

# INSTALLATION

The Model 349A Jake Brake® engine retarder is designed and approved for use on Caterpillar® 3406B and 3406C ATAAC (Air-to-air after-cooled) engines with PEEC® or mechanical fuel controls. The Model 349A replaces the former Model 349.

The Model 349A is NOT to be installed on 3406B engines with serial numbers lower than 7FB39279 or any 3406 engines with the 92U serial number prefix. At the time of this printing, the Model 349A is approved for use ONLY on 350, 400, 425 and 460 horsepower rated engines which FULLY conform to original factory specifications.

Caterpillar dealers can help with engine identification if they are supplied with the engine serial number.

Information 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 applications and updated information.

# Table of Contents

<b>Section 1: Introduction</b> .....	<b>3</b>
Special Tools .....	3
Torque Specifications .....	3
<b>Section 2: Engine Preparation</b> .....	<b>4 - 8</b>
Adjustment Reference Point .....	4
Fuel Line and Rocker Arm Group Removal .....	5
Replace Exhaust Valve Bridges .....	6
Bridge Adjustment .....	6
Exhaust Rocker Adjusting Screw Exchange .....	6
Installation of Jacobs Oil Supply Adapter .....	7
Rocker Arm Group Installation .....	7
Installation of Support Bases .....	8
<b>Section 3: Brake Housing Installation</b> .....	<b>9 - 13</b>
Fuel Line Installation .....	9
Brake Housing Installation .....	9
Adjustment Procedures .....	10
Exhaust and Intake Valve Clearance Adjustment .....	10
Slave Piston Adjustment .....	10
Trigger Valve Adjustment .....	10
Cover Base and Spacer Installation .....	12
Brake Unit Bleed and Operation Check .....	13
<b>Section 4: Electrical System Installation</b> .....	<b>14 - 16</b>
Dash Switch .....	14
Clutch Switch .....	14
Fuel Pump Switch .....	15
Final Wiring .....	15
Electronic Controls for PEEC® Engines .....	16
<b>Section 5: Engine Brake Maintenance</b> .....	<b>18 - 20</b>
Theory of Operation .....	18
Exhaust Blowdown .....	18
Control Valve .....	19
Check Valve .....	20
Trigger Valve .....	20
Delay Piston .....	20
Solenoid Valve .....	20
Slave Piston .....	20
Master Piston .....	21

# 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 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.

# Section 1: Introduction

## Special Tools

### Caterpillar® Tools

	Caterpillar Part No.
Fuel line socket, flank drive, 3/4"	5P144
Fuel line wrench, 7/8"	5P5195
Turning tool	9S9082
Fuel pump timing pin (3406B)	6V4186

### Commercially Available Tools

- 9/16" Crowfoot wrench
- Deep socket (1-1/8" - 3/4" drive)
- 5/32" Hex key wrench (long)
- 3/8" Hex key wrench

### Jacobs Tools

	Jacobs Part No.
Dowel pin extractor	007397
Feeler gage, 0.018" (0.46 mm)	003087
Trigger adjusting group	018196
Master piston holding wedge	018279
Fuel line protective group	011724

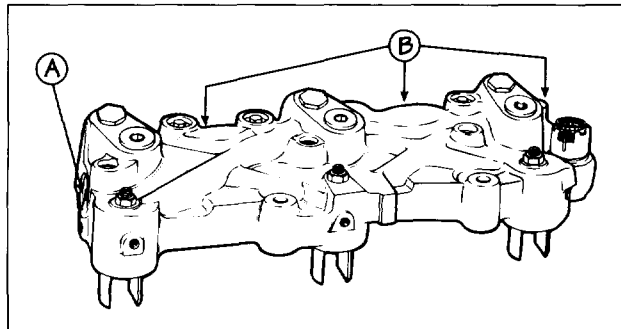


FIG. 1

## Torque Specifications

Exhaust valve bridge jam nut	24 lb.-ft. (35 N•m)
Rocker hold-down bolts	330 lb.-ft. (450 N•m)
Brake housing flange screw	120 lb.-ft. (163 N•m)
Hex-head bolt	60 lb.-ft. (83 N•m)
POWER-LASH® locknut	25 lb.-ft. (35 N•m)
Check Valve Body	35 lb.-ft. (47 N•m)
Trigger cap	35 lb.-ft. (47 N•m)
CAT® cylinder-head bolt	330 lb.-ft. (450 N•m)
CAT lower base capscrews	10 lb.-ft. (14 N•m)
CAT Rocker Arm Adj. Screw Locknuts	22 lb.-ft. (30 N•m)



ALL PARTS USED FOR THE MODEL 349A MUST BE ORIGINAL JACOBS PARTS OR JACOBS APPROVED PARTS. USE OF OTHER THAN JACOBS APPROVED PARTS MAY RESULT IN SERIOUS ENGINE DAMAGE AND/OR LOSS OF ENGINE BRAKE WARRANTY.

#### NOTE:

THE TRIGGER VALVE ADJUSTMENT MUST BE MADE WHENEVER THE ENGINE BRAKE HOUSINGS ARE REMOVED AND REPLACED (SEE PAGES 10 - 12).



DO NOT REMOVE THE PLENUM CHAMBER CAP (A) OR THE THREE 3/8" PIPE PLUGS (B) FROM THE SIDE AND REAR OF THE HOUSING WITHOUT FIRST REMOVING THE CHECK VALVE BODY. THESE SYSTEMS ARE UNDER EXTREMELY HIGH PRESSURE AND PERSONAL INJURY CAN RESULT IF PROPER PROCEDURES ARE NOT FOLLOWED (SEE FIG. 1).

REMOVAL OF ANY OTHER COMPONENTS FROM THE HOUSING, SHOULD BE DONE ONLY ACCORDING TO THE PROCEDURES GIVEN IN THIS MANUAL.

# Section 2: Engine Preparation

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

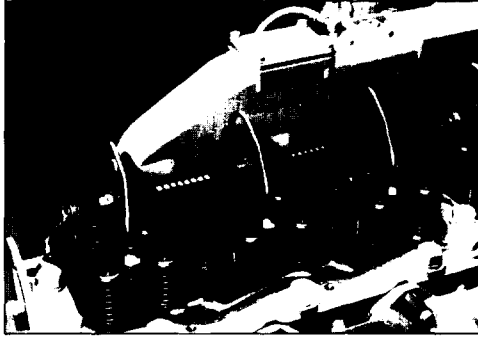


FIG. 2

## Adjustment Reference Point

No. 1 piston at top-dead center (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 the timing bolt from its storage area above the left side starter location (see Fig. 3).



FIG. 3

Insert the 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.



FIG. 4

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.



FIG. 5

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° (one revolution) and reinsert the timing bolt. The No. 1 cylinder is now at TDC compression. Make a mark both on the engine vibration damper and on the front case of the engine in line with each other, as this move will be used as a reference point for cylinder No. 6 TDC compression (see Fig. 6). Remove the timing bolt.

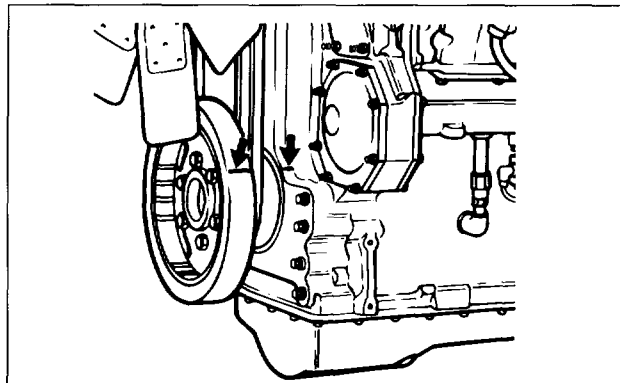
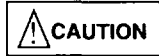


FIG. 6

## Alternate Method

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

1. Remove the plug from the fuel injection pump housing and install the correct timing pin.
2. Slowly rotate the crankshaft counterclockwise until the pin goes into the groove (see Fig. 7).



DO NOT ATTEMPT TO BAR THE ENGINE WITH THE TIMING PIN ENGAGED. THE PIN MAY BE SHEARED OFF AND CAUSE ENGINE DAMAGE.

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 the engine in line with each other. This mark will be used as a reference point for cylinder No. 6 TDC compression (see Fig. 6).
4. Remove the timing pin from the fuel pump and replace the plug (see Fig. 7).

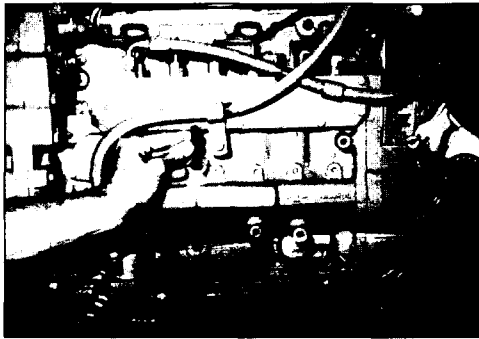
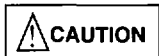


FIG. 7

## Fuel Line and Rocker Arm Group Removal

Remove the fuel lines using the Caterpillar fuel line wrenches (Caterpillar P/N 5P144 and 5P5195) (see Fig. 8).



FUEL LINES AND NOZZLE ASSEMBLIES MUST BE PROTECTED FROM CONTAMINATION BECAUSE FUEL LINE REMOVAL TAKES PLACE DOWNSTREAM FROM FINAL FUEL INFILTRATION.



FIG. 8

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).

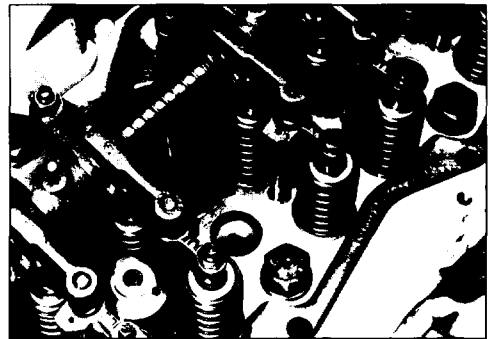
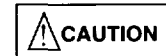


FIG. 9



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.

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).

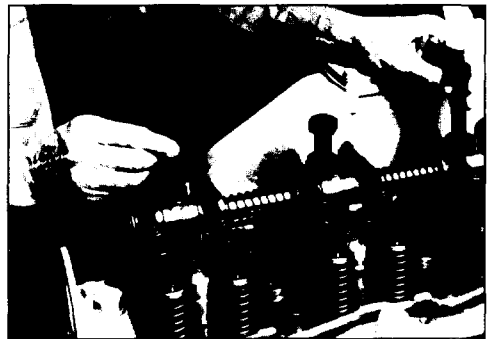


FIG. 10

## Replace Exhaust Valve Bridges

Remove and discard the exhaust valve bridges from the engine (see Fig. 11).

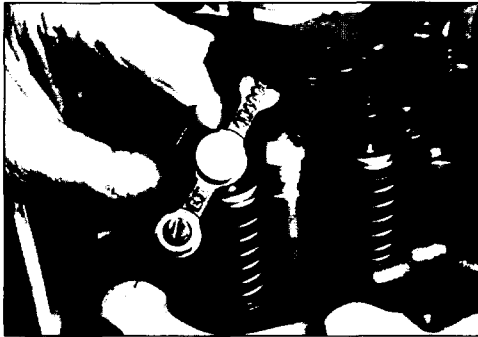


FIG. 11

NOTE:

THE EXHAUST VALVE BRIDGES HAVE "EX" CAST INTO THE TOP SURFACE.

Remove the exhaust valve bridge leveling screws and jam nuts 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:

THIS PROCEDURE IS A CHANGE TO EARLIER 349 AND 349A INSTRUCTIONS. THE JACOBS BRIDGE AND CATERPILLAR ADJUSTING SCREW COMBINATION IS NOW QUALIFIED FOR USE WITH THE 349A.



FIG. 12

Apply clean engine oil to the Jacobs bridge bore and install the Jacobs exhaust valve bridge.

## Bridge Adjustment

Level the exhaust valve bridge assemblies as follows:

1. Back off the 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 (see Fig. 13).



FIG. 13

3. Turn the adjusting screw clockwise until contact is made with the valve stem, then turn the adjusting screw an additional 30° (1/2 of one flat of the locknut).
4. Hold the adjusting screw in this position and tighten the jam nut to 24 lb.-ft. (35 N•m).
5. Apply clean engine lube oil on the area where the rocker arm contacts the bridge.

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 (A) and the Jacobs (B) rocker adjusting screw shown in Fig. 14.

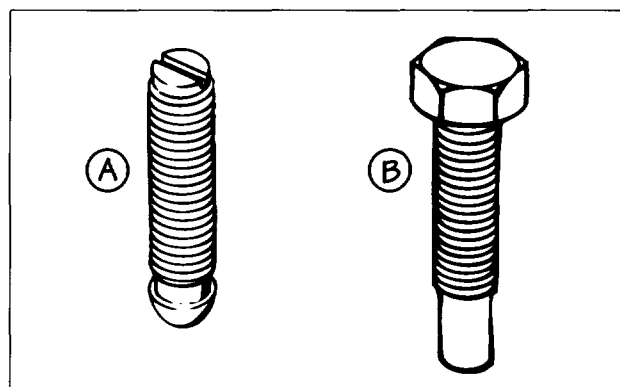


FIG. 14

Install the Jacobs rocker adjusting screws and the Caterpillar jam nut in the exhaust rocker levers. Discard the Caterpillar adjusting screws (see Fig. 15).



FIG. 15

## Installation of Jacobs Oil Supply Adapter

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). The pin must be extracted at cylinder No. 1 location. Be sure to do the same at the No. 4 location later on when installing the second housing.

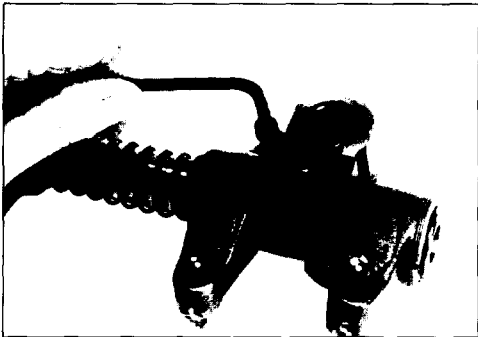


FIG. 16

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

Coat the end of the Jacobs oil supply adapter with clean engine oil and install it 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 the "O" ring at this time.

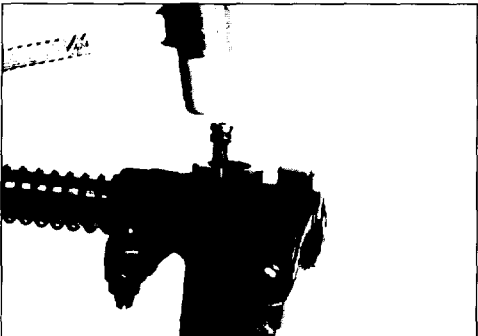


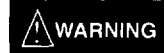
FIG. 17

## 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 TIGHTENING OF THE JACOBS HOLD-DOWN STUD.

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.

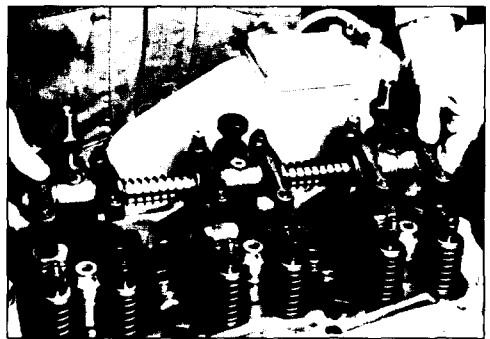


FIG. 19

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 the adjusting screws are located in pushrod sockets.

Starting with the inner bolt and progressing toward either end of the engine, tighten to 200 lb.-ft. (270 N•m) of torque. Then repeat the sequence in 50 lb.-ft. (70 N•m) increments (see Fig. 20) to 330 lb.-ft. (450•N m).



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.

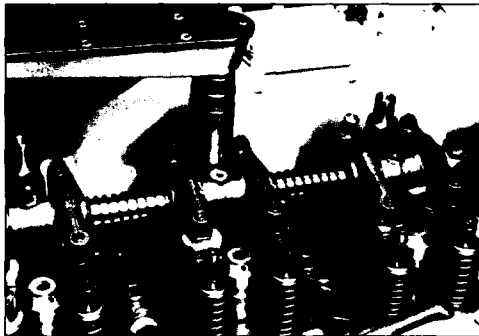


FIG. 20

## Installation of Support Bases

Fig. 21 shows the Caterpillar head bolts to be removed for installation of the Jacobs support bases. Blow the oil out of the head bolt holes using the air gun and hose as before (see Fig. 22).

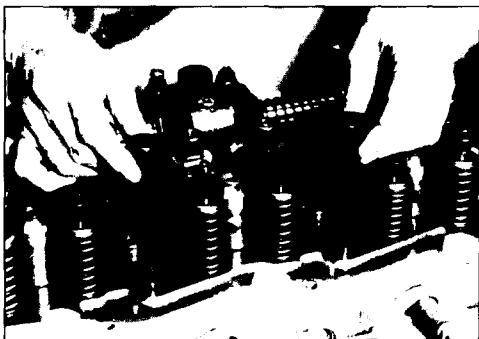


FIG. 21

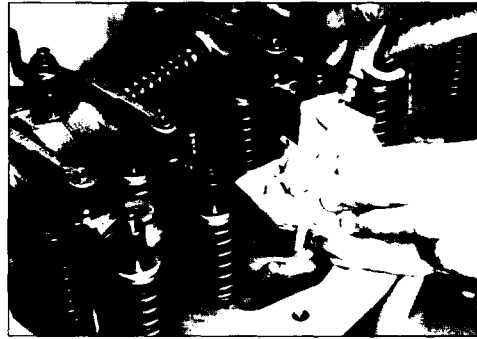


FIG. 22



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 TIGHTENING OF THE JACOBS HOLD-DOWN STUD.

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).

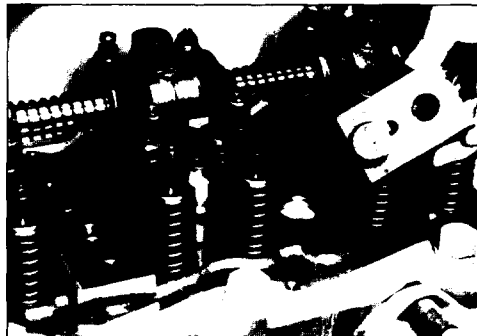


FIG. 23

Coat the head bolt threads and both faces of related washers with a moly lube (Caterpillar P/N 1E2407A or G-N metal assembly paste) prior to assembly.

Install the bolts with washers and tighten to 200 lb.-ft. (270 N•m) of torque. Tighten to 330 lb.-ft. (450 N•m) of torque (see Fig. 24).

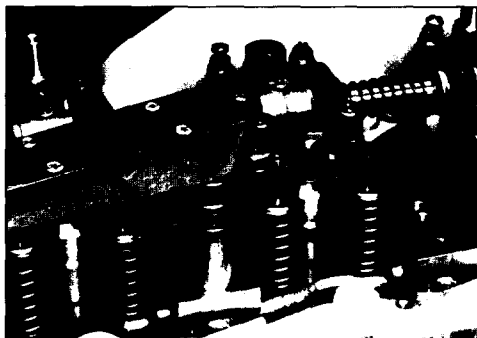


FIG. 24



# Section 3: Brake Housing Installation

## Fuel Line Installation

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 the nuts using the Caterpillar fuel line socket wrenches to 30 lb.-ft. (41 N•m) of torque (see Fig. 25).

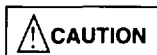


FIG. 25

**NOTE:**

IF NEW FUEL LINES ARE BEING USED, BE SURE TO INSTALL THE NEW "O" RINGS ON THE RISER END OF THE FUEL LINES. LUBRICATE THE "O" RINGS WITH CLEAN ENGINE OIL BEFORE INSTALLING.

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



DO NOT BEND FUEL LINES AS FUEL LEAKAGE MAY RESULT.

## Brake Housing Installation

Before placing the brake housing on the engine, loosen and back out the slave piston adjusting screw until slave piston is fully retracted in its bore.

Install an "O" ring on the oil supply adapter. Place a small amount of grease on the adapter (see Fig. 26).



FIG. 26

**NOTE:**

THE HOUSINGS ARE MARKED FRONT AND REAR. THE FRONT HOUSING MUST BE INSTALLED ON THE FRONT THREE CYLINDERS AND THE REAR HOUSING ON THE REAR THREE CYLINDERS.

Place the housing over the studs and install the two support tubes between the housing and support bases (see Fig. 27).

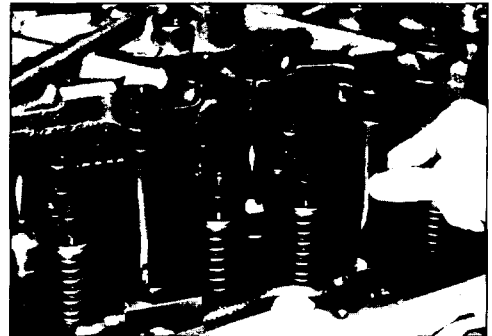


FIG. 27

Install the Jacobs washers and the hex-head bolts through the housing and support tubes and into the support bases. Hand tighten only.

Install the two flanged screws with washers at the rocker shaft location.

Tighten the flanged screws at the rocker shaft location to 60 lb.-ft. (82 N•m). Tighten the next head bolts at the support base locations to 60 lb.-ft. (82 N•m). Tighten the two flanged screws at the rocker shaft location to 120 lb.-ft. (163 N•m).

Follow the same procedure for installing the engine brake housing on the other three cylinders.

# Adjustment Procedures

Make adjustments in the following order:

1. Engine intake/exhaust valves and engine brake slave pistons
2. Engine brake trigger valves



THE ONLY SLAVE PISTON TO BE USED IN THE MODEL 349A IS P/N 018251. USE OF ANY SLAVE PISTON OTHER THAN P/N 018251 MAY RESULT IN SERIOUS DAMAGE.

## Exhaust and Intake Valve Clearance Adjustment

Adjustments must be made with the engine stopped and cold with established water temperature of 140° F. (60° C.) or below.

Adjust the valve clearances to Caterpillar specifications. Refer to the sequence in Chart 1. After the exhaust valve clearance is set, the slave piston clearance can be set following the sequence in the same chart (Chart 1).

### Valve and Slave Piston Adjustment Sequence

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

CHART 1

Set intake valve clearance to 0.015" (0.38 mm). Hold the adjusting screw and tighten the locknuts to 22 lb.-ft. (30 N•m).

Set the exhaust valve clearance to 0.030" (0.76 mm). Use a 1/2" open-end wrench for turning the rocker adjusting screw. Hold the adjusting screw and tighten the locknut to 22 lb.-ft. (30 N•m) (see Fig. 28).



FIG. 28

## Slave Piston Adjustment

The exhaust valves on the cylinder to be adjusted must be closed.

Insert a Jacobs 0.018" feeler gage between the slave piston feet and the exhaust bridge (see Fig. 29).



FIG. 29

Turn the POWER-LASH® assembly in until a slight drag is felt on feeler gage. Hold the POWER-LASH assembly in position and tighten the locknut to 25 lb.-ft. (35 N•m). Continue the slave piston adjustments following the sequence in the above chart.

## Trigger Valve Adjustment

Trigger valve travel adjustment is set according to the settings shown in Chart 2.

### Trigger Adjustments

Cylinder Number	Pre-1991 Model Year 3406B	'91 & Later Model Year 3406B/3406C	
		400 HP	All Others
1	0.100"	0.130"	0.100"
2, 3, 4, 5, 6	0.100"	0.095"	0.100"
All adjustments are ± 0.003"			

CHART 2



CYLINDER NO. 1 TRIGGER VALVE SETTING ON 1991 MODEL YEAR ENGINES WITH 400 HORSEPOWER IS DIFFERENT THAN FOR THE OTHER CYLINDERS ON THAT ENGINE.

### NOTE:

TRIGGER VALVE ADJUSTMENT, AS WELL AS SLAVE PISTON ADJUSTMENT, MUST BE MADE ANY TIME THE BRAKE HOUSINGS ARE REMOVED AND REPLACED.

After the valves and slave pistons are adjusted on all cylinders, the trigger valves should be adjusted using the trigger adjusting group shown in Fig. 30.

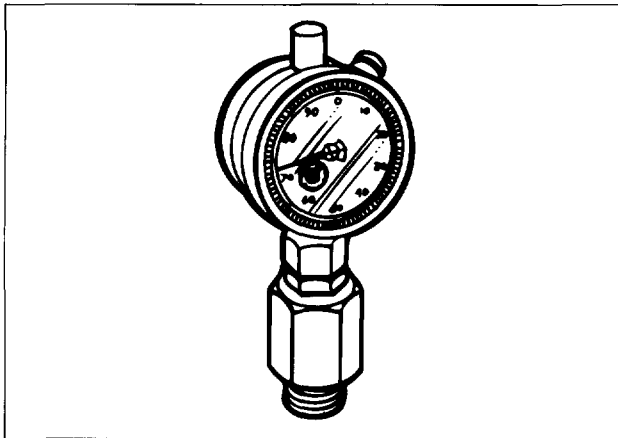
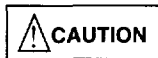


FIG. 30



MAKE THIS ADJUSTMENT CAREFULLY AND ACCURATELY TO ASSURE MAXIMUM ENGINE BRAKE PERFORMANCE AND TO PREVENT POSSIBLE ENGINE DAMAGE. THE JACOBS TRIGGER ADJUSTMENT GROUP IS REQUIRED FOR THIS ADJUSTMENT.



MAKE SURE THAT THE TRIGGER ADJUSTING GROUP IS CALIBRATED ACCORDING TO THE INSTRUCTIONS INCLUDED IN THE GROUP BEFORE EACH INSTALLATION.

1. Remove the cap and spring from the trigger valve on the cylinder to be adjusted. Do not remove the trigger valve (see Fig. 31). The first trigger adjustment should be made on the cylinder last adjusted for slave piston lash.



FIG. 31

2. Install the dial indicator assembly into the trigger valve bore (see Fig. 32). Hand tighten until metal-to-metal contact is made.

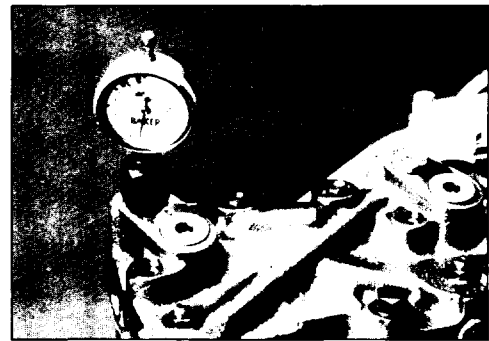


FIG. 32

3. The indicator extension will contact the trigger valve and push the master piston down slightly (see Fig. 33).

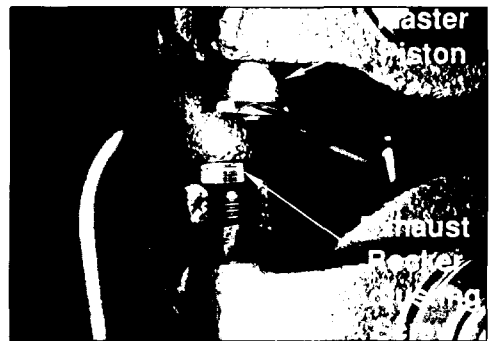


FIG. 33

**NOTE:**

THE MASTER PISTON MUST NOT COME IN CONTACT WITH THE EXHAUST ROCKER ADJUSTING SCREW AT THIS TIME.

4. Set the indicator to zero.
5. Rotate the engine crankshaft slowly in the direction of rotation. The exhaust rocker adjusting screw will contact the master piston and the dial indicator needle will begin to move. Continue rotating the crankshaft until the trigger reaches maximum travel and reverses direction. Record the maximum travel of the indicator. The travel must be set according to Trigger Adjustment Chart on page 10.
6. Use the following procedure to adjust the trigger travel. The indicator travel must be within  $\pm 0.003$ " of specific trigger adjustment as shown in Chart 2 on page 10.

## If necessary to further adjust trigger travel:

1. Remove the dial indicator/adaptor assembly and insert a long 5/32" hex key wrench through the trigger valve bore and into the master piston assembly (see Fig. 34).



FIG. 34

2. Insert the Jacobs master piston holding wedge between the master piston and exhaust rocker adjusting screw. Push the wedge in until the master piston bottoms in its bore (see Fig. 35). This will prevent the master piston from turning while the trigger adjustment is being made.

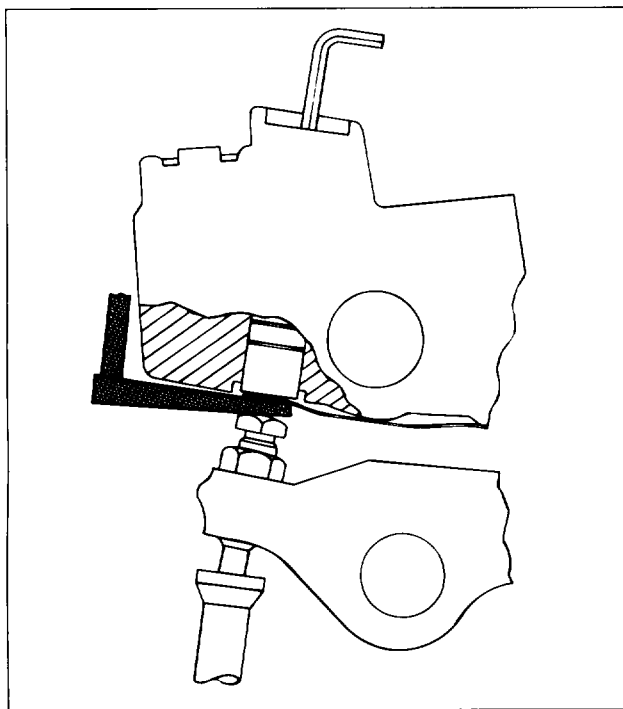


FIG. 35

3. Push down on the hex key wrench (A). This unlocks the adjusting screw (B) from the hex pin (C) (see Fig. 36).
4. Refer to the original recorded travel found in step 4 on the previous page and adjust by pressing the hex key wrench against spring pressure. Maintain pressure while turning clockwise (to decrease travel) or counter-clockwise (to increase travel). Each side of the hex (60°) equals approximately 0.005" of trigger travel.

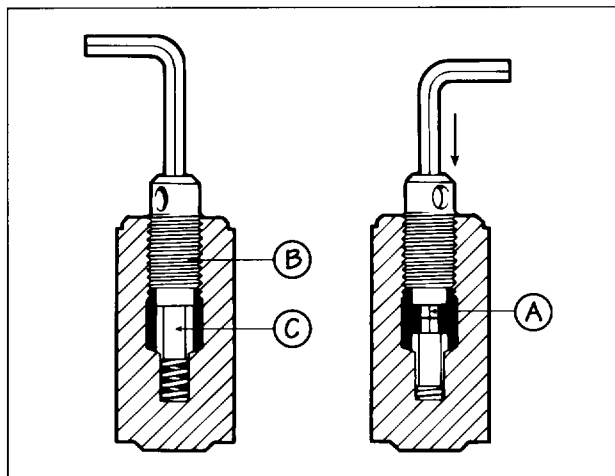


FIG. 36

5. Remove the hex key wrench. The adjusting screw must be locked.

### NOTE:

SPRING PRESSURE ON THE HEX PIN SHOULD LOCK THE ADJUSTING SCREW IN POSITION WHEN PRESSURE ON THE HEX KEY WRENCH IS REMOVED. IF THE SCREW DOES NOT LOCK, MOVE IT SLIGHTLY UNTIL THE HEX PIN WILL GO IN TO LOCKED POSITION.

Reinstall the dial indicator assembly. Recheck the travel by rotating the engine crankshaft back and forth. Repeat the setting procedure if necessary.

6. Replace the trigger spring and cap. Tighten the cap to 35 lb.-ft. (47 N•m). Do not over-tighten.
7. Continue the adjustment of the remaining cylinders in the engine firing order. Recheck the torque on all six trigger caps.



DO NOT OVER-TORQUE THE TRIGGER CAPS.

## Cover Base and Spacer Installation

Note the four mounting stud locations for the valve cover base in Fig. 37.

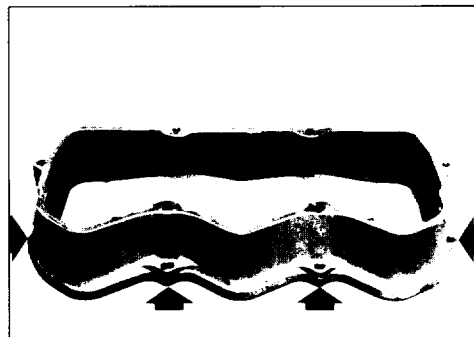


FIG. 37

Refer to Fig. 38; install both of the valve cover bases and thread the studs into the cylinder head in the locations shown in Fig. 37. Use the Caterpillar screws in the other three locations in the valve cover base. Tighten the studs and screws to 10 lb.-ft. (14 N•m).



FIG. 38

Install the Jacobs spacers and washers on top of the valve cover bases.

Reuse the four Caterpillar lower base capscrews at the four stud locations and the two Jacobs serrated capscrews at the other two locations. Tighten all capscrews to 10 lb.-ft. (14 N•m).



FIG. 39

Connect the solenoid harness to the solenoid valve and the terminal leadout (see Fig. 40). Clip the solenoid harness into the wire clip mounted on the brake housing.



FIG. 40

The Jacobs Model 349A engine brake housing installation is now complete.

Take a few minutes to 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



WEAR EYE PROTECTION AND DO NOT EXPOSE YOUR FACE OVER THE ENGINE AREA. WHENEVER THE ENGINE IS RUNNING AND THE VALVE COVERS ARE REMOVED, OIL SPLASHING IN THE ENGINE COULD CAUSE PERSONAL INJURY. TAKE PRECAUTIONS TO PREVENT OIL LEAKAGE ONTO THE OUTSIDE OF THE ENGINE, ESPECIALLY THE TURBOCHARGER HOUSING.

Start the engine and allow to run 5 to 10 minutes.

With the engine at low idle, manually depress the solenoid disc 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 prepares the brake for operation.



FIG. 41

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

Install the valve covers using Caterpillar screws and tighten to 10 lb.-ft. (14 N•m).

# Section 4: Electrical System Installation

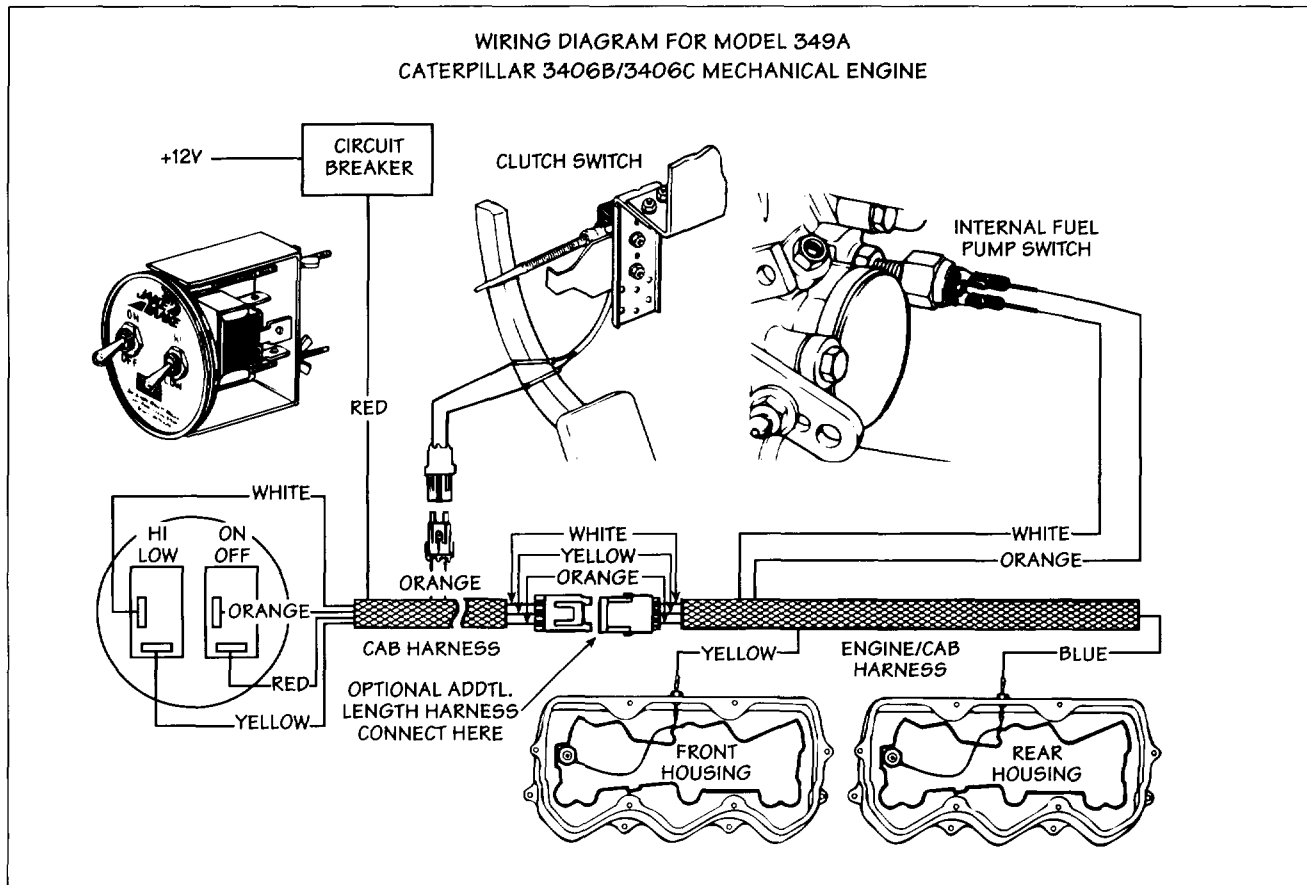
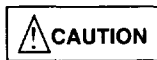


FIG. 42

## Dash Switch

1. Locate an appropriate area on the dash for the dash switch assembly. Cut a 2" diameter hole in the dash.
2. Attach the connectors to the switches as shown in the Electrical System Installation Diagram (see Fig. 42).
3. Install the switch assembly with the bracket, lockwasher and wing nuts.



DO NOT OVERTIGHTEN THE WING NUTS.  
SWITCH FAILURE WILL RESULT.

## Alternate Dash Switch Mounting

Drill two 1/2" diameter 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

NOTE:

FOR SOME AUTOMATIC TRANSMISSIONS, A PRESSURE SWITCH INSTALLED IN THE TRANSMISSION IS USED IN PLACE OF THE CLUTCH SWITCH. CONTACT YOUR JACOBS DISTRIBUTOR FOR DETAILS.

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 the cab under the dash, under the 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.

- Adjust the switch by moving the switch along the mounting bracket. The actuator arm should be deflected 1.0 - 1.5" (25 - 38 mm), measured at the tip of the actuator, when the clutch pedal is in the up (clutch engaged) position (see Fig. 43).

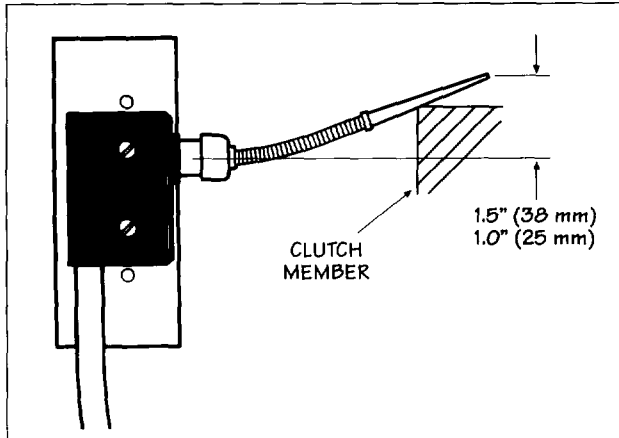


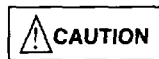
FIG. 43

- Check the installation by moving the clutch pedal.

**NOTE:**

THIS ADJUSTMENT SHOULD ALLOW THE SWITCH TO ACTIVATE IN THE FREE-PLAY OF THE CLUTCH PEDAL BEFORE ACTUAL CLUTCH DISENGAGEMENT TAKES PLACE.

## Fuel Pump Switch



DO NOT USE THE FUEL PUMP SWITCH ON POSITIVE GROUND APPLICATIONS.

- Remove the fuel pump low idle screw (see Fig. 44). Install the seal, washer and locknut from the low idle screw on the fuel pump switch.



FIG. 44

- Insert the switch to about the same depth as the idle screw was turned (see Fig. 45).

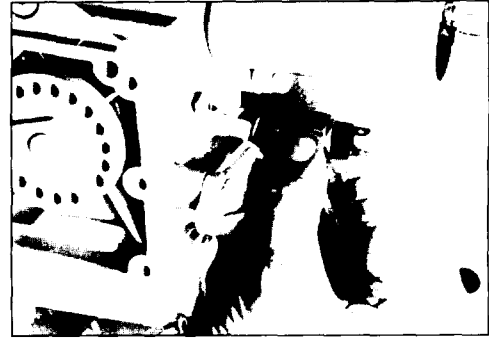


FIG. 45



CHECK TO BE SURE THAT THE GOVERNOR OPERATING LEVER MOVES FREELY FROM LOW IDLE TO HIGH IDLE POSITION AND RELEASES WITHOUT BINDING.

- Start the engine and check low idle RPM. Disconnect the throttle linkage and adjust the idle per Caterpillar specification by turning the switch clockwise (to increase) or counterclockwise (to decrease) the low idle RPM.
- When the 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.
- Hold the Jacobs switch and tighten the locknut to 5 lb.-ft. (7 N·m). Reconnect the throttle linkage.
- Connect the engine/cab harness to the fuel pump switch as shown in Fig. 42.

## Final Wiring

- Complete the wiring. Refer to the electrical system installation diagram on page 14. Connect the switches with the wire harness as shown. Connect the other end of the harness to the wire going to the brake housing.
- Check all wiring. Make sure all wiring has been installed properly, tied off and moved out of sight. Wires should be routed where no chafing, mechanical interference or similar conditions can occur. Often 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 an extension harness between the engine and cab harnesses.
- With the engine shut down, check the electrical system by turning on the ignition switch and moving the Jacobs ON/OFF switch to "ON". With the HI/LO switch in the "LO" position, only the rear engine brake solenoid valve should activate. In the "HI" position, both the front and rear solenoids should activate.
- Finally, attach the OPERATING WARNING DECAL in a convenient location on the dash. Record the engine brake serial number and place the 349A installation literature package in the cab.

# Electronic Controls for PEEC® Engines

The Programmable Electronic Engine Control (PEEC) is a fuel control system used on Caterpillar 3406B PEEC engines which have engine serial numbers beginning with 8TC, 5YG and 2EK prefixes. A wiring diagram for these PEEC engines is shown in Fig. 46 for reference. This diagram, along with the associated components and installation instructions, are contained in the Jacobs PEEC Retarder Control Group.

Engines with the newer PEEC III fuel control system (engine serial numbers beginning with 4CK) use one of two different control groups. One group is used if the vehicle is equipped with ABS, and the other is for vehicles without ABS. The wiring diagrams for these two groups are shown in Fig. 47 for reference. These diagrams, along with the appropriate components, are included in their respective Jacobs PEEC III Retarder Control Groups.

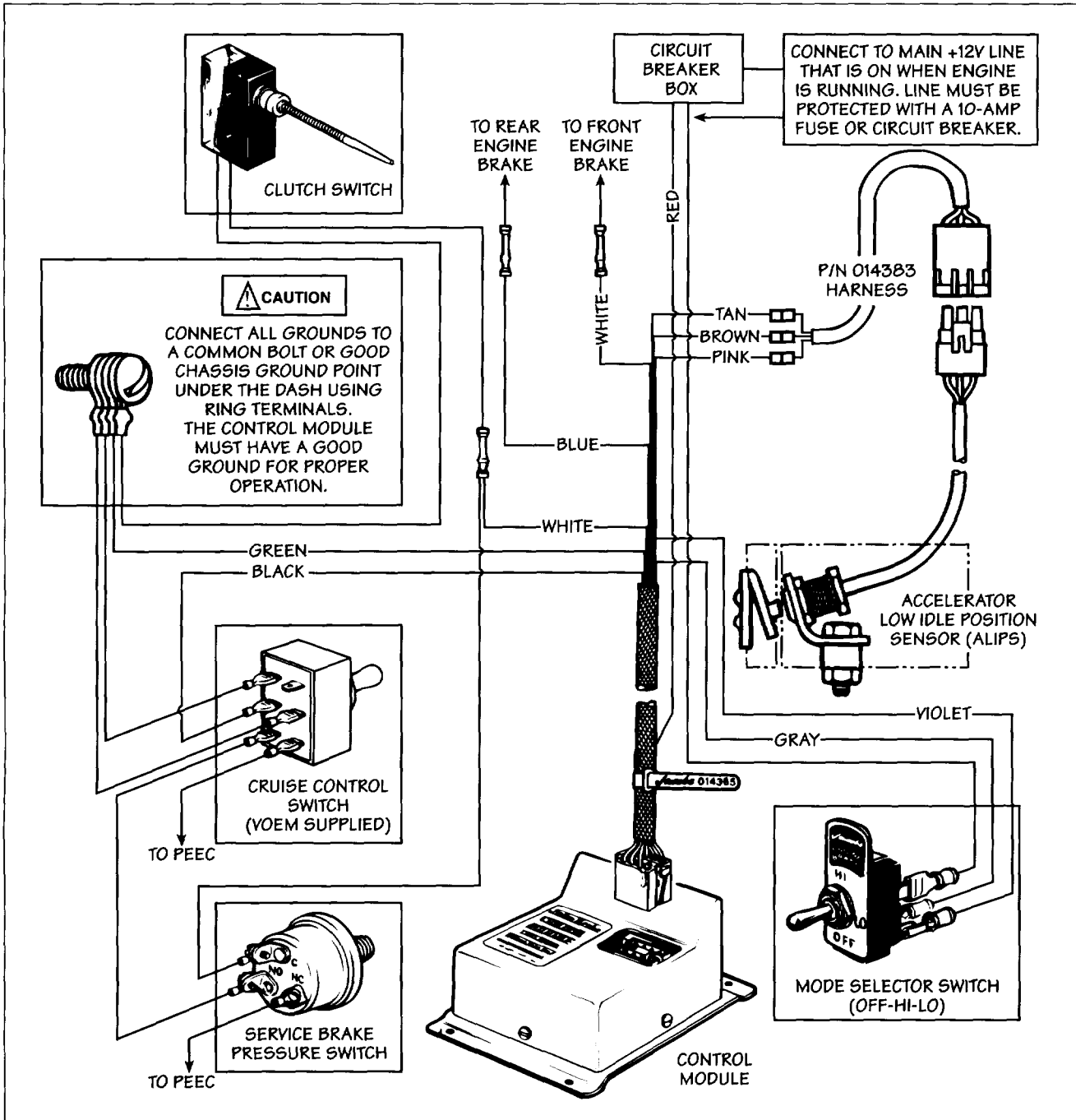
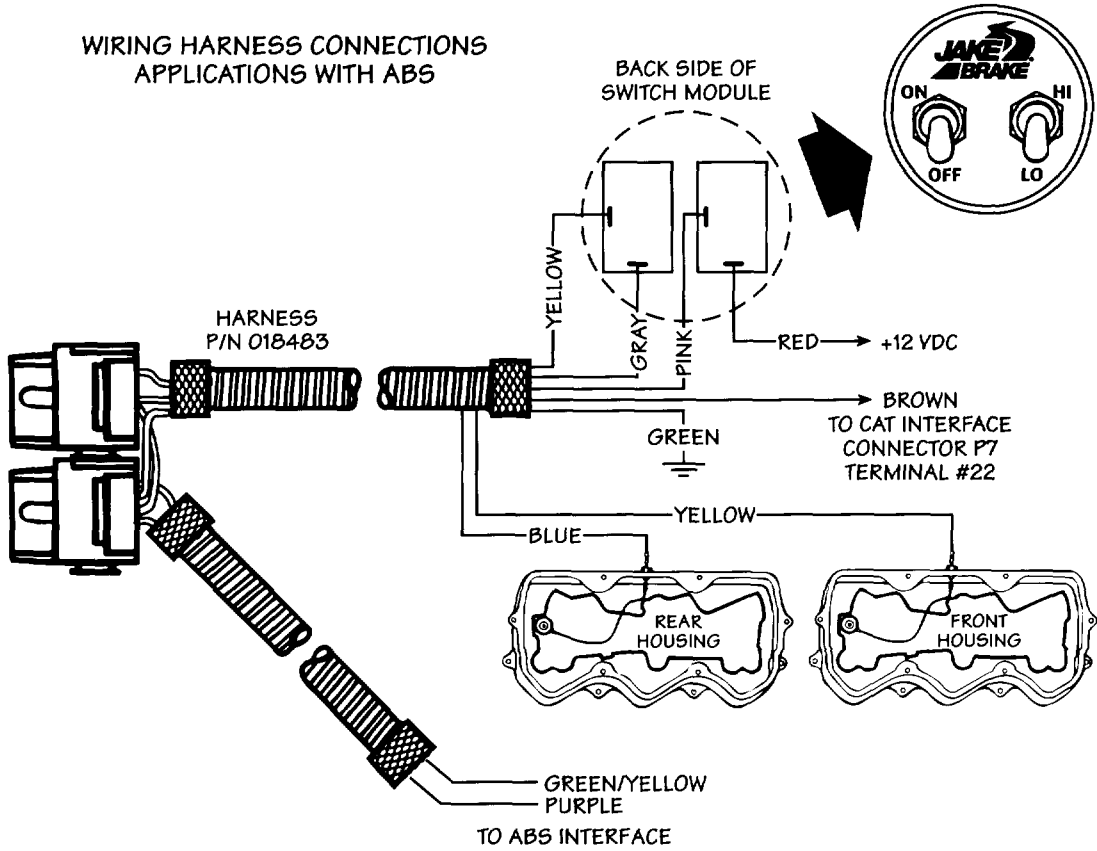


FIG. 46



WIRING HARNESS CONNECTIONS  
APPLICATIONS WITH ABS



WIRING HARNESS CONNECTIONS  
APPLICATIONS WITHOUT ABS

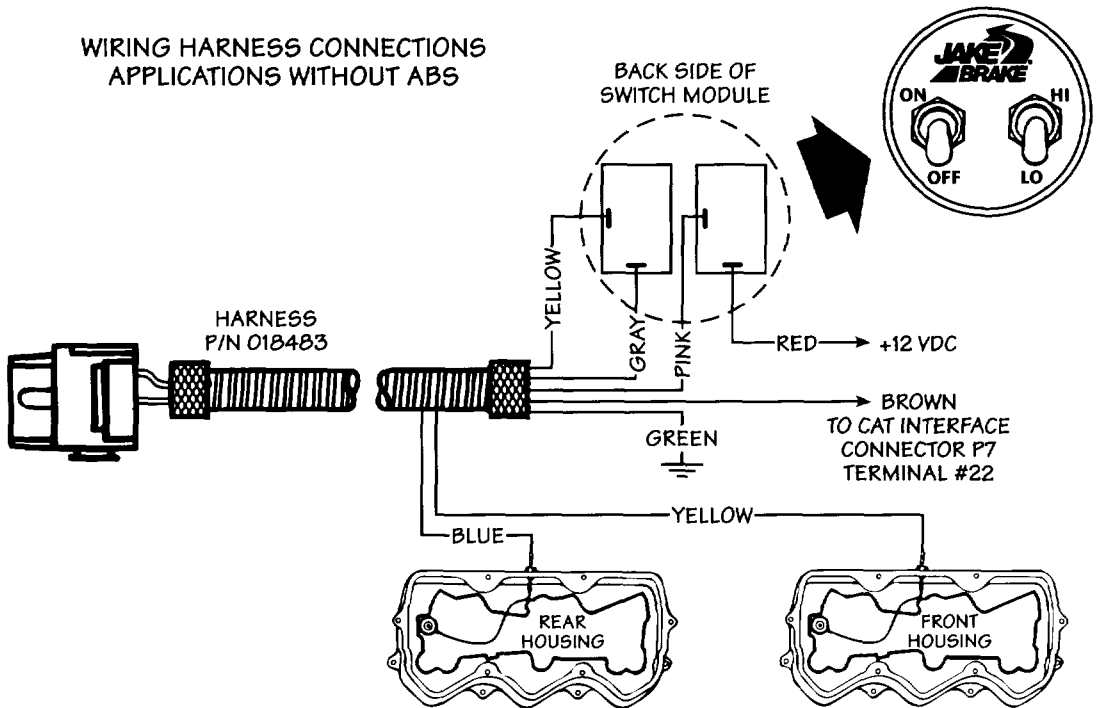


FIG. 47

# Section 5: Engine Brake Maintenance

## Theory of Operation

Energizing the engine brake effectively converts a power-producing diesel engine into a power-absorbing air compressor. This is accomplished 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 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

The braking cycle is accomplished by utilizing the pushrod motion of an exhaust valve of another cylinder during its normal exhaust cycle. Referring to Fig. 48, Cylinder No. 1 exhaust pushrod opens the exhaust valves of Cylinder No. 3 in this sequence.

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 corresponding exhaust rocker arm adjusting screw. See the accompanying chart for the master/slave operation relationship.
3. 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 delay piston.
4. The delay piston moves and compresses the plenum oil to high pressure. The delay piston and plenum act as a high pressure "spring" to activate the slave piston at the appropriate time.
5. The master piston moves upward and at the appropriate time, opens the trigger valve.
6. High pressure oil flows from the delay piston through the trigger valve to the slave piston.
7. The slave piston moves down, contacts the exhaust valve bridge and opens the exhaust valves, releasing compressed cylinder air to the exhaust manifold.
8. Compressed air escapes to atmosphere, completing a compression braking cycle.

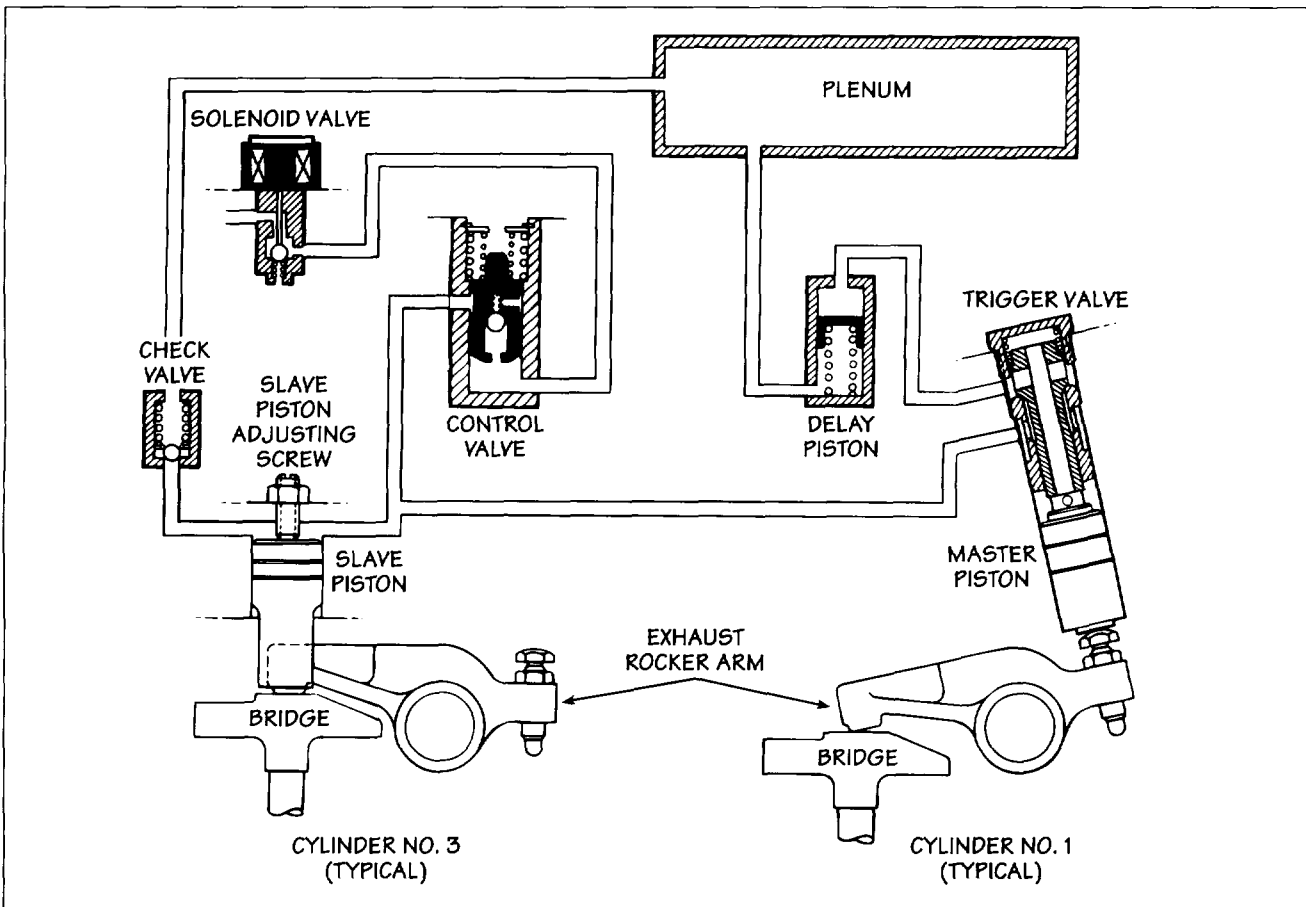


FIG. 48

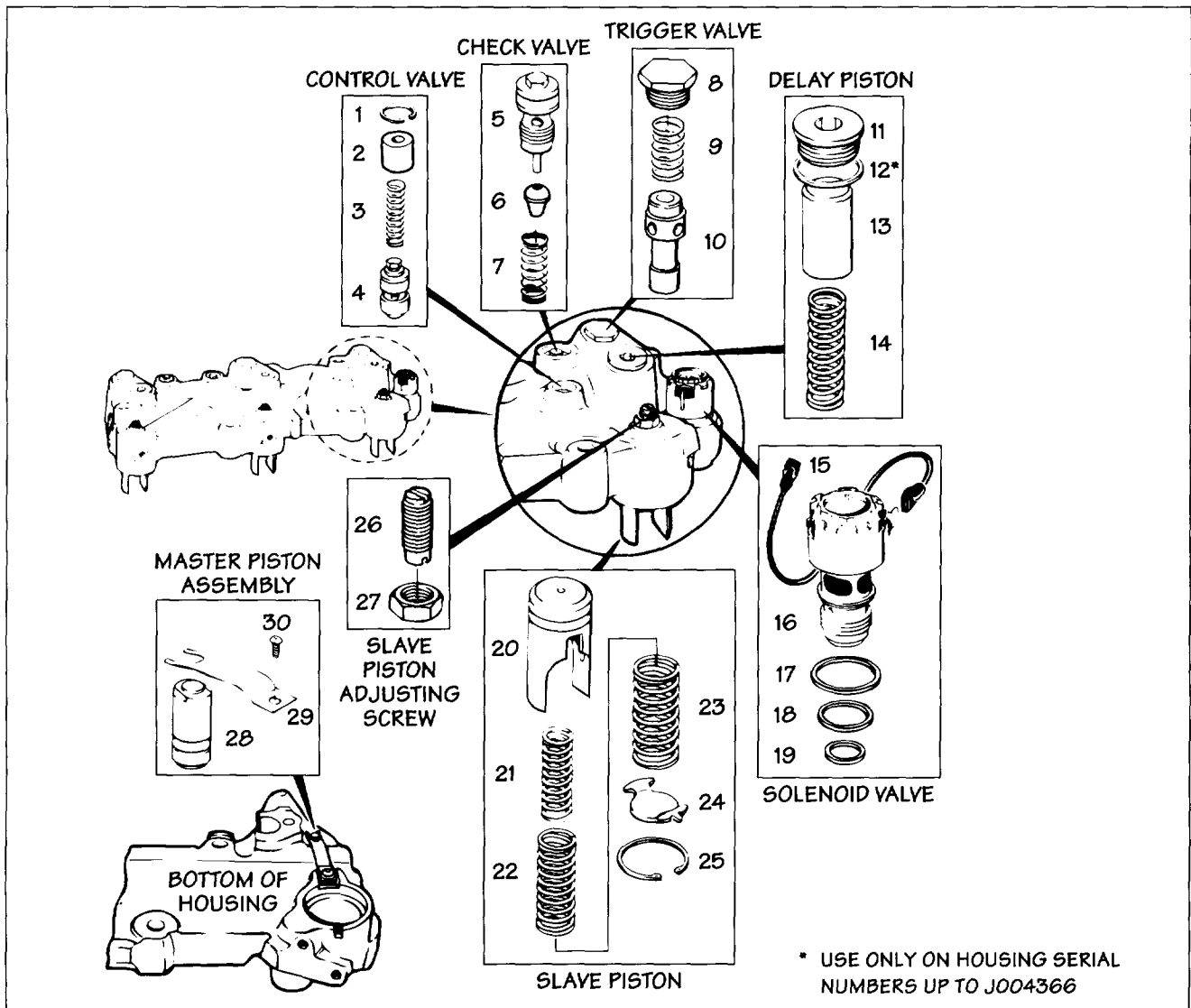


FIG. 49

For the following instructions, refer to Fig. 49

## Control Valve

Press down on the control valve spacer/cover (2) to relieve spring pressure. Remove the retaining ring (1) using retaining ring pliers. Slowly remove the cover until spring pressure ceases, then remove the control valve spring (3).



REMOVE THE CONTROL VALVE SPACER/COVER (2) CAREFULLY. CONTROL VALVE COVER IS UNDER LOAD FROM THE CONTROL VALVE SPRING.

NOTE:

HOUSINGS MADE BEFORE S/N J017768 HAVE TWO CONTROL VALVE SPRINGS.

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

Thoroughly clean the control valve bore in the housing using clean paper towels. Dip the new control valve (4) in clean lube oil and place the valve into its bore.

NOTE:

DO NOT USE SHOP RAGS AS THEY MAY LEAVE LINT OR RESIDUE WHICH CAN PLUG PASSAGEWAYS.

## Check Valve

Remove the check valve (5, 6) and spring (7). Inspect all parts for damage or wear and replace as necessary.

Replace all parts in the order shown in Fig. 48. Tighten the check valve assembly (5) to 35 lb.-ft. (48 N•m).

### NOTE:

THE CHECK VALVE ASSEMBLY (5) CONTAINS A THREE-PIECE SEAL. DO NOT ATTEMPT TO REMOVE THE SEAL. IF THE SEAL IS DAMAGED, REPLACE THE COMPLETE CHECK VALVE ASSEMBLY.

## Trigger Valve

Remove the trigger cap (8) and spring (9). Remove the trigger valve (10). Inspect the trigger parts for damage or wear and replace if necessary.

Replace the trigger valves (10) using a new cap (8) and spring (9). Tighten the cap (8) to 35 lb.-ft. (48 N•m).

## Delay Piston



REMOVE THE CHECK VALVES (5, 6) BEFORE REMOVING THE DELAY PISTON CAPS (11). THIS RELIEVES PRESSURE IN THE PLENUM CHAMBER SO THAT THE DELAY PISTON CAPS CAN BE SAFELY REMOVED.

Remove the delay piston cap (11) slowly. Use a magnet to remove delay piston (13) and spring (14). If piston is scored or damaged in any way, replace it.

Reinstall the spring (14), delay piston (13) and cap (11). If the housing was originally equipped with a copper seal (12), use a new copper seal (12). Housings with serial numbers J004367 and up do not use a copper seal.

Clean the oil from the cap threads and apply Loctite 271 (or equivalent) before installing. Tighten the delay piston cap (11) to 65 lb.-ft. (88 N•m).

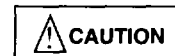
## Solenoid Valve

Disconnect the solenoid harness (15). Use a 7/8" socket and extension to remove the solenoid assembly (16). Remove and discard the three rubber seal rings (17, 18, 19). If the lower ring (19) stays in the bottom of the housing solenoid bore, remove it with a seal pick.

Wash out the solenoid assembly (16) with approved cleaning solvent. Use a brush to clean the oil screen. When clean, dry valve with compressed air. Clean out the solenoid valve bore in the housing. Use clean paper towels.

### NOTE:

DO NOT USE SHOP RAGS AS THEY MAY LEAVE LINT OR RESIDUE WHICH CAN PLUG PASSAGEWAYS.



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

Reinstall the solenoid (16) using new seal rings. Seat the lower seal ring in the base of the solenoid valve bore. Wipe clean lube oil into and around the bore. Place the upper and center seal rings on the solenoid valve body.

Be sure the seals are seated properly and carefully screw the solenoid into the housing without unseating the seals. Tighten the valve to 110 lb.-in. (12.5 N•m). Be careful not to twist the seals while installing.

## Slave Piston



REMOVE THE SLAVE PISTON (20) CAREFULLY. THE SLAVE PISTON IS RETAINED BY SPRINGS (21, 22, 23) THAT ARE UNDER HEAVY COMPRESSION. IF THE FOLLOWING INSTRUCTIONS ARE NOT FOLLOWED AND PROPER TOOLS NOT USED, THE SPRINGS COULD BE DISCHARGED WITH ENOUGH FORCE TO CAUSE PERSONAL INJURY.

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Remove the hex jam nut (27) on the slave piston adjusting screw (POWER-LASH®) (26). Back out the adjusting screw until the slave piston (20) is fully retracted (screw is loose). Install the slave piston removal tool. Turn the tool handle in to relieve the spring pressure. Using retaining ring pliers, rotate the retaining ring (25) to the slot in the housing and remove the retaining ring. Turn the tool handle out to relieve the spring force and remove the retainer (24), springs (21, 22, 23) and slave piston (20).

Reassemble the slave piston (20), springs (21, 22, 23), retainer (24), POWER-LASH® (26), and hex jam nut (27) using the Jacobs slave piston tool. Rotate the slave piston retaining ring (25) 90° from the slot in the housing to ensure that it is properly seated.

## Master Piston

Remove the buttonhead screw (30) and flat spring (29). Remove the master piston assembly (28). Inspect all parts for damage or wear and replace if necessary. If the master piston hard-face surface is scored or damaged, the corresponding rocker arm adjusting screw, master piston assembly, flat spring and buttonhead screw must ALL be replaced.

### NOTE:

DO NOT CHANGE THE ADJUSTMENT OF THE MASTER PISTON. FINAL ADJUSTMENT IS DONE ON THE ENGINE.

Reinstall the master piston (28) and replace the master piston flat spring (29) and buttonhead screw (30). Tighten the buttonhead screw to 60 lb.-in. (7 N•m).

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# NOTES

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