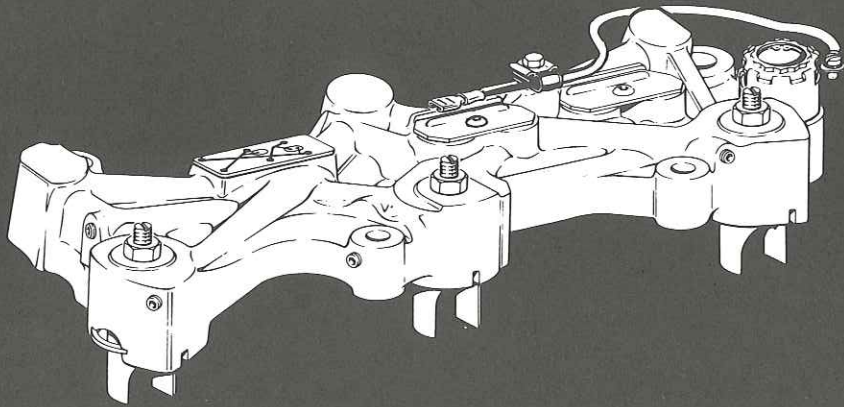




Installation Manual for MODEL C-346B

Jacobs[®]
**ENGINE
BRAKE**



also includes information for earlier models C-346A & C-346

GENERAL APPLICATION INFORMATION

The Jacobs Model C-346B is designed and approved for use on both the Caterpillar 3406B (Jacket water aftercooled and air to air aftercooled) and 3406 truck engines.

Models C-346A and C-346 are designed for Caterpillar 3406 truck engines and must not be used on 3406B engines.

The Model C-346B now replaces the models C-346 and C-346A in the Jacobs Engine Brake product line.

Jacobs service letters should be consulted for additional applications and updated information.

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.

Do not work on this equipment when mentally or physically fatigued. Always wear eye protection.

Fuels, electrical equipment, exhaust gases and moving 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.

THE JAKE BRAKE[®] 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.

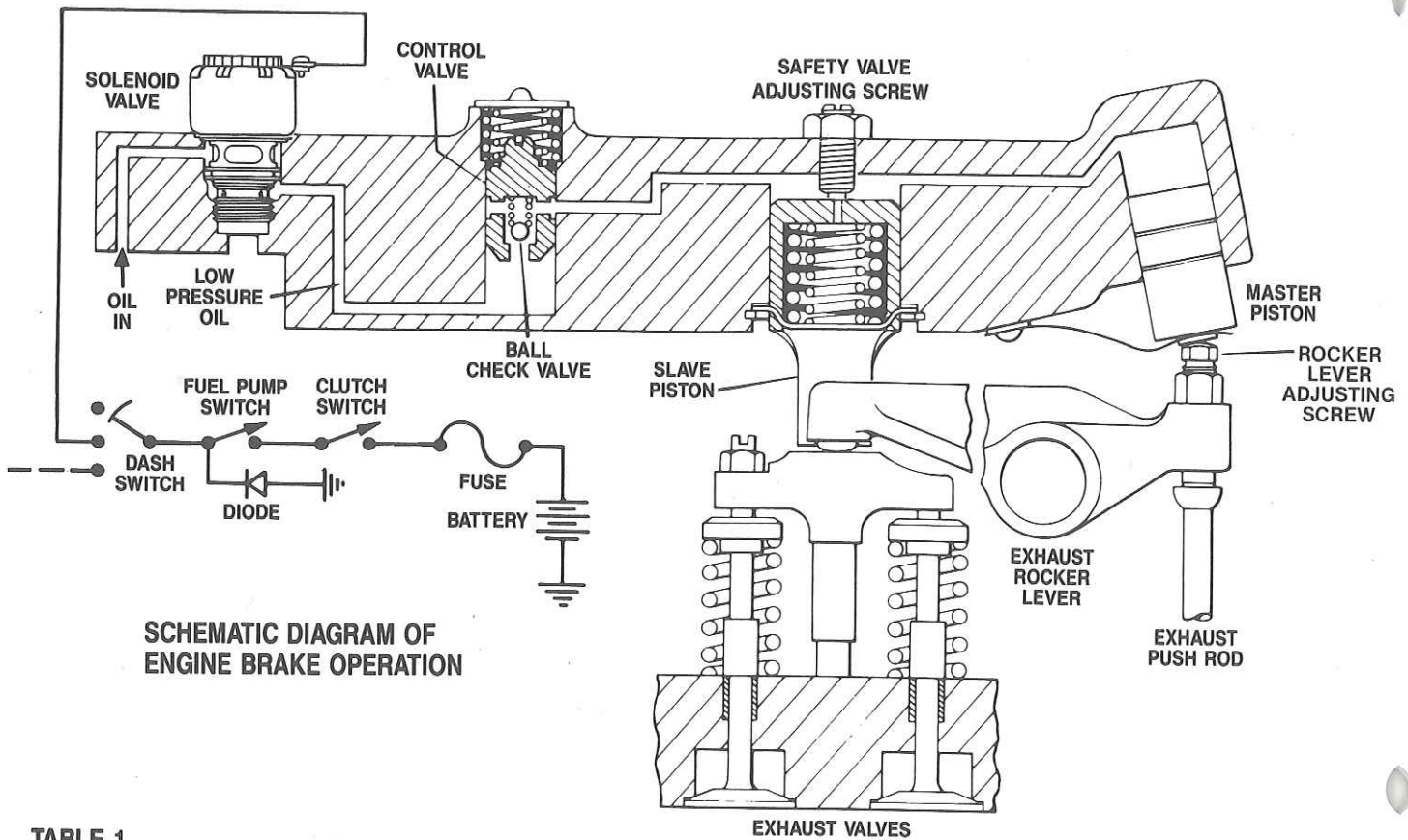


The Jacobs Manufacturing Company
Vehicle Equipment Division
Bloomfield, CT 06002 U.S.A.

TABLE OF CONTENTS

Section	Page
1 INTRODUCTION	4
Method of Driving a Vehicle Equipped with a Jacobs Engine Brake	4
Model Number Identification and Engine Brake Housing Part Number Identification	5
Engine Brake Housing Serial Number	5
Engine Model Identification	5
Automatic Transmission	6
Special Tools	6
2 ENGINE PREPARATION	7
Adjustment Reference Point	7
Fuel Line and Rocker Arm Removal	8
Bridge Adjustment	9
Exhaust Rocker Adjusting Screw Exchange	10
Extraction of Dowel Pin	10
Rocker Arm Reassembly	10
Installation of Support Brackets	12
3 BRAKE HOUSING INSTALLATION	12
Fuel Line Installation	13
Brake Housing Installation	13
Alternate Housing Installation Leveling Procedures	18,19
Valve Adjustment Procedure	14
Slave Piston Adjustment Procedure	14
Final Installation Procedures	15
Final Adjustments	15
Brake Unit Bleed and Operation Check	16
4 ELECTRICAL SYSTEM INSTALLATION	21
Dash Switch	21
Clutch Switch	21
Fuel Pump Switch	22
Actuating Arm Switch Assembly	22
Final Wiring	22
5 ENGINE BRAKE MAINTENANCE	24
Control Valve	25
Solenoid Valve	26
Slave Piston	27
Slave Piston Adjusting Screw	28
Master Piston	29
Reinstallation of Housing Assembly	29
6 CONVERSION OF BRAKE UNITS	30

SECTION 1 INTRODUCTION



**SCHEMATIC DIAGRAM OF
ENGINE BRAKE OPERATION**

**TABLE 1
MASTER-SLAVE CIRCUIT RELATIONSHIP
LISTED IN ENGINE FIRING ORDER**

LOCATION OF MASTER PISTON	LOCATION OF SLAVE PISTON
ACTUATES	
NO. 1 PUSHROD NO. 5 PUSHROD NO. 3 PUSHROD NO. 6 PUSHROD NO. 2 PUSHROD NO. 4 PUSHROD	NO. 3 EXHAUST VALVE NO. 6 EXHAUST VALVE NO. 2 EXHAUST VALVE NO. 4 EXHAUST VALVE NO. 1 EXHAUST VALVE NO. 5 EXHAUST VALVE

THEORY OF OPERATION — Simply stated, energizing the Engine Brake effectively converts a power producing diesel engine into a power absorbing air compressor. This is accomplished when desired by motion transfer through a master-slave piston arrangement which opens 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 being 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 of another cylinder during its normal exhaust cycle as follows:

1. 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.
2. Oil pressure causes the master piston to move down, coming to rest on the corresponding exhaust rocker arm adjusting screw. (See Table No. 1 for master-slave operating 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 slave piston braking cylinder. The ball check valve in the control valve traps high pressure oil in the master-slave piston system.
4. The slave piston under the influence of the high pressure oil flow moves down, momentarily opening the exhaust valve while the engine piston is near its top dead center position, releasing compressed cylinder air to the exhaust manifold.
5. Compressed air escapes to atmosphere completing a compression braking cycle.

SECTION 1 INTRODUCTION (Contd.)

METHOD OF DRIVING A VEHICLE EQUIPPED WITH A JACOBS ENGINE BRAKE

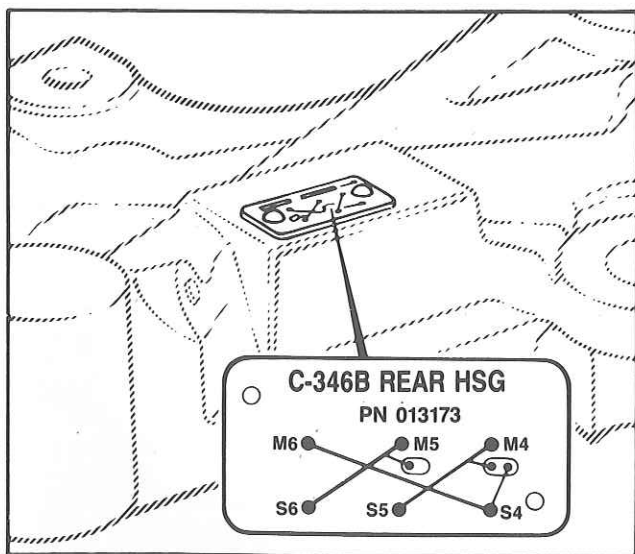
It is easy to learn the proper method of driving a vehicle that's equipped with a Jacobs Engine Brake. Since the engine brake is most effective at higher engine speeds, gear selection is very important. Gearing down the vehicle within the limits of recommended engine speed makes the engine brake a more effective retarder. Maximum retarding occurs with the selection of the lowest gear that prevents exceeding the maximum allowable engine speed.

The Model C-346 Series Engine Brake kits contain a progressive switch that provides three- or six-cylinder operation with greater flexibility in selecting the amount of retarding needed for various road conditions.

For more information on driving with the Jake Brake, consult your owners' Driver's Manual. To get a detailed presentation on driving with the Jacobs Engine Brake, consult your Jacobs Distributor.

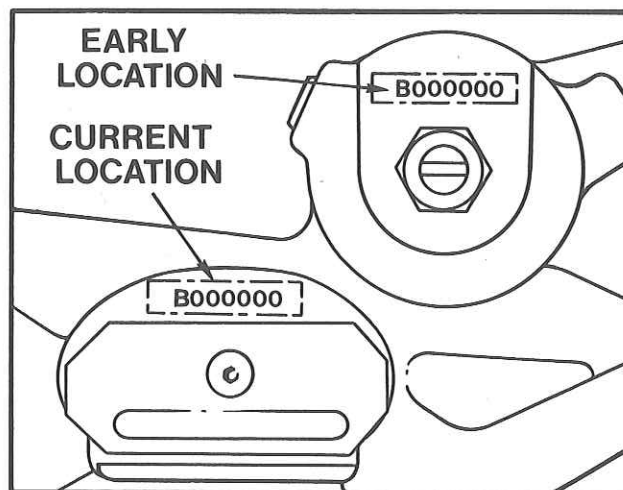
MODEL NUMBER IDENTIFICATION AND ENGINE BRAKE HOUSING PART NUMBER IDENTIFICATION

Each C-346B engine brake housing assembly has an identification plate showing model number and part number.



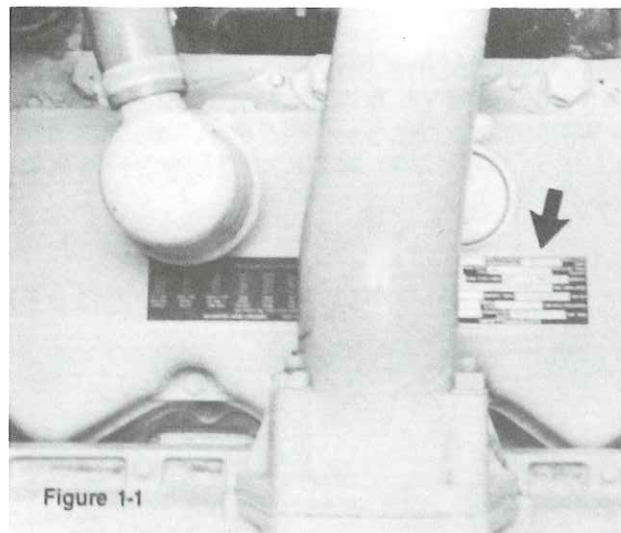
Model numbers for C-346A and C-346 housings can be found stamped in the casting.

ENGINE BRAKE HOUSING SERIAL NUMBER



The brake housing serial number is located on the brake housing. This Installation Manual should be used in conjunction with Jacobs Parts Manual when replacement part information is required. The Parts Manual can be obtained from your Jacobs distributor.

ENGINE MODEL IDENTIFICATION



Prior to engine brake installation, check engine model number. Verify that engine model is correct for engine brake model being installed. The engine model identification is on the serial number plate shown above and below. Engines prior to serial number 7FB39279 require leveling shims. See Alternate Housing Installation Procedure on page 18.

SECTION 1 INTRODUCTION (Contd.)

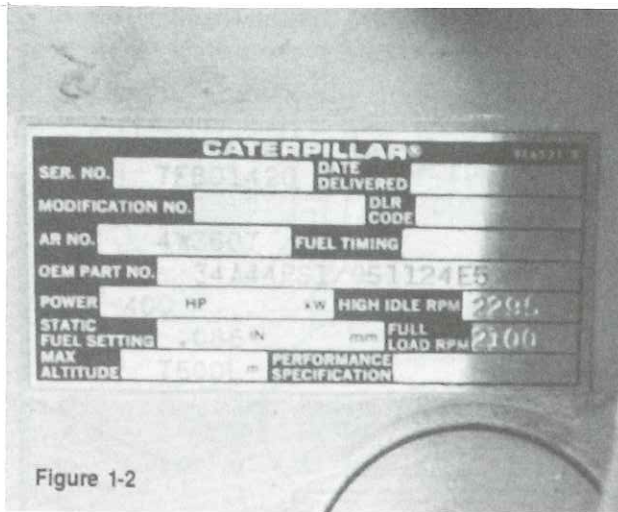


Figure 1-2

7FB Serial Number Prefix is 3406B Engine
 92U Serial Number Prefix is Earlier 3406 Engine
 3406-3406B Engine identification is by Serial Number prefix.

CAUTION

DO NOT USE MODEL C-346 OR MODEL C-346A ON 3406B ENGINES.

3406B ENGINE IDENTIFICATION IS ESSENTIAL TO PREVENT MISMATCH OF ENGINE BRAKE AND ENGINE. OPERATION OF MODEL C-346 OR C-346A ENGINE BRAKE ON 3406B ENGINE WILL RESULT IN ENGINE DAMAGE.

AUTOMATIC TRANSMISSIONS

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

SPECIAL TOOLS

CATERPILLAR TOOLS	CATERPILLAR PART NO.
Fuel line socket - Flank drive 3/4"	5P144
Fuel line wrench - 7/8"	5P5195
Turning tool	9S9082
Timing pin - Fuel pump (3406)	8S2291
Timing pin - Fuel pump (3406B)	6V4186

COMMERCIALLY AVAILABLE TOOLS

9/16" Crowfoot wrench
 Deep socket (1 1/8 in. - 3/4 in. drive)

JACOBS TOOLS	JACOBS PART NO.
Feeler gage - 0.070 in. (1.78mm)(C-346B) (For C-346B on 3406B Engine)	013184
Feeler gage - 0.060 in. (1.52mm)(C-346) (For C-346, C-346A & C-346B on 3406 Engine)	007446
Dowel pin extractor	007397

NOTE: OPTIONAL SHIM & WASHER GROUP IS REQUIRED FOR 3406B ENGINES WITH S.N. LOWER THAN 7FB39279 AND ALL 92U PREFIX ENGINES. SEE PAGE 18.

SECTION 2 ENGINE PREPARATION

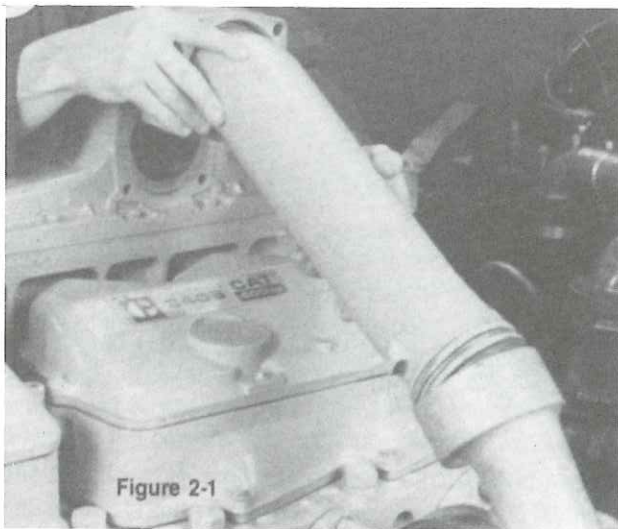


Figure 2-1

1. Clean engine thoroughly.
2. Remove crossover pipes and other components to gain access to covers.

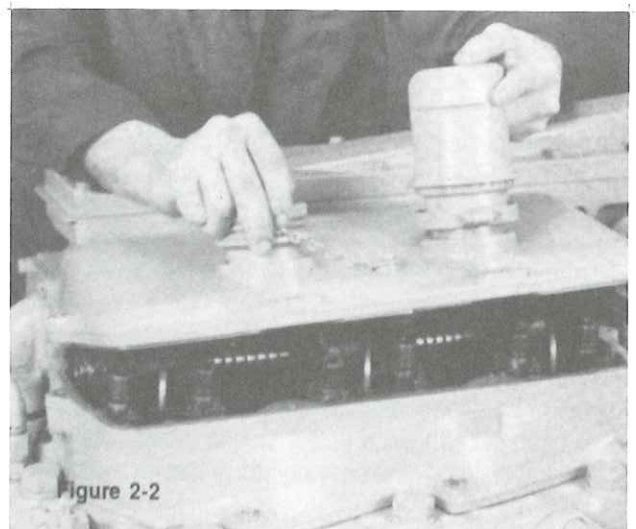


Figure 2-2

3. Remove the valve mechanism upper covers.

SECTION 2 ENGINE PREPARATION (Contd.)

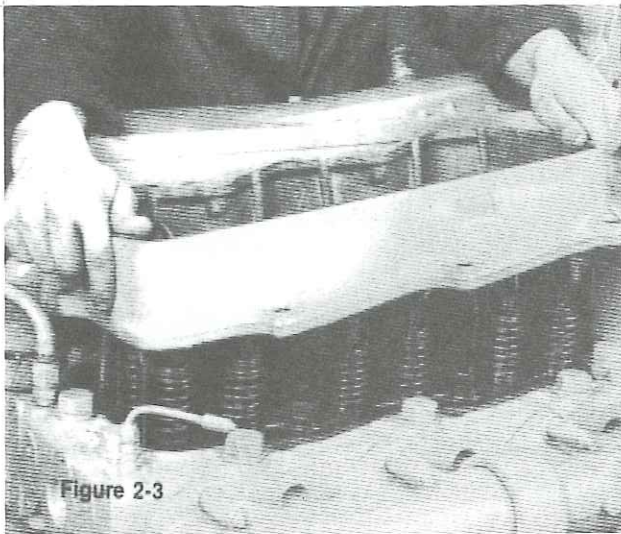


Figure 2-3

4. Remove valve mechanism cover base.

ADJUSTMENT REFERENCE POINT

Number 1 piston at top center (TC) 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.

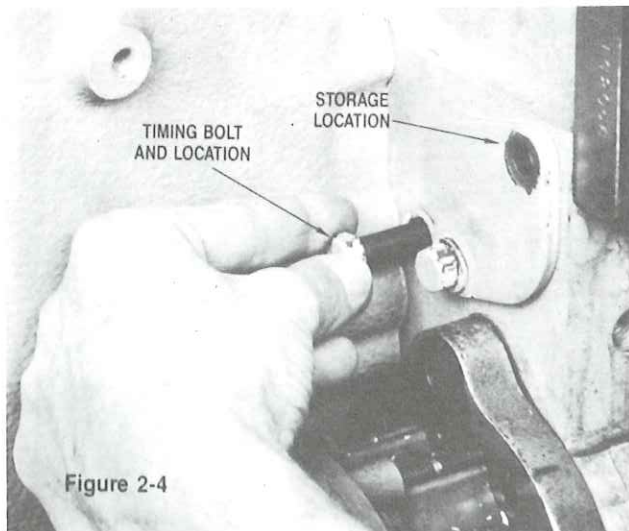


Figure 2-4

5. Remove timing bolt from its storage area above the left side starter location.

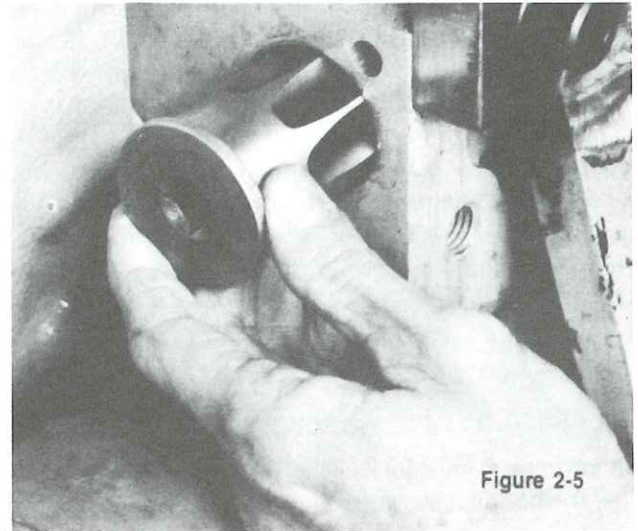


Figure 2-5

6. Insert the Caterpillar turning tool.

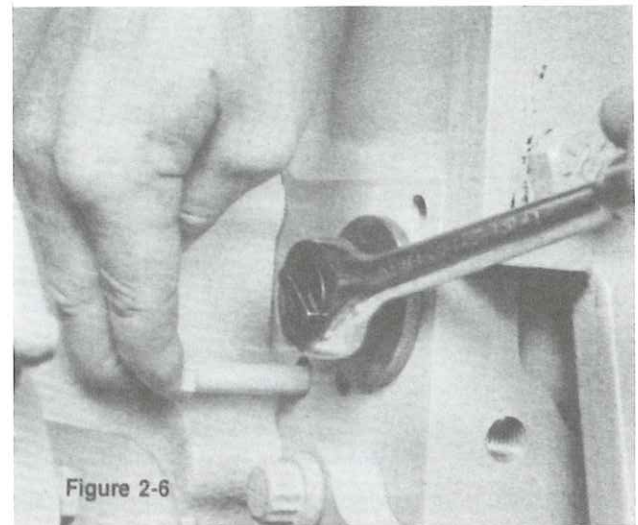


Figure 2-6

7. Insert timing bolt.

NOTE:

There are two threaded holes in the flywheel. These holes are in alignment with the plugged hole in the left front of the flywheel housing. Remove plug. The two holes in the flywheel are at a different distance from the center of the flywheel so the timing bolt cannot be put in the wrong hole.

SECTION 2 ENGINE PREPARATION (Contd.)

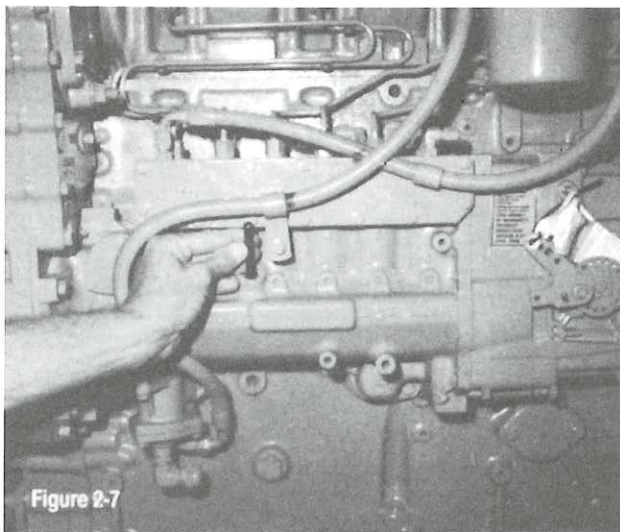
Next, turn the flywheel counterclockwise (as viewed from the flywheel end of the engine) until the flywheel hole is aligned with the timing bolt. When the timing bolt can be turned freely in the flywheel threaded hole, the engine No. 1 piston is on top center.

Look at the valves of No. 1 cylinder to see if No. 1 piston is on the compression stroke. If No. 1 cylinder is on the compression stroke, the valves will be closed and the rocker arms can be moved up and down by hand.

If No. 1 piston is not on the compression stroke, remove the timing bolt. Turn the flywheel 360 degrees counterclockwise and reinsert the timing bolt.

ADJUSTMENT REFERENCE POINT. ALTERNATE METHOD

The following method for locating No. 1 T.D.C. may be used if the flywheel is inaccessible.



1. Remove plug from fuel injection pump housing and install correct timing pin.
2. Slowly rotate crankshaft counterclockwise until pin goes into groove.

⚠ CAUTION

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

The engine is now set at No. 1 T.D.C. compression stroke.

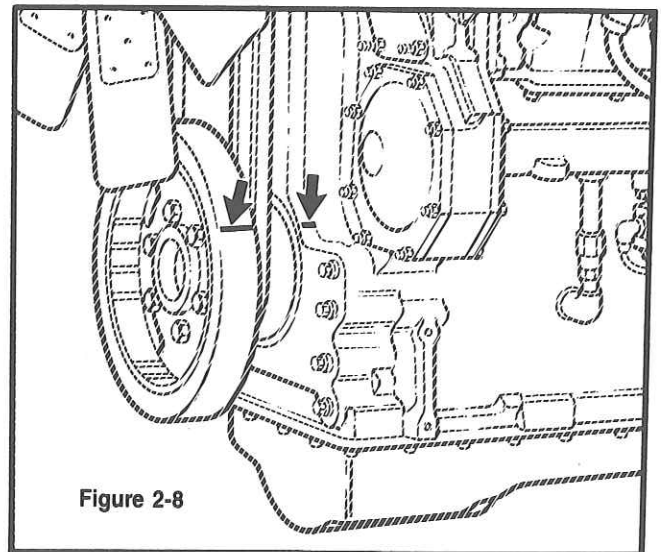
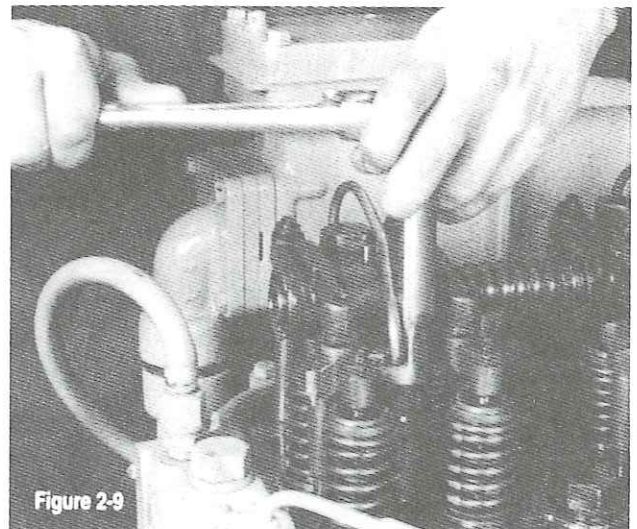


Figure 2-8

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 T.D.C. compression.
4. Remove timing pin from fuel pump and replace plug.

FUEL LINE AND ROCKER ARM REMOVAL



1. Remove the fuel lines using the special Caterpillar fuel line wrench.

⚠ CAUTION

THE FUEL LINES AND NOZZLE ASSEMBLIES MUST BE PROTECTED FROM CONTAMINATION. FUEL LINE REMOVAL TAKES PLACE DOWN-STREAM FROM FINAL FILTRATION.

SECTION 2 ENGINE PREPARATION (Contd.)

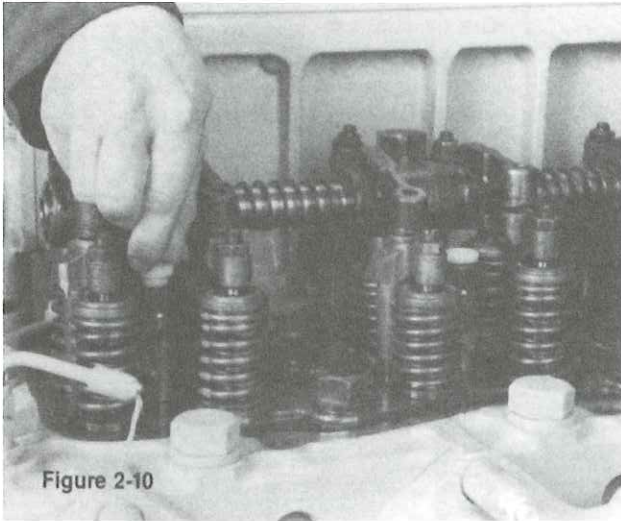


Figure 2-10

2. 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.

CAUTION

COMPLETE ONE ENGINE BRAKE HOUSING INSTALLATION BEFORE STARTING THE INSTALLATION OF THE SECOND HOUSING. THE PRACTICE OF REMOVING SIX ROCKER ARM HEAD BOLTS AT ONE TIME CAN INTERFERE WITH THE PROPER SEATING OF THE ENGINE HEAD.

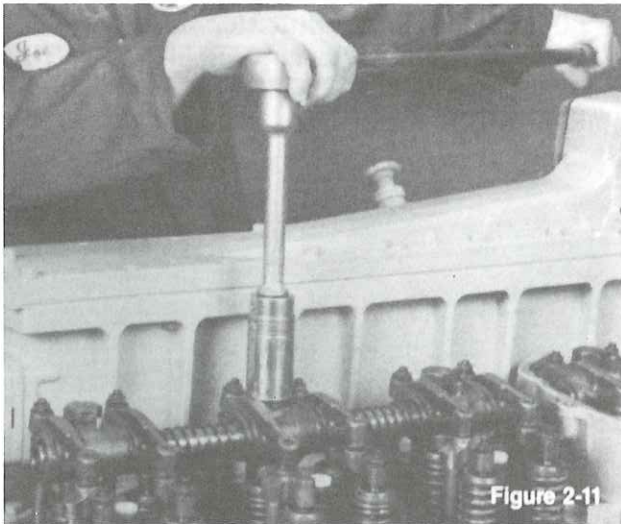


Figure 2-11

3. Loosen the rocker arm adjusting screw locknuts. Remove the rocker arm bolts. Save the washers for use later.

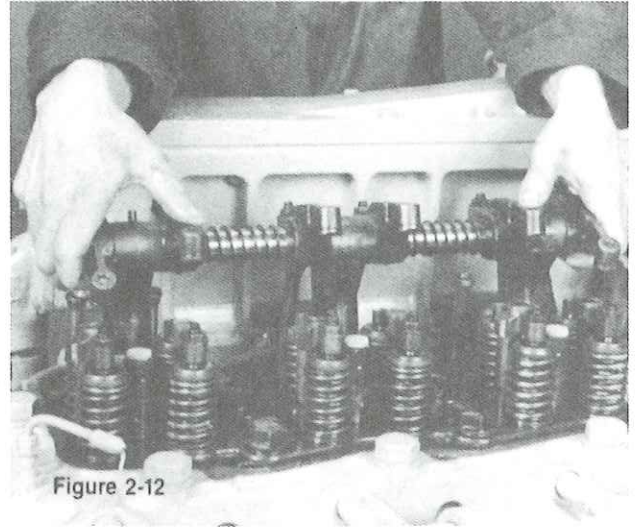


Figure 2-12

4. Remove the entire rocker arm group.(3 cyl.)

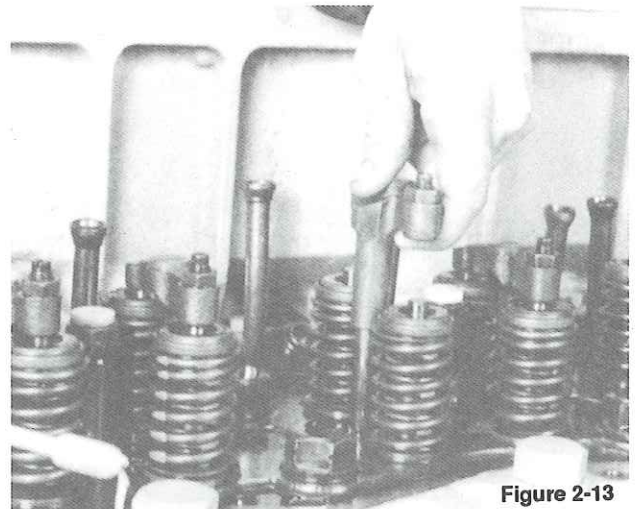


Figure 2-13

5. Remove the exhaust valve bridges from the engine.

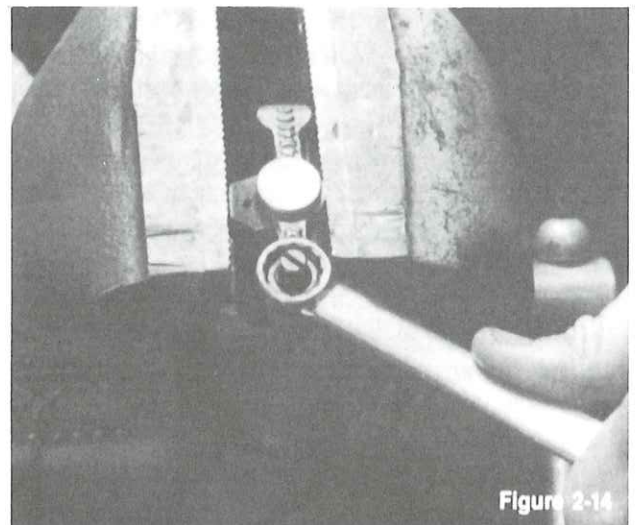


Figure 2-14

6. Remove the exhaust valve bridge leveling screws and jam nuts from the Caterpillar exhaust valve bridges.

SECTION 2 ENGINE PREPARATION (Contd.)

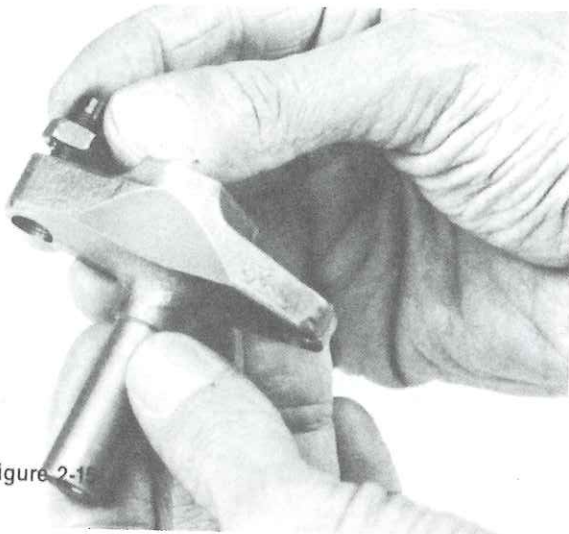


Figure 2-15

7. Loosely install the Caterpillar exhaust valve bridge leveling screws and nuts into the Jacobs bridges.

BRIDGE ADJUSTMENT

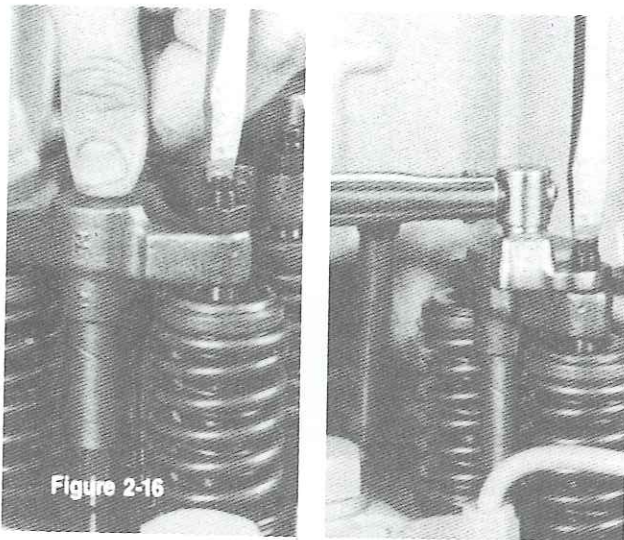
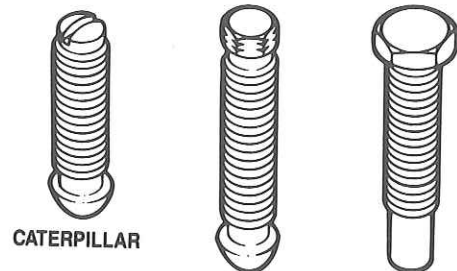
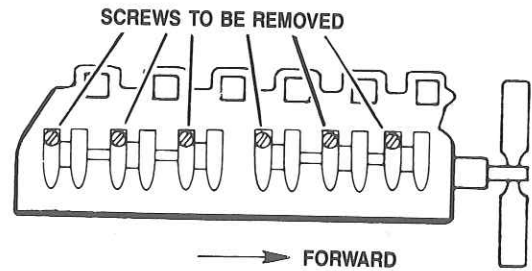


Figure 2-16

1. Put some clean engine lube oil into the bridge bore. Install the Jacobs Exhaust Valve Bridges on the engine and level them as follows:
 - a. Back off adjusting screw several turns making sure it is not in contact with the valve stem.
 - b. Press firmly and straight down on the top of the bridge.
 - c. Turn the adjusting screw clockwise until contact is made with the valve stem, then turn the adjusting screw an additional 20 to 30 degrees ($\frac{1}{2}$ flat of locknut).
 - d. Hold the adjusting screw in this position and tighten the locknut to 24 lbft (32N•m).
 - e. Put some 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 SAME PROCEDURE.

EXHAUST ROCKER ADJUSTING SCREW EXCHANGE



CATERPILLAR

JACOBS C-346
JACOBS C-346A

JACOBS
C-346B

Figure 2-17

1. Remove the slotted head Caterpillar exhaust rocker adjusting screws.

Note the difference between the Caterpillar and Jacobs Rocker Adjusting Screws.

⚠ CAUTION

THE LARGE HEADED C-346B SCREWS CAN BE USED WITH C-346A AND C-346 HOUSINGS. IF C-346B SCREWS ARE USED ON C-346A AND C-346 HOUSINGS, MODEL C-346B MASTER PISTON RETURN SPRINGS MUST ALSO BE USED. SEE PARTS MANUAL FOR PART NUMBERS.

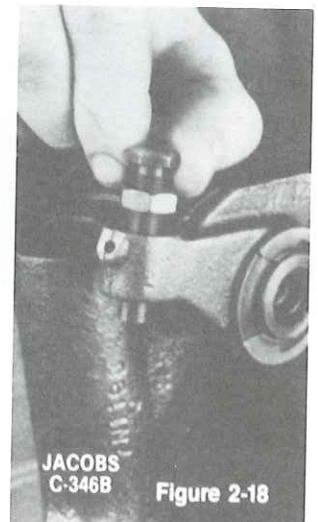


Figure 2-18

2. Install the Jacobs rocker adjusting screws in the exhaust rocker levers. Reuse the Caterpillar lock nuts. Discard Caterpillar adjusting screws after substitution.

SECTION 2 ENGINE PREPARATION (Contd.)

EXTRACTION OF DOWEL PIN

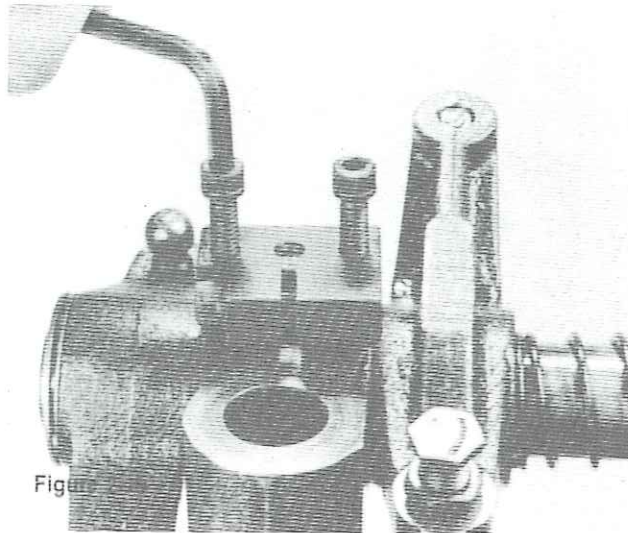


Figure 2-20

1. 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. 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 cap-screws in small equal increments ($\frac{1}{4}$ turn each).

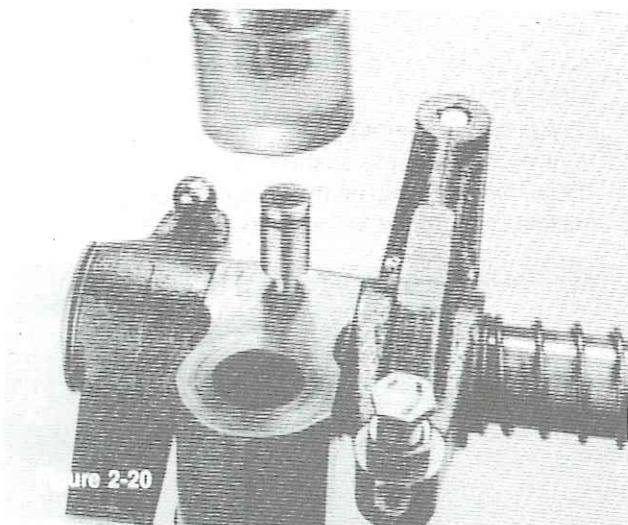


Figure 2-20

2. Lubricate the end of the Jacobs oil supply adapter 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. Do not install "O" ring at this time.

ROCKER ARM REASSEMBLY

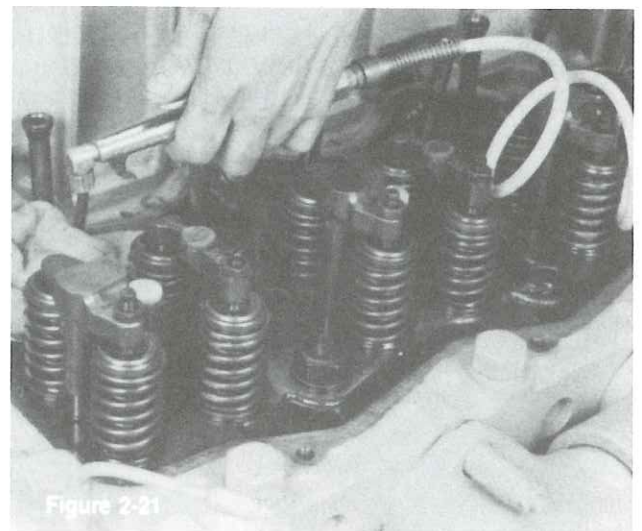


Figure 2-21

1. Before installing rocker arms group back on engine, attach a suitable length of tubing to a blow gun nozzle. Blow the oil out of the holddown bolt holes. While blowing the oil out, cover the bolt holes with a clean rag to prevent oil from spraying.

⚠ WARNING

EYE PROTECTION MUST BE WORN. OIL IN HOLD-DOWN BOLT HOLES IS BLOWN OUT TO PREVENT THE ENGINE BLOCK FROM CRACKING DURING THE TORQUING OF JACOBS HOLDDOWN STUD.

PERSONAL INJURY CAN RESULT IF SAFETY GLASSES ARE NOT USED.

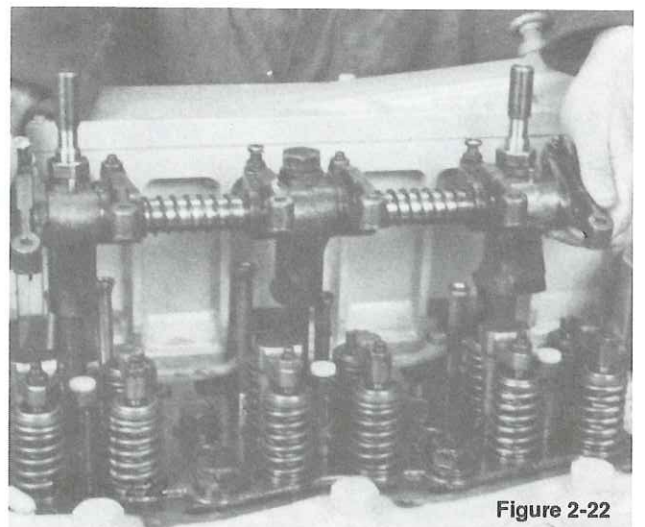


Figure 2-22

2. Apply clean engine oil to the threads and underside of all Jacobs studs. Place the rocker arm groups back on the engine. The two outside (end) bolts and washers in each group must be replaced with Jacobs studs and washers. Use the Jacobs washers marked 'A' under the head of the Jacobs $\frac{3}{4}$ " studs. Fit the push tubes to the rocker adjusting screws.

SECTION 2 ENGINE PREPARATION (Contd.)

⚠ CAUTION

WORK CAREFULLY ON ENGINES WITH GLOW PLUGS. WIRE LEADS CAN BE PUNCTURED IF THEY ARE ALLOWED TO MOVE UNDER THE ROCKER ARM GROUP PEDESTAL.

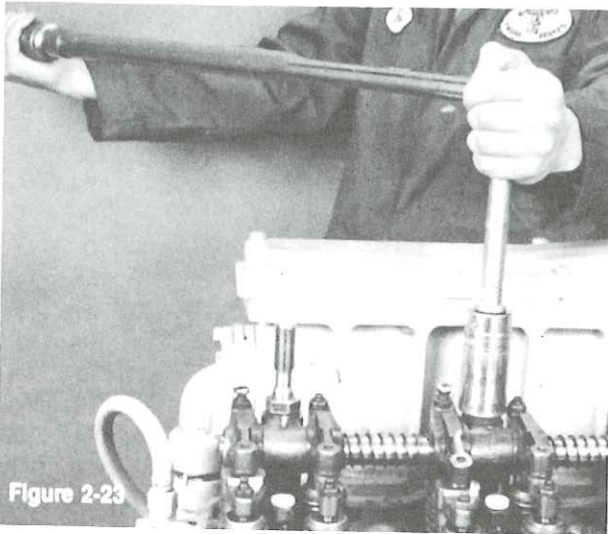


Figure 2-23

3. Make certain that the rocker assembly is centered in the bolt hole clearances. Grasp rocker assembly and move back and forth to assure proper centering. Snug the studs and bolts firmly in the centered position.

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

INSTALLATION OF SUPPORT BRACKET

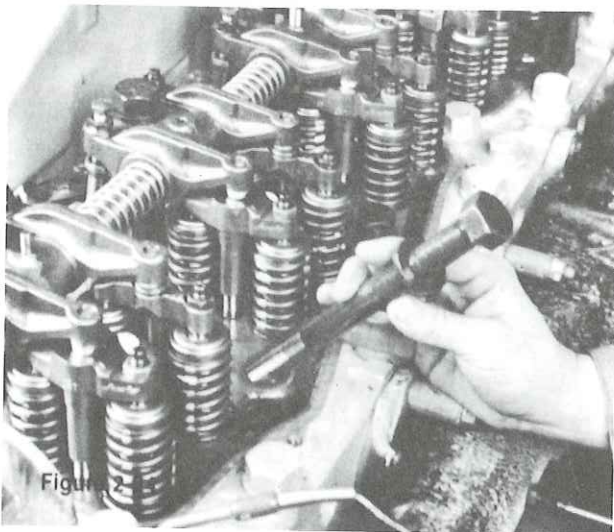


Figure 2-24

1. Fig. 2-24 shows the Caterpillar head bolt to be removed for installation of the Jacobs support bracket.

NOTE:

Models C-346B and C-346A require one support bracket at the rear position for each engine brake housing. The earlier C-346 uses two support brackets for each engine brake housing.

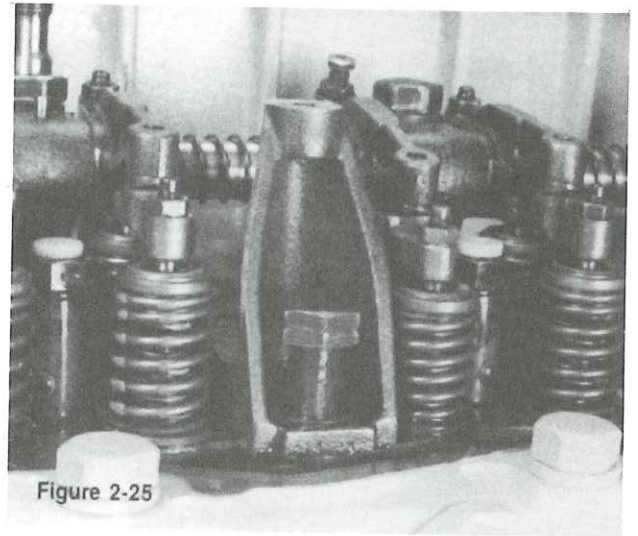


Figure 2-25

2. Apply clean engine oil to the threads and underside of head of the bolt and install the Jacobs support bracket. Reuse the Caterpillar washer and head bolt at this location. Center the bracket in the bolt hole clearance and hand tighten.

BRAKE HOUSING INSTALLATION

For engines with serial numbers lower than 7FB39279 and all 92U prefix engines, the "HOUSING LEVELING PROCEDURE" is required. Refer to pages 18 and 19 for the leveling (shimming) instructions.

NOTE: The following housing installation procedure is for engines with serial number 7FB39279 or higher.

Flow plates on engine brake housings have part number and front or rear housing stamped on plate. Housing marked "front" *must* be used on the front three cylinders. Housings marked "rear" *must* be used on rear three cylinders.

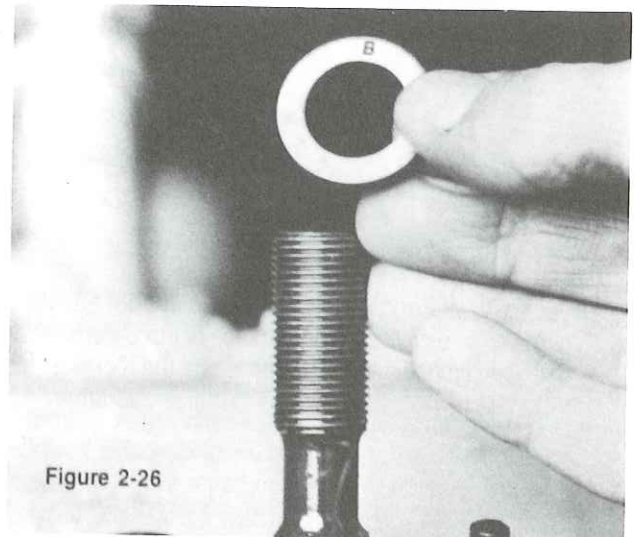


Figure 2-26

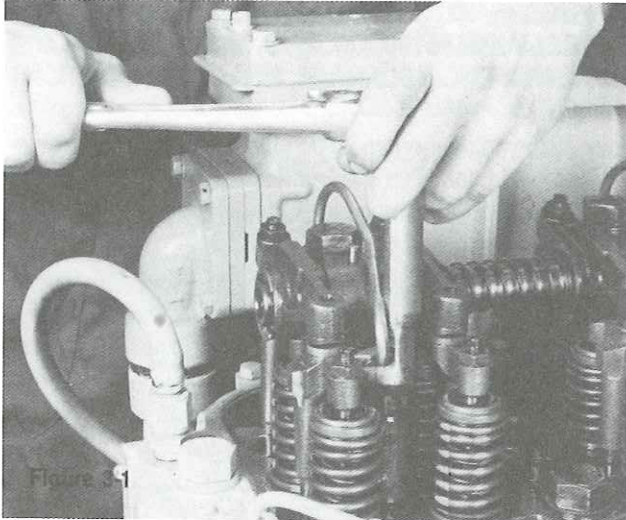
1. Install the Jacobs spacers marked "B" on the Jacobs studs.

SECTION 3 BRAKE HOUSING INSTALLATION

FUEL LINE INSTALLATION

NOTE:

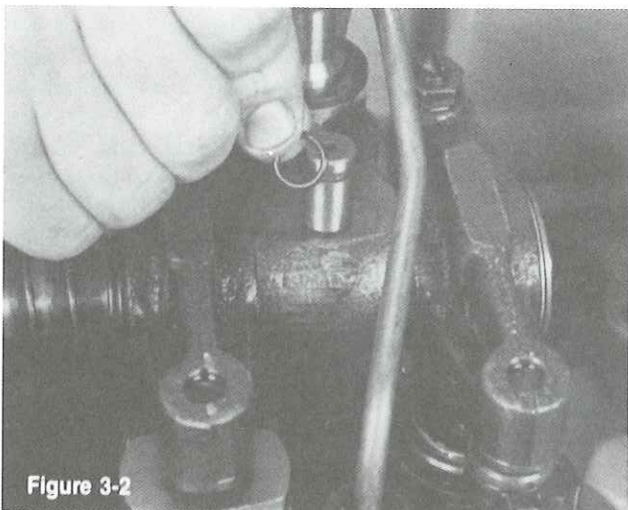
1. If new fuel lines are being used, be sure to install the new "O" rings on the riser end of fuel lines. Lubricate the "O" rings with clean engine oil before installing.



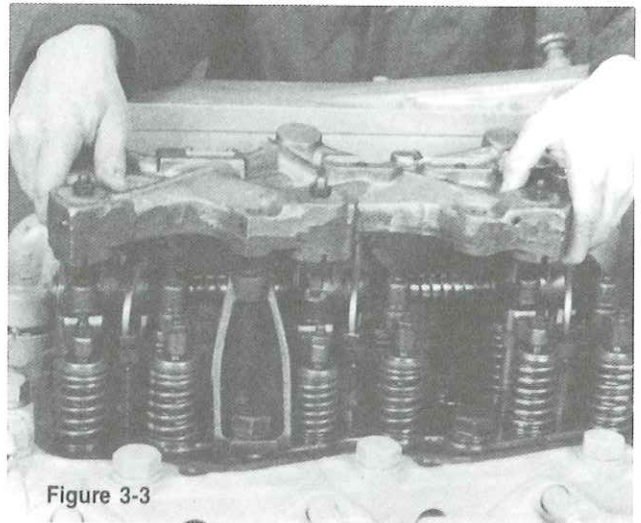
2. Remove the protective caps and plugs from nozzles and fuel lines.
3. Install the fuel lines on the engine. First hand tighten the retainer nuts. Then tighten nuts using the Caterpillar fuel line socket wrench to 30 lbft (41N•m).
4. Check the clearance between the fuel lines and the necked down portion of the mounting studs. A clearance of 0.125 in. (3.175mm) minimum to 0.375 in. (9.525mm) maximum is required. If insufficient clearance is found, reposition or interchange fuel lines until all lines meet clearance specifications.

⚠ CAUTION

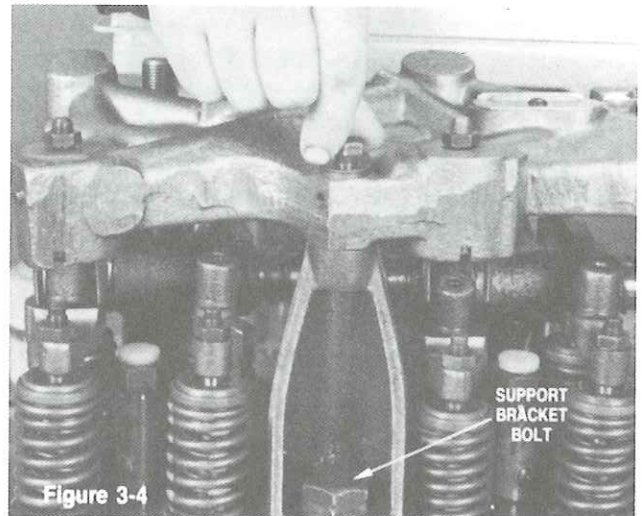
DO NOT BEND FUEL LINES AS FUEL LEAKAGE MAY RESULT.



5. Install "O" ring on oil supply adapter. Place a small amount of grease on the adapter.



6. Before placing brake units on engine, loosen and backout the slave piston adjusting screw until slave piston is seated in its bore.
7. Carefully install the brake housing. Pay particular attention to the oil supply adapter to ensure proper alignment.



8. Install the Jacobs washer and the 3/8" capscrew through the housing and into the support bracket. Adjust bracket location as needed. Hand tighten only.
9. Torque the support bracket bolt to 200 lbft (270N•m). Retorque to 330 lbft (450N•m). Always repeat torquing of bolts as a check.

SECTION 3 BRAKE HOUSING INSTALLATION (Contd.)

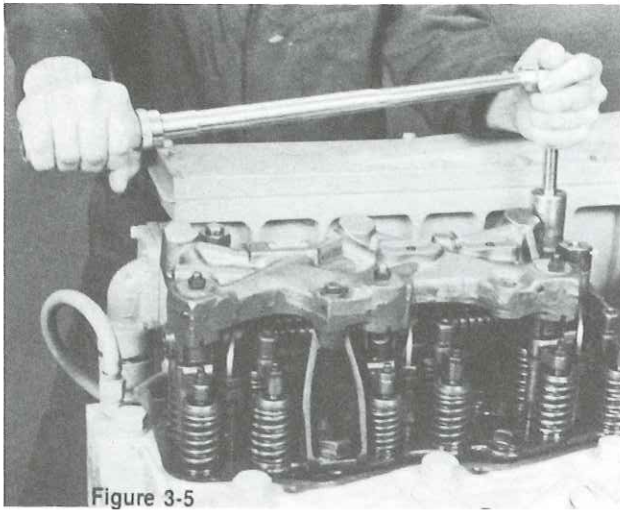


Figure 3-5

10. Place Caterpillar cylinder head bolt washers on to the 3/4" Jacobs holddown studs. Hand tighten the Jacobs holddown nuts onto the 3/4" holddown studs.

Reinstall the Jacobs 3/8" cap screw and washer.

Torque the Jacobs holddown nuts to 60 lbft (81.6N•m) and the 3/8" cap screw to 30 lbft (41N•m).

Retorque 3/8" cap screw to 47 lbft (64N•m) and the Jacobs holddown nuts to 100 lbft (135N•m). Repeat the last procedure to secure the brake housing.

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

TABLE 1	Set Exh. Valve Cyl.	Set Intake Valve Cyl.	Set Slave Piston Cyl.
CYL. 1 TDC	1,3,5	1,2,4	1,3,5
CYL. 6 TDC	2,4,6	3,5,6	2,4,6

11. Adjust the intake and exhaust valves on each cylinder. (See Table 1.) 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: Set lash at 0.015 in. (0.38mm) for intake and 0.030 in. (0.76mm) for exhaust.

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

SLAVE PISTON ADJUSTMENT PROCEDURE

⚠ CAUTION

PAY SPECIAL ATTENTION TO THIS ADJUSTMENT. TO ENSURE MAXIMUM BRAKE OPERATING EFFICIENCY AND TO PREVENT ENGINE DAMAGE, FOLLOW INSTRUCTIONS CAREFULLY.

Slave piston adjustment must be made with the engine stopped and cold (stabilized water temperature of 140°F (60°C) or below). Exhaust valves on the Cylinder to be adjusted must be in the closed position. (See Table 1.)

- Loosen and back off adjusting screw locknut. Use a screwdriver or hex wrench, as required, to back out slave piston adjusting screw until slave piston is seated in bore.

ENGINE	JAKE BRAKE MODEL	LASH ADJUSTMENT	JACOBS GAUGE P/N
3406B	C-346B	0.070in. (1.78mm)	P/N 013184
3406	C-346B, C-346A and C-346	0.060in. (1.52mm)	P/N 007446

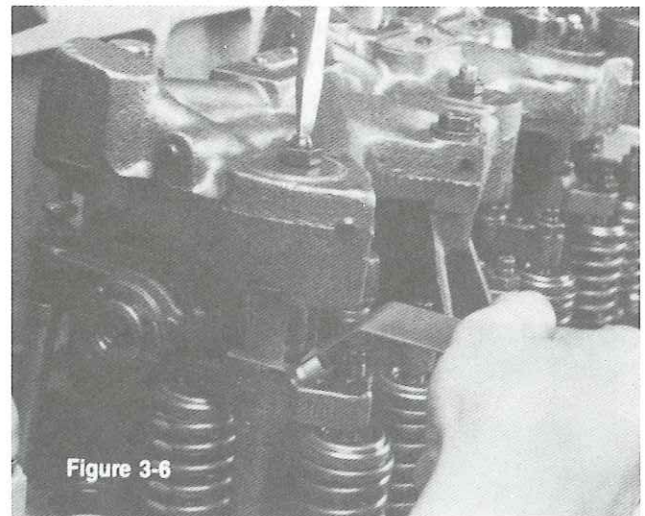


Figure 3-6

- INSERT CORRECT 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 LOCK NUT TO 16 LBFT (22N•m). Remove timing bolt. Rotate the engine over to cylinder 6TDC, 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.

SECTION 3 BRAKE HOUSING INSTALLATION (Contd.)

⚠ CAUTION

MAKE THIS ADJUSTMENT CAREFULLY. AFTER SLAVE PISTON ADJUSTING SCREW LOCKNUT IS PROPERLY TORQUED, RECHECK THE CLEARANCE WITH THE JACOBS FEELER GAUGE. OVERTORQUING LOCKNUT COULD DAMAGE SLAVE PISTON ADJUSTING SCREW. THIS WILL CAUSE ENGINE DAMAGE.

FINAL INSTALLATION PROCEDURES

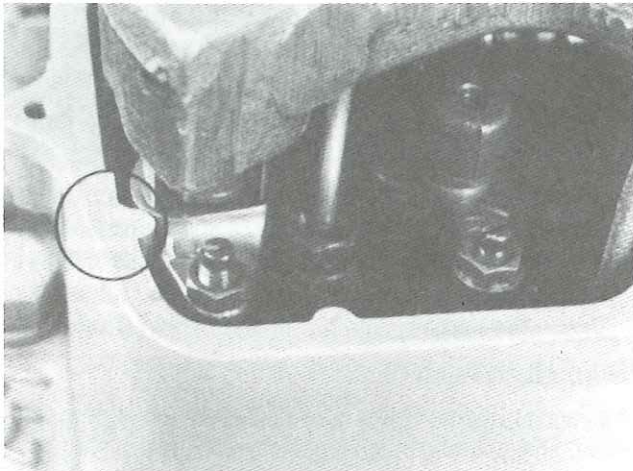


Figure 3-7

1. Place the cover bases on the cylinder head. Check for interference between #3 and #6 exhaust valve bridges and the casting ribs.

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.

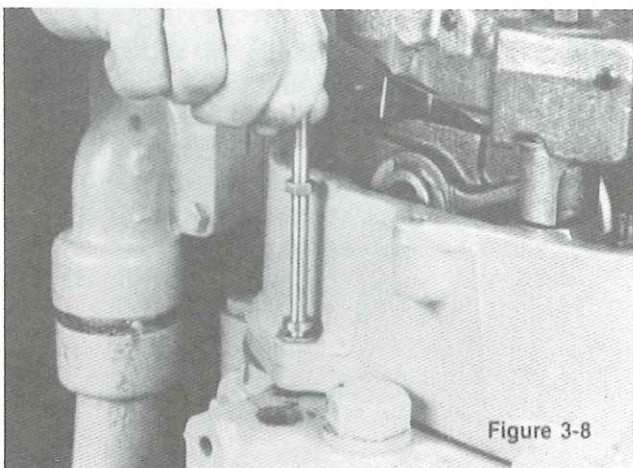


Figure 3-8

2. Fasten the valve mechanism cover bases in the four indicated locations with Jacobs mounting studs and washers

(see Figure 3-8). Short threaded end of stud must go into engine head. Use the Caterpillar nuts and washers in the other two locations. Torque spacer studs and nuts to 10 lbft (13.5N•m).

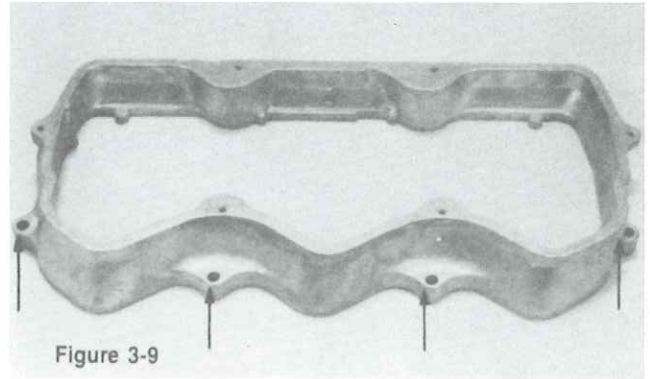


Figure 3-9

NOTE MOUNTING STUD LOCATIONS

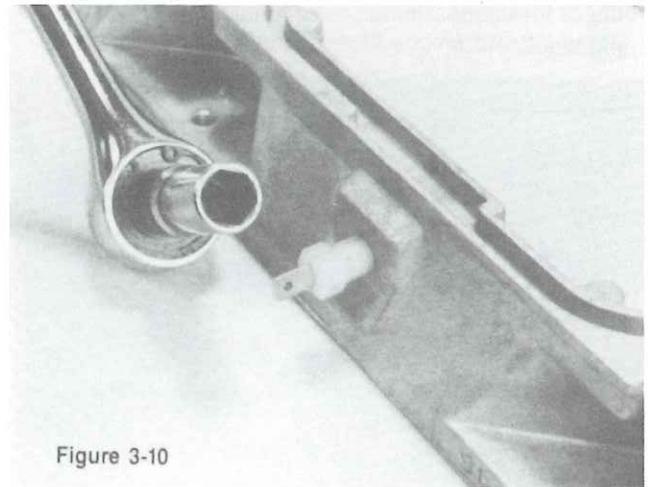


Figure 3-10

3. Tighten the terminal leadout assembly in the spacer using a hex box socket wrench until leadout assembly is seated in the spacer.

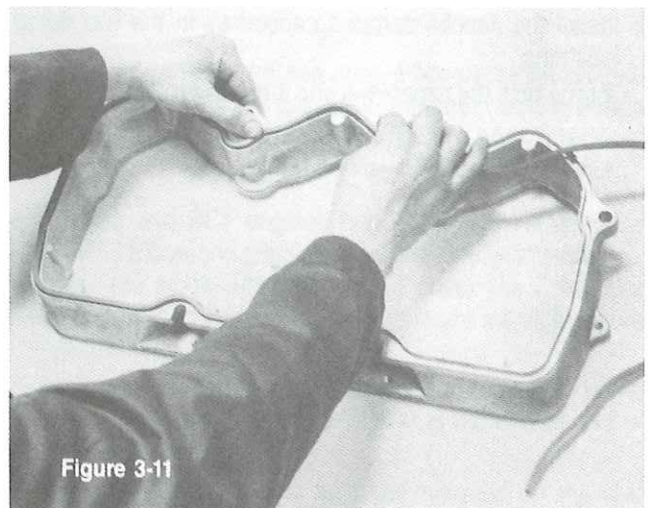
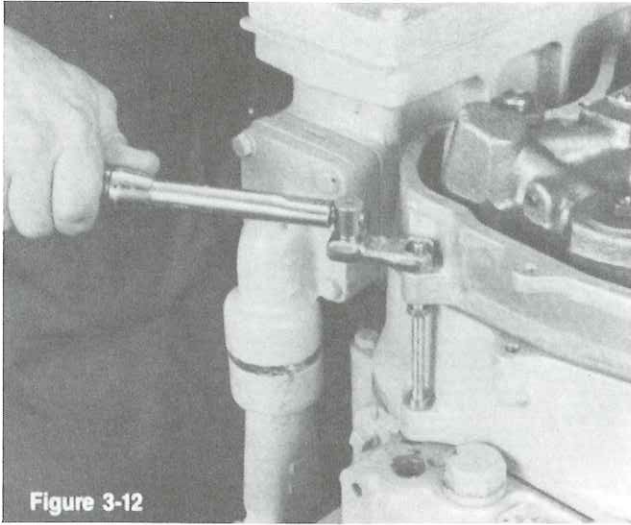


Figure 3-11

4. Install the Jacobs gaskets in the spacers.

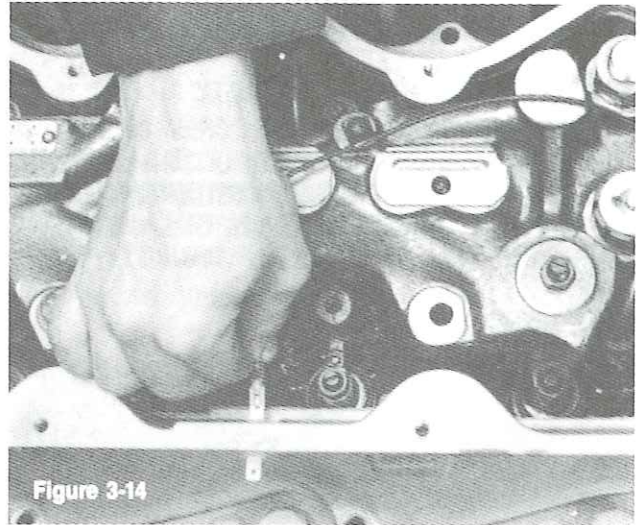
SECTION 3 BRAKE HOUSING INSTALLATION (Contd.)



5. 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.



6. Install the Jacobs serrated capscrews in the two noted locations.
Torque both the capscrews and the nuts to 13 lbft (18N•m).



7. Install the solenoid valve harness and its clamp. The tab end of the harness attaches to the solenoid. The other end attaches to the inside terminal of the leadout assembly in the spacer.
Torque the harness clamp screw to 60 lbin (7N•m).

FINAL ADJUSTMENTS

The Jacobs Engine Brake housing installation is now completed. The following procedures and adjustments should be made.

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

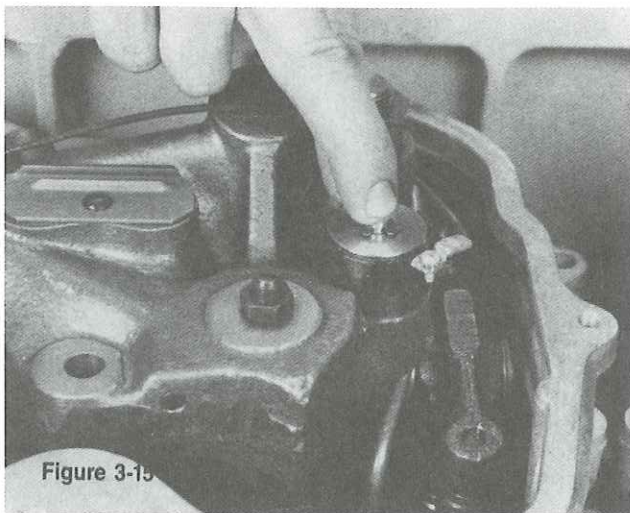
BRAKE UNIT BLEED AND OPERATION CHECK

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

⚠ WARNING

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

SECTION 3 BRAKE HOUSING INSTALLATION (Contd.)



2. With the engine at low idle, manually depress the solenoid armature five or six times in succession. This permits oil to fill the passages in the brake housing and readies the brake for operation.

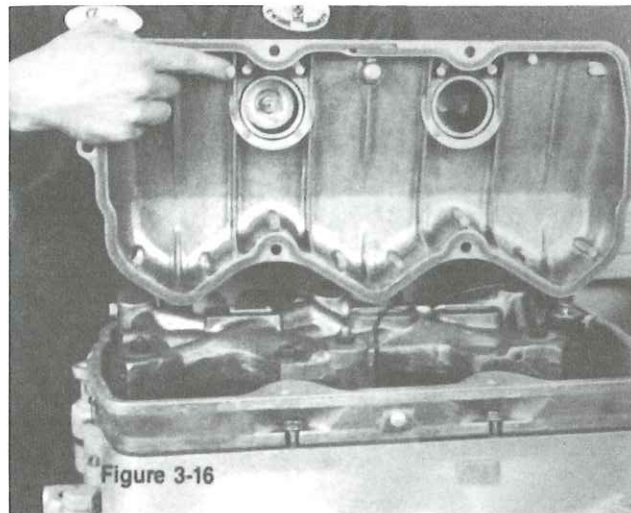
Inspect the installation for any abnormal oil or fuel leakage and component interference. If either is found, the problem must be corrected at this time.

3. If the engine fails to start or misfires, the following Caterpillar procedure must be initiated:

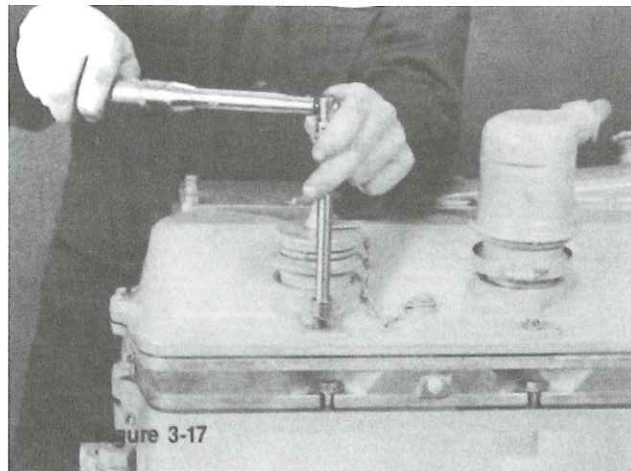
TO PRIME THE SYSTEM: If air is trapped in the fuel system, the diesel engine will either not start, or will misfire. Then it is necessary to prime the system. A fuel priming pump is located either on the engine, or remotely mounted for convenience.

- 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. Tighten fuel line nuts to 30 lbf (41N•m).



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



5. Clean and install covers. Torque holddown nuts to 13 lbf (18N•m).

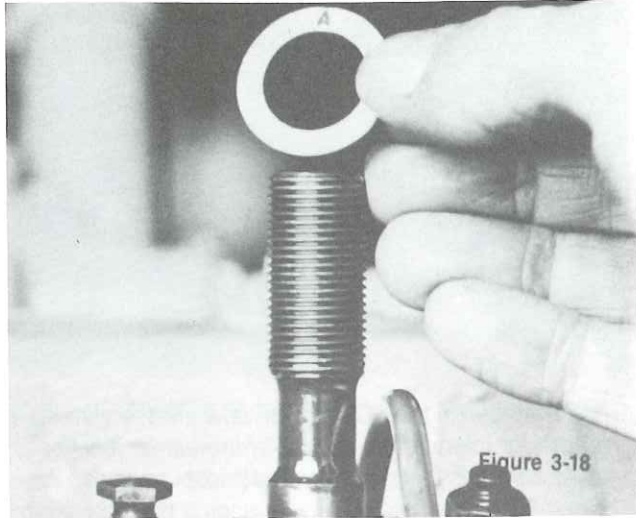
NOTE:

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.

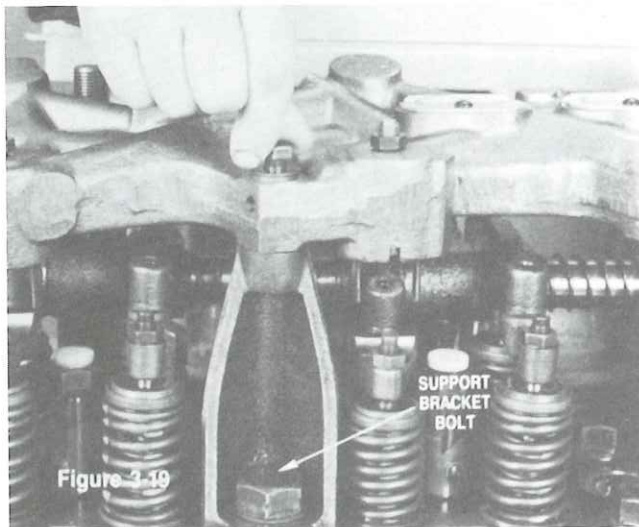
6. On DIT and PCT engines *only*, remove the Caterpillar 7N2446 Elbow and grind away boss to remove interference, clean the elbow after rework and check the Caterpillar 2N8630 gasket between elbow and intake manifold before reassembly.
7. On engines which have the oil breather mounted on the front valve cover, install the rubber breather pipe extension hose from the kit.
8. On engines with the oil breather mounted on the rear valve cover relocate breather pipe brackets as necessary on engines with the oil breather mounted on the rear valve cover to ensure adequate retention of the breather pipe.

SECTION 3 BRAKE HOUSING INSTALLATION ALTERNATE PROCEDURE — HOUSING LEVELING

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

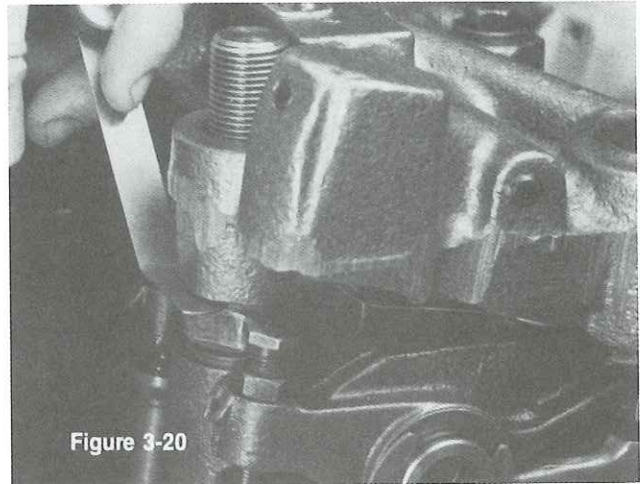


1. Install Jacobs mounting washers marked "A" on studs.
2. Before placing brake units on engine, loosen and backout the slave piston adjusting screw until slave piston is seated in its bore.
3. Carefully install the brake housing. Pay particular attention to the oil supply adapter to ensure proper alignment.

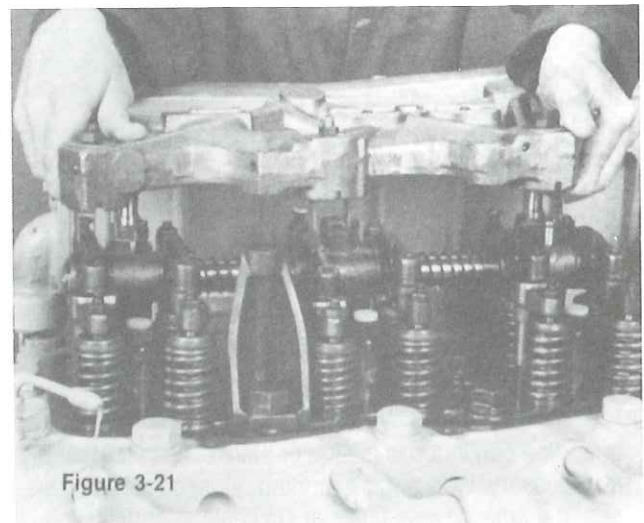


4. Install the Jacobs 3/8" cap screw and the washer through the housing and into the support bracket. Adjust bracket location as needed. Do NOT install large Jacobs nut on Jacobs stud at this time. Jacobs 3/8" cap screw should be tightened to only 10 lbft (13N•m).

Torque the support bracket bolt to 200 lbft (270N•m). Retorque to 330 lbft (450N•m). Always repeat torquing of bolts and studs as a check.



5. 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.



6. Remove the 3/8" cap screw and remove the engine brake housings from the engine.

SECTION 3 BRAKE HOUSING INSTALLATION (Contd.) ALTERNATE PROCEDURE — HOUSING LEVELING

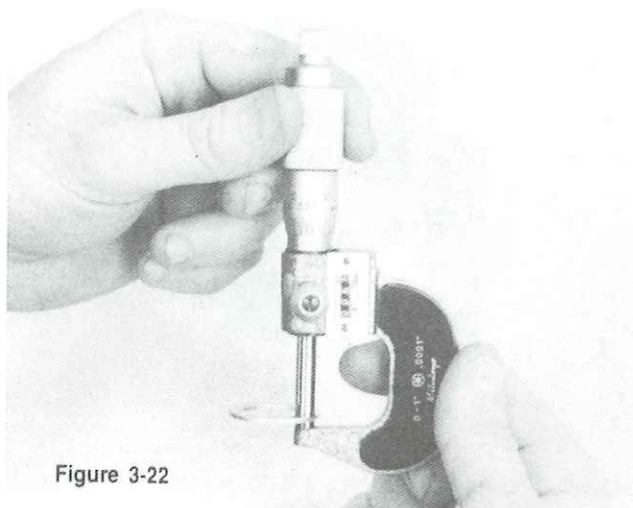


Figure 3-22

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

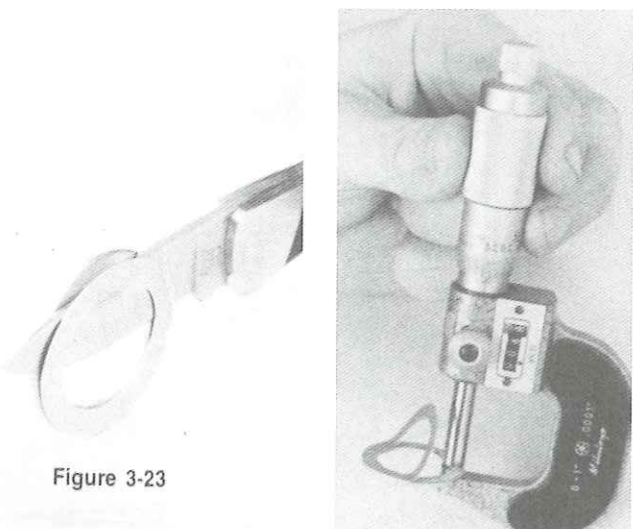


Figure 3-23

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

⚠ 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 THE HOUSING BOTTOM.

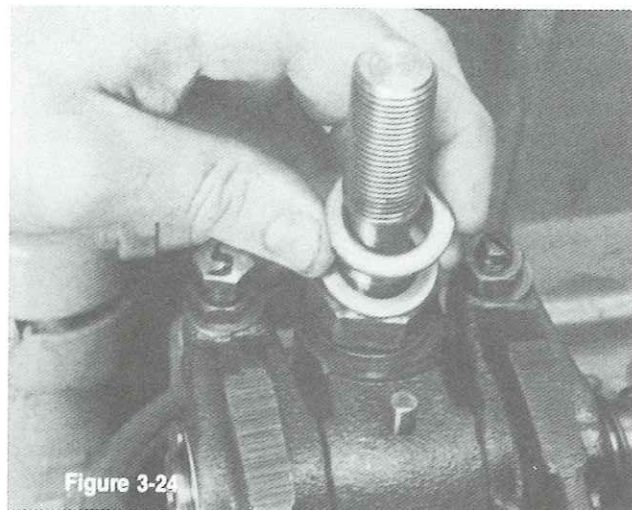


Figure 3-24

9. 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 install the fuel lines as shown on page 13.

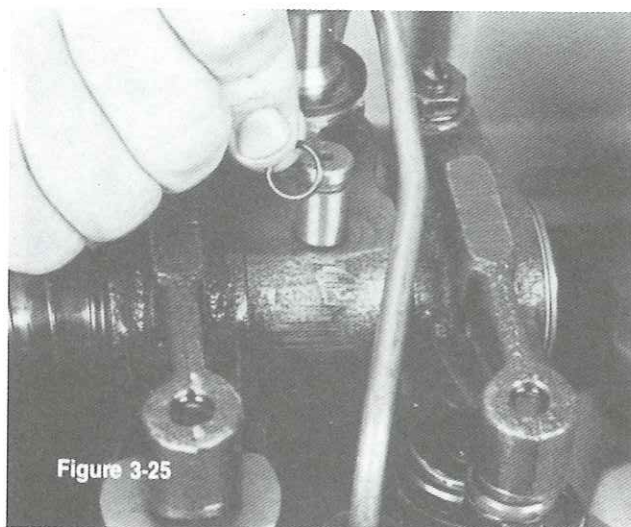


Figure 3-25

10. Install "O" ring on oil supply adapter. Place a small amount of grease on the adapter.

SECTION 3 BRAKE HOUSING INSTALLATION (Contd.) ALTERNATE PROCEDURE — HOUSING LEVELING

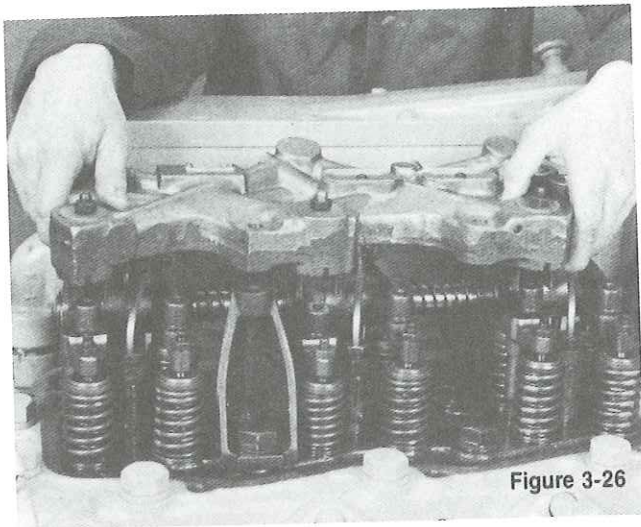


Figure 3-26

11. Reinstall the housing again being careful about the oil supply adapter and its "O" ring. Make sure that fuel lines clear housing by 0.125 in. min. (3.175mm).

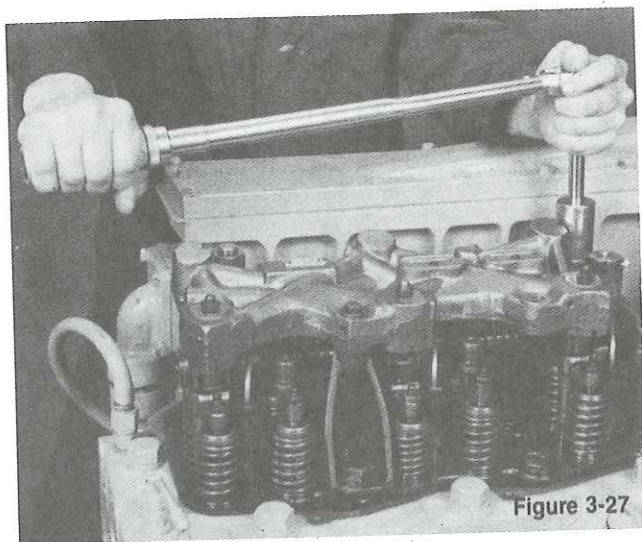


Figure 3-27

12. Place Jacobs washers, marked "A" and holddown nuts on the Jacobs studs.

13. Reinstall the Jacobs 3/8" cap screws and washers.

Torque the Jacobs holddown nuts to 60 lbft (81.6N•m). Retorque 3/8" cap screws to 47 lbft (64N•m) and the Jacobs holddown nuts to 100 lbft (135N•m). Repeat the last procedure to secure the brake housing.

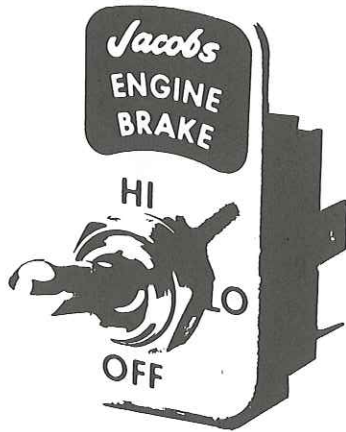
Reinspect each fuel line location to ensure that there is no contact between brake components and the fuel lines.

Reset fuel lines if necessary.

NOW REPEAT THE ALTERNATE HOUSING LEVELING PROCEDURES AND INSTALL THE ENGINE BRAKE ON THE OTHER 3 CYLINDERS AND PROCEED WITH VALVE AND SLAVE PISTON ADJUSTMENTS SHOWN ON PAGE 14.

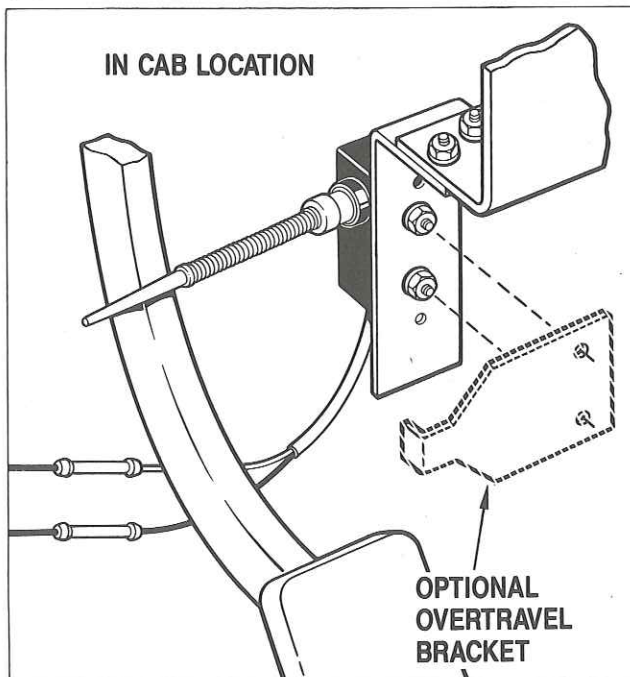
SECTION 4 ELECTRICAL SYSTEM INSTALLATION

DASH SWITCH



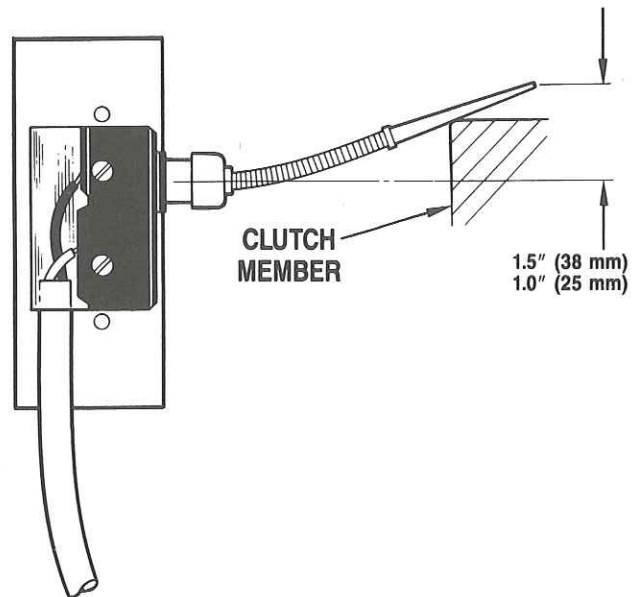
1. Install the dash switch in a convenient location in the cab. Carefully measure and cut all harnesses to proper length. Thread wires through the loom provided. Install receptacles at locations shown in wiring diagram furnished in the kit.

CLUTCH SWITCH



The optional 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 inches (25 - 38 mm), measured at the tip of the actuator, when the clutch pedal is in the up (clutch engaged) position.
4. Check installation by moving the clutch pedal. The switch should click in the freeplay motion of the clutch pedal before actual clutch disengagement takes place.

NOTE:

This adjustment should allow the switch to work the freeplay of the clutch pedal before actual clutch disengaging takes place.

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

SECTION 4 ELECTRICAL SYSTEM INSTALLATION (Contd.)

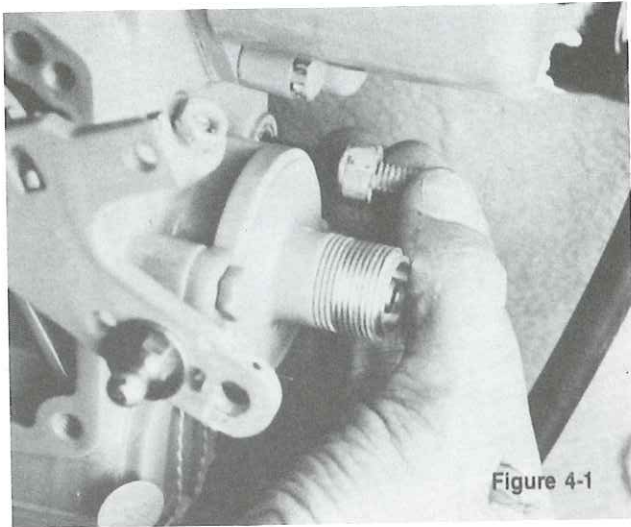


Figure 4-1

1. Remove the fuel pump low idle screw. On 3406B engines, install the seal, washer, gasket and locknut from the low idle screw on the switch. On 3406 engines, install the Jacobs locknut and seal washer on the switch. Insert the switch to about the same depth as the idle screw was. 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 counter-clockwise to decrease engine RPM. 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.

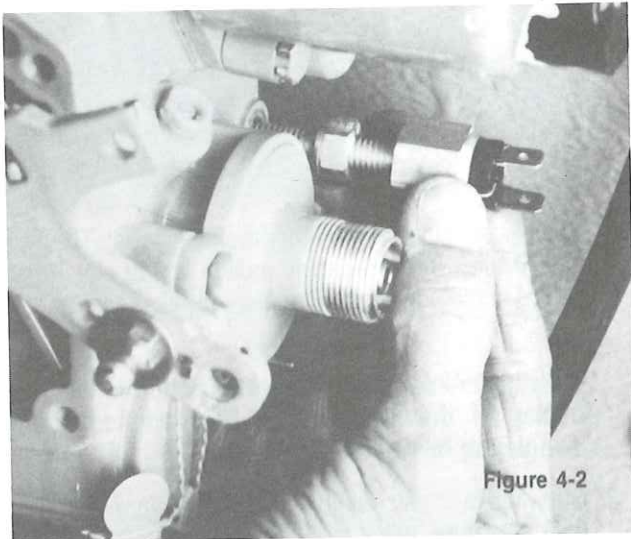


Figure 4-2

2. Hold the Jacobs switch and tighten lock nut to 5 lbf (7N•m). Reconnect throttle linkage. Connect leads to the proper switch terminals. The brass terminal is positive. Follow the wiring diagram.

NOTE:

The internal switch for the 3406B engine is different from the internal switch on the 3406 engine.

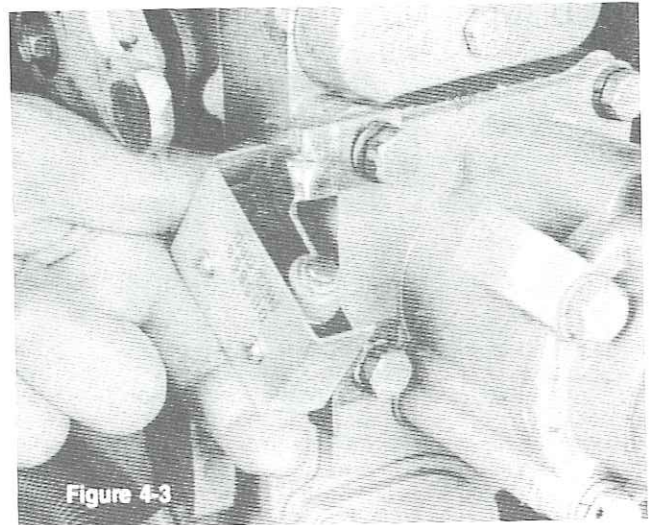
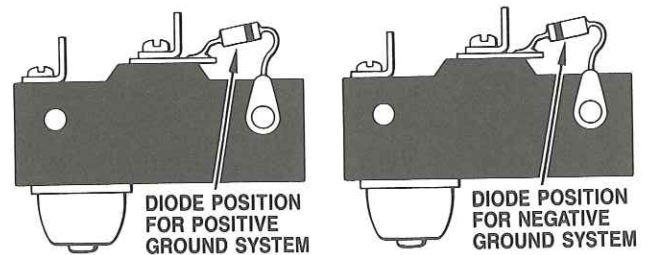


Figure 4-3

ACTUATING ARM SWITCH ASSEMBLY

The earlier type of fuel pump switch (shown above), if used, is adjusted by positioning the actuating arm on the fuel pump governor to a point where you hear a "click" when the throttle arm moves to an idle fuel position.



CAUTION

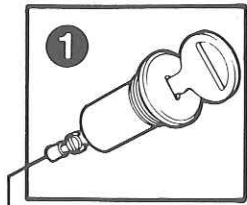
CHECK TO BE SURE THAT THE GOVERNOR OPERATING LEVER MOVES FREELY FROM LOW IDLE TO HIGH IDLE POSITION AND RELEASES WITHOUT BINDING.

FINAL WIRING

1. Complete the wiring. Refer to the wiring diagram.
2. Check all wiring. Make sure all wiring has been cut to correct length, installed properly, tied off, and moved out of sight. Wires should be routed where no chafing, mechanical interference, or similar interference can occur. Generally, a malfunctioning engine brake is due to faulty or careless wiring.
3. With the engines shut down, check electrical system by turning on ignition switch and moving Jacobs dash switch from OFF to LO to HI. In LO, only the rear brake housing solenoid valve should activate. In HI, both front and rear solenoids should activate.
4. Finally, attach the OPERATING INSTRUCTION decal in a convenient location on the dash. Then complete and mail the Engine Brake Warranty card.

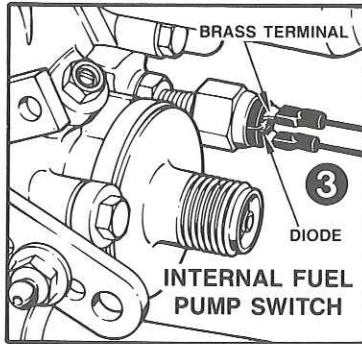
SECTION 4 ELECTRICAL SYSTEM INSTALLATION (Contd.)

IGNITION SWITCH

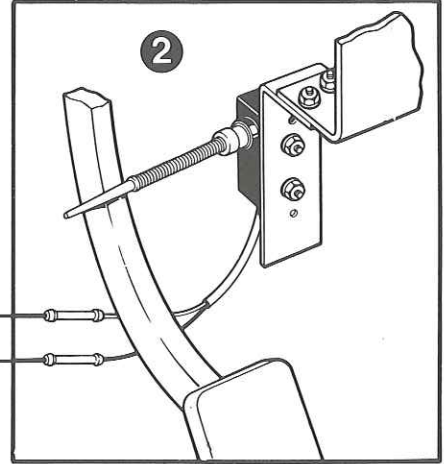
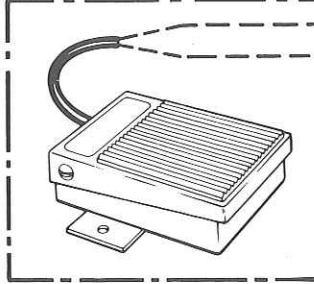


CONNECT TO MAIN +12V LINE THAT IS ON WHEN ENGINE IS RUNNING. LINE MUST BE PROTECTED WITH A 10 AMP BREAKER OR FUSE

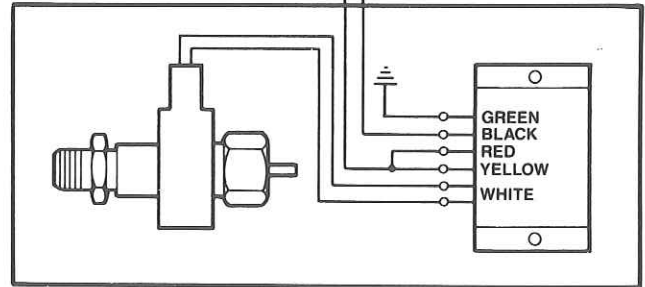
CIRCUIT BREAKER BOX



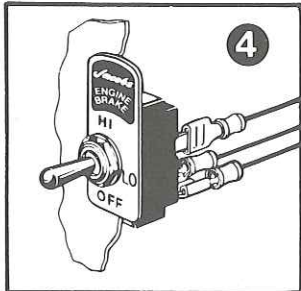
**FOOT SWITCH (Optional)
REPLACES CLUTCH SWITCH**



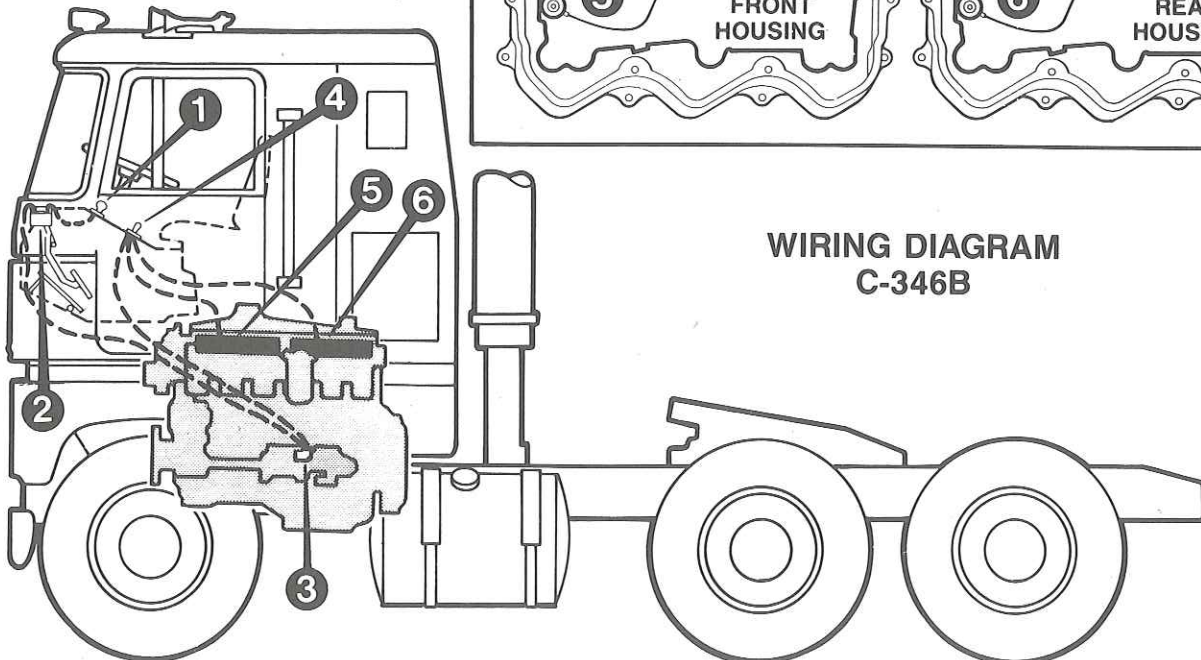
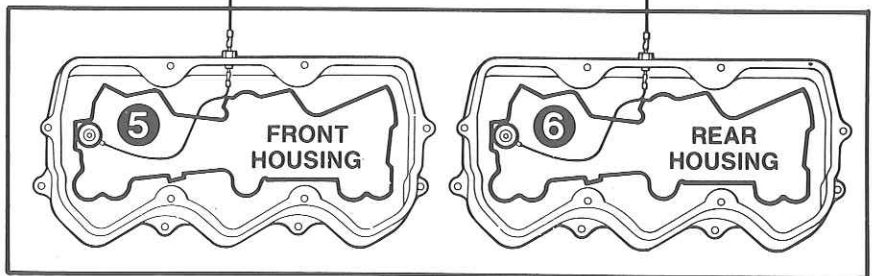
CLUTCH SWITCH



LOW SPEED SHUT OFF SWITCH (Optional)

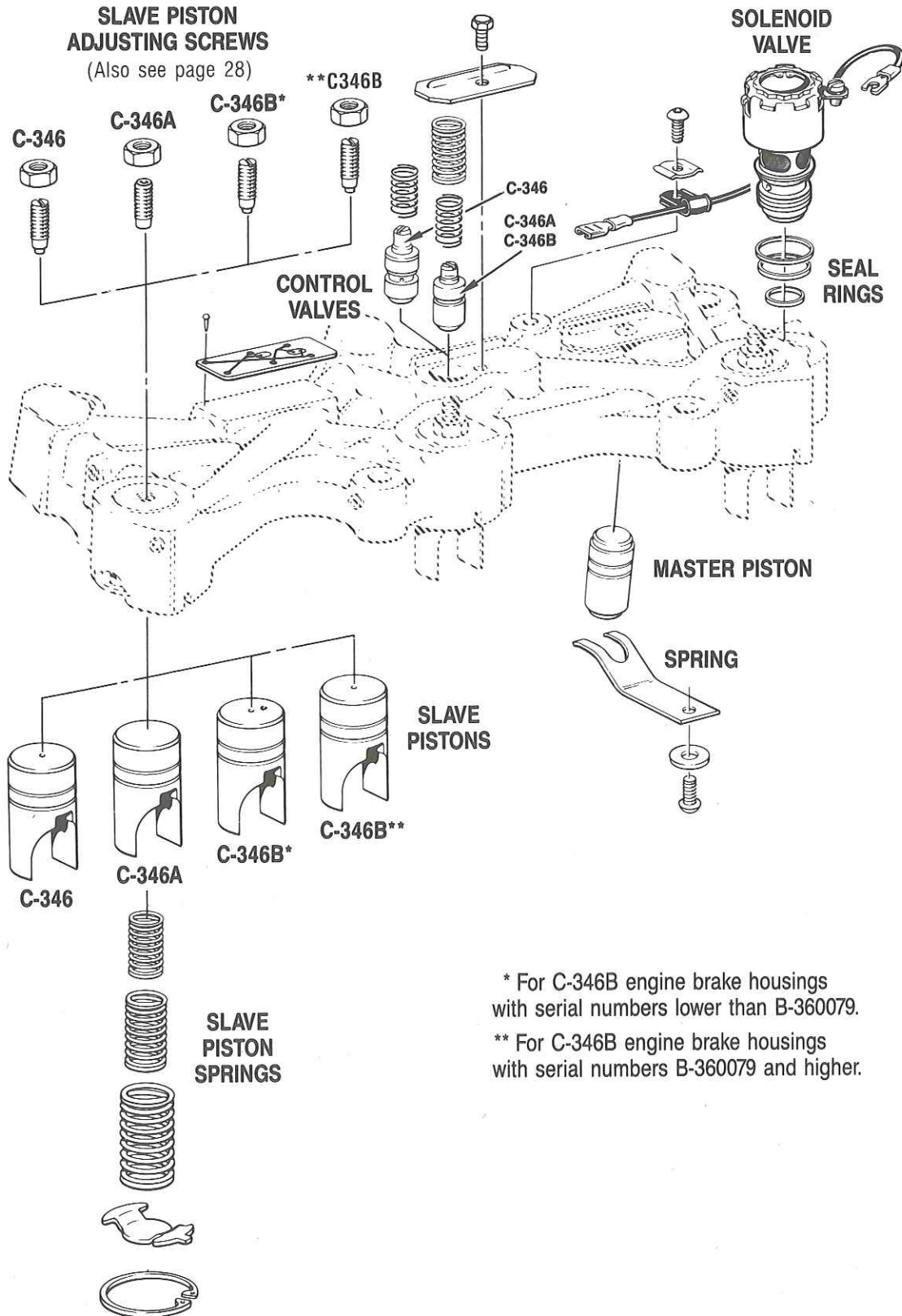


DASH SWITCH (3-Position)



**WIRING DIAGRAM
C-346B**

SECTION 5 ENGINE BRAKE MAINTENANCE



* For C-346B engine brake housings with serial numbers lower than B-360079.

** For C-346B engine brake housings with serial numbers B-360079 and higher.

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, periodic inspections and part replacement will need to be made from time-to-time. Use the following procedures to keep the engine brake in top condition.

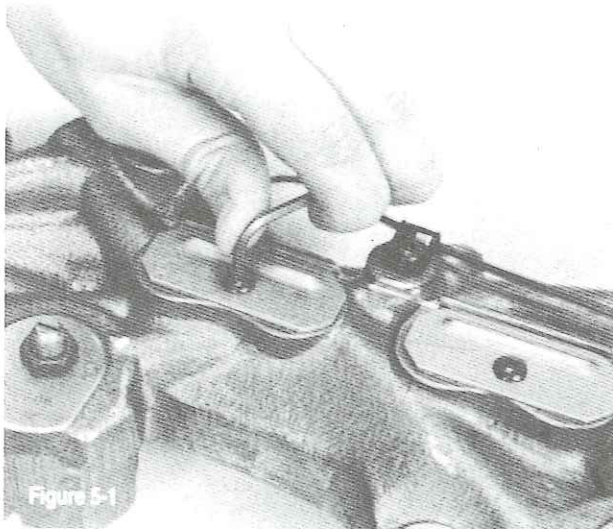
This section will cover how to properly remove, clean and reinstall engine brake components. Use an OSHA-approved cleaning solvent when washing parts. Be sure to coat parts with clean engine oil when reinstalling them.

CONTROL VALVE

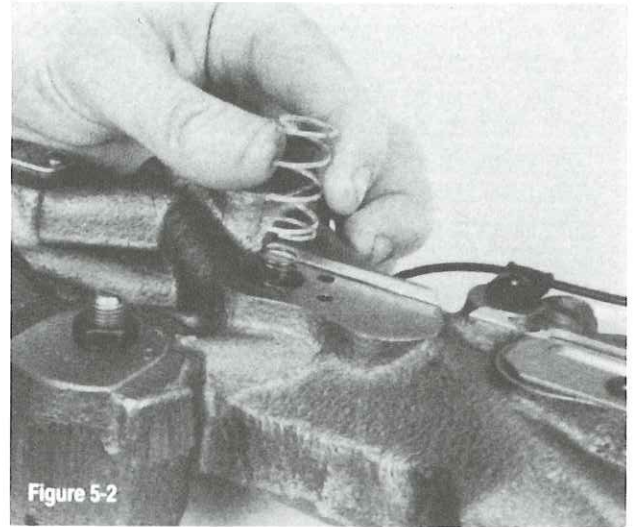
⚠ WARNING

REMOVE CONTROL VALVE COVERS CAREFULLY. CONTROL VALVE COVERS ARE UNDER LOAD FROM THE CONTROL VALVE SPRINGS.

REMOVE WITH CARE TO AVOID PERSONAL INJURY.



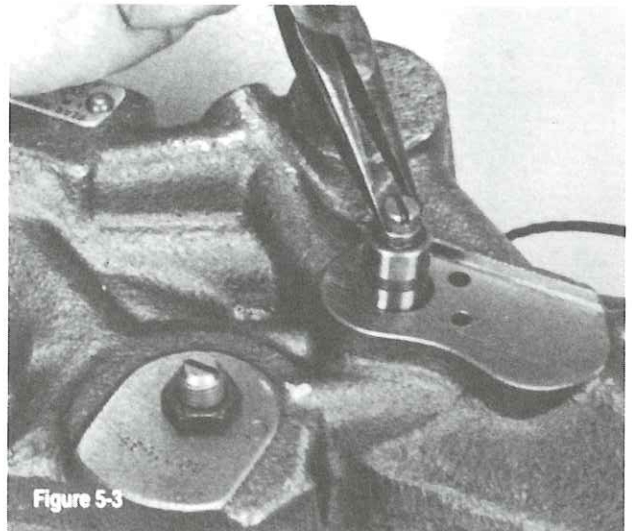
1. Remove capscrews and covers from top of brake housing.



2. Carefully remove the control valve springs.

NOTE:

Only one spring is used in the Model C-346 housing. Models C-346A and C-346B use two springs.



3. Using needle-nose pliers, reach into the bore and grasp the stem of the control valve. Pull valve straight up and out of its bore.

NOTE:

The C-346 housing has a long-stemmed control valve. C-346A and C-346B housings use short-stemmed control valves.

SECTION 5 ENGINE BRAKE MAINTENANCE (Contd.)

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

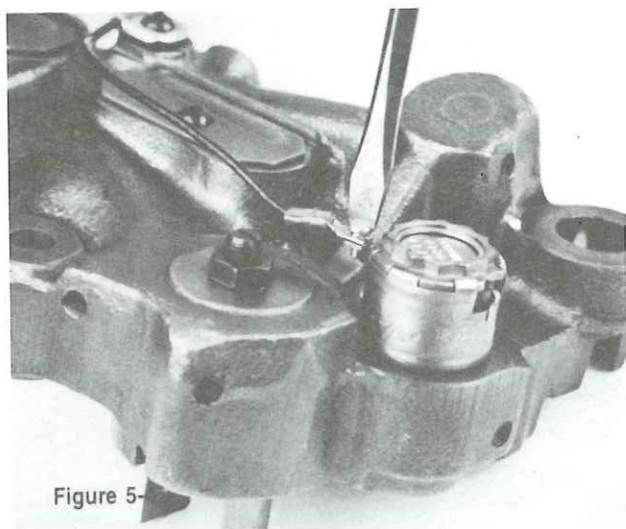


Figure 5-

1. Disconnect the solenoid harness.

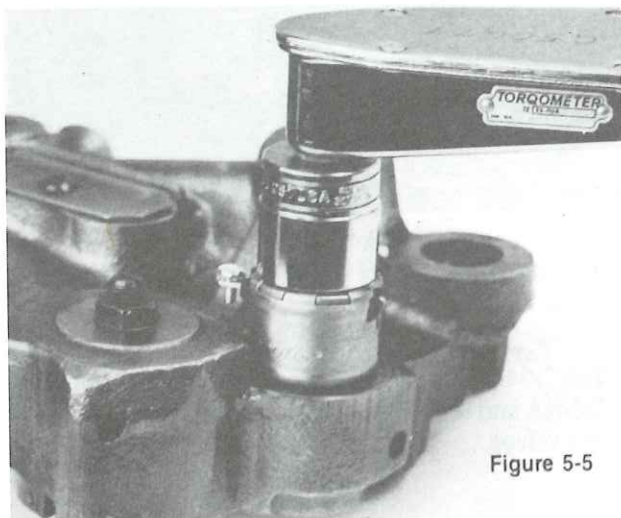


Figure 5-5

2. For earlier style solenoid valves, unscrew with a Jacobs solenoid socket. Use a 12 pt. socket wrench to remove the current solenoid valves.

⚠ CAUTION

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

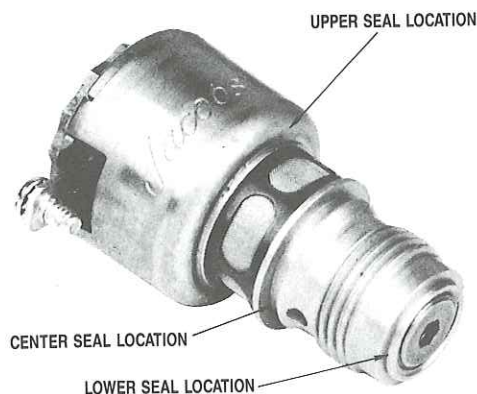


Figure 5-6

3. 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.
4. 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.

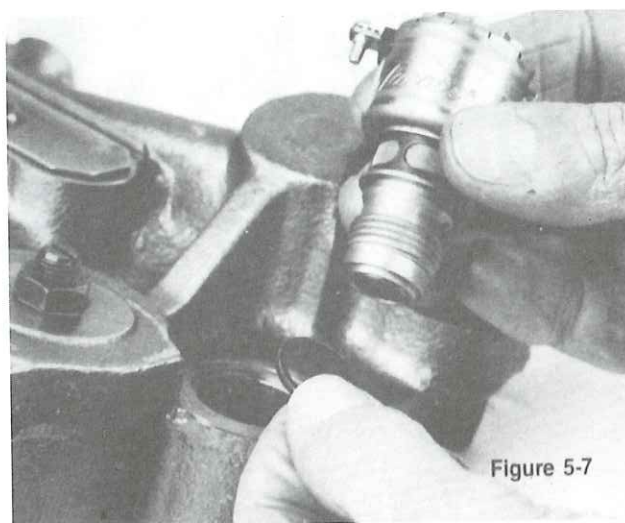


Figure 5-7

5. Reinstall solenoid using new seal rings. Seat lower seal ring in the base of the solenoid valve bore. Wipe clean lube

SECTION 5 ENGINE BRAKE MAINTENANCE (Contd.)

oil into and around the bore. Place upper and center seal rings on the solenoid valve body. See Figure 5-6 for seal locations.

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

SLAVE PISTON

⚠ WARNING

WEAR SAFETY GLASSES. REMOVE SLAVE PISTON CAREFULLY.

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

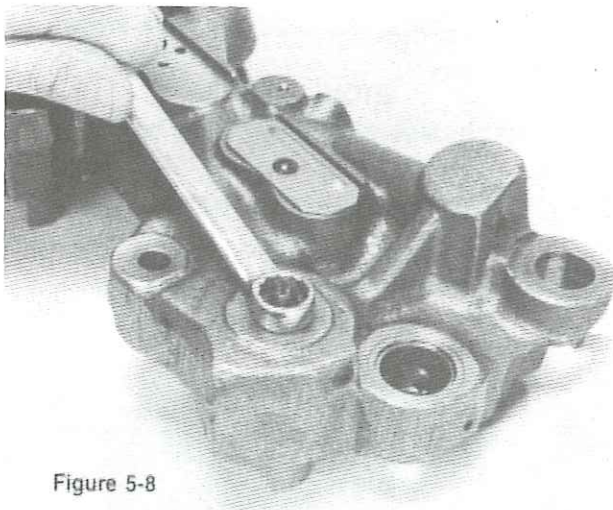
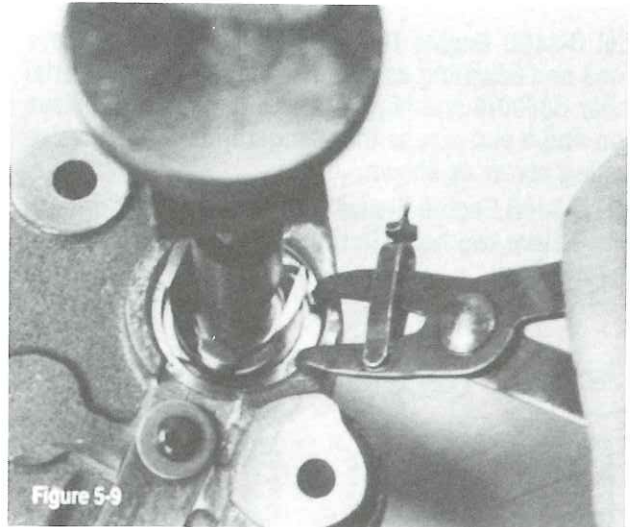
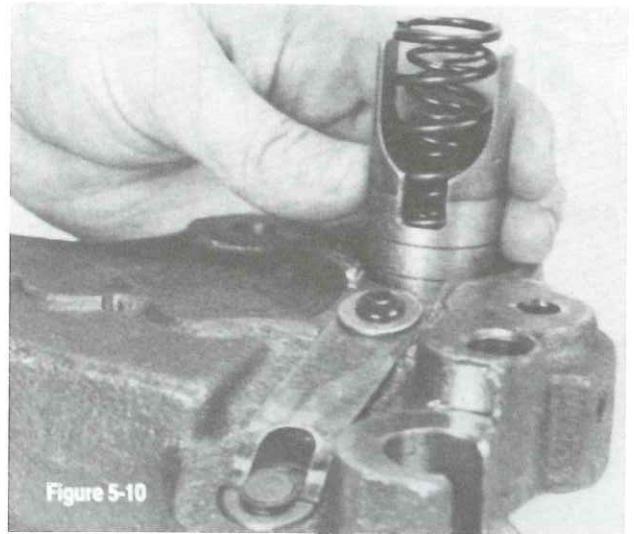


Figure 5-8

1. Remove the locknut on the slave piston adjusting screw. Back out the adjusting screw until the slave piston is fully retracted (screw is loose).



2. Using an arbor press, or a suitable clamp, slowly apply pressure to the retainer and remove the snap ring. Relieve the clamping pressure gradually until the springs are free.



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

NOTE:

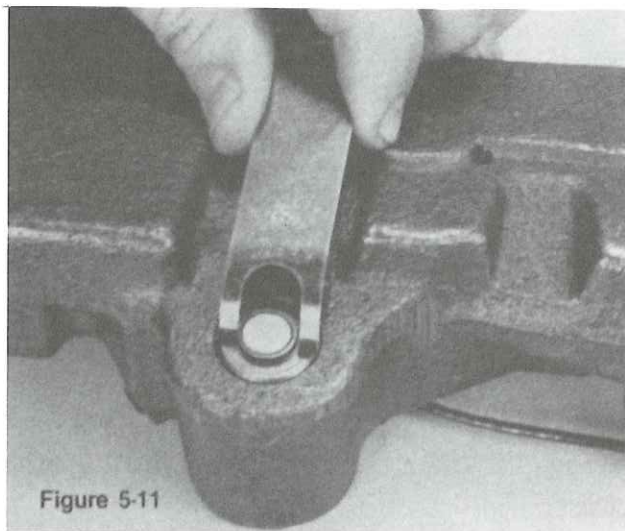
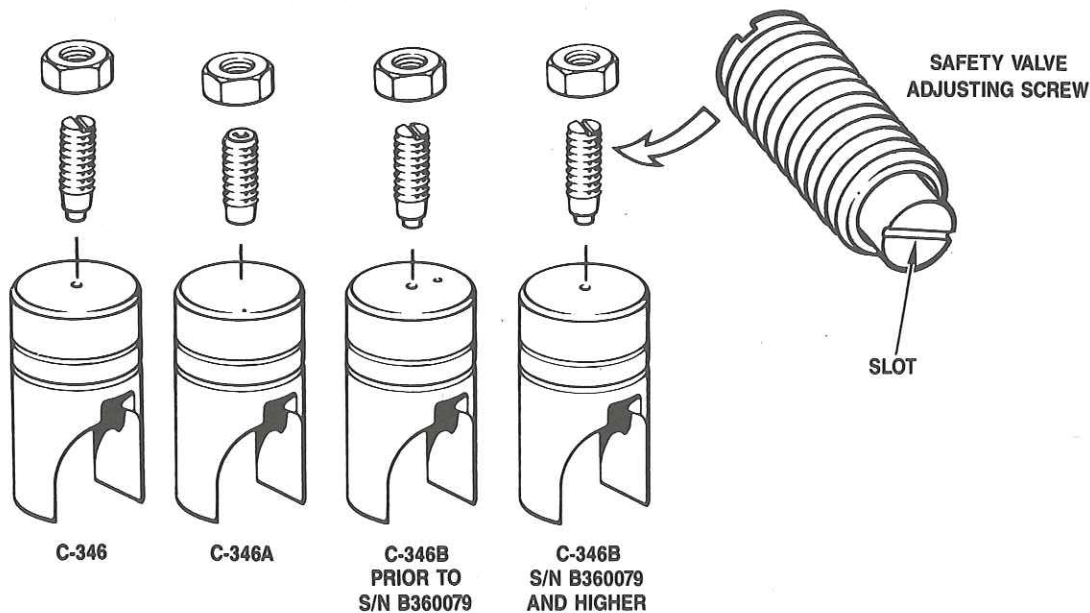
The correct slave piston must always be used with a specific Model housing. Check the Parts Manual.

SECTION 5 ENGINE BRAKE MAINTENANCE (Contd.)

NOTE:

Model C-346B Engine Brakes have two styles of slave pistons and adjusting screws. Engine Brakes with serial number B360079 and higher have one hole in the slave piston and a slot across the plunger in the safety valve adjusting screw as shown.

Model C-346B Engine Brakes with serial number prior to B360079 have two holes in the slave piston and no slot in the plunger.

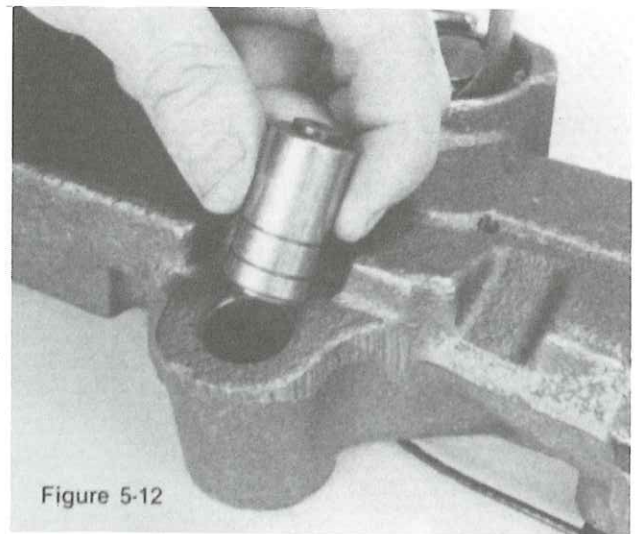


MASTER PISTON

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

NOTE:

The master piston spring used on C-346B housings is shorter than the spring used on C-346 and C-346A housings. The shorter springs may be used as a replacement part on Models C-346 and C-346A.



2. Remove master piston from its bore. 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 surface. Pitted, chipped, cracked or galled pistons should be replaced.

SECTION 5 ENGINE BRAKE MAINTENANCE (Contd.)

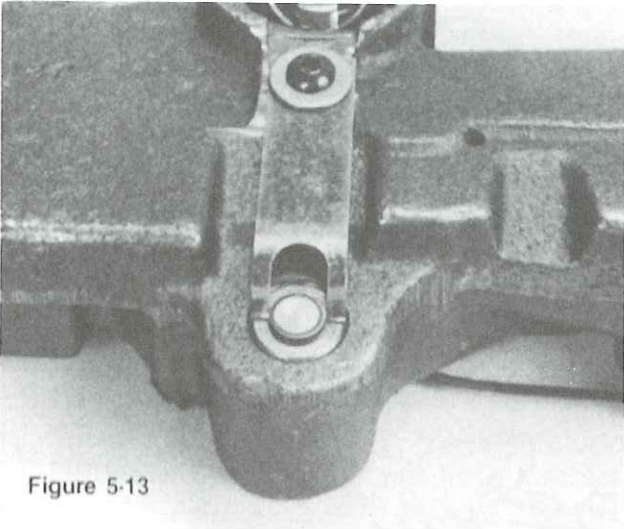


Figure 5-13

3. 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 center raised portion.

NOTE:

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

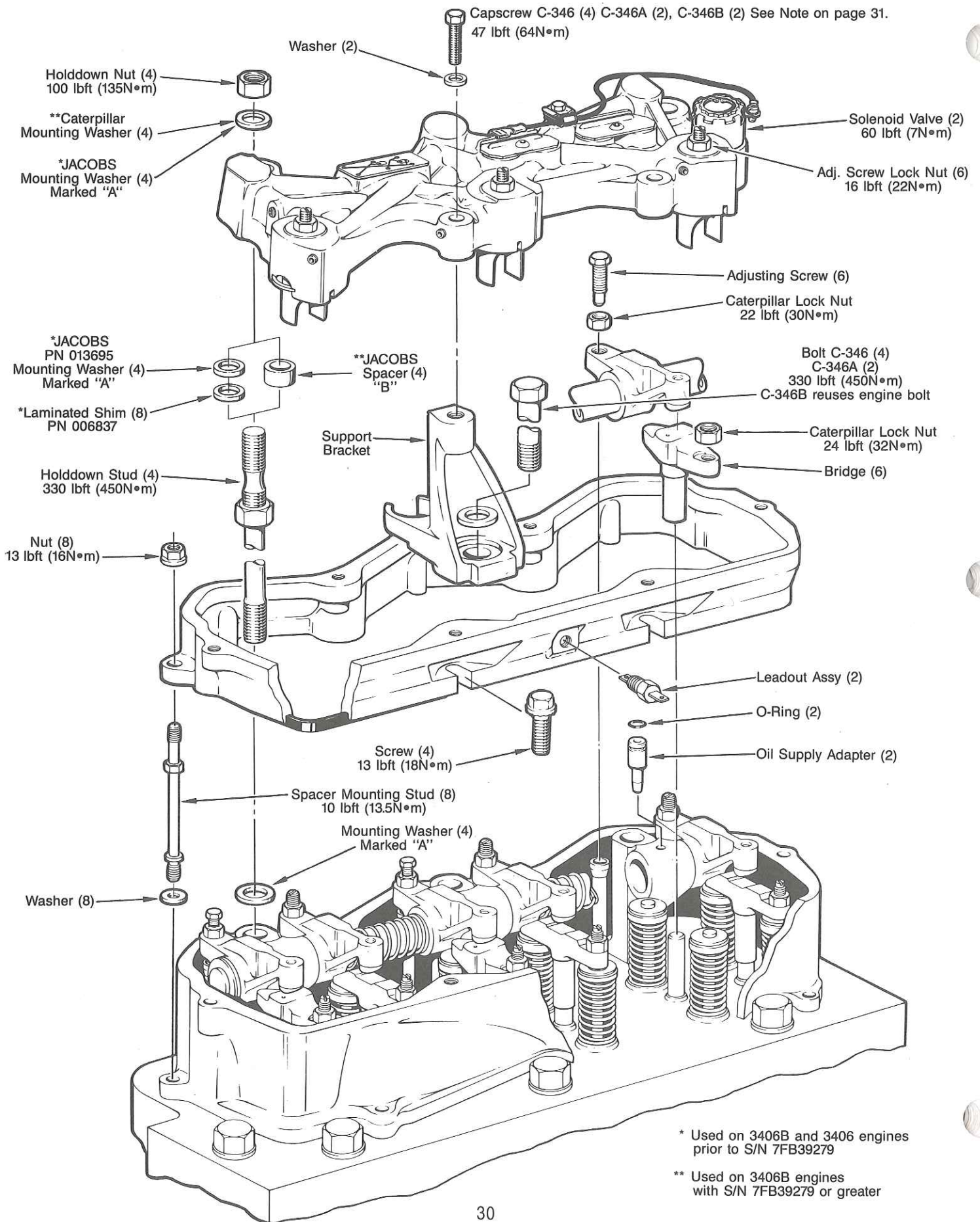
REINSTALLATION OF HOUSING ASSEMBLY

1. Install a new oil supply seal ring.
2. Always readjust slave piston lash. Use the procedure shown in Section 3, Page 14.

CAUTION

SLAVE PISTON ADJUSTMENT MUST BE MADE WITH THE ENGINE STOPPED AND COLD. THE EXHAUST VALVES ON THE CYLINDER TO BE ADJUSTED MUST BE IN THE CLOSED POSITION.

SECTION 6 CONVERSION OF BRAKE UNITS



SECTION 6 CONVERSION OF BRAKE UNITS (Contd.)

The preceding information can be used as supplement to this Manual. Shown are the locations, arrangements, and torque values of nuts, bolts, washers, etc. The quantities shown are for one complete Engine Brake Kit.

A Model C-346 Housing Assembly can be updated to a C-346A or C-346B Housing Assembly. Also, a C-346A Housing Assembly can be updated to a C-346B Housing Assembly. This is done by changing the different parts as noted in the Parts Manual. Always stamp the housing identification plate with proper model number. This will show that an update has been made.

When replacing a Model C-346 Housing Assembly with a C-346A or C-346B Housing Assembly, the other Housing Assembly (front or rear) should be updated to the same Model.

NOTE:

C-346 Engine Brake Housings with Serial Numbers up through A272883 will use (3/8" x 16" x 1 1/4") Capscrews.

C-346 Engine Brake Housings with Serial Numbers A272884 and greater will use (3/8" x 16" x 1 3/4") Capscrews.

C-346A Engine Brake Housings use (3/8" x 16" x 1 3/4") Capscrews.

C-346B Engine Brake Housings use (3/8" x 16" x 1 3/4") Capscrews.

Jacobs® and Jake Brake® are registered trademarks of The Jacobs Manufacturing Company.