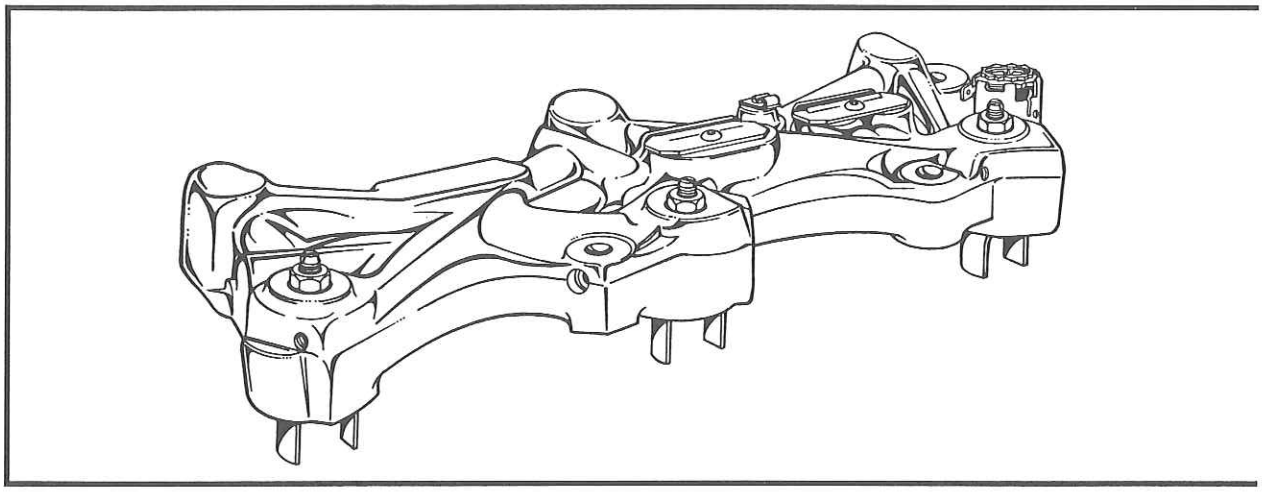
Installation Manual for Model 346D Engine Brake



The Model 346D *Jake Brake*® engine retarder is designed and approved for use on all Caterpillar 3406 and 3406B engines. The Model 346D replaces the former Models C346, C346A, C346B and C346C.

Installation procedures for early production 3406 engines will vary and specific information regarding these applications is covered in this manual.

The information contained in this manual was current at the time of printing and is subject to change without notice or liability. *Jacobs* service letters should be consulted for additional updated information.

⚠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.

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P/N17317

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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

Special Tools

Caterpillar Tools	Caterpillar Part No.
Fuel Line Socket - Flank Drive 3/4 in.	5P144
Fuel Line Wrench - 7/8 in.	5P5195
Turning Tool	9S9082
Timing Pin - Fuel Pump (3406B)	6V4186
Timing Pin - Fuel Pump (3406)	8V2291

Commercially Available Tools

9/16 in. Crowfoot Wrench
Deep Socket (1 1/8 in. - 3/4 in. drive)
3/8 in. Hex Key Wrench

Jacobs Tools	*Jacobs* Part No.
Dowel Pin Extractor	7397
Gauge - 0.060 in (1.52 mm) - 3406	7446
Gauge - 0.067 in (1.70 mm) - 3406B	17920
Gauge - 0.080 in (2.03 mm) - 3406B	17099

NOTE:
Engines prior to S/N 7FB39279 and all 92U prefix engines require leveling shims. See alternate housing leveling procedure in Section 3.

The shim and washer group is not included in the standard kit and must be obtained from a *Jacobs* distributor.

Torque Specifications

Exhaust valve bridge jamnuts	24 lbft. (32 N•m)
Rocker hold-down bolts	330 lbft. (450 N•m)
Cat Cylinder head bolts	330 lbft. (450 N•m)
Hold-down nuts	100 lbft. (135 N•m)
Hex head capscrews	60 lbft. (82 N•m)
Fuel line retainer nuts	30 lbft. (41 N•m)
Slave piston adj. screw locknuts	16 lbft. (22 N•m)
Vibration-proof nuts	13 lbft. (18 N•m)
Spacer studs and nuts	10 lbft. (14 N•m)
Rocker adj. screw locknuts	22 lbft. (30 N•m)

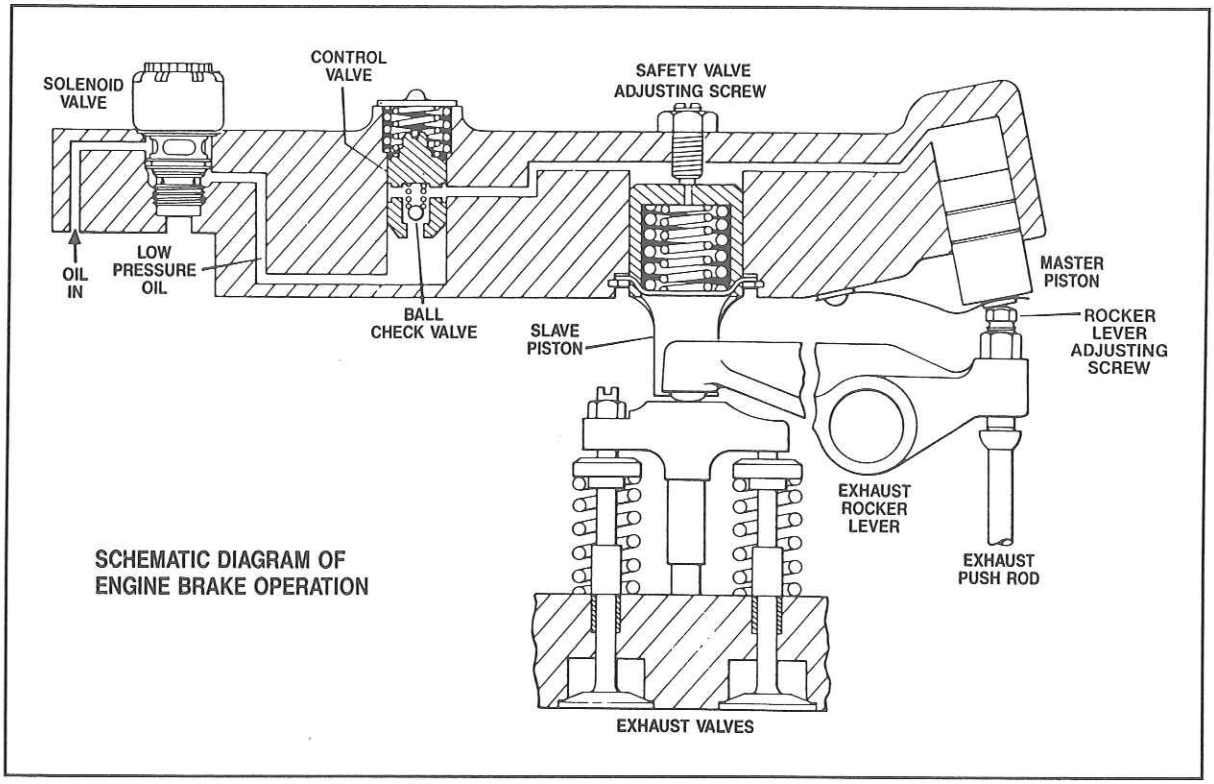

Fig. 1

Theory of Operation

Energizing the engine brake effectively converts a power-producing diesel engine into a power-absorbing air compressor. This is accomplished by opening the cylinder exhaust valves near the top of the normal compression stroke, releasing the compressed cylinder charge to exhaust.

The blowdown of compressed air to atmosphere 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 of the braking cylinder is accomplished by utilizing the push rod motion of an exhaust valve on another cylinder during its normal exhaust cycle as follows:

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

Oil pressure causes the master piston to move down, coming to rest on the corresponding exhaust rocker arm adjusting screw. See chart for master-slave operating relationship.

The exhaust rocker pushrod begins upward travel (as in normal exhaust cycle) forcing the master piston upward and creating a high pressure oil flow to the slave piston of the braking cylinder. The ball check valve in the control valve traps high pressure oil in the master-slave piston system.

The slave piston under the influence of the high pressure oil flow moves down, momentarily opening the exhaust valves while the engine piston is near its top dead center position and releasing compressed cylinder air to the exhaust manifold.

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

Master/Slave Circuit Relationship Listed In Engine Firing Order

Location of Master Piston	Location of Slave Piston
Actuates	
No. 1 Pushrod	No. 3 Exhaust Valve
No. 5 Pushrod	No. 6 Exhaust Valve
No. 3 Pushrod	No. 2 Exhaust Valve
No. 6 Pushrod	No. 4 Exhaust Valve
No. 2 Pushrod	No. 1 Exhaust Valve
No. 4 Pushrod	No. 5 Exhaust Valve

SECTION 2
ENGINE PREPARATION

Remove the valve mechanism upper covers and valve mechanism cover bases.

Adjustment Reference Point

No. 1 piston at TDC on the compression stroke is the starting point for all timing procedures and is the reference point for all engine valve and engine brake adjustments.

Remove timing bolt from its storage area above the left side starter location. See Fig. 3.

Insert timing bolt into the access hole.

Refer to Fig. 4. Insert the Caterpillar turning tool.

NOTE:
There are two threaded holes in the flywheel. These holes are in alignment with the plugged hole in the left and right front of the flywheel housing. The two holes in the flywheel are at different distances from the center of the flywheel so the timing bolt cannot be put in the wrong hole.

Next, turn the flywheel counterclockwise (as viewed from the flywheel end of the engine) until the flywheel hole is aligned with the timing bolt. See Fig. 5. When the timing bolt can be turned freely in the flywheel threaded hole, the engine No. 1 piston is on top center.

Look at the valves of No. 1 cylinder to see if No. 1 piston is on the compression stroke. The valves should be closed and the rocker arms able to be moved up and down by hand. If not, remove the timing bolt and rotate the flywheel 360 deg. (one revolution) and reinsert the timing bolt. The No. 1 cylinder is now at TDC compression. Make a mark on the engine vibration damper and on the front case of engine in line with each other as a reference point for cylinder No. 6 TDC compression. Remove timing bolt.

Alternate Method

The following method may also be used for locating cylinder No. 1 TDC:

1. Remove plug from fuel injection pump housing and install correct timing pin.

2. Slowly rotate crankshaft counterclockwise until pin goes into groove. See Fig. 6.

⚠CAUTION
Do not attempt to bar engine with the timing pin engaged. The pin may be sheared off and cause engine damage.

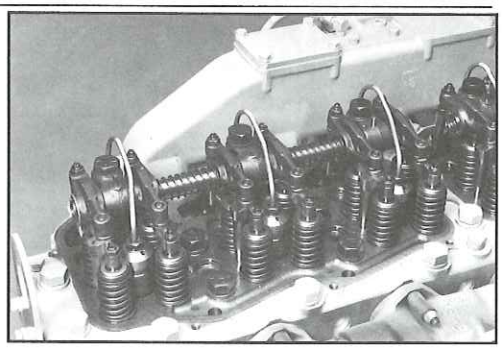

Fig. 2

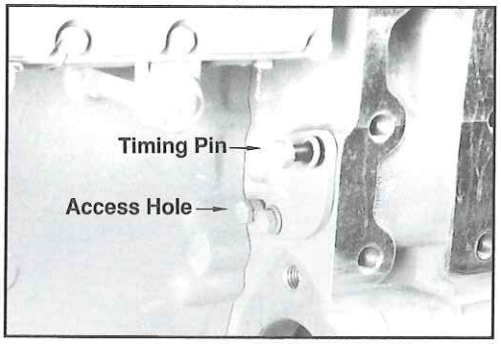

Fig. 3

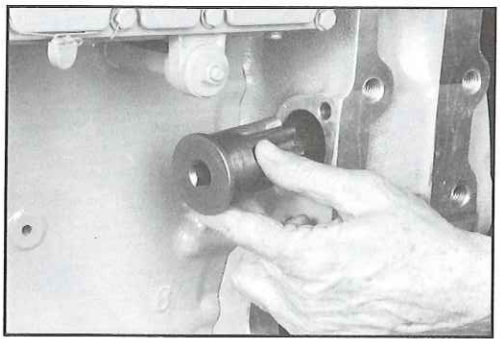

Fig. 4

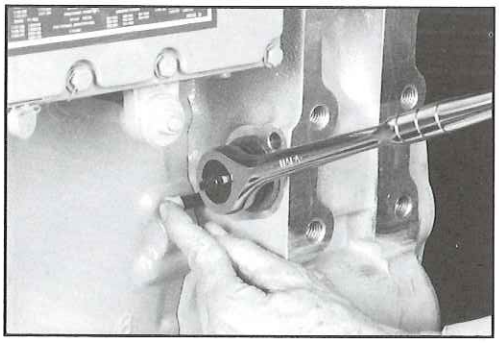

Fig. 5

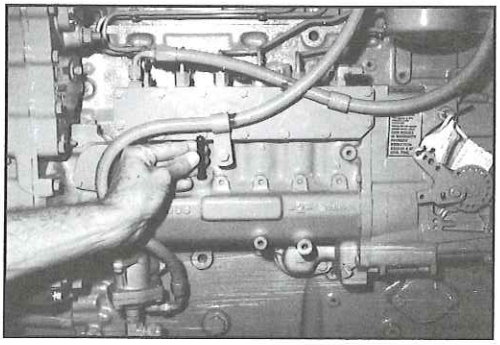

Fig. 6

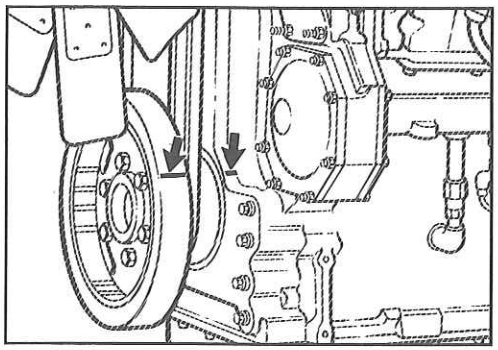

Fig. 7

The engine is now set at No. 1 TDC compression stroke.

3. Make a mark on the engine crankshaft vibration damper and on the front case of engine in line with each other as a reference point for cylinder No. 6 TDC compression. See Fig. 7.

4. **Remove timing pin from fuel pump and replace plug.**

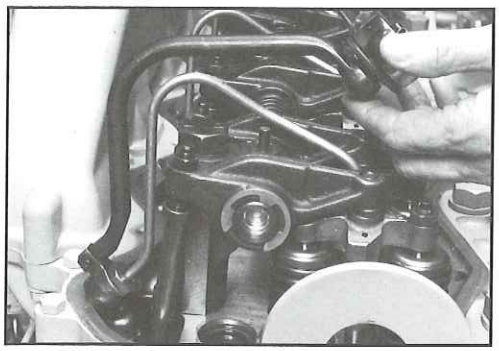

Fig. 8

Fuel Line and Rocker Arm Group Removal

Remove the fuel lines using the Caterpillar fuel line wrenches. See Fig. 8.

⚠CAUTION

Fuel lines and nozzle assemblies must be protected from contamination because fuel line removal takes place down-stream from final filtration.

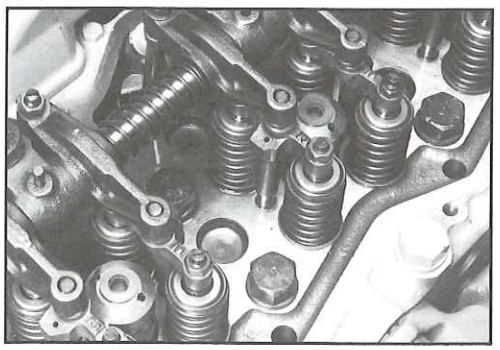

Fig. 9

After removing the fuel lines, place them in the plastic bag found in the fuel line protective group. Install the protective caps on the nozzle assemblies. Push the plastic plugs into the open fuel lines. See Fig. 9.

⚠CAUTION

Complete one engine brake housing installation before starting the installation of the second housing. The incorrect practice of removing six rocker shaft bolts at one time can interfere with the proper seating of the engine head.

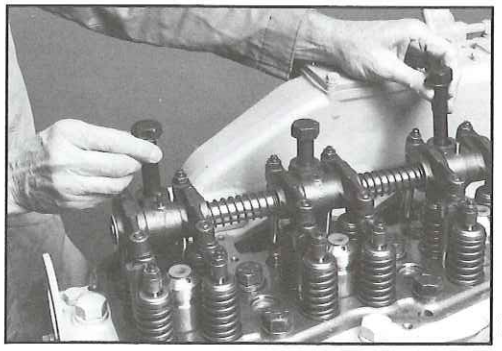

Fig. 10

Loosen the locknuts on the rocker arm adjusting screws. Remove the rocker shaft pedestal bolts and the entire rocker arm group (3 cylinders). See Fig. 10.

Fig. 11

Replace Exhaust Valve Bridges

Remove and discard the exhaust valve bridges from the engine. See Fig. 11.

NOTE:
The exhaust valve bridges have "Ex" cast into the top surface.

Remove the exhaust valve bridge leveling screws and jamnuts from the Caterpillar exhaust valve bridges. Loosely install the Caterpillar exhaust valve bridge leveling screws and nuts into the *Jacobs* bridges. See Fig. 12.

NOTE:
On older engines it is advisable to install new screws and nuts in the bridges.

NOTE:
Exhaust and intake valve bridges are identified by "EX" (exhaust) and "IN" (intake) cast into the top surface of the bridge.

Fig. 12

Bridge Adjustment

Level the exhaust valve bridge assemblies as follows:

1. Back off adjusting screw several turns making sure it is not in contact with the valve stem.
2. Press firmly and straight down on the top of the bridge (Fig. 13).
3. Turn the adjusting screw clockwise until contact is made with the valve stem, then turn the adjusting screw an additional 30 deg. (1/2 flat of locknut).
4. Hold the adjusting screw in this position and tighten the jamnut to 24 lbft. (32 N•m).
5. Apply clean engine lube oil on the area where the rocker arm contacts the bridge.

Fig. 13

NOTE:
The intake valve bridges must also be adjusted at this time using the same procedure.

Exhaust Rocker Adjusting Screw Exchange

Remove the slotted head Caterpillar exhaust rocker adjusting screws.

Note the difference between the Caterpillar and *Jacobs* rocker adjusting screw shown in Fig. 14.

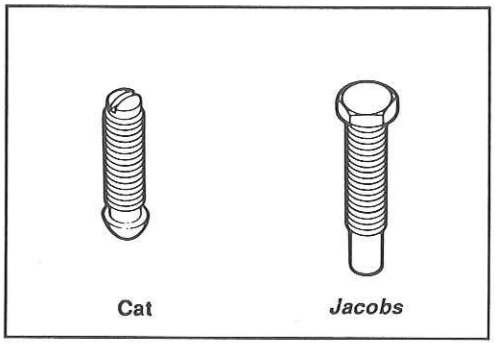

Fig. 14

Install the *Jacobs* rocker adjusting screws and the Caterpillar jamnut in the exhaust rocker levers. See Fig. 15. Discard Caterpillar adjusting screws.

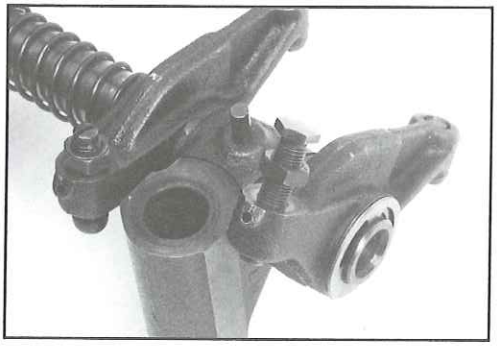

Fig. 15

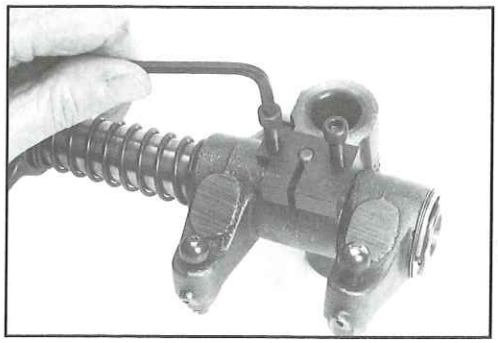

Fig. 16

Installation Of *Jacobs* Oil Supply Adaptor

Identify the front (fan end) of the rocker arm groups. Tightly clamp the *Jacobs* special dowel pin extractor or similar tool on the front locating pin of the rocker group. See Fig. 16. Pin must be extracted at cylinder No. 1 location. Be sure to do the same at the No. 4 location later on.

Carefully extract the dowel pin by tightening the two capscrews in small equal increments (1/4 turn each).

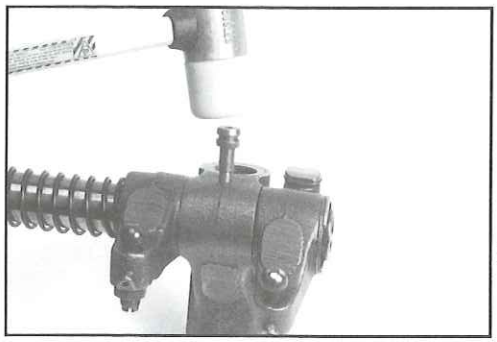

Fig. 17

Coat the end of the *Jacobs* oil supply adaptor with clean engine oil and install in place of the Caterpillar dowel pin. The pin holes in the pedestal and the rocker arm shaft must align. See Fig. 17. Do not install O-ring at this time.

Rocker Arm Group Installation

Before installing rocker arm group back on engine, attach a suitable length of tubing to a blow gun nozzle. Blow the oil out of the hold-down bolt holes. See Fig. 18. While blowing the oil out, cover the bolt holes with a clean towel to prevent oil from spraying.

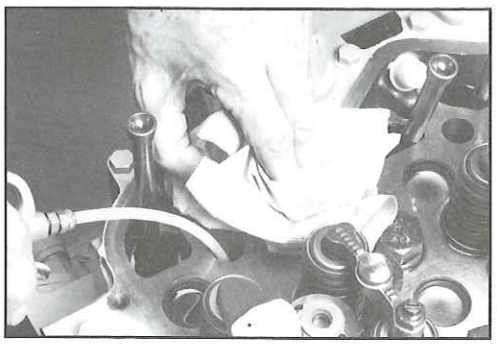

Fig. 18

⚠WARNING

Eye protection must be worn to prevent personal injury. Oil in hold-down bolt holes is blown out to prevent the engine block from cracking during the torquing of *Jacobs* hold-down studs.

Apply clean engine oil to the threads and underside of all *Jacobs* studs. Place the rocker arm group back on the engine. See Fig. 19. **The two outside (end) bolts and washers in each group must be replaced with *Jacobs* studs and *Jacobs* washers.**

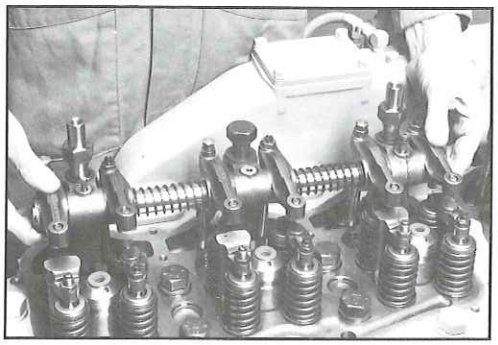

Fig. 19

Reuse a Caterpillar bolt and washer for the center location. Fit the pushrods to the rocker adjusting screws.

Make certain that the rocker group is centered in the bolt hole clearances. Move the rocker group back and forth to assure proper centering. Snug the studs and bolts firmly in the centered position. Be sure adjusting screws are located in pushrod sockets.

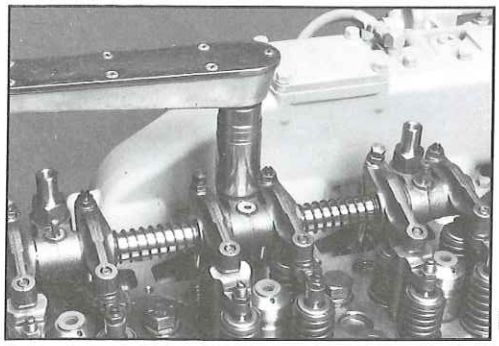

Fig. 20

Starting with the inner bolt and progressing towards either end of the engine, torque to 200 lbft. (270 N•m), then to 330 lbft. (450 N•m) in 50 lbft. (70 N•m) increments. See Fig. 20.

⚠CAUTION

It is important that the rocker group studs and bolts are tightened before removing the cylinder head bolts for installation of support bases. Removal of the five bolts at the same time may result in improper seating of the cylinder head.

Installation Of Support Bases

Fig. 21 shows the Caterpillar head bolts to be removed for installation of the *Jacobs* support bases.

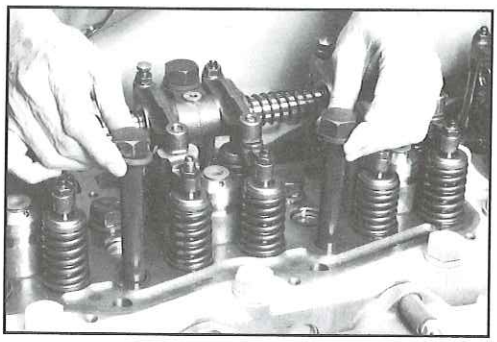

Fig. 21

⚠WARNING

While blowing out the oil from the bolt holes, cover the holes with towels to prevent oil spray. Wear safety glasses. Personal injury can result if eye protection is not worn. The oil is blown out to prevent the engine block from cracking.

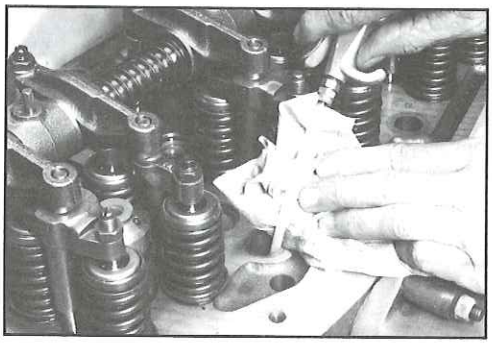

Fig. 22

Install the support bases with the bosses on the bottom of the support bases located in the cylinder head expansion holes. This will provide proper alignment of the support bases. See Fig. 23.

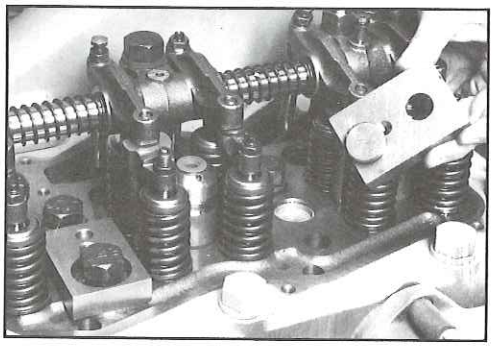

Fig. 23

Coat head bolt threads and both faces of related washers with a moly lube (6V4876 Moly Kote or G-N metal assembly paste) prior to assembly.

Install the bolts with washers and torque to 200 lbft. (270 N•m). Retorque to 330 lbft. (450 N•m). See Fig. 24.

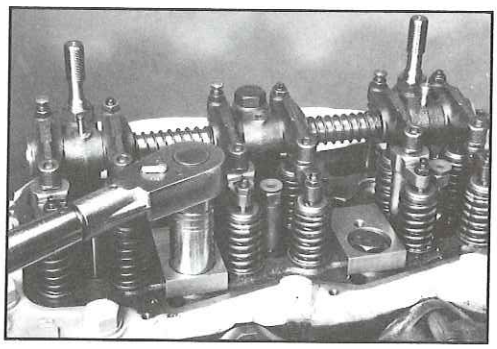

Fig. 24

SECTION 3
BRAKE HOUSING INSTALLATION

Fuel Line Installation

NOTE:
If new fuel lines are used, be sure to install the new O-rings on the riser end of fuel lines. Lubricate the O-rings with clean engine oil before installing.

1. Remove the protective caps and plugs from nozzles and fuel lines.

2. Install the fuel lines on the engine. First, hand tighten the retainer nuts. Next tighten nuts using the Caterpillar fuel line socket wrenches to 30 lbft. (41 N•m). See Fig. 25.

3. Check the clearance between the fuel lines and mounting studs. A clearance of 0.125 in. (3.175 mm) minimum to 0.375 in. (9.525 mm) maximum is required. If insufficient clearance is found, reposition or interchange fuel lines until all lines meet clearance specifications.

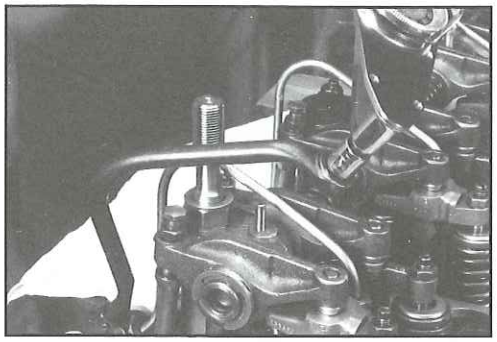

Fig. 25

⚠CAUTION
Do not bend fuel lines as fuel leakage may result.

Brake Housing Installation

For 3406B engines with serial numbers lower than 7FB39279 and all 92U prefix engines, the "HOUSING LEVELING PROCEDURE" is required. Refer to page 15 for the leveling (shimming) instructions.

NOTE:
The following housing installation procedure is for 3406B engines with serial number 7FB39279 or higher. Housing marked "rear" must be used on rear three cylinders; front housing on front three cylinders.

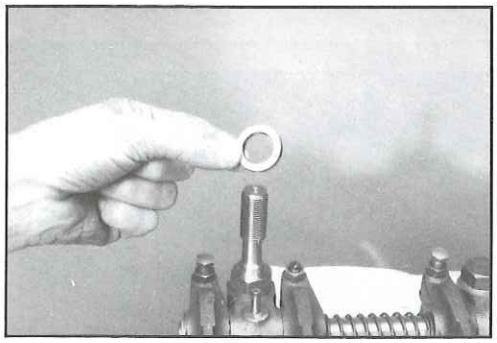

Fig. 26

Install the *Jacobs* spacers marked "B" on the *Jacobs* studs (Fig. 26).

Place a small amount of grease on the oil supply adaptor and install the O-ring (Fig. 27).

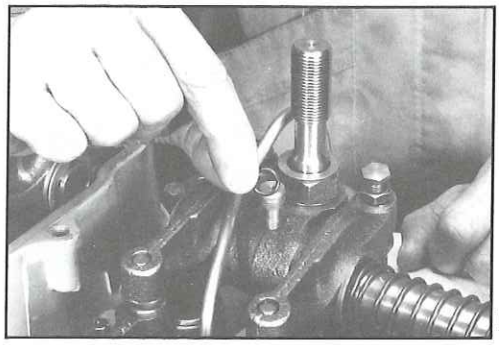

Fig. 27

Before placing brake units on engine, loosen and back out the slave piston adjusting screws until slave pistons are seated in bores. Carefully install the brake housing. Pay particular attention to the oil supply adaptor, checking for proper alignment.

Locate support tubes under housing and install the *Jacobs* washers and the 7/16 in. hex head capscrews through the housing, tubes and into the support bases. See Fig. 28.

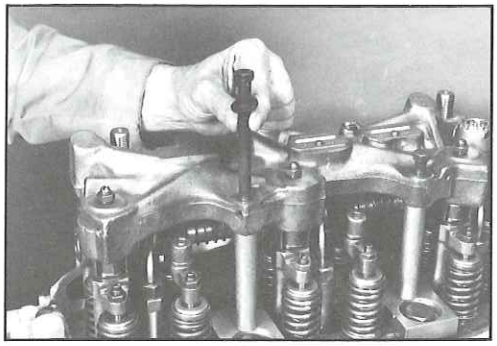

Fig. 28

Place Caterpillar cylinder head bolt washers on the 3/4 in. *Jacobs* hold-down studs. Hand tighten the *Jacobs* hold-down nuts onto the 3/4 in. hold-down studs. Use the following sequence to tighten the nuts and capscrews:

Torque the hold-down nuts to 60 lbft. (82 N•m).
Torque the 7/16 in. hex head capscrew to 60 lbft. (82 N•m).
Retorque the hold-down nuts to 100 lbft. (135 N•m).

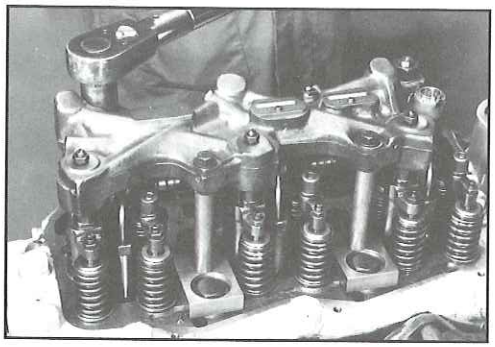

Fig. 29

Reinspect each fuel line location to ensure that there is no contact between brake components and the fuel lines. Reset fuel lines if necessary.

Now follow the same procedures on the other three cylinders.

Valve Adjustment Procedure

Valve and Slave Piston Adjustment Sequence

Engine Position	Set Intake Valve Cyl.	Set Exhaust Valve Cyl.	Slave Piston Cyl.
CYL. 1 TDC	1,2,4	1,3,5	1,3,5
CYL. 6 TDC	3,5,6	2,4,6	2,4,6

Adjust the intake and exhaust valves on each cylinder. See chart above. After setting the exhaust valve clearance and while the exhaust valve is closed and the bridge loose, the slave piston clearance can be set.

Adjust the intake and exhaust rocker lever clearance to Caterpillar specifications:

Intake lash	0.015 in. (0.38 mm)
Exhaust lash	0.030 in. (0.76 mm)

Torque rocker adjusting screw locknuts to 22 lbft. (30 N•m).

Slave Piston Adjustment Procedure

⚠CAUTION

Follow the adjustment instructions carefully to prevent engine damage and ensure maximum brake operating efficiency.

Slave piston adjustment must be made with the engine stopped and cold — stabilized water temperature of 140 deg. F (60 deg. C) or below. Exhaust valve on the cylinder to be adjusted must be in the closed position. See chart above.

Slave Lash Adjustment Chart

Engine	Mod. Yr.	Lash Adjustment	Gauge P/N
3406B	91*	0.067 in. (1.70 mm)	17920
3406B	Pre-91	0.080 in. (2.03 mm)	17099
3406	Pre-91	0.060 in. (1.52 mm)	7446

* Serial number prefixes for 1991 model year:
Mechanical Control - 3ZJ; PEEC Control - 2EK

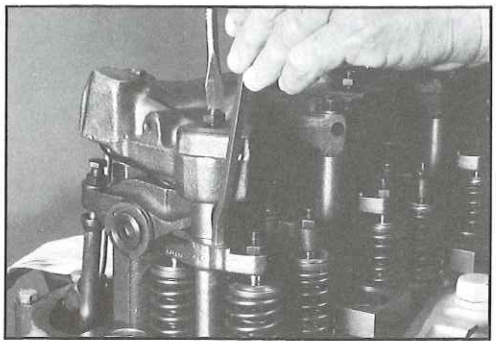

Fig. 30

Insert *Jacobs* feeler gauge between the slave piston feet and bridge. Turn the adjusting screw in until a slight drag is felt on feeler gauge. Torque locknut to 16 lbft. (22 N•m). After slave piston adjusting screw locknut is properly torqued, recheck the clearance with the *Jacobs* feeler gauge.

Remove timing bolt. Rotate the engine over to cylinder 6 TDC, reinstall timing bolt and continue the valve and slave piston adjustment. Remove the timing bolt from the flywheel location when all valves and slave pistons are adjusted. The timing bolt and access cover can now be returned to their storage location.

⚠CAUTION

Do not overtorque locknut. This could cause slave piston adjusting screw breakage and possible engine damage.

Final Installation Procedures

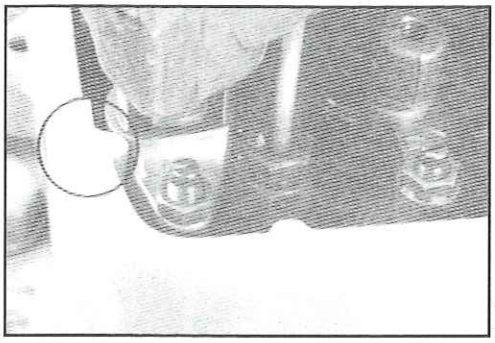

Fig. 31

Place the cover bases on the cylinder head. Check for interference between no. 3 and no. 6 exhaust valve bridges and the casting ribs (Fig. 31).

If there is interference, remove base and grind away the rib as necessary. Clean the base thoroughly and reinstall.

⚠CAUTION

Never grind bridge to obtain clearance. This could result in weakness of the bridge with subsequent bridge failure and possible engine damage.

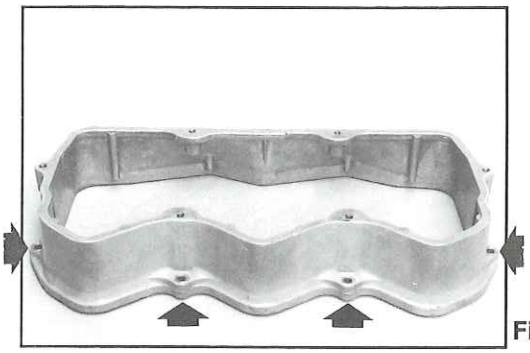

Fig. 32

Note the four locations for the mounting studs (Fig. 32).

The short threaded end of stud must go into engine head. See Fig. 33. Use the Caterpillar nuts and washers in the other two locations. Torque spacer studs and nuts to 10 lbft. (14 N•m).

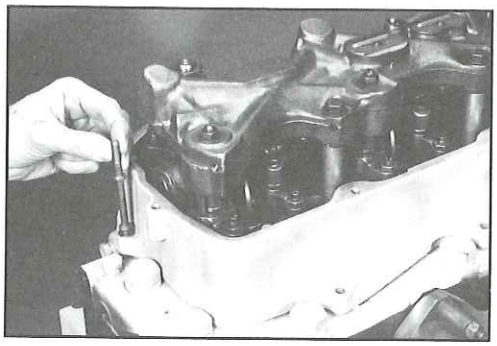

Fig. 33

NOTE:
Electrical connectors and gaskets may have been installed in the spacer prior to shipping. If not, use the following procedures.

Tighten the electrical connectors in the spacer to 10 lbft. (14 N•m). See Fig. 34.

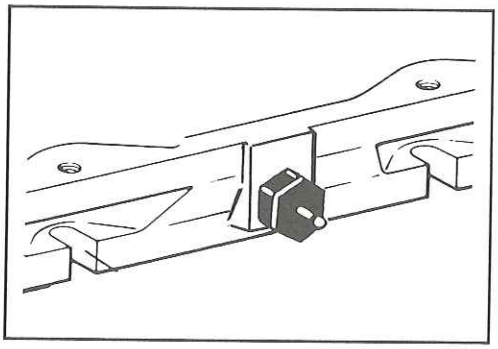

Fig. 34

Install a *Jacobs* gasket in each spacer. Overlap the gasket, but leave approximately 3/8 in. from the ends of the gasket to the ends of the spacer groove (Fig. 35).

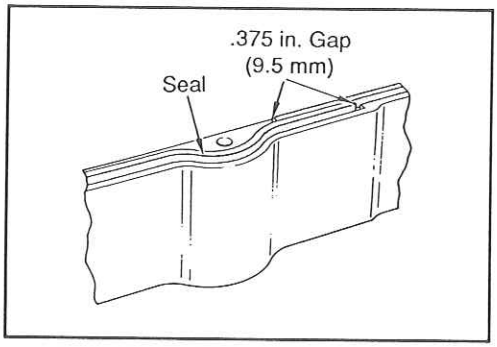

Fig. 35

Install the spacers on top of the valve mechanism cover bases and over the mounting studs.

Install the *Jacobs* vibration-proof nuts on the four mounting studs and torque to 13 lbft. (18 N•m). See Fig. 36.

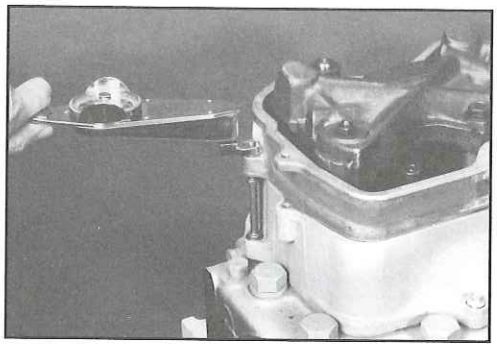

Fig. 36

Install the *Jacobs* serrated capscrews in the two noted locations. See Fig. 37. Torque the capscrews and the nuts to 10 lbft. (14 N•m).

Connect the solenoid harness to the solenoid valve and the terminal leadout. Push wire into the clip.

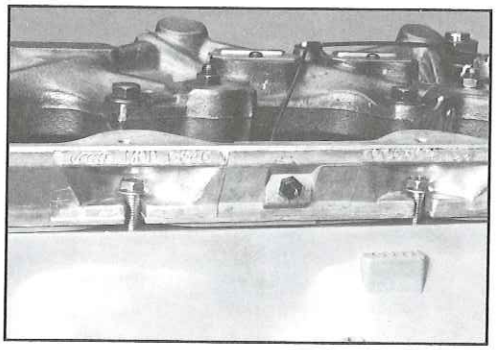

Fig. 37

The *Jacobs* Engine Brake housing installation is now complete.

Recheck the housing installation. Be certain no foreign objects have been left behind and all correct clearance requirements have been met.

Brake Unit Bleed and Operation Check

⚠WARNING

Wear eye protection and do not expose your face over engine area. Whenever engine is running and valve covers are removed, oil splashing in the engine could cause personal injury.

Take precautions to prevent oil leakage down onto the engine.

Start engine and allow to run 5 to 10 minutes.

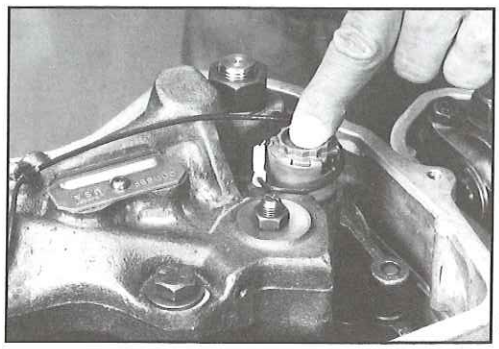

Fig. 38

With the engine at low idle, manually depress the solenoid armature several times in succession until the master pistons move out of the housing and the engine brake begins to operate. Normal oil evacuating from the control valve covers should be free of air bubbles before replacing the valve covers. This permits oil to fill brake housing passages and readies the brake for operation.

Inspect the installation for oil/fuel leakage or component interference. If either is found, the problem must be corrected at this time.

If engine fails to start or misfires, the following Caterpillar procedure must be performed:

TO PRIME THE SYSTEM: If air is trapped in the fuel system, the diesel engine will either not start, or will misfire. Then it is necessary to prime the system. A fuel priming pump is located either on the engine, or remotely mounted for convenience.

a. Be sure the fuel line valve is open and the engine shutoff control is "off."
b. Loosen the fuel line nuts (one at a time) at the pump housing.
c. Unlock the fuel priming pump.
d. Operate priming pump until clear fuel flows from fuel pump. Tighten fuel line nut.
e. Repeat for each fuel line.
f. Lock fuel priming pump.

If engine continues to misfire or smoke, further bleeding is necessary. With engine running, loosen fuel line nuts, one at a time, several times in succession and allow fuel to run until free of air bubbles. Torque fuel line nuts to 30 lbft. (41 N•m).

Before replacing the Caterpillar valve mechanism cover, check for interference at oil fill and breather locations. See Fig. 39. If interference is found, remove sufficient material from the cover to ensure clearance with engine brake housing.

Clean and install covers. Torque hold-down capscrews to 10 lbft. (14 N•m).

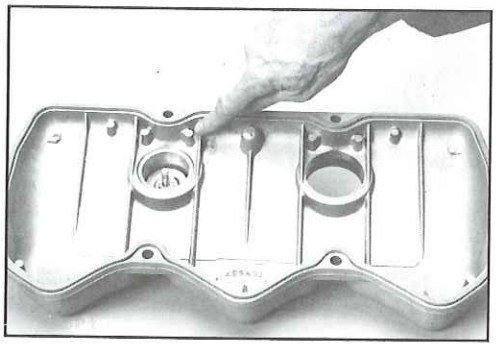

Fig. 39

On DIT and PCT engines only, remove the Caterpillar 7N2446 elbow and grind away boss to remove interference. Clean the elbow after rework and check the Caterpillar 2N8630 gasket between elbow and intake manifold before reassembly.

NOTE:
On DIT and PCT engines only, a boss may be located on the bottom of the crossover pipe connecting flange on the Caterpillar 7N2446 elbow. The boss interferes with the valve cover when the brake is installed.

On engines which have the oil breather mounted on the front valve cover, install the rubber breather pipe extension hose from the kit.

On engines with the oil breather mounted on the rear valve cover, relocate breather pipe brackets as necessary to ensure adequate retention of the breather pipe.

Brake Housing Installation
Alternate Procedure - Housing Leveling

The following leveling (shimming) procedure is required on 3406B engines with serial number lower than 7FB39279 and all 92U prefix engines.

NOTE:
The shim and washer group required for the shimming procedure is not included in the standard kit as supplied. It must be obtained from a *Jacobs* distributor.

Install *Jacobs* mounting washers marked "A" on studs.

Before placing brake units on engine, loosen and back out the slave piston adjusting screws until slave pistons are seated in their bores.

Carefully install the brake housings. Check for proper alignment of the oil supply adaptor.

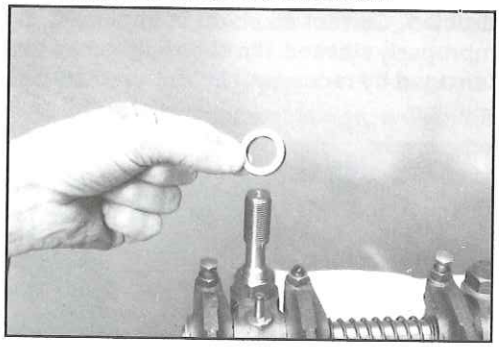

Fig. 40

Locate support tubes under housing and install the *Jacobs* washers and the 7/16 in. capscrews through the housing tubes and into the support bases. Torque the capscrew to only 10 lbft. (13 N•m).

With the front and rear housings now on the engine, a gap should exist between the bottom of the brake housing and the top of the *Jacobs* washer at the four stud locations. Measure the gap with a feeler gauge at all four locations and record the measurements. See Fig. 41.

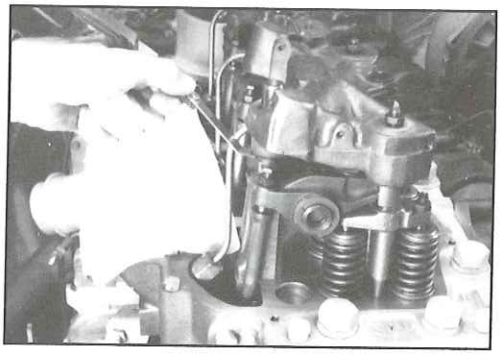

Fig. 41

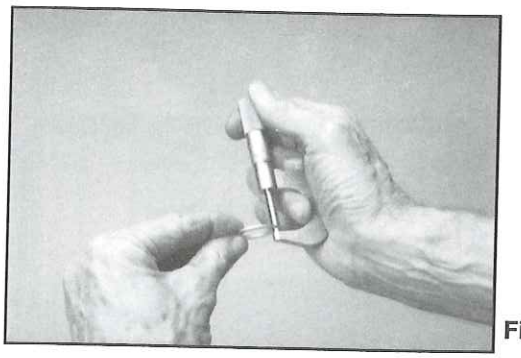

Fig. 42

Remove the 7/16 in. capscrews, washers and tubes. Remove the engine brake housings from the engine.

Measure the thickness of the *Jacobs* shim packs (Fig. 42). These are laminated shims; each shim measures 0.003 in. (0.08 mm).

Using knife and micrometer, separate and remeasure the shim packs. See Figs. 43a and 43b. These shim packs must be within 0.003 in. (0.08 mm) of the gap under the housing previously measured. Repeat this procedure for all stud locations.

Fig. 43a

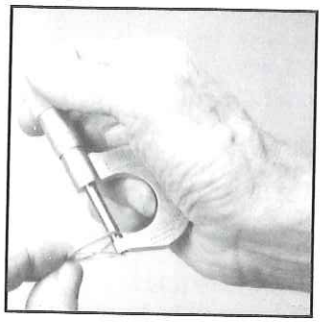

Fig. 43b

⚠CAUTION

Stack washers and shim packs as instructed. Correct stack-up is important. If improperly stacked, the shim pack could be damaged by recess cut in bottom of brake housing.

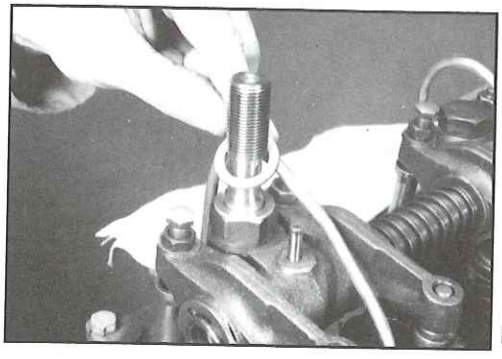

Fig. 44

Remove the *Jacobs* washers and place the measured shim packs on the *Jacobs* studs. Place the *Jacobs* washers previously removed on top of the shim packs. Note that the washer is larger in diameter than the shim pack, and that a recess is cut in bottom of housing.

Now continue with the housing installation procedure beginning on page 10.

SECTION 4
Electrical System Installation

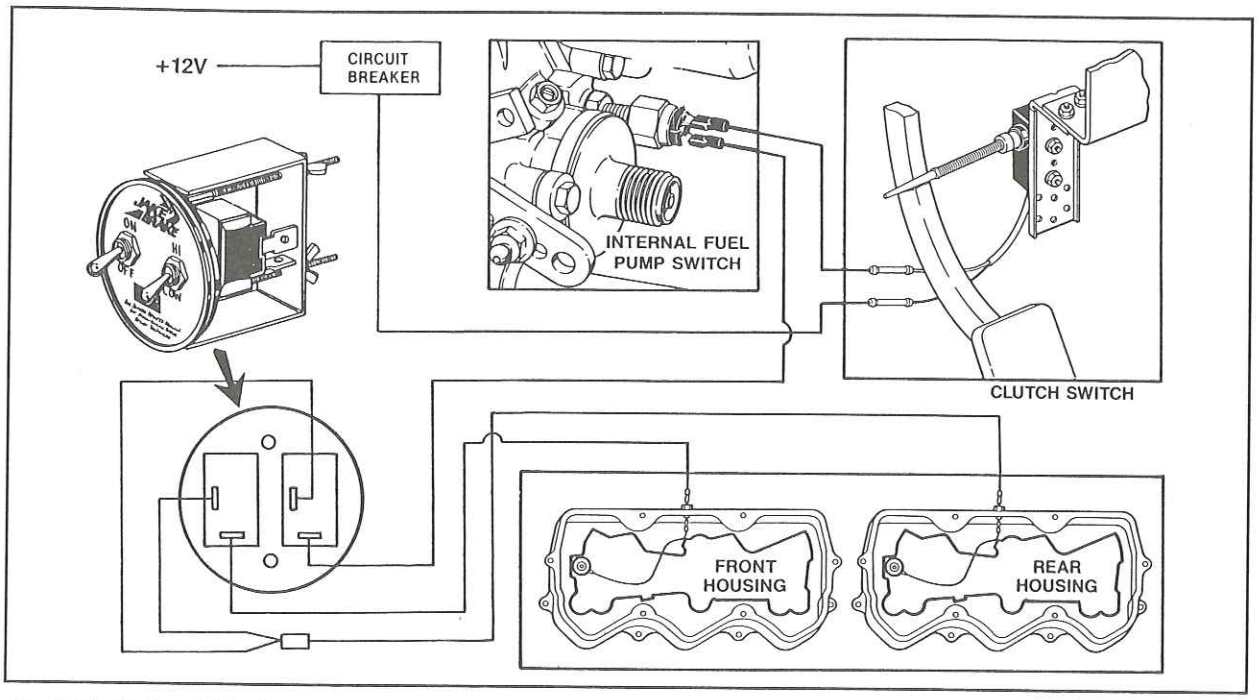

Fig. 45

Dash Switch - 2 Mode

1. Locate area on the dash for the dash switch assembly and drill a 2 in. hole.
2. Attach the connectors to the switches as shown in the electrical system installation diagram, Fig. 45.
3. Install the switch assembly with the bracket, lockwasher and wing nuts.

⚠CAUTION

DO NOT overtighten wing nuts. Switch failure will result.

Alternate Dash Switch Mounting

Drill two 1/2 in. holes using the switch plate as a template. Mount the two dash switches with the faceplate and nuts. The groove in the switch threads must face down.

Clutch Switch

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

1. Mount the clutch switch in the most convenient or accessible location possible. Locations may include in cab under dash, under floor wheel well location or in the area of the bell housing.
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 the switch 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. 46.
4. Check installation by moving the clutch pedal.

NOTE:
For automatic transmissions, a pressure switch installed in the transmission is used in place of the clutch switch. Contact a *Jacobs* distributor for details.

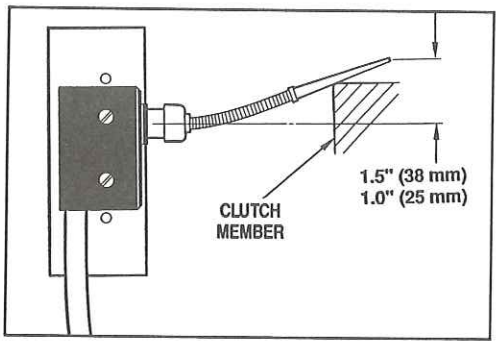

Fig. 46

NOTE:
This adjustment should allow the switch to activate in the freeplay of the clutch pedal before actual clutch disengagement takes place.

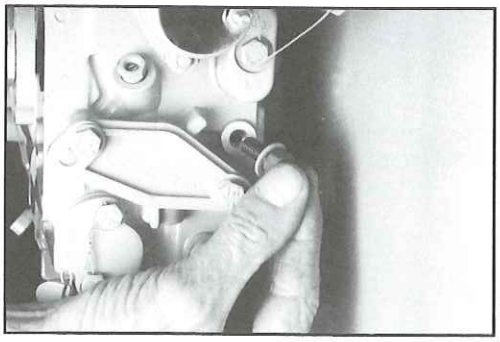

Fig. 47

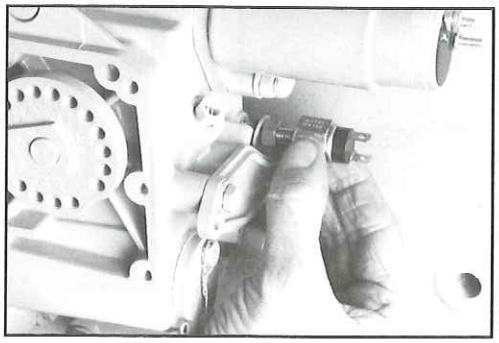

Fig. 48

⚠CAUTION

Check to be sure that the governor operating lever moves freely from low idle to high idle position and releases without binding.

Fuel Pump Switch

1. Remove the fuel pump low idle screw. See Fig. 47. Install the seal, washer and locknut from the low idle screw on the switch.

   Insert the switch to about the same depth as the idle screw was turned. See Fig. 48.

2. Start engine and check low idle RPM. Disconnect the throttle linkage and adjust the idle per Caterpillar specification by turning the switch clockwise to increase and counterclockwise to decrease engine RPM.

3. When proper RPM is set, advance the throttle lever to increase engine speed and then return to idle. Check to be sure the idle RPM setting did not change. Readjust if necessary.

4. Hold the *Jacobs* switch and tighten locknut to 5 lbft. (7 N•m). Reconnect throttle linkage.

If the fuel pump switch has a letter D or lower suffix after the part number, connect the white wire from the engine harness to the silver terminal. Connect the orange wire from the engine harness to the brass (load side) contact. This ensures diode protection of the switches.

If the fuel pump switch has a letter E or greater suffix after the part number, harness wires can be connected to either switch terminal. These switches have two diodes for protection and are not polarity sensitive.

Final Wiring

1. Complete the wiring. Refer to the electrical system installation diagram on page 17. Connect the switches with the wire harness as shown. Connect the other end of the harness to the wire going to the brake housing.

2. Check that all wiring has been installed properly, tied off and moved out of sight. Wires should be routed where no chafing, mechanical or similar interference can occur. Generally, a malfunctioning engine brake is due to faulty or careless wiring. If the cab harness is not long enough to reach the engine harness, install extension harness, P/N 18017, between the engine and cab harnesses.

3. With the engine shut down, check electrical system by turning on ignition switch and moving *Jacobs* On/Off switch to "On." With the Hi/Lo switch in "Lo" position, only rear engine brake solenoid valve should activate. In "Hi" position, both front and rear solenoids should activate.

4. Finally, attach the OPERATING WARNING DECAL in a convenient location on the dash. **Record engine brake S/N and place installation literature package in cab.**

Optional Controls For Non-PEEC Engines

Foot Switch

The foot switch is installed on the cab floor within the 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.

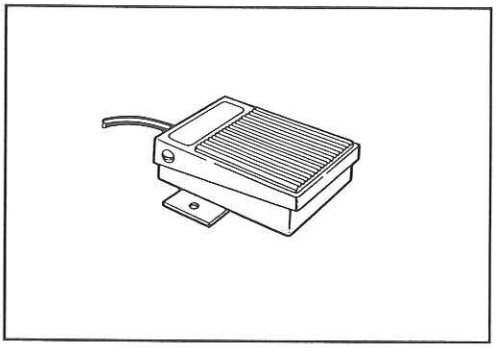

Fig. 49

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.

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.

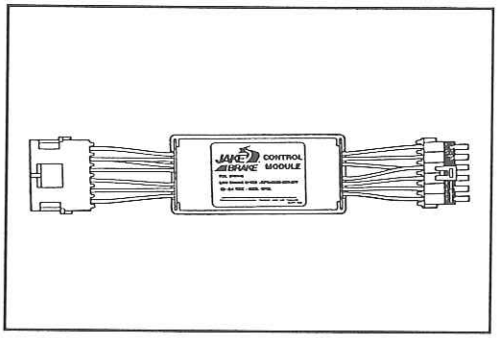

Fig. 50

Electronic Controls For PEEC Engines

The fuel control system, programmable electronic engine control (PEEC) is used on Caterpillar 3406B PEEC engines. *Jacobs* electronic controls as shown in the illustration are required for *Jake Brake* operation on PEEC engines.

These parts, along with associated harnesses and installation instructions, P/N 17888, are contained in the *Jacobs* PEEC Retarder Control Group.

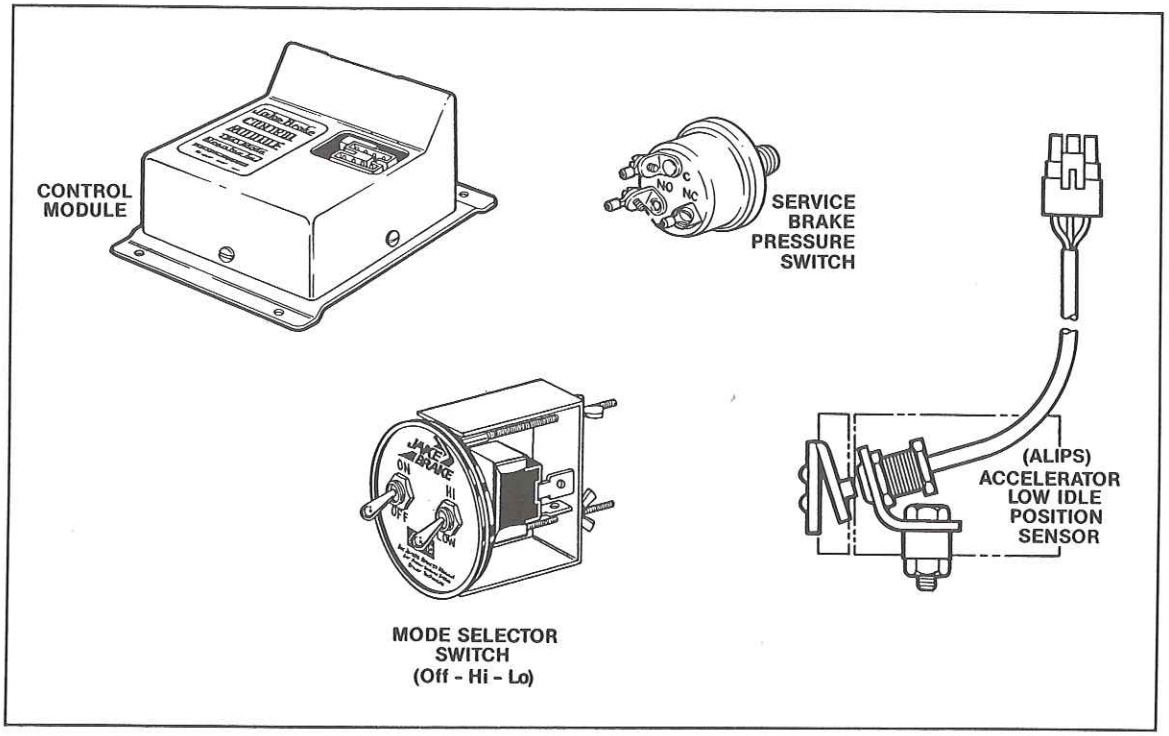

Fig. 51

SECTION 5
ENGINE BRAKE MAINTENANCE

⚠WARNING

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

The *Jacobs* Engine Brake is a relatively trouble-free and maintenance-free device. However, 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.

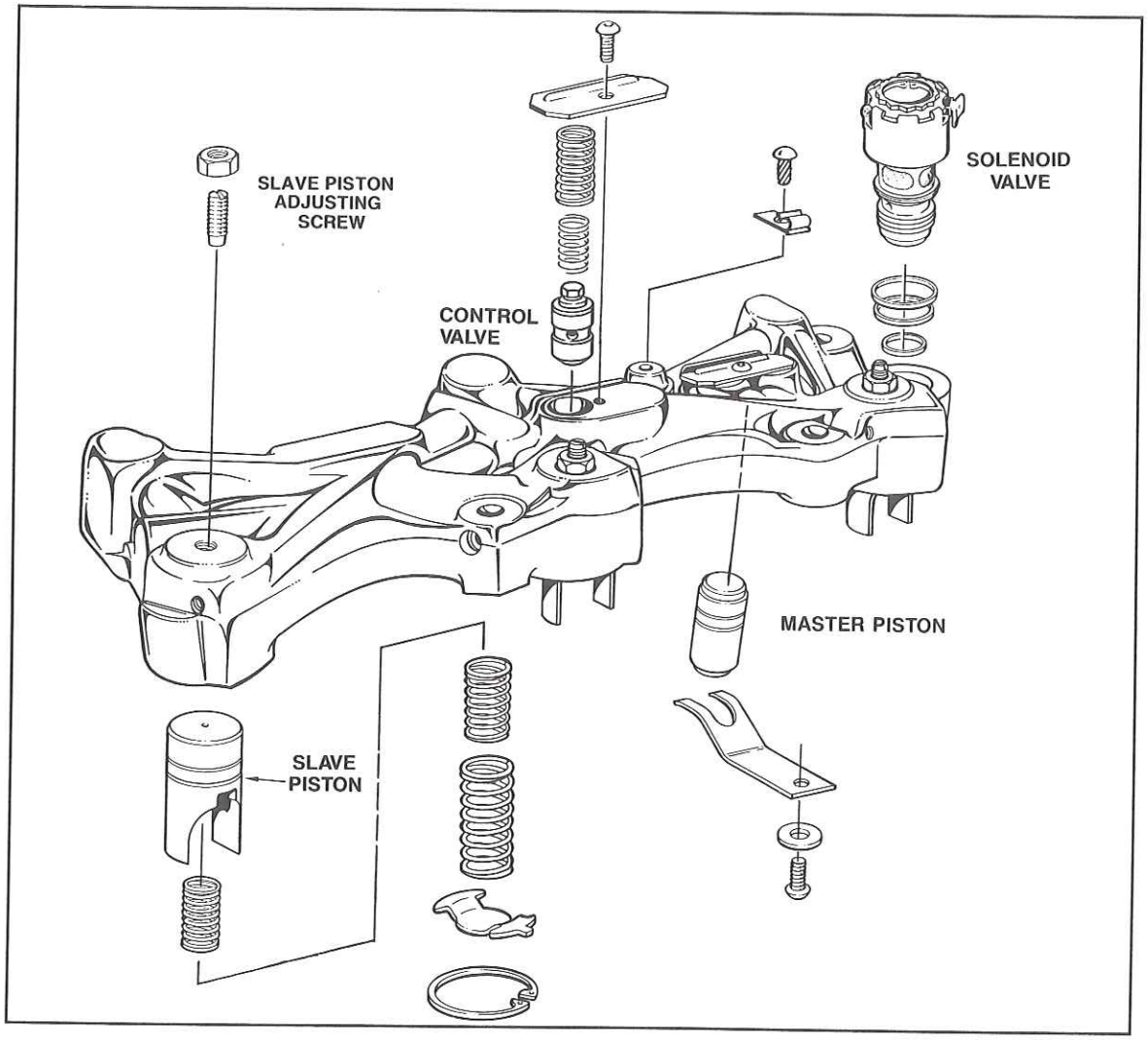

Fig. 52

MODEL 346D HOUSING ASSEMBLY- EXPLODED VIEW

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.

Remove capscrews and covers from top of brake housing.

Remove the control valve springs.

Using needle-nose pliers, remove the control valve. See Fig. 53.

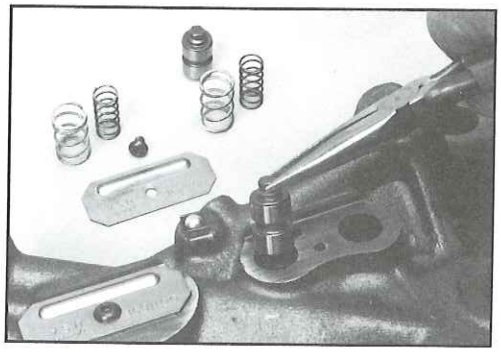

Fig. 53

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

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

Dip the control valve in clean lube oil. Holding the valve by the stem, let the valve drop into its bore. If binding occurs, the control valve should be replaced.

Solenoid

Disconnect the solenoid harness. Using a 7/8 in. socket and extension, remove the solenoid valve.

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

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.

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.

Reinstall solenoid using new seal rings. Seat lower seal ring in the base of the solenoid valve bore. Wipe clean lube oil into and around the bore. Place upper and center seal rings on the solenoid valve body.

Be sure the seals are seated properly and carefully screw the solenoid into housing without unseating the seals. Torque the valve to 5 lbft. (7 N•m). Be careful not to twist the seals while installing.

⚠CAUTION

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

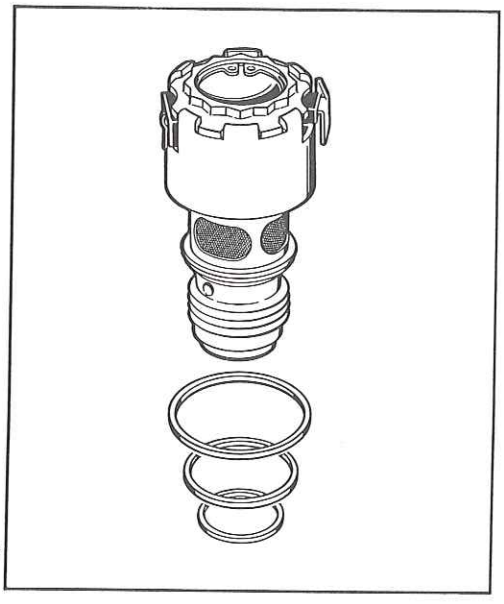

Fig. 54

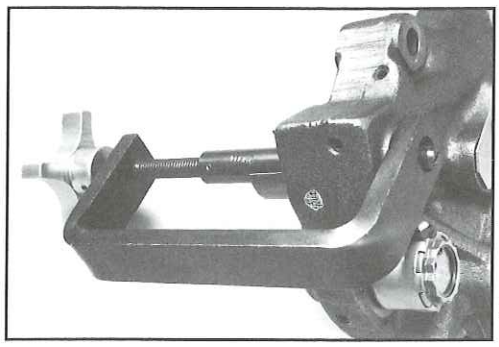

Fig. 55

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.

Remove the locknut on the slave piston adjusting screw. Back out the adjusting screw until the slave piston is fully retracted (screw is loose). Install the slave piston removal tool as shown in Fig. 55.

Turn the tool handle in to relieve the spring pressure. Using retaining ring pliers, rotate the retaining ring to the slot in the housing and remove the retaining ring.

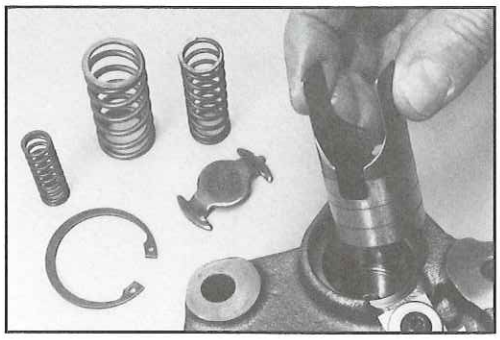

Fig. 56

Remove the retainer, springs and slave piston (Fig. 56). Check for nicks or burrs that could cause binding. Clean piston in an approved cleaning solvent. Run a small wire through the bleed hole. Replace the piston if the ground surface on the outside diameter is scored or pitted. Reassemble all parts, reversing the removal procedure.

Master Piston

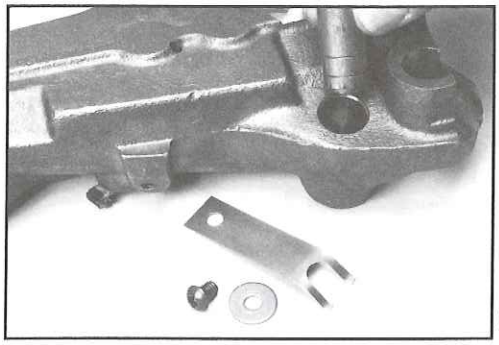

Fig. 57

Remove button head screw, washer and master piston spring from brake housing.

Remove master piston from its bore. See Fig. 57. Needle nose pliers are usually needed to initially pull the piston up. If binding occurs, check for burrs or contaminants in lube oil. Clean in an approved solvent. Inspect the hard-faced surface. Pitted, chipped, cracked or galled pistons should be replaced.

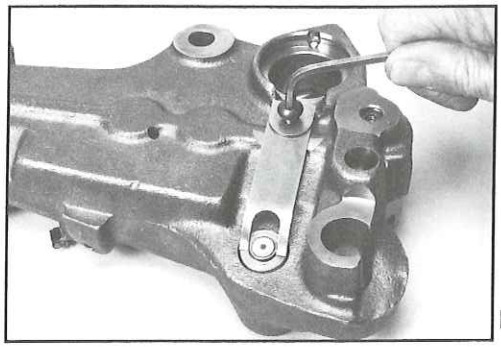

Fig. 58

Reassemble in reverse order. When tightening the button-head screw, make certain the two spring tabs do not interfere with the sides of the master piston's center raised portion.

NOTE:
The tabs should be equally spaced from the raised piston area. See Fig. 58.

Slave Piston Adjusting Screw (Safety Valve)

Remove the slave piston adjusting screw from the housing. Check to be sure the plunger is free to move in and out with light spring pressure.

NOTE:
Do not attempt to disassemble adjusting screw. Adjusting screw is not serviceable in field.

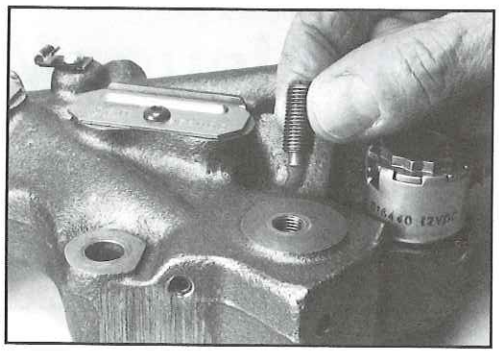

Fig. 59