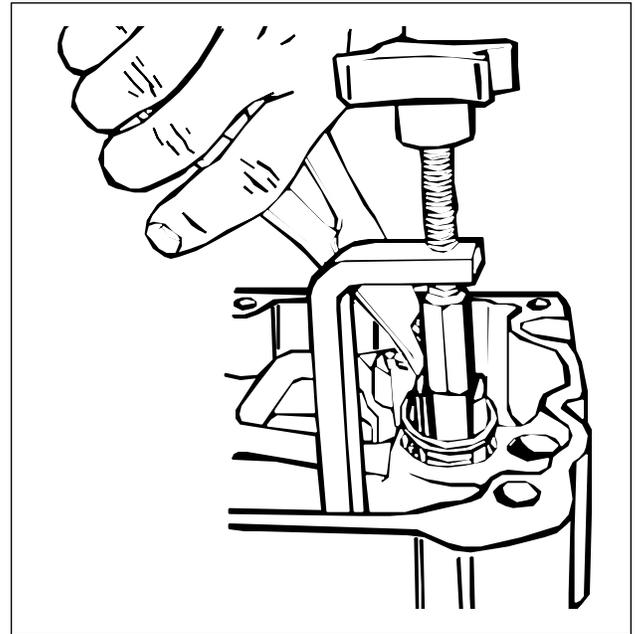


FIG. 24

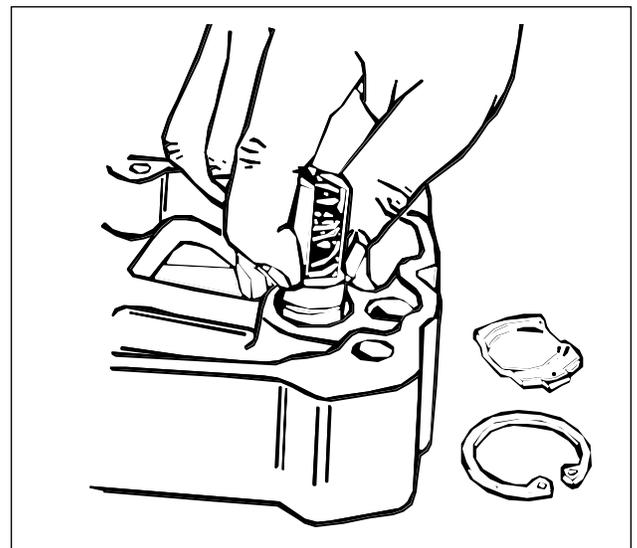


FIG. 25

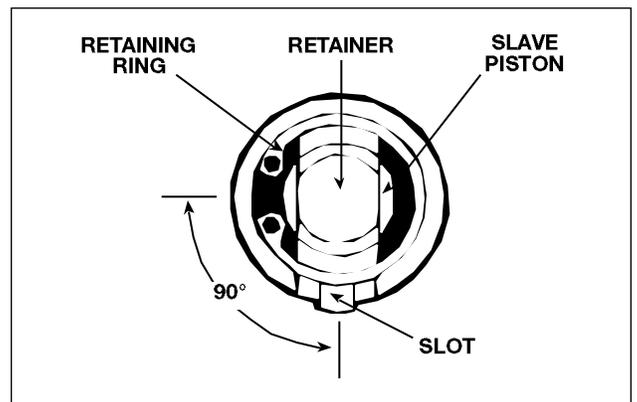


FIG. 26



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Bulletin 3698823
Printed in U.S.A. 12/97

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