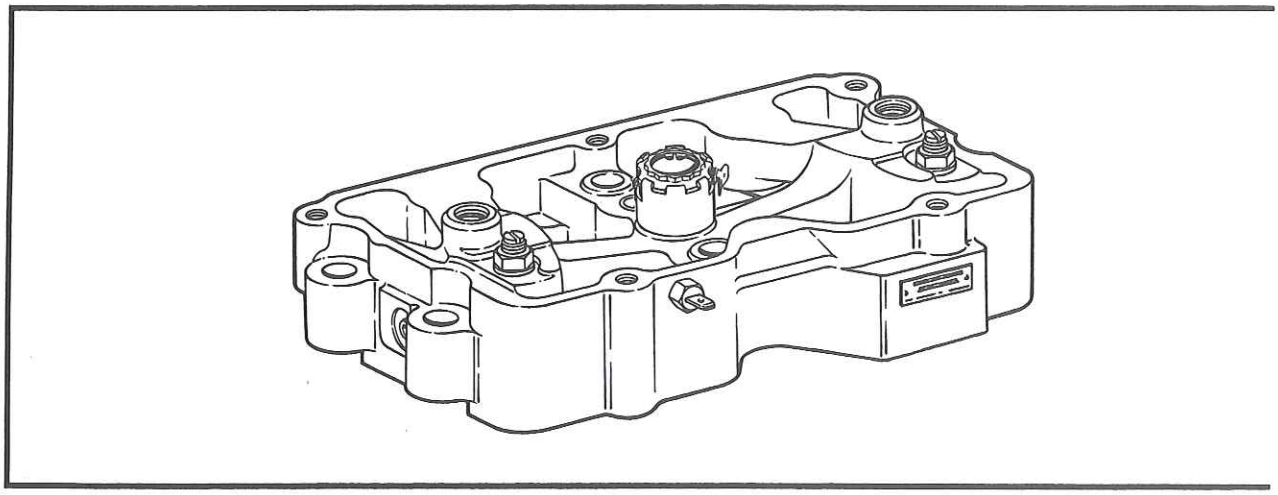
Installation Manual for Engine Brake Model 425A



The Model 425A *Jake Brake*® is designed and approved for use on Cummins pre-88/89 Small Cam and Big Cam NH/NT engines.

Model 425A replaces Models 420 and 425. Installation and maintenance information for all three models is contained in this manual.

For specific application and slave piston adjustment information, refer to *Jacobs* Service Letter No. 342, Rev. A.

⚠WARNING

See Jacobs Driver's Manual for proper engine brake driver techniques

The *Jake Brake* 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.

Information contained in this manual was current at the time of printing and is subject to change without notice or liability.

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Printed in U.S.A. 6/91

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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.

⚠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 wear eye protection. Always use correct tools and proper procedures as outlined in this manual.

SECTION 1
INTRODUCTION

Housing Identification

Each housing assembly is identified by a name tag which shows the model number and part number. The housing serial number is stamped on the top surface of the housing. See Fig. 1.

Housing Assemblies (Pkg)	P/N
420 (12 VDC)	014491
420 (24 VDC)	014587
425 (12 VDC)	015860
425 (24 VDC)	015940
425 (12 VDC)	016632
425 (24 VDC)	016646
425 (24 VDC Dual Lead)	016651
425A (12 VDC)	016656
425A (24 VDC)	016660
425A (24 VDC Dual Lead)	016667

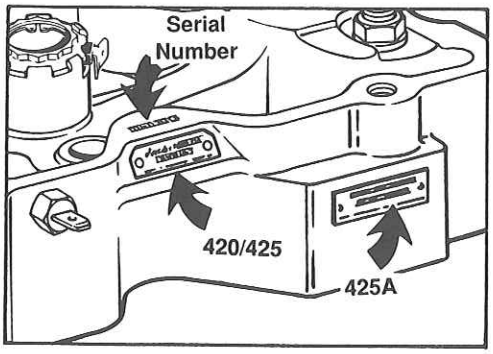

Fig. 1

The Model 425A is the current production engine brake for all Cummins 855 cu. in. engines except the 88/89NH/NT and 91 N14. The other engine brakes listed above are for service replacement. Consult the Model 420/425A parts manual for specific parts identification. Refer to Service Letter 342, Rev. A for specific application information.

Recommended Torque Values

Exhaust Valve Crosshead Adjusting Screw Locknuts	25 lbft. (35 N•m)
Rocker Housing Studs	70 lbft. (95 N•m)
Engine Brake Hold-down Nuts	60 lbft. (80 N•m)
Slave Piston Adjusting Screw Locknuts	25 lbft. (35 N•m)
Rocker Lever Adjusting Screw Locknuts	45 lbft. (60 N•m)

Special Tools

Jacobs Tools

Feeler Gauge, P/N 003087 (.018 in.)
Feeler Gauge, P/N 015877 (.030 in.)
Feeler Gauge, P/N 015878 (.037 in.)
Slave Piston Clamp Fixture, P/N 017397

Cummins Tool

STC Tappet Setting Tool, PN 3822648
Injector Torque Wrench, PN 3376592

General Tools

Crowfoot Wrench 9/16 in.
Crowfoot Wrench 5/8 in.
Extra Deep Socket 5/8 in.

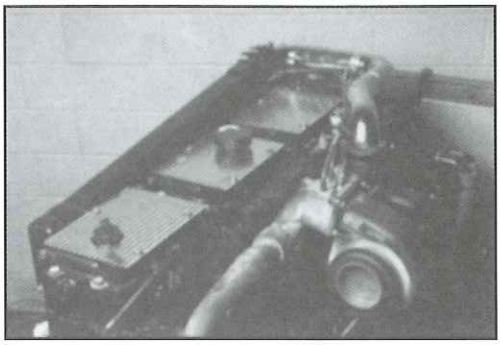

Fig. 2

SECTION 2
ENGINE PREPARATION

Before installing the engine brake, engine identification must be established to insure that the correct model engine brake is installed on the engine. The engine used throughout this installation manual is an NTC-444, CPL 821.

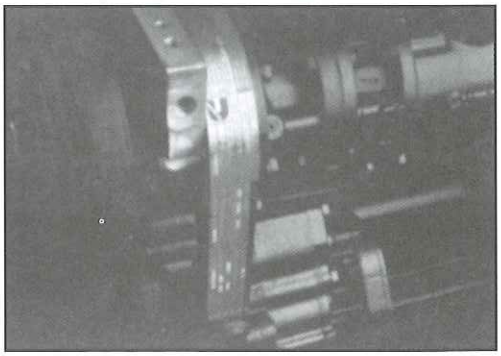

Fig. 3

The engine CPL number is stamped on the identification tag located on the engine gear case mounting flange (Fig. 3). Be sure the correct engine brake model is installed on the engine.

Clean engine thoroughly before removing the rocker housing covers and gaskets.

Injector and Valve Set Position

Prepare the engine for injector, valve and slave piston adjustments that will be done later on.

The following instructions are from the Cummins Service Manual:

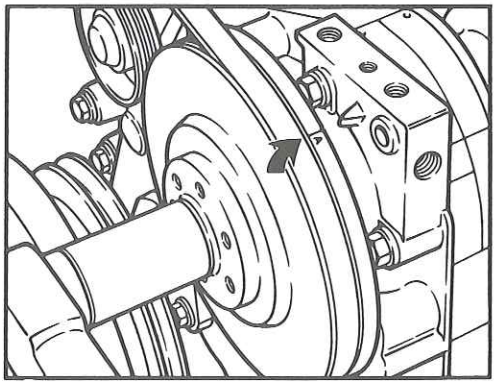

Fig. 4

1. Turn the crankshaft in the direction of rotation until the "A" mark is aligned with the pointer on the gear cover. See Fig. 4.

2. When "A" mark is aligned with the pointer, the intake and exhaust valves should be closed for cylinder number 5. The injector plunger for cylinder number 3 must be at the top of its travel; if not, turn the crankshaft another 360 deg. and realign the "A" mark with the pointer.

3. When the valves for cylinder number 5 are closed, the rocker levers for cylinder number 5 will be loose. Valve set marks used for this instruction were chosen for convenience. With experience, any valve set mark may be used as a starting point.

NOTE:
See table on page 8 for valve and injector adjustment sequence.

Loosen the locknuts on the exhaust and injector rocker lever adjusting screws (Fig. 5).

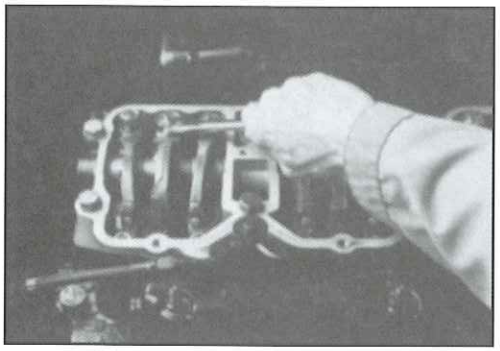

Fig. 5

Remove adjusting screws from exhaust and injector rocker levers.

NOTE:

Current production Cummins NH/NT engines have exhaust rocker levers with narrow pads designed to fit between the legs of the engine brake slave piston.

(A) If the rocker lever pads are not narrow as shown in Fig. 6, then...

(B) The rocker boxes must be removed and the exhaust rocker levers modified. Follow the instructions on page 20 in the maintenance section of this manual.

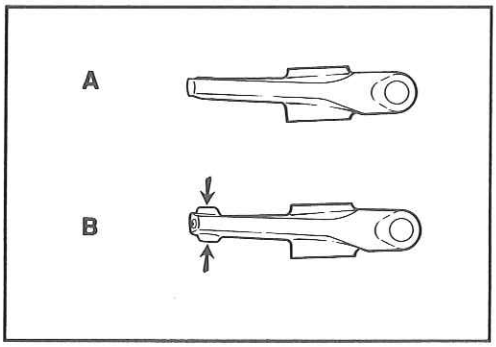

Fig. 6

Move exhaust push rod aside and rotate rocker lever upward.

Remove the Cummins exhaust crossheads and install Cummins adjusting screws and locknuts into *Jacobs* crossheads (Fig. 7).

NOTE:

When replacing old crossheads with new *Jacobs* crossheads, use new Cummins adjusting screws and locknuts.

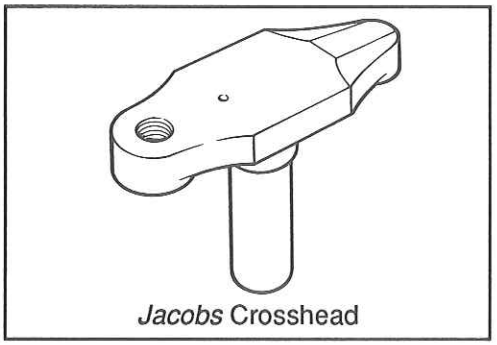

Fig. 7 *Jacobs* Crosshead

Crosshead Screw Adjustment

Install *Jacobs* crossheads and adjust as follows:

1. Lubricate the valve stems and the crosshead guide with clean lube oil.

2. Install the crossheads onto the crosshead guides. The adjusting screw must be toward the exhaust manifold.

3. Hold the crosshead down against the valve stem that is nearest the push rod. Turn the adjusting screw clockwise until it touches the valve stem (Fig. 8).

4. Hold the screw in this position and torque the locknut to 25 lbft. (35 N•m).

5. Continue adjustment of the remaining exhaust valve crossheads following the same procedure.

NOTE:

Crosshead adjustment should always be made before attempting to adjust the valves.

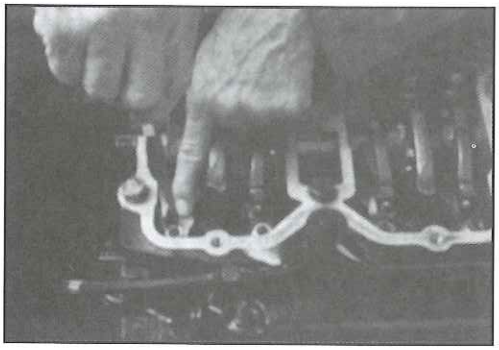

Fig. 8

NOTE:

When ST-669 Torque Wrench Adapter is used, tighten locknut to 22 lbft. (30 N•m).

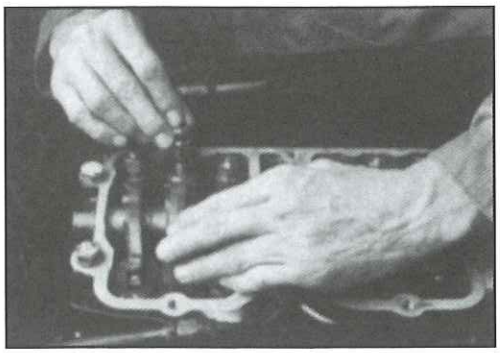

Fig. 9

Reinstall the Cummins exhaust rocker adjusting screw and locknut into rocker lever. Locate adjusting screw into push rod socket. See Fig. 9.

Install the Cummins locknut on the *Jacobs* injector adjusting screw and install into injector rocker lever.

Injector Adjusting Screws

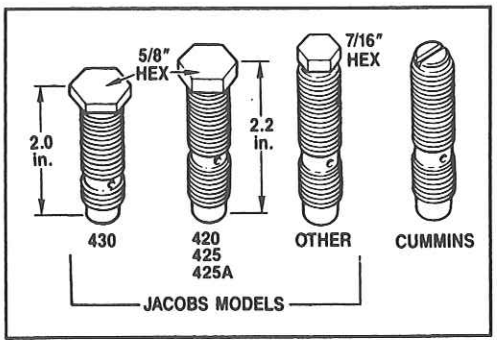

Fig. 10

NOTE:
The *Jacobs* injector adjusting screws for the Models 420, 425 and 425A Engine Brakes are different from adjusting screws used in other engine brake applications (Fig. 10). Be sure the correct adjusting screw is installed.

⚠CAUTION

These screws are not interchangeable. Installation of the wrong screw will result in engine and engine brake damage.

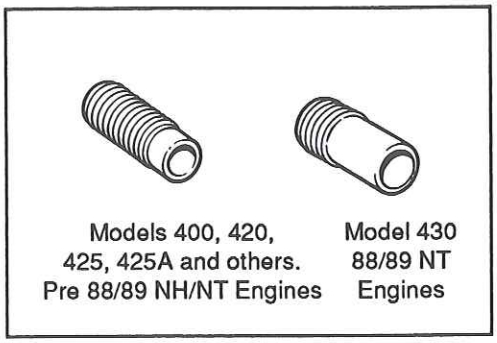

Fig. 11

Jacobs Oil Supply Screws

NOTE:
There are currently two different styles of *Jacobs* oil supply screws in use for Cummins NH/NT applications. Be sure the correct style screw is installed. See Fig 11.

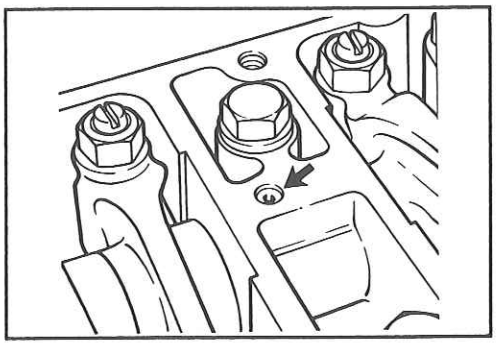

Fig. 12

Remove the Cummins solid rocker shaft locking screw and install the *Jacobs* hollow oil supply screw from kit.

Be sure top of screw is below the flat surface on rocker housing (Fig. 12).

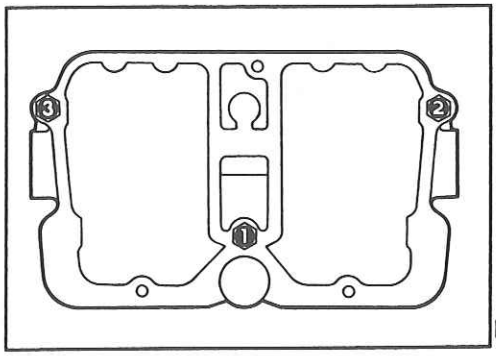

Fig. 13

Remove the rocker housing capscrews from positions 1, 2 and 3 of each rocker housing (Fig. 13).

NOTE:
Do not remove all six capscrews at the same time. If this is done, the rocker gasket seal will be disturbed and a new rocker housing gasket must be installed.

Install special steel washers from kit into each hold-down bolt hole (Fig. 14). Put leading edge of washer into hole and press in firmly until washer is seated. DO NOT use flat washers that were used with the rocker housing capscrews.

NOTE:
DO NOT use special steel washers at positions 2 and 5 of the front housing, IF the fan brace is located on top of the rocker housing.

Refer to Fig. 16 for proper stud location and torque sequence.

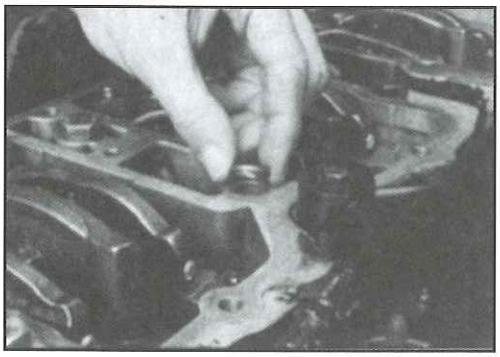

Fig. 14

Tighten studs in sequence to 30 lbft. (40 N•m), then retorque to 70 lbft. (95 N•m).

⚠CAUTION

Use of power tools may result in overtightening of hold-down studs. Engine and engine brake failure will result.

Remove the rocker housing capscrews from positions 4, 5 and 6. Install special steel washers and hold-down studs. Torque to 30 lbft. (40 N•m), then retorque to 70 lbft. (95 N•m).

Refer to Fig. 16 for location of optional length studs that may be required for accessory equipment.

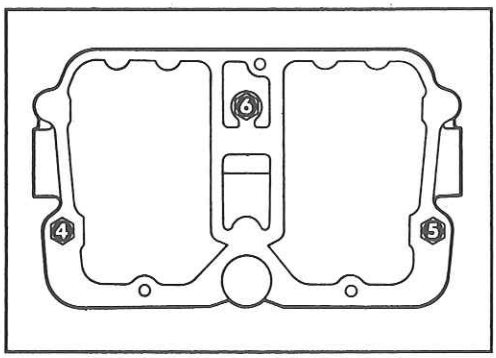

Fig. 15

Stud Location and Torque Sequence

There are 18 extension studs of three different lengths and up to eight spacers supplied in the stud and spacer groups. Refer to the *Jacobs* Parts Manual for various available combinations.

Stud and spacer locations and torquing sequences for the most common installations are as follows:

- ■ PN 013542 Stud 8 1/8 in. (6)
- ● PN 001199 Stud 7 in. (12)
- ○ PN 001234 Spacer (4)
  PN 013540 Stud 8 5/8 in. (Optional for special applications)

NOTE:
Special steel washers, P/N 002514, are used on the aluminum rocker housings to prevent distortion of the holes. If the fan brace is positioned on top of the front rocker housing, the two special steel washers are not required in positions 2 and 5.

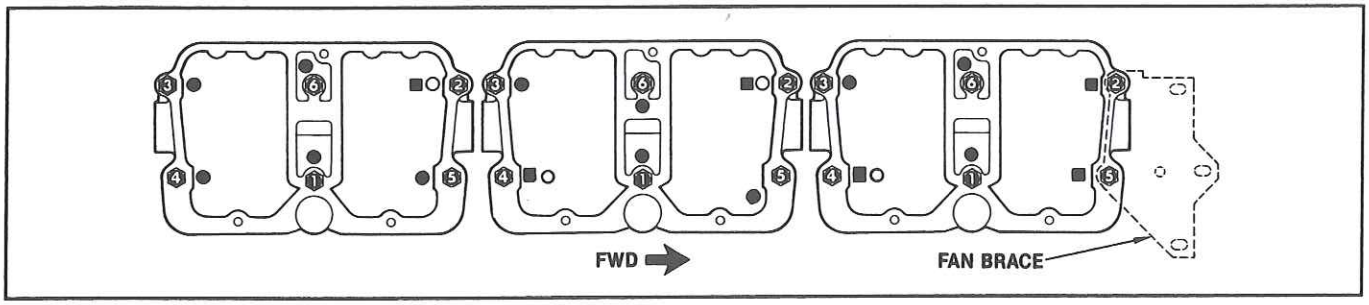

Fig. 16

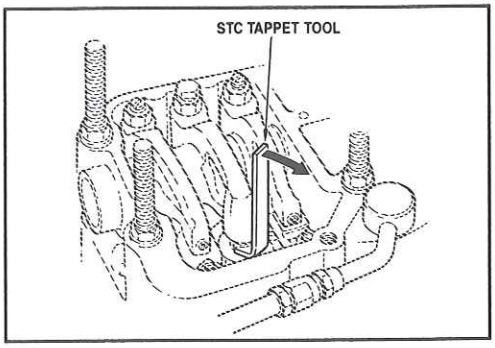

Fig. 17

Valve and Injector Adjustment

Setting the Injector (STC)

A special STC tappet tool, ST-3822648, must be used to prevent compressing the tappet spring while setting the injector overhead. Compression of the tappet spring defeats the top stop feature and can result in premature injector train and camshaft wear.

The tappet tool has a small locating pin designed for insertion into the top of the STC tappet. Each tappet contains four evenly spaced holes to ensure that at least one hole is easily accessible. Rotate the engine to the cylinder to be set. See "Injector and Valve Set Position" instructions on pages 4 and 5.

Place the tool on the upper surface of the injector so that the tool straddles the top of the tappet (Fig. 17). Rotate the tool around the tappet until the locating pin can be inserted into one of the four holes. Apply thumb pressure to the tool handle to hold the tappet piston in the maximum extended position while setting the injector rocker lever set screw to 5 or 6 lbin. Excessive force on the tool can break the locating pin off in a tappet hole.

The tool must be removed before barring the engine to prevent damaging a tappet or the tool.

Bar in Direction of Rotation	Pulley Position	Set Cylinder Injector Valve	
START	A	3	5
Adv. To	B	6	3
Adv. To	C	2	6
Adv. To	A	4	2
Adv. To	B	1	4
Adv. To	C	5	1

NOTE:
Check the engine data plate for possible variations to the valve and injector adjustments.

NOTE:
For setting the injectors on fixed timed or STC engines, the Cummins injector torque wrench, Cummins, PN 3376592, may be used. This wrench is preset to 6 lbin.

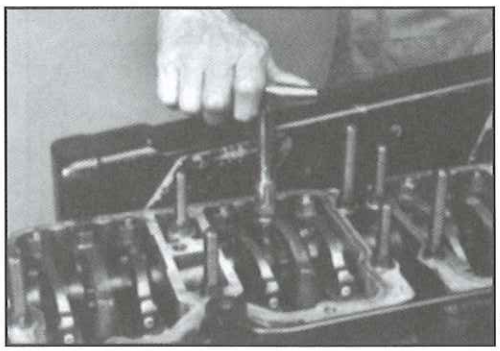

Fig. 18

Setting the Injector (Fixed Timed)

Using the Cummins injector adjusting tool, PN 3376592, set the injectors to 6 lbin. (0.7 N•m). See Fig. 18. Follow the sequence in the above chart.

After setting the injector, tighten the injector adjusting screw locknut to 45 lbft. (61 N•m).

Following the sequence in the chart on page 8, adjust the exhaust and intake valves. Insert the proper feeler gauge between the rocker arm and crosshead of the cylinder to be adjusted (Fig. 19). Turn the adjusting screw in until a slight drag is felt on the feeler gauge.

Set intake valve clearance to 0.011 in. (0.28 mm).

Set exhaust valve clearance to 0.023 in. (0.58 mm).

NOTE:
The Cummins injector adjusting tool may also be used to adjust the valves. With the feeler gauge inserted, turn the adjusting screw in until the tool clicks.

Hold the adjusting screw in this position and tighten locknut to 45 lbft. (61 N•m).

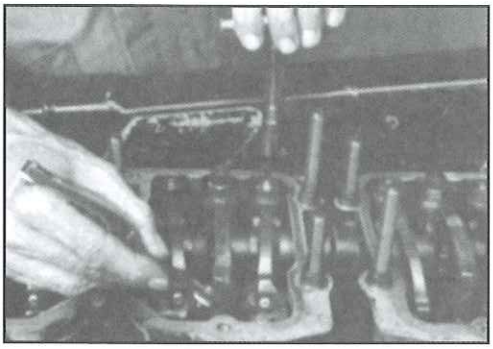

Fig. 19

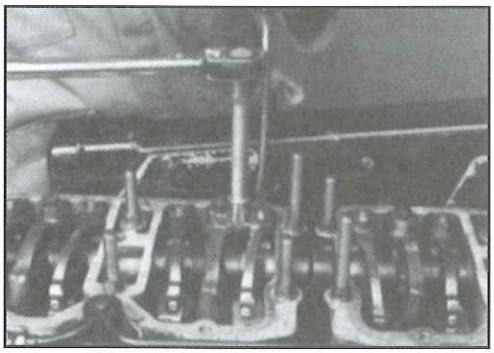

Fig. 20

SECTION 3
BRAKE HOUSING INSTALLATION

Check rocker housing surface to make sure it is clean and smooth. Install *Jacobs* gasket on rocker housing.

Before placing brake units on engine, loosen and back out the slave piston adjusting screw until slave piston is seated in its bore. Install the rubber seal (from kit) in center of the web on the bottom of engine brake housing (Fig. 21). If necessary, use a little grease to hold seal in place.

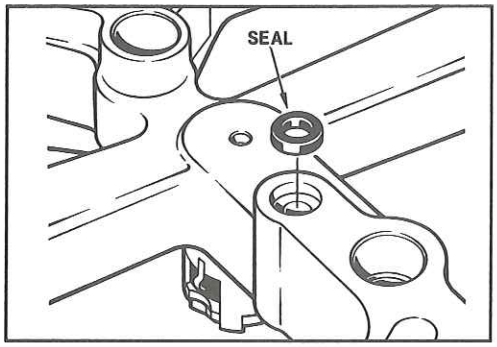

Fig. 21

Install engine brake units on engine. Units must go into place without rocker lever interference.

Install *Jacobs* spacers as required (Fig. 22). See STUD LOCATION AND TORQUE SEQUENCE on page 7 for spacer positions on housings.

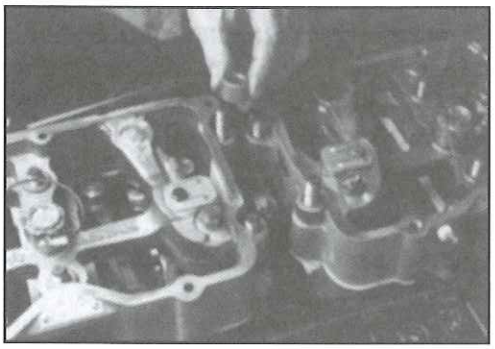

Fig. 22

Install *Jacobs* hold-down nuts and torque to 60 lbft. (80 N•m) following the sequence shown in Fig. 23.

⚠CAUTION

Use of power tools may result in overtightening of hold-down nuts. Engine brake housing failure will result.

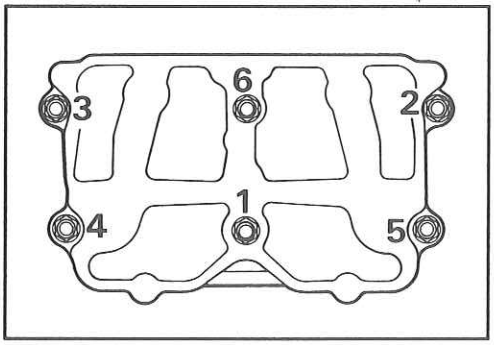

Fig. 23

Slave Piston Adjustment Procedure

Slave piston adjustment must be made 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.

⚠CAUTION

The following adjustmemt procedure must be strictly adhered to. Any other method of adjusting the slave piston clearance is not authorized by *Jacobs* and may result in serious engine and/or engine brake damage.

Slave Piston Clearance

Correct slave piston clearance requires identifying the following:

1. CPL Number (engine data plate on gear case mounting flange)
2. Injector Timing - Fixed Timed or STC (valve located on fuel pump side of engine)
3. Big Cam Identification (under cam follower housing)
4. Turbocharger Configuration (Fig. 24)

Measure 5 in. (127 mm) from the turbine flange and put a mark on the turbine housing. See Fig. 24 (A). Use Vernier calipers to measure the width of the turbine housing at the 5 in. (127 mm) mark. See Fig. 24 (B). If the width is greater than 3.6 in. (91 mm), then it is a twin entry turbine housing. If the width is smaller than 3.6 in. (91 mm), it is a single entry turbine housing.

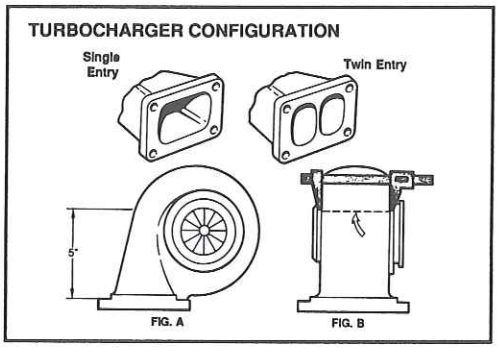

Fig. 24

Three lash adjustment tags are included in the Engine Brake kits. **No tags are required for the Model 420.**

Select the appropriate lash adjustment tag and install under the locknut of the *Auto-Lash* adjusting screw (Fig. 25). Install the appropriate tag on the number one cylinder. **Discard the remaining tags.**

A slave piston adjustment decal is included in the engine brake kit. Follow the instructions on the back of the decal and install it in a suitable place on the aftercooler manifold. Be sure to cut out the adjustments that do not apply to this installation.

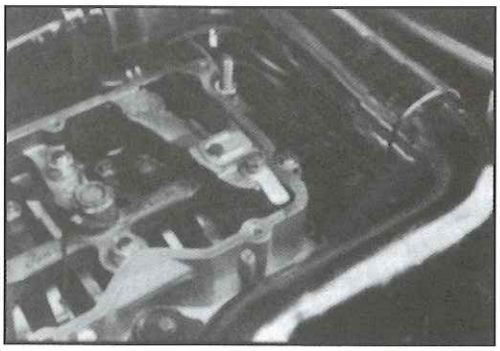

Fig. 25

Back out the adjusting screw on the cylinder with the exhaust valves closed (Fig. 26) and insert the appropriate *Jacobs* feeler gauge between the slave piston and crosshead. See Charts on page 11.

Turn the adjusting screw in until a slight drag is felt on the feeler gauge. Torque the locknut to 25 lbft. (35 N•m).

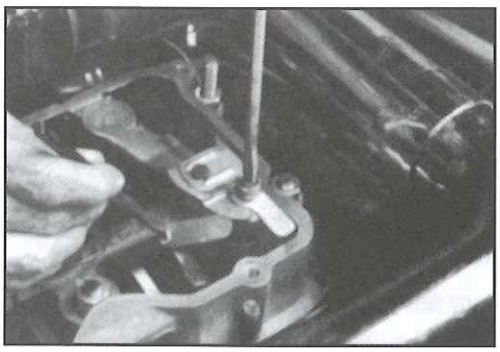

Fig. 26

Continue turning engine in direction of rotation and set slave piston clearance on the remaining cylinders in firing order.

NOTE:
If crowfoot wrench is used, tighten locknut to 22 lbft. (31 N•m).

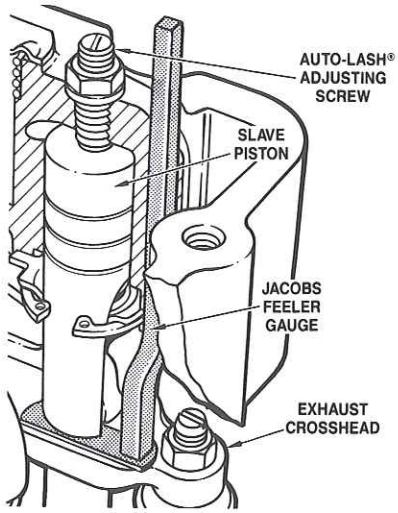

Fig. 27

Model 420 Slave Piston Clearance

CLEARANCE	ENGINE CONFIGURATION (PRE 88/89)
0.018 in. *Jacobs* Gauge P/N 003087	NEW BIG CAM IV WITH: Step Timing Control

Model 425/425A Application/Slave Piston Clearance

CLEARANCE	ENGINE CONFIGURATION (PRE 88/89)
0.018 in. *Jacobs* Gauge P/N 003087	BIG CAM WITH: DIVIDED ENTRY TURBO Fixed Timing Control (Includes NTE [European]) Mechanical Variable Timing (MVT) SMALL CAM WITH: DIVIDED ENTRY TURBO
0.030 in. *Jacobs* Gauge P/N 015877	BIG CAM WITH : SINGLE ENTRY TURBO Fixed Timing Control **Except** CPL Nos. 393, 449, 531 and 588
0.037 in. *Jacobs* Gauge P/N 015878	BIG CAM WITH: SINGLE ENTRY TURBO CPL Nos. 393, 449, 531 and 588 STEP TIMING CONTROL (STC) CPL 806 NBCIV 365/400/444 CPL 821 NBCIV 444 CPL 833 NBCIV 365/400 CPL 1215 NBCIV 440 Plus (Recon) SMALL CAM WITH: SINGLE ENTRY TURBO NO TURBO (Naturally aspirated)

For Engines with Step Timing Control

An oil connection is required from the rear engine brake housing to the STC valve located on the fuel pump side of the engine (Fig. 28). This sensing line allows the operation of the engine brake without incurring undue stress on the valve train and camshaft.

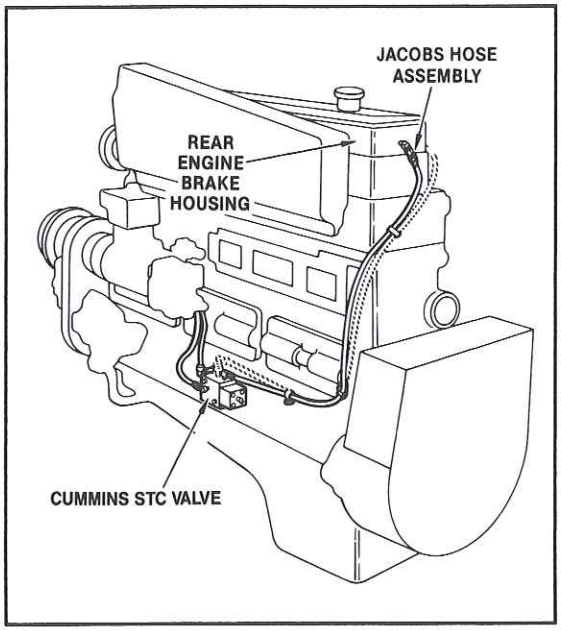

Fig. 28

1. Remove hose that connects STC valve to the engine block (Fig. 29).

2. Cap off fitting in the block with cap from *Jacobs* kit.

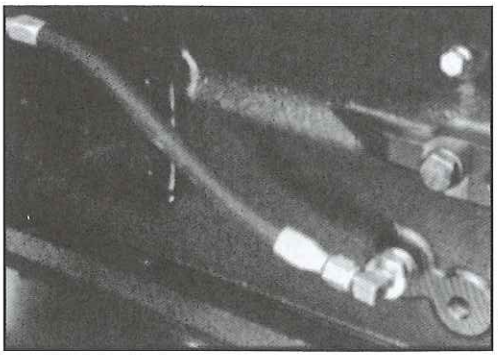

Fig. 29

3. Remove the plug from the rear engine brake housing. See Fig. 30.

4. Install the *Jacobs* elbow fitting into the rear brake housing and turn until the O-ring is seated firmly against the housing. Be sure the open end of the fitting is aimed downward.

5. Connect one end of the *Jacobs* hose assembly to the fitting. Tighten jam snut securely.

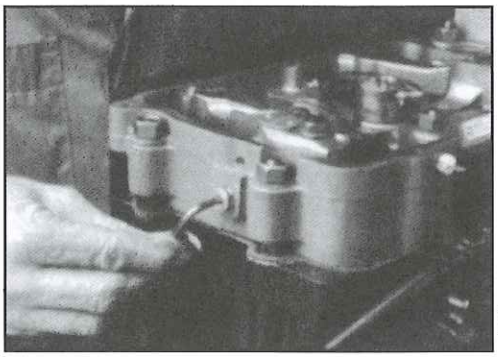

Fig. 30

6. Connect the other end to the fitting on the STC valve as shown in Fig. 31. Route the hose along the engine. Tighten the fittings at each end of the hose.

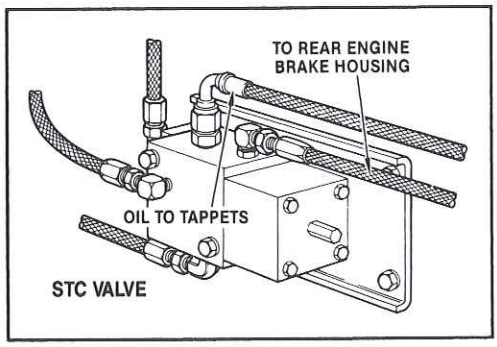

Fig. 31

7. Secure hose to engine using clamps and ties. See Fig. 32. This minimizes stress and mechanical damage to hoses.

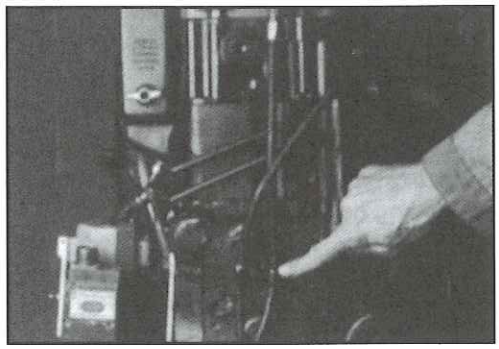

Fig. 32

SECTION 4
Electrical System Installation

Clutch Switch

NOTE:
For vehicles with automatic transmissions, refer to *Jacobs* service letters or contact your nearest distributor.

1. Mount the clutch switch in the most convenient or accessible location; in cab under dash, under floor wheel well or in the bell housing area.

2. Install this switch with the switch actuator arm in contact with the clutch pedal arm or other clutch member.

3. Adjust the switch by moving it along the mounting bracket. The actuator arm should be deflected 1.0 - 1.5 in. (25-38 mm), measured at the tip of the actuator, when the clutch pedal is in the up (clutch engaged) position. See Fig. 33.

4. Check installation by moving the clutch pedal. The switch should click within the freeplay motion of the clutch pedal before actual clutch disengagement takes place.

5. Cut wires to proper length and secure them with ties. Connect the wires. Black lead to electrical power source.

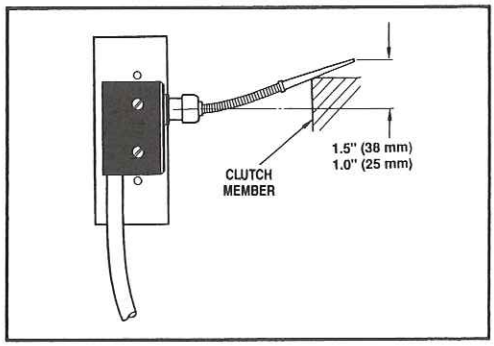

Fig. 33

The optional overtravel bracket should be used when the clutch switch is installed in the wheel well location or a location where a buildup of road contamination (ice, mud, etc.) can stick to the actuator arm.

Dash Switch

Install the two dash switches in a convenient location in the cab. Carefully measure and cut all harnesses to proper length. Thread wires through the loom provided. Install receptacles at locations shown in wiring diagram furnished in the kit.

Fuel Pump Switch

NOTE:
The fuel pump switch contacts are protected against arcing by a small diode connected between the load side switch terminal and ground. Locate diode according to Fig. 34.

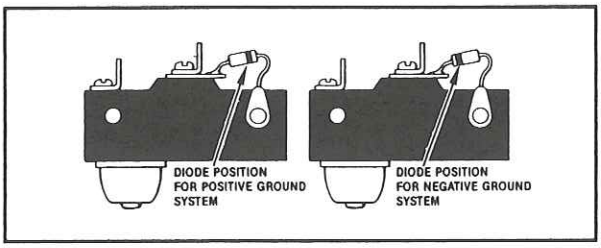

Fig. 34

⚠CAUTION

Improper connections to the switch will result in premature switch failure and inoperable engine brakes.

Before connecting the leads to the switch, turn the vehicle ignition on, turn engine brake switch on and engage the clutch (clutch pedal up). With a volt/Ohm meter, measure the voltage at each lead. The lead with +12V DC must be attached to the switch terminal that does not have the diode attached. The lead with 0V DC must be attached to the other switch terminal.

1. Loosen the two cap screws on the fuel pump housing and remove the upper screw.

2. Install the *Jacobs* fuel pump switch. The slotted area in the switch bracket is for easier installation and for minor bracket adjustments. Tighten the cap screws.

3. Remove Cummins nut, washers and cap screw. Install the *Jacobs* tee bolt, guide, actuating lever and nut. Install parts in correct order.

4. With the throttle shaft in the idle position, move actuating arm until switch actuates. Hold in this position and torque nut to 10 lbft. (14 N•m). See Fig. 35.

⚠CAUTION

Do not bend actuating arm to adjust switch. Bending the arm will result in premature failure of the arm and loss of engine braking.

⚠CAUTION

Check the fuel pump throttle shaft to ensure that the throttle pedal will move the shaft to the full fuel position after installing the acutating arm.

Alternate Switch and Throttle Lever Positions

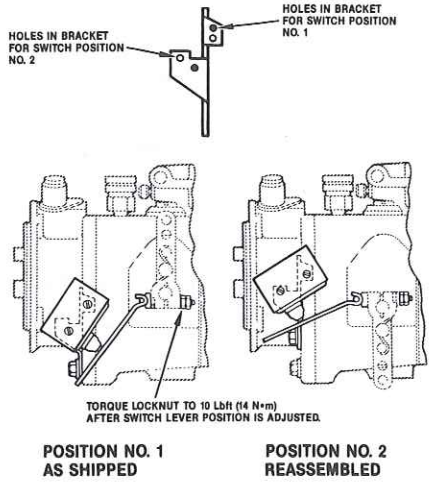

Fig. 35

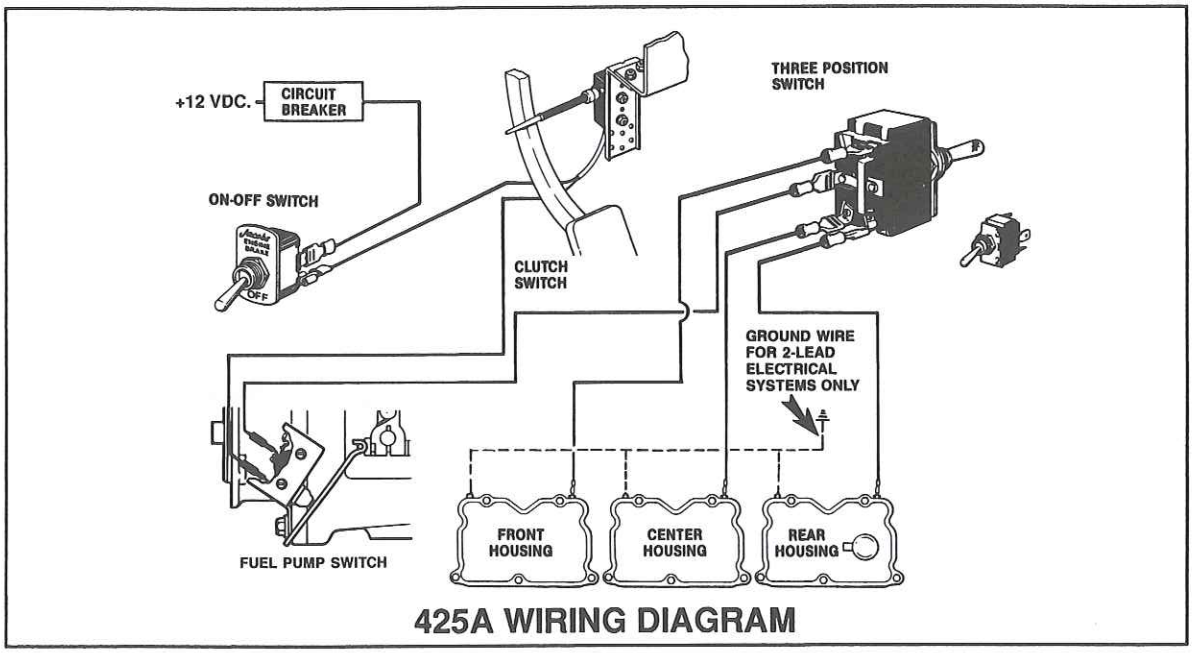

Fig. 36

Optional Control Systems

Jacobs offers three different systems for engine brake control. Besides the standard semi-automatic system, the customer has the choice of two added options: fully automatic control with a "low speed" shut-off or fully manual control with a "Foot Switch".

Foot Switch

The Foot Switch is installed on the cab floor within easy reach of the operator's left foot. After installation, light pressure on the top plate is all that is needed to operate the *Jake Brake*. The throttle switch remains in the system to ensure that fueling and engine braking do not occur at the same time.

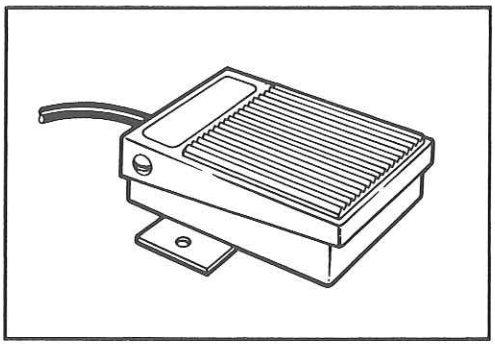

Fig. 37

Low Engine Speed Retarder Cut-off System

The low engine speed retarder cut-off system is a fully automatic engine brake control system that senses engine speed (RPM) and electrically deactivates the engine brake at speeds below approximately 900 RPM. The low speed cut-off feature provides added driver convenience in frequent stop/start operations. Additionally, the low speed cut-off feature is useful for "slip seat" operations where several drivers may operate one vehicle.

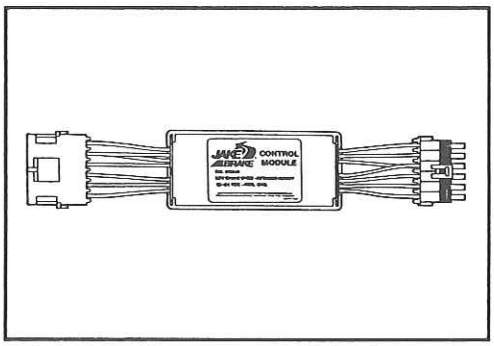

Fig. 38

The kit consists of a low speed retarder cut-off module and wiring harnesses. The module can be mounted in the engine compartment on the firewall or other convenient location. Complete instructions are included in the kit.

⚠WARNING

Wear eye protection and do not expose your face over engine area. Take precautions to prevent oil leakage down on the engine.
Whenever engine is running and valve covers are removed, oil splashing in the engine brake area could cause personal injury.

SECTION 5
ENGINE BRAKE OPERATIONAL CHECK

The *Jacobs* Engine Brake installation is now complete. The following procedures and adjustments should be made.

1. Bleed brake units and check their operation. Start engine and allow to run 5 to 10 minutes. Accelerate engine to approximately 1800 RPM. Release throttle and then manually depress each solenoid armature. Repeat this procedure five or six times to permit engine oil to fill the brake housing passages completely.

2. Connect control wires to terminal leadout assemblies in engine brake housing.

3. With the engine shut down, check electrical system by turning on ignition switch and the ON/OFF dash switch. Move the three-position dash switch from 1 to 2 and, then, 3. In position 1, only the center housing solenoid valve should activate. In position 2, only front and rear housing solenoids should activate. In position 3, all three housing solenoids should activate.

4. Using new Cummins gaskets, replace rocker housing covers and all previously removed parts.

Attach the **OPERATING TECHNIQUES** decal in a convenient location on the dash.

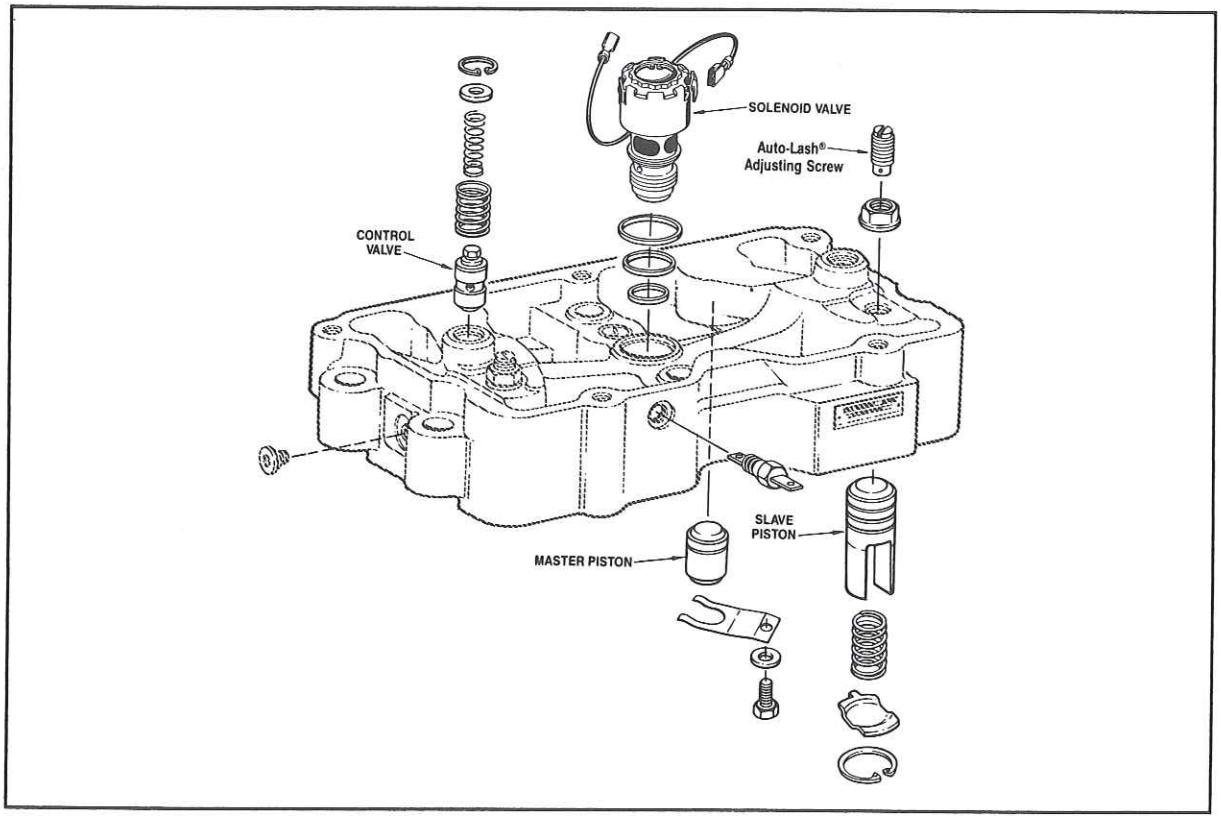

Fig. 39

SECTION 6
ENGINE BRAKE MAINTENANCE

The *Jacobs* Engine Brake is typically a trouble-free and maintenance-free device. However, periodic inspections are necessary and some maintenance is required. Use the following procedures to keep the engine brake in top condition.

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.

⚠WARNING

Never remove any engine brake component with engine running. Personal injury may result.

Control Valve

NOTE:
Early style housings use a flat control valve cover plate with a capscrew. Use a 7/16 in. wrench to loosen the capscrew. Current housings have a washer-like control valve cover held in place with a retaining ring. Use retaining ring pliers to remove. See Fig. 40.

⚠WARNING

Remove control valve covers carefully to avoid personal injury. Control valve covers are under load from the conrol valve springs.

1. Carefully remove cover until spring pressure ceases, then remove the two control valve springs.

2. Using needle nose pliers, reach into the bore and grasp the stem of the control valve. Pull valve straight up and out of its bore (Fig. 41).

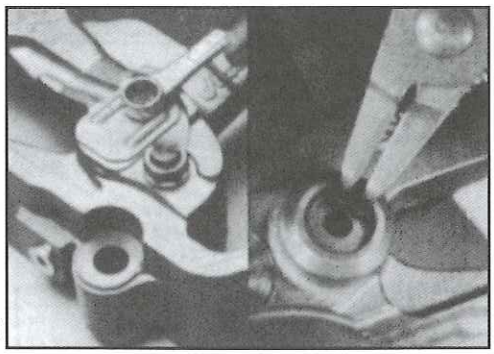

Fig. 40

3. Wash the control valves with 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.

4. Thoroughly clean the control valve bore in the housing, using clean paper towels.

5. Dip the control valves in clean lube oil. Dip the control valves in clean lube oil and replace the valve into its bore. If binding occurs, replace the control valve.

6. Replace parts in reverse order of removal.

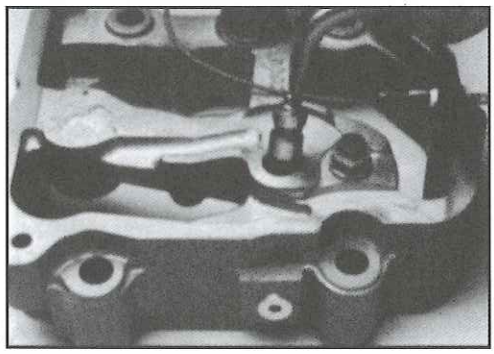

Fig. 41

Slave Piston

⚠WARNING

Wear safety glasses.
Remove slave piston carefully. The slave piston is retained by springs that are under heavy compression. If the following 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. Back out the adjusting screw until the slave piston is fully retracted (screw is loose).

2. Use the slave piston clamp fixture, P/N 017397, and the following procedure to remove and replace the slave piston.

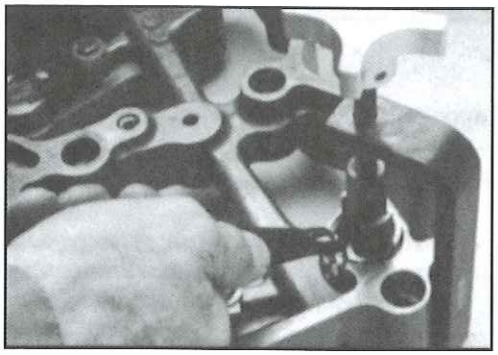

Fig. 42

3. Place the hole in the clamp fixture over the slave piston adjusting screw. Replace locknut. Tighten to hold fixture securely.

4. While holding the fixture in position, screw the holder down over the slave piston until the retainer is contacted.

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

6. Remove the retaining ring (Fig. 42). Use retaining ring pliers. Back out the holder until the springs are loose. Remove fixture.

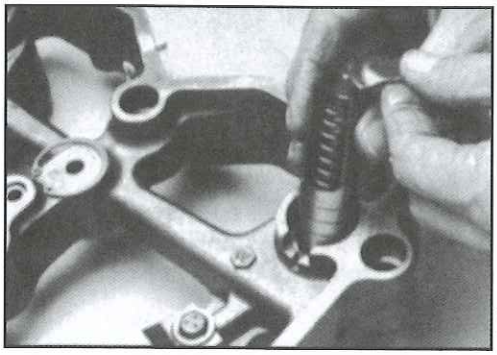

Fig. 43

7. Remove all components ensuring there is no binding or burrs. Clean in an approved cleaning solvent, or replace as necessary.

NOTE:
Be sure all components are reassembled in proper order. See Fig. 43.

8. Reinstall piston, springs and retainer.

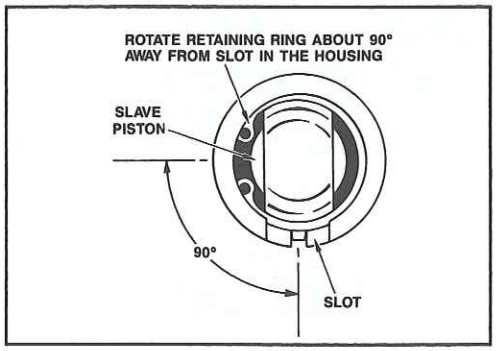

Fig. 44

9. With the clamp fixture, compress the springs until the retainer is about 0.040 in. (1 mm) below the retaining ring groove. Reinstall the retaining ring. Be sure the retaining ring is fully seated in the groove.

⚠CAUTION

Do not leave open portion of retaining ring aligned with opening in housings. See Fig. 44. This will permit the spring retainer to become loose when the engine brake is operating. Serious engine damage will result.

10. Remove the clamp fixture slowly to insure proper seating of retaining ring.

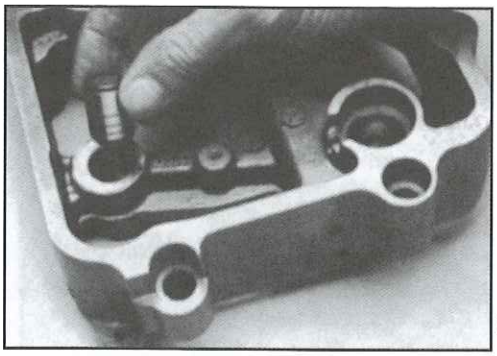

Fig. 45

Master Piston

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

2. Remove master piston from its bore using needle nose pliers to initially pull the piston out, if necessary. If binding occurs, check for burrs or contaminants in lube oil. Clean in an approved solvent. Inspect the hard face surface (Fig. 45). Pitted, chipped, cracked or galled pistons should be replaced.

NOTE:
If hard facing is damaged, inspect the corresponding rocker arm adjusting screws for excessive wear or pitting. Replace if damaged.

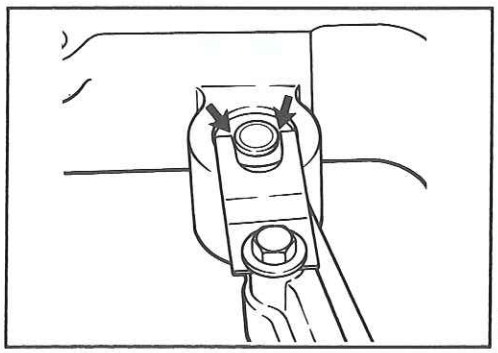

Fig. 46

3. 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. 46.

NOTE:
The tabs should be equally spaced from the raised piston area.

Slave Piston Adjusting Screw (*Auto- Lash*)

1. Loosen *Auto-Lash* adjusting screw locknut and remove adjusting screw from housing.

2. Inspect *Auto-Lash* adjusting screw. The plunger should protrude from the bottom of the screw. Approximately 12 lbs. (53 N) force is required to move the plunger. Be sure the retaining pin is fully engaged in its groove.

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.

⚠CAUTION

Do not disassemble or tamper with the *Auto-Lash* adjusting screw assembly. Engine damage could result.

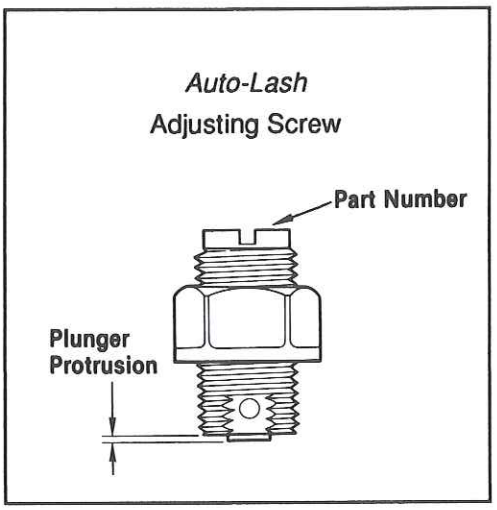

Fig. 47

Solenoid Valve

1. Disconnect solenoid harness. Using 7/8 in. socket and extension, unscrew solenoid valve.

2. Remove and discard the three rubber seal rings. If the lower ring stays in the bottom of the housing solenoid bore, remove with a piece of wire.

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. Carefully screw the solenoid into the housing without unseating the seals. Torque the valve to 60 lbin. (7 N•m). Be careful not to twist the seals while installing.

⚠CAUTION

Do not disassemble or tamper with the solenoid valve. Engine damage could result.

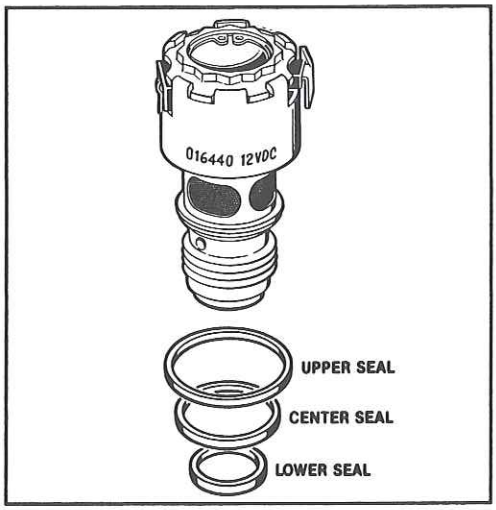

Fig. 48

Exhaust Rocker Arm Modification

Engines built prior to 1980 may have exhaust rocker levers with pads that will not fit between the legs of the slave piston. See page 5. Use *Jacobs* Grinding Gauge, P/N 001153, according to the following procedure to modify the exhaust rocker lever, if necessary.

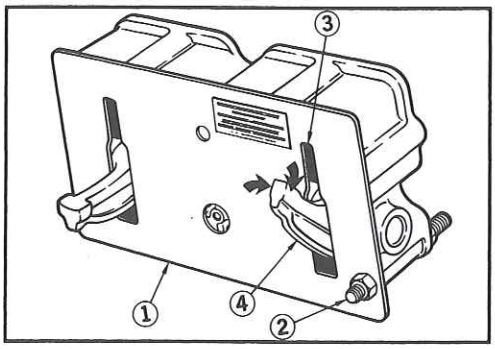

Fig. 49

1. Remove the rocker lever housing. Refer to Fig. 49.
2. Rotate the rocker levers so that the grinding gauge (1) will mount on the top side of the rocker lever housing with the name plate side out.
3. Insert each exhaust rocker lever (4) through wide slot in gauge and secure the gauge with two housing capscrews (2).
4. Lightly grind both sides of the exhaust rocker lever until the foot passes through the narrow slot (3) in the gauge.

⚠CAUTION

Do not overheat the rocker lever foot while grinding. Overheating will draw the temper from the foot.

5. Remove gauge and remove burrs from rocker lever foot.
6. Clean rocker box and reinstall on engine using new gaskets. Continue with engine preparation (Page 5).