

# Models 680A/B

The Model 680A Jake Brake® engine retarder is designed and approved for use on Mack® E6 engines with four-valve cylinder head configuration. The Model 680B is designed and approved for use on Mack E7 engines. 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.

# INSTALLATION

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# Safety Precautions

The following symbols in this manual signal potentially dangerous conditions to the mechanic or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.



THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.



THIS SYMBOL REFERS TO POSSIBLE EQUIPMENT DAMAGE.

NOTE:

INDICATES AN OPERATION, PROCEDURE OR INSTRUCTION THAT IS IMPORTANT FOR CORRECT SERVICE.

Fuels, electrical equipment, exhaust gases and moving engine parts present potential hazards that could result in personal injury. Take care when installing an engine brake. Always use correct tools and proper procedures as outlined in this manual.



SEE 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

## Housing Identification

Each engine brake housing assembly has an identification tag (A, Fig. 1) showing model number and installation location marked FRONT or REAR. Engine brake housing serial numbers are stamped on the top of the castings (B).

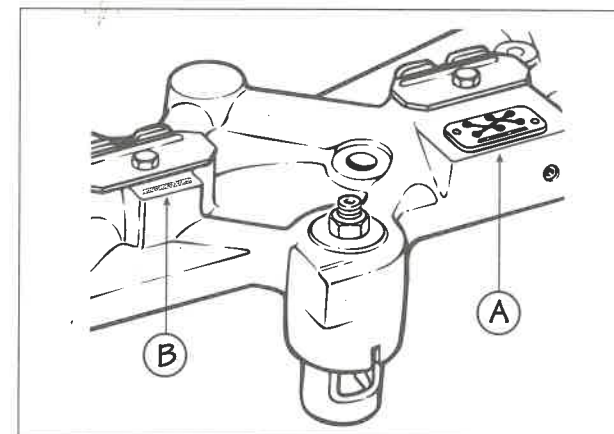


FIG. 1

## Tools Needed

	Part No.
Jacobs Feeler Gage, 0.080" (2.03 mm)	018781
Jacobs Feeler Gage, 0.085" (2.16 mm)	014177
9/16" Crowfoot Wrench	
5/8" Crowfoot Wrench	

## Torque Values

NOTE:

MACK E6 AND E7 ENGINES INSTALLED IN AN "MH" CHASSIS WITH A METAL AIR CLEANER CASE REQUIRE INSTALLATION OF A JACOBS MH AIR CLEANER ADAPTER KIT, P/N 015875 (E6) OR P/N 017700 (E7).

	Lb.-ft.	N•m
Rocker bracket hold-down capscrew (E7)	40	54
Rocker bracket hold-down capscrew (E6)	55	75
Rocker arm adjusting screw jam nut (E7)	40	54
Rocker arm adjusting screw jam nut (E6)	26	35
Cylinder head cover/spacer capscrews	20	27
Engine brake hold-down capscrew (E7)	45	61
Engine brake hold-down capscrew (E6)	55	75
Slave piston adjusting screw nut	17	23
Throttle switch actuating arm	55 (lb.-in.)	6
Oil supply screw	5	7
Yoke levelling screw jam nut	33	44
Jacobs electrical connector	5	7

## Section 2: Engine Preparation

Clean engine thoroughly. Remove all accessory components required to remove cylinder head covers. Remove both cylinder head covers. At this time, we recommend rotating the engine to top dead center (TDC) for cylinder no. 1. See Section 3, Slave Piston Inlet Valve and Exhaust Valve Lash Adjustments, for the procedure. This will aid in setting the engine timing later. Loosen the inlet and exhaust rocker arm adjusting screw locknuts (see Fig. 2).



FIG. 2

Remove the rocker bracket bolts and washers and then remove the rocker arm shaft assemblies (see Fig. 3).



FIG. 3

### Exhaust Rocker Arm Adjusting Screw

As shown in Fig. 4, the Jacobs exhaust rocker arm adjusting screws have hex heads. Mack screws have a screwdriver slot.

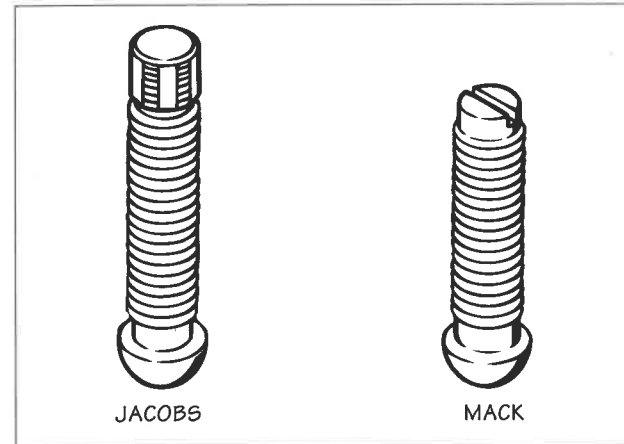


FIG. 4



USE ONLY JACOBS EXHAUST ROCKER ARM ADJUSTING SCREWS FOR ENGINE BRAKE INSTALLATION. THE USE OF MACK OR ANY OTHER TYPE OF SCREW WILL RESULT IN SEVERE SCREW WEAR AND ENGINE DAMAGE.

Remove the Mack exhaust rocker arm adjusting screws and install Jacobs adjusting screw (Fig. 5). Turn the screws all the way into the rocker arm from the underside. Install the Mack locknuts.



FIG. 5

### Exhaust Valve Yoke Replacement

Remove the Mack exhaust valve yokes (see Fig. 6).



FIG. 6

NOTE:

THE EXHAUST VALVE YOKES IN THE E6 ENGINE HAVE SAE THREADS. THE JACOBS EXHAUST VALVE YOKES HAVE METRIC THREADS. JACOBS ADJUSTING SCREWS AND LOCKNUTS ARE INCLUDED IN THE 680A ENGINE BRAKE KITS. THE YOKES IN THE E7 ENGINE HAVE METRIC THREADS AND THE MACK ADJUSTING SCREWS AND LOCKNUTS SHOULD BE REUSED FOR 680B INSTALLATIONS WITH JACOBS YOKES.

For **Model 680A** installation, use the Jacobs adjusting screw and locknut provided in the kit.

For **Model 680B** installation, remove the Mack adjusting screw and locknut from the Mack exhaust yoke and install in the Jacobs yoke.

Apply engine oil to the yoke guide pin, guide pin bore and top pallet of yoke (see Fig. 7). Install the Jacobs yokes in the engine with the adjusting screw outboard (toward the intake manifold side of the engine).



FIG. 7

### Exhaust Valve Yoke Adjustment

Apply light pressure to the yoke by pressing on the top of the yoke (see Fig. 8). Turn the adjusting screw down until a slight "drag" on the adjusting screw indicates contact with outboard valve stem.



FIG. 8

Turn adjusting screw an additional 1/6 turn (60° clockwise) (see insert in Fig. 9).



HOLD THE ADJUSTING SCREW IN THIS POSITION AND TORQUE THE LOCKNUT TO 33 LB.-FT. (44 N•M). TO CHECK THE YOKE ADJUSTMENT, INSERT A 0.010" THICKNESS GAGE BETWEEN THE YOKE AND VALVE STEM AT BOTH THE INBOARD AND OUTBOARD LOCATIONS. EXERT A MODERATE FORCE BY PRESSING ON THE TOP OF THE YOKE. AN EQUAL "DRAG" SHOULD BE FELT ON BOTH THICKNESS GAGES. IF THE "DRAG" IS UNEQUAL, READJUST THE YOKE ADJUSTING SCREW.

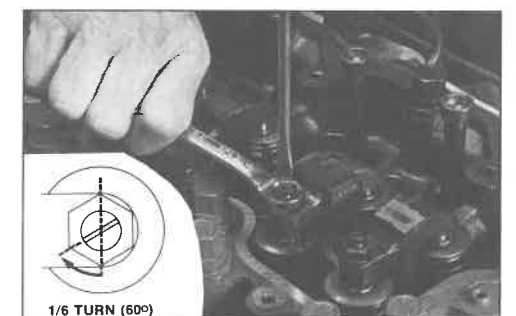


FIG. 9



Replace the rocker assemblies. Apply clean engine oil to the Mack hold-down capscrews and install one capscrew with a Mack washer in each bracket, next to the pushrods (see Fig. 10). There are three (3) capscrews to each rocker assembly.

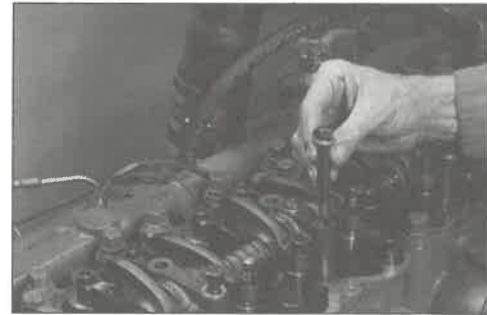


FIG. 10

Check that all pushrods are in their sockets (Fig. 11) and rocker adjusting screws are backed out so valves are not forced against pistons.



FIG. 11

Starting at center, tighten each bracket hold-down capscrew in two steps:

1. Torque to 20 lb.-ft. (27 N•m).
2. Retorque as follows:
 

680A (E6)	55 lb.-ft. (75 N•m)
680B (E7)	40 lb.-ft. (54 N•m)

Remove the two hex head screws and lock washers located on the rocker brackets which lock the rocker shafts (see Fig. 12). There are six (6) rocker shaft brackets. The two screws that lock the shafts are on the first and fourth shaft brackets (from the front of the engine).

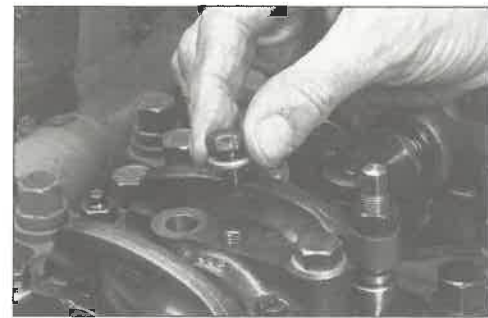


FIG. 12

NOTE:

E6 ENGINES MANUFACTURED PRIOR TO MARCH, 1986 HAVE A 1/4 - 20 THREADED HOLE FOR THE ROCKER SHAFT LOCKING SCREWS (SEE FIG. 13). THESE ENGINES REQUIRE JACOBS OIL SUPPLY SCREW, P/N 014043, AND WASHER, P/N 014104.

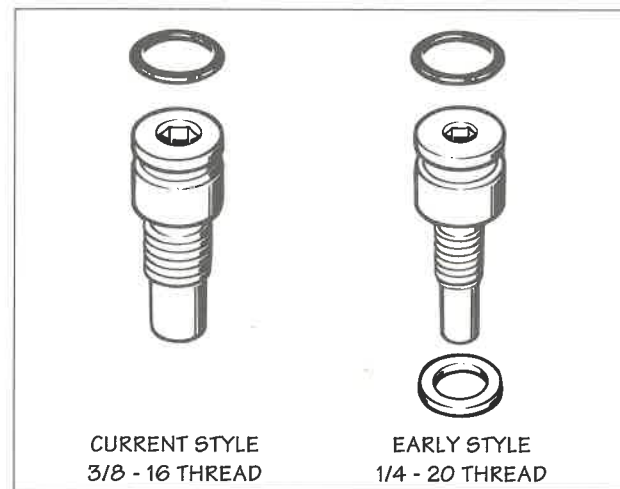


FIG. 13

Lubricate and install "O" rings in the groove in the Jacobs oil supply screws. Install the screws into the rocker brackets and tighten to 5 lb.-ft. (7 N•m). Apply clean engine oil to the "O" rings (see Fig. 14).



FIG. 14

## Section 3: Brake Housing Installation

Place the engine brake housings in position on the rocker shaft brackets. Be sure the front housing is over cylinders 1, 2 and 3 and the rear housing is over cylinders 4, 5 and 6. Position the housing so that the oil supply bore is located over the oil supply screw. Carefully push the housing down until the "O" ring enters the bore and the housing rests flat against the rocker shaft brackets. Do not damage the "O" ring.

Apply clean engine oil to the six (6) Jacobs engine bracket hold-down capscrews and install them through each brake housing and into the rocker shaft brackets (see Fig. 15).

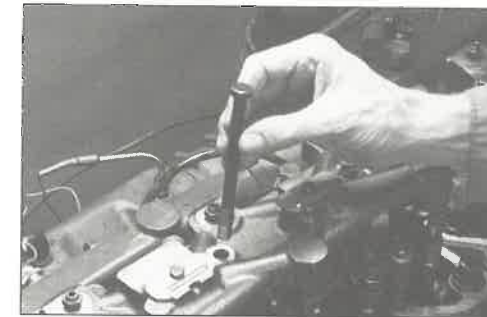


FIG. 15

Starting with the center capscrew, tighten the three (3) capscrews on each housing to 20 lb.-ft. (27 N•m). Then retorque to 55 lb.-ft. (75 N•m) for E6 engines and 45 lb.-ft. (61 N•m) for E7 engines (see Fig. 16).

NOTE:

CHECK THAT THERE IS NO INTERFERENCE BETWEEN THE ROCKER ARM AND THE SLAVE PISTON BY MANUALLY MOVING EACH ROCKER ARM WITH THE VALVES CLOSED. BE SURE TO CHECK ALL CYLINDERS. IF BINDING OCCURS, LOOSEN THE BOLTS AND REPOSITION THE HOUSING.



FIG. 16

### Slave Piston, Inlet Valve and Exhaust Valve Lash Adjustments

The following adjustments must be made with the engine shut down. Coolant temperature must be below 100° F. to assure proper lash adjustment.



BEFORE ROTATING THE ENGINE CRANKSHAFT, MAKE CERTAIN THAT THE VALVE ADJUSTMENT SCREWS ARE IN THEIR RETRACTED POSITION TO PREVENT THE POSSIBILITY OF VALVES HITTING THE PISTON AND BENDING THE PUSHRODS.

DO NOT ROTATE THE ENGINE CRANKSHAFT BACKWARDS WHEN USING THE HUB-DAMPER BOLT, SINCE THIS MIGHT CHANGE THE BOLT TORQUE.

#### Prior to 1991 engines and all engines with Allison Automatic Transmissions:

To adjust the slave piston lash and valve lash, bar the engine in normal rotation until the No. 1 piston timing mark (on the compression stroke) is in alignment with pointer marked "valve". This provides the 30° after top-dead center (TDC) relationship for the valve lash adjustment, necessary with the 4VH camshaft design. See Fig. 17 for valve timing mark locations on vibration damper.

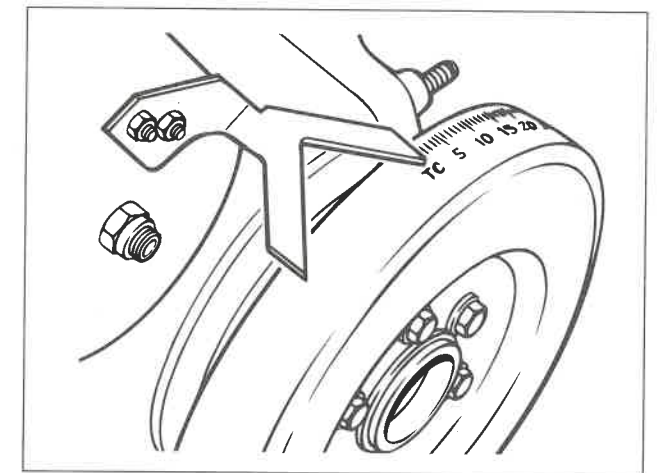


FIG. 17

#### IMPORTANT!

For 1991 and later engines with manual transmissions, refer to Mack's E7 Engine Manual.

Adjust the slave piston first, then the inlet and exhaust valves. Start with cylinder no. 1 and follow the firing order: 1, 5, 3, 6, 2, 4.

Loosen the slave piston adjusting screw until the slave piston is fully retracted in its bore (no drag on screw).

With the exhaust valves closed (yoke loose) on the cylinder to be adjusted, insert the proper Jacobs feeler gage (see the following lash adjustment chart) between slave piston feet and Jacobs yoke. Turn the adjusting screw in until a slight drag is felt on the feeler gage (see Fig. 18). Hold adjusting screw in this position and tighten locknut to 17 lb.-ft. (23 N•m).



MAKE THIS ADJUSTMENT CAREFULLY. AFTER SLAVE PISTON ADJUSTING SCREW LOCKNUT IS PROPERLY TORQUED, RECHECK THE CLEARANCE WITH THE JACOBS FEELER GAGE.

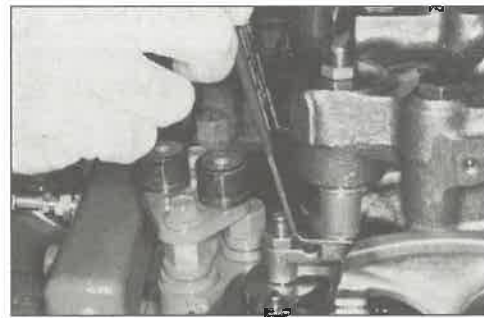


FIG. 18

## Slave Piston Adjustment

### Lash Adjustment

Model Year	Lash Setting	Gage P/N
1991*	0.080" (2.05 mm)	017099
Selected 1990**	0.080" (2.05 mm)	017099
All other pre-1991	0.085" (2.16 mm)	014177

\* 1991 Engine S/N 1B0001 and higher

\*\* Selected 1990 Engine S/N listed below

### Selected 1990 Engine Serial Numbers

OW1577	OZ0056	OZ0483	OZ0768
OX0114	OZ0064	OZ0484	OZ0843
OX0115	OZ0089	OZ0485	OZ0848
OX0116	OZ0090	OZ0486	OZ0882
OX0169	OZ0092	OZ0487	OZ0899
OX0170	OZ0093	OZ0488	OZ0900
OX0234	OZ0094	OZ0497	OZ0928
OX0235	OZ0148	OZ0498	OZ0929
OX0258	OZ0163	OZ0553	OZ0930
OX0306	OZ0164	OZ0554	OZ0931
OX0307	OZ0166	OZ0564	OZ0939
OX0334	OZ0167	OZ0579	OZ0940
OX0417	OZ0192	OZ0580	OZ0983
OX0468	OZ0193	OZ0581	OZ0984
OX0481	OZ0194	OZ0582	OZ0985
OX0482	OZ0205	OZ0586	OZ0986
OX0483	OZ0206	OZ0597	OZ0987
OX0512	OZ0207	OZ0604	OZ0989
OX0549	OZ0208	OZ0624	OZ0992
OX0594	OZ0227	OZ0655	OZ0993
OX0595	OZ0228	OZ0663	OZ0995
OX0602	OZ0229	OZ0674	OZ0996
OX0603	OZ0230	OZ0675	OZ0997
OX0604	OZ0231	OZ0690	OZ0998
OX0605	OZ0244	OZ0745	OZ1003
OX0637	OZ0284	OZ0746	OZ1035
OX0638	OZ0286	OZ0747	OZ1036
OX0639	OZ0351	OZ0748	OZ1037
OX0640	OZ0352	OZ0749	OZ1038
OX0646	OZ0353	OZ0750	OZ1039
OX0647	OZ0357	OZ0751	OZ1040
OX0720	OZ0358	OZ0752	OZ1041
OX1134	OZ0359	OZ0753	OZ1043
OX1157	OZ0360	OZ0754	OZ1044
OX1158	OZ0361	OZ0755	OZ1045
OX1159	OZ0391	OZ0756	OZ1046
OX1168	OZ0392	OZ0757	OZ1047
OX1169	OZ0393	OZ0758	OZ1048
OX1273	OZ0405	OZ0759	OZ1049
OX1274	OZ0406	OZ0760	OZ1050
OZ0009	OZ0426	OZ0761	OZ1051
OZ0028	OZ0427	OZ0762	OZ1052
OZ0029	OZ0428	OZ0763	OZ1053
OZ0030	OZ0429	OZ0765	OZ1054
OZ0031	OZ0430	OZ0766	

## Inlet and Exhaust Valve Adjustment

The following procedures for adjusting the inlet and exhaust valves have been taken from the Mack® Service Manual. The installer should be aware that a Mack Service Bulletin may supersede the procedures outlined below. Always use the up-to-date recommended procedures from the Mack Service Manual.

The procedure for setting exhaust and inlet valve lash adjustments is outlined in this section. Inlet valve lash clearance is 0.016" and exhaust is 0.024". Place the specified thickness gage between the rocker arm and yoke (see Fig. 19).



FIG. 19

For the inlet valve adjustment, turn the adjusting screw with a screwdriver until a slight drag is felt on the thickness gage.

After setting the adjustment screw, tighten the locknut to 40 lb.-ft. (55 N•m). After tightening the nut, recheck the lash setting. If it has changed, repeat the entire procedure.

For the exhaust valve adjustment, turn the Jacobs rocker arm adjusting screw using a 10 mm open-end wrench until a slight drag is felt on the 0.024" thickness gage. After setting the adjustment screw, tighten the locknut to 40 lb.-ft. (55 N•m). After tightening the nut, recheck the lash setting. If it has changed, repeat the entire procedure.

### For engines built prior to 1991 and all engines with Allison Automatic Transmissions:

Following the adjustment of the slave piston lash and intake and exhaust valve lashes on cylinder no. 1, bar the engine in normal rotation 120° until the no. 5 piston timing mark (on the compression stroke) is in alignment with the pointer marked "valve". This will place piston no. 5 30° after TDC. Refer to Fig. 17 for location of the timing marks on the vibration damper.

### For 1991 and later engines with manual transmissions, refer to Mack's E7 Engine Manual.

Adjust the slave piston lash and valve lash as previously outlined for cylinder no. 1.

Continue adjusting (in firing order) the slave piston and valve lash for the remaining cylinders, placing each piston 30° after TDC by aligning the pointer marked "valve" with the proper timing mark on the vibration damper.



THIS PROCEDURE MUST BE FOLLOWED TO ESTABLISH PROPER SLAVE PISTON AND VALVE LASH ADJUSTMENT.

## Brake Housing Spacer Installation

If the electrical connector is not installed in the spacer, install the connector using a 7/8" box wrench and tighten to 5 lb.-ft. (7 N•m) (see Fig. 20).

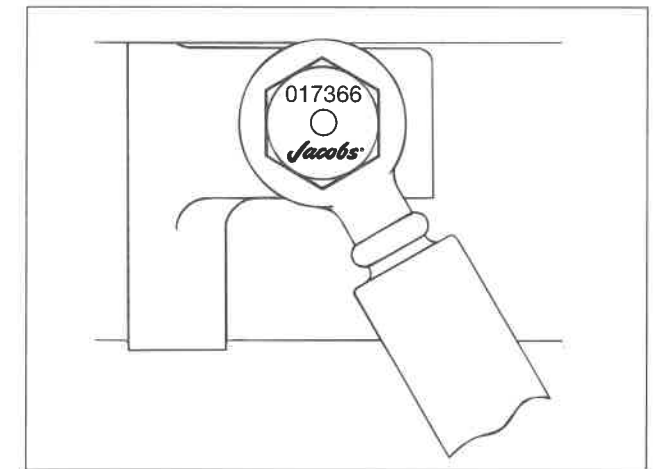


FIG. 20



Clean the top of the cylinder head. Install the Jacobs spacer gasket into the groove (A) in the spacer. Overlap the gasket (more than 1/2" but less than 3/4") and cut (B) to length (see Fig. 21).

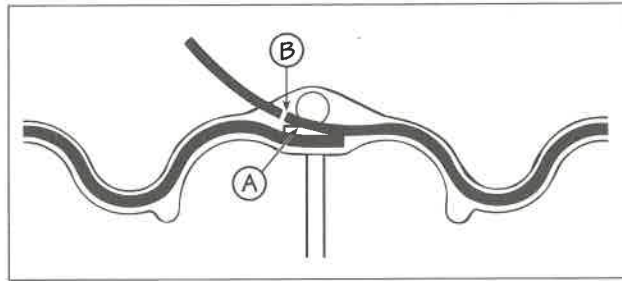


FIG. 21

Place the Jacobs spacer, with the gasket installed, on the cylinder head. Connect the solenoid valve electrical harness to the terminal lead out on the inside of the spacer and to the solenoid.

## Replacement of Valve Covers and Accessories

Place the valve covers on the top of each spacer. Mack valve cover gaskets are reusable. They should be replaced only if damaged. Install six (6) valve cover/spacer hold-down bolts in each cover. Torque the cover bolts to 20 lb.-ft. (27 N•m), beginning with the two center bolts. Replace the cylinder head cover breather. Reconnect the vent tube (3/16 I.D.) from the centrifugal oil filter to the cylinder head cover breather or directly to the cylinder head cover, depending on the truck chassis model. If this vent tube is damaged, then replace it with the tube included in the brake kit.

## Section 4: Electrical System Installation

### For Non V-MAC Engines

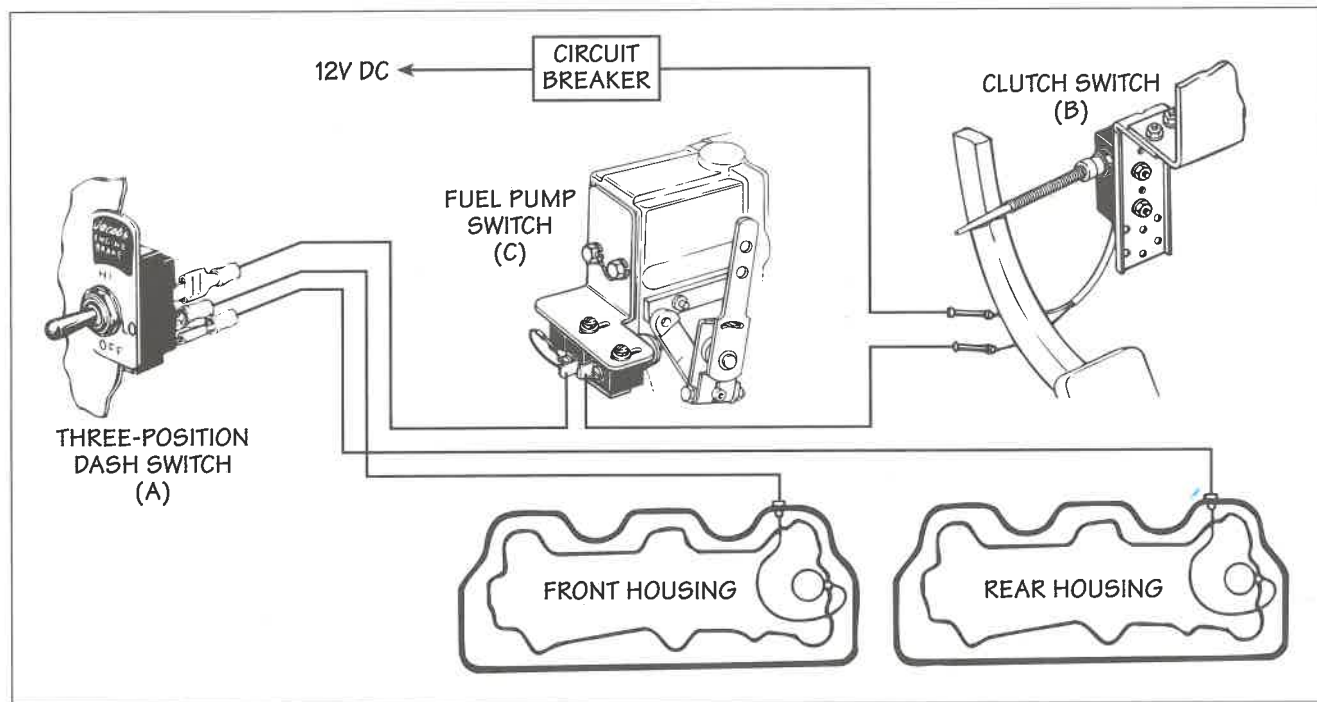


FIG. 22

**NOTE:**

CONTROL SYSTEM COMPONENTS INSTALLED OR SUPPLIED BY MACK MAY DIFFER FROM JACOBS SUPPLIED PARTS. REFER TO PAGE 13 FOR INFORMATION ON THE PRE-WIRING OF VEHICLES.

Refer to fig. 22, page 10 for the following:

### Dash Switch (A)

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 the locations shown in the wiring diagram furnished in the kit.

### Clutch Switch (B)

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 area, 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" (25 - 38 mm), measured at the tip of the actuator, when the clutch pedal is in the up (clutch engaged) position (see Fig. 23).

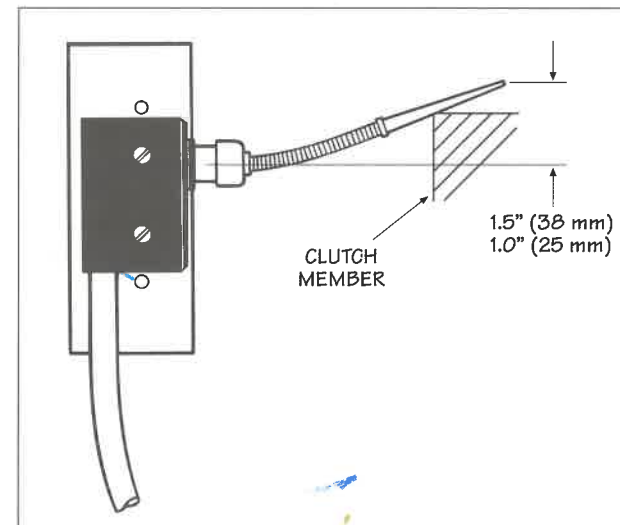


FIG. 23



EXCEEDING 1.5" DEFLECTION OF THE ACTUATOR ARM MAY CAUSE SWITCH DAMAGE RESULTING IN ENGINE BRAKE MALFUNCTION.

4. Check the installation by moving the clutch pedal. The switch should click in the freeplay motion of the clutch pedal before actual clutch disengagement takes place.
5. Cut wires to the proper length and secure them with ties. Connect the wires as shown in Fig. 22.

## Fuel Pump Switch (C)

**NOTES:**

JACOBS FUEL PUMP SWITCH GROUPS FOR THE MODEL 680A ARE AVAILABLE IN SEVERAL CONFIGURATIONS. SEE THE PARTS MANUAL, P/N 018060, FOR ADDITIONAL SWITCH GROUPS.

FUEL PUMP SWITCH CONTACTS ARE PROTECTED AGAINST ARCING BY A SMALL DIODE CONNECTED BETWEEN THE LOAD SIDE SWITCH TERMINAL AND GROUND. THE ENGINE BRAKE MUST BE CONNECTED TO THE LOAD SIDE TERMINAL. IF THE VEHICLE HAS A POSITIVE GROUND ELECTRICAL SYSTEM, REVERSE THE DIRECTION OF THE DIODE (SEE FIG. 24).

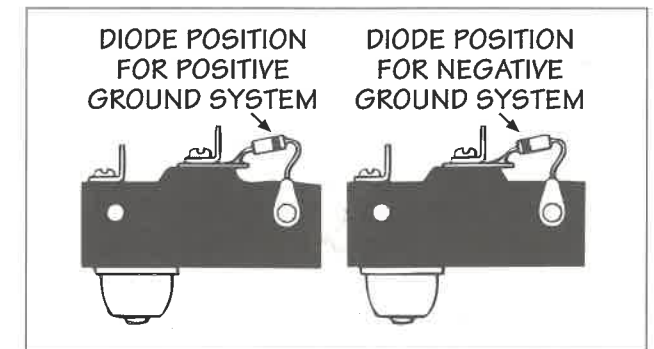


FIG. 24

### For Model 680A (E6 Engine with UTD Fuel Pump)

When used on a Mack engine outfitted with a UTD fuel pump, modify P/N 020605 as shown in the engine control group assembly instructions (P/N 020624). Then, install as follows:

1. Refer to Fig. 25 and remove the two governor screws from the rear of the fuel pump assembly. Install the Jacobs fuel pump switch using the two governor screws. Torque to 100 lb.-in. (11 N•m).

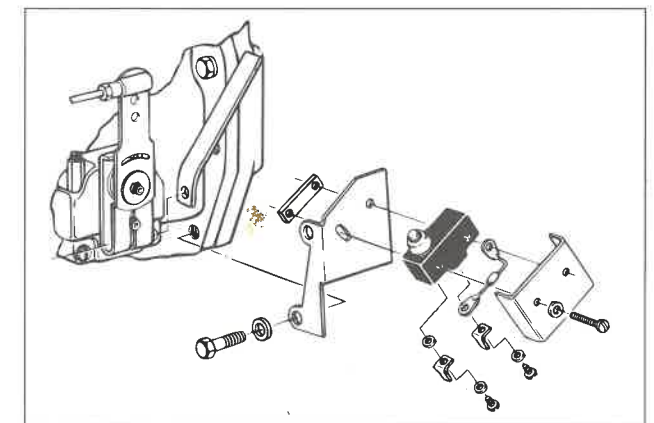


FIG. 25

2. Bolt the Jacobs actuating arm (A) to the fuel pump operating lever as shown. Tighten to 55 lb.-in. (6 N·m).
3. Adjust the switch with the fuel pump operating lever in the idle fuel position. Correct adjustment is made by sliding the switch in the slots on the bracket or by slightly bending the actuating arm until the switch activates when the operating lever moves to the idle fuel position.

**NOTE:**

THE SWITCH SHOULD BE ACTUATED ONLY WHEN THE THROTTLE PEDAL IS NOT DEPRESSED (IDLE FUEL POSITION).

To prevent the Jacobs fuel pump switch actuator arm from interfering with the accelerator spring, the accelerator spring anchor bracket, Jacobs P/N 013863, and a spring extension wire form, Jacobs P/N 013862, are provided. Only engines with the UTD fuel pump require the relocated spring bracket and extension wire.

Remove and discard the anchor bracket originally installed on the vehicle. Replace with the bracket and extension rod as shown in Fig. 26.

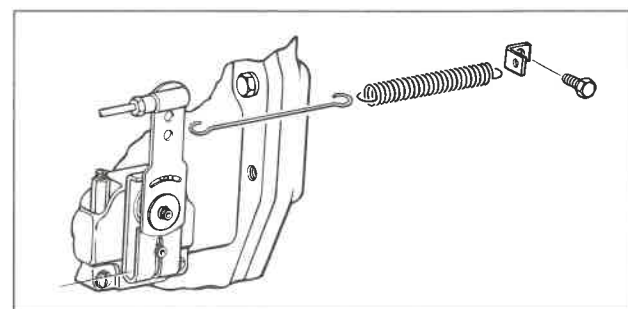


FIG. 26

### For Model 680B (E7 Engine), Non V-MAC

1. Refer to Fig. 27 and remove the two screws, washers and cover plate from the rear of the fuel pump.
2. Attach the switch bracket assembly to the fuel pump with the two screws and lock washers from the engine brake kit.
3. Tighten the screws to 55 lb.-in. (6 N·m).

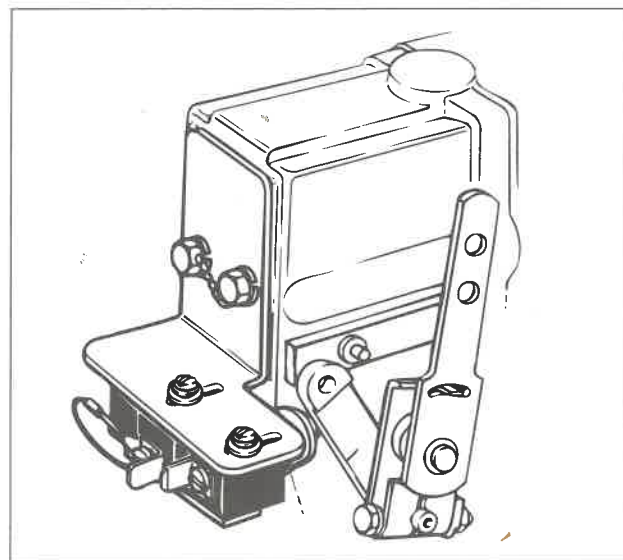


FIG. 27

4. Adjust the switch by holding the throttle actuating lever in the idle fuel position and moving the switch toward the actuating lever until the switch actuates.
5. Hold the switch in this position and tighten the two switch screws.



**WARNING**

AFTER INSTALLING THE ACTUATING ARM, CHECK THE OPERATION OF THE FUEL THROTTLE LEVER TO BE SURE IT MOVES THROUGH ITS FULL OPERATING RANGE. IMPAIRED MOTION OF THE THROTTLE LEVER COULD CAUSE LOSS OF VEHICLE CONTROL.

Complete the wiring. Refer to the wiring diagram in Fig. 22.

Check all wiring. Make sure all wiring has been cut to the 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.

With the engine shut down, check the electrical system by turning on the ignition switch and moving the Jacobs dash switch from OFF to LO to HI. In LO, only one brake housing solenoid valve should activate. In HI, both the front and rear solenoids should activate.

## Control Systems for Non V-MAC® Applications

### Foot Switch

The foot switch (see Fig. 28) is installed on the cab floor within easy reach of the operator's left foot. After installation, light pressure on the top plate is all that is needed to operate the Jake Brake. The throttle switch remains in the system to ensure that fueling and engine braking do not occur at the same time.

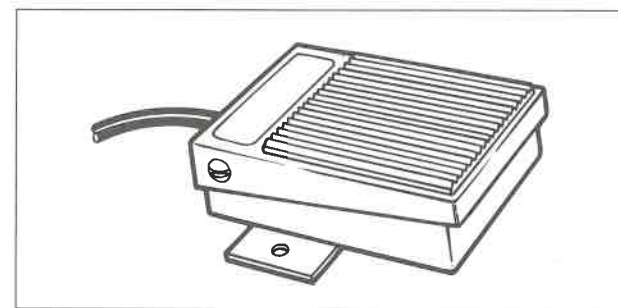


FIG. 28

### Low Engine Speed Retarder Cut-off System

The low engine speed retarder cut-off system (see Fig. 29) is a fully automatic engine brake control system that senses engine speed (RPM) and electrically deactivates the engine brake at speeds below approximately 900 RPM. The low speed cut-off feature provides added drive convenience in frequent stop/start operations. Additionally, the low speed cut-off feature is useful for "slip seat" operations where several drivers may operate one vehicle.

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

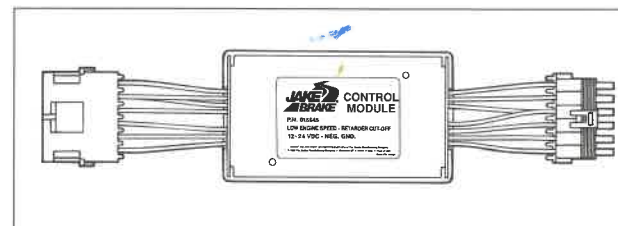


FIG. 29

## Control Systems for E7 V-MAC® Applications

### IMPORTANT!

Vehicles built after the following dates are pre-wired for the Jake Brake:

CH, CL	September, 1992
RD, RB	February, 1993
DM, DMM	April, 1993
MR	May, 1993

To complete the controls installation, insert the appropriate relays, dash switches and engine harness, which are available through your Mack dealer.

An optional Jacobs control system is available for the Mack Electrical Vehicle Management and Control (V-MAC) system built before the dates listed above. The standard engine and cab control systems are not required for V-MAC equipped vehicles. Fuel pump and clutch switches are not required. Wiring for the Jake Brake engine retarder is incorporated in the V-MAC control system. Complete instructions and wiring diagrams are included in the kit.



## Section 5: Engine Brake Operation Check

The Jacobs engine brake installation is now complete. The following procedures should be made.

Bleed the brake units and check their operation. Start the engine and allow it to run for 5 to 10 minutes. Accelerate the engine to approximately 1800 RPM. Release the throttle and then manually depress each solenoid armature (see Fig. 30). Repeat this procedure 5 or 6 times to permit engine oil to fill the brake housing passages completely.



FIG. 30

### WARNING

WEAR EYE PROTECTION AND DO NOT EXPOSE YOUR FACE OVER THE ENGINE AREA. TAKE PRECAUTIONS TO PREVENT OIL LEAKAGE DOWN ONTO THE ENGINE.

WHENEVER ENGINE IS RUNNING AND CYLINDER HEAD COVERS ARE REMOVED, OIL SPLASHING IN THE ENGINE BRAKE AREA COULD CAUSE PERSONAL INJURY.

### CAUTION

DO NOT ATTEMPT TO READJUST THE SLAVE PISTON LASH IN ORDER TO STALL THE ENGINE AT LOW IDLE. ENGINE DAMAGE COULD RESULT.

BE SURE SOLENOID VALVE WIRE HARNESS IS CLEAR OF VALVE COMPONENTS. DO NOT TRAP THE WIRE HARNESS BETWEEN THE ENGINE BRAKE HOUSING AND THE COVER. WIRE WILL SHORT OUT IF INSULATION IS BROKEN. THIS WILL TRIP CIRCUIT BREAKER AND CAUSE ENGINE BRAKE TO NOT OPERATE.

Replace the cylinder head cover (the Mack gasket is reusable). Use the Jacobs cylinder head cover capscrews to hold down the engine brake spacer and the cylinder head cover. Snug up the cylinder head cover center capscrews and then the outer capscrews. Apply a final torque of 20 lb.-ft. (27 N·m) (see Fig. 31). This tightening sequence will help prevent distortion or rupture of the Mack cylinder head cover gasket.

Replace all parts previously removed from the engine and the cab.

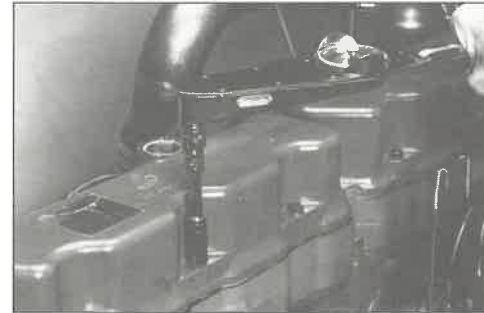


FIG. 31

## MH Air Cleaner Adapter Kit

Install the Jacobs MH Adapter Kit to raise the air cleaner for cover clearance when the engine brake is installed. MH Adapter Kits contain front (A) and rear (B) support brackets, mounting hardware and complete installation instructions required to raise the air cleaner (C) (see Fig. 32).

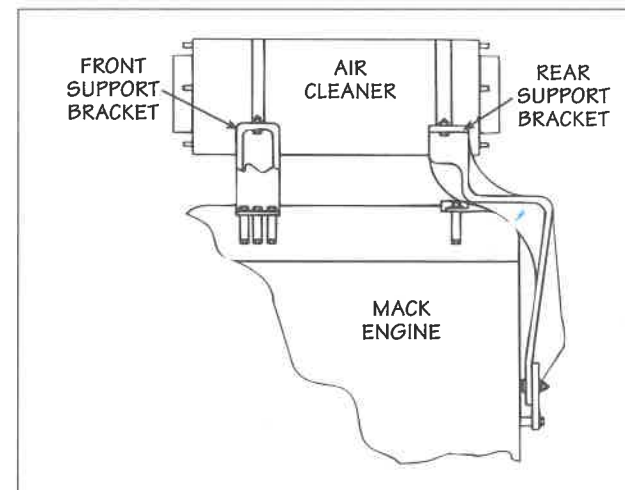


FIG. 32

## Section 6: Engine Brake Maintenance

### Theory of Operation

Refer to the Schematic Drawing below.

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 (A) near the top of the normal compression stroke, releasing the compressed cylinder charge to exhaust.

The blow-down of compressed air to atmosphere prevents the return of energy to the engine piston on the expansion stroke. The effect is a net energy loss, since the work done in compressing the cylinder charge is not returned during the expansion process.

Exhaust blow-down of the braking cylinder is accomplished by utilizing the Injector Rocker Arm (B) motion of that cylinder.

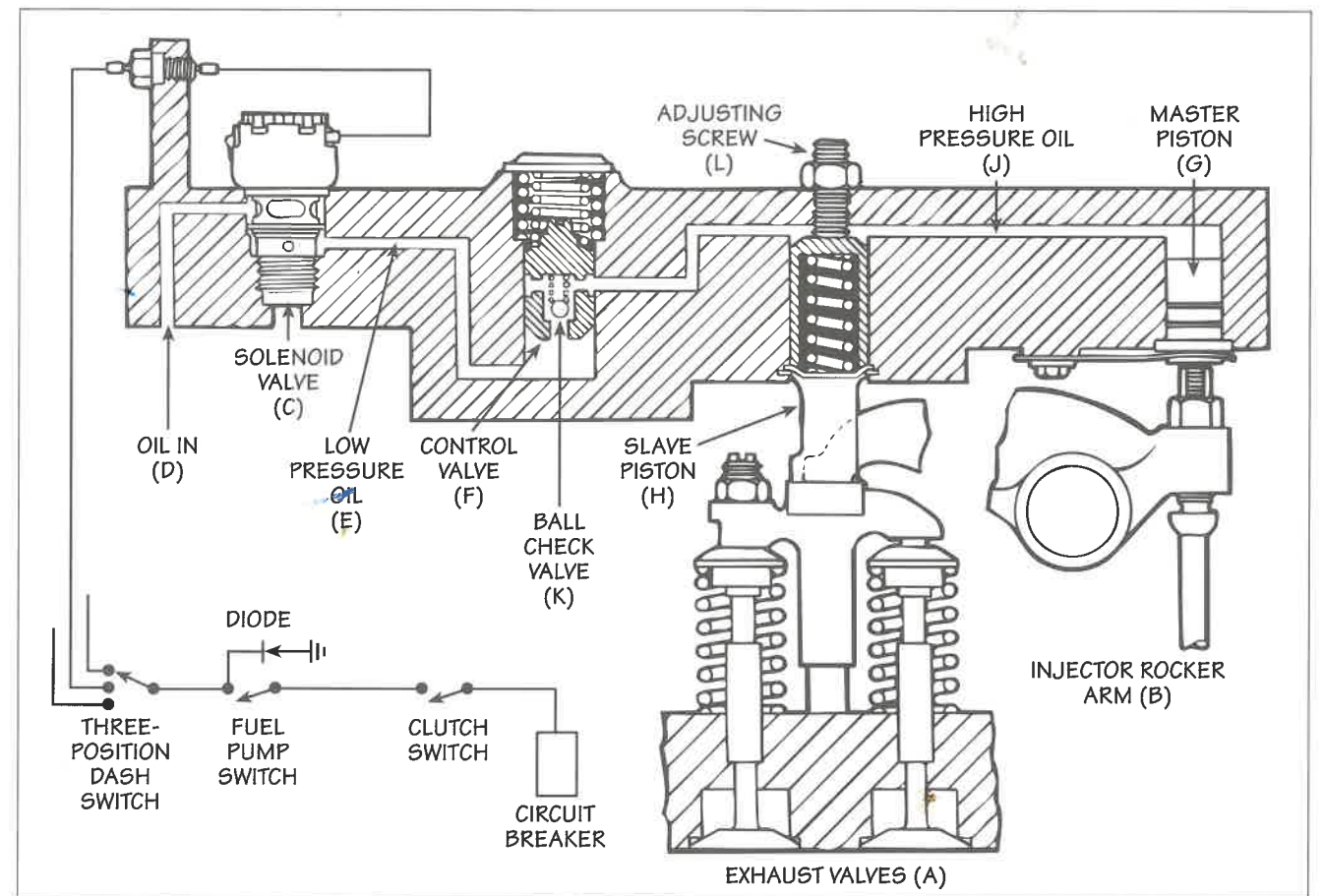
Energizing the Solenoid Valve (C) permits Engine Lube Oil to Flow Under Pressure (D, E) through the Control Valve (F) to both the Master Piston (G) and Slave Piston (H).

Oil pressure causes the Master Piston (G) to move down, coming to rest on the corresponding Injector Rocker Arm (B).

The Injector Rocker Arm moves up (as in normal injector cycle), forcing the Master Piston upward and creating a High Pressure Oil Flow (J) to the Slave Piston of the braking cylinder. The Ball Check Valve (K) in the Control Valve traps high pressure oil in the Master/Slave Piston system.

Under the influence of the high pressure oil flow, the Slave Piston moves down, momentarily opening the Exhaust Valves at a pre-determined amount of slave stroke. The Adjusting Screw (L) uncovers a passageway in the Slave Piston, thus allowing oil to flow back to the underside of the Control Valve, where it is stored for the next cycle. Prior to top dead center position, the Exhaust Valve is forced open, releasing the compressed cylinder air to the exhaust manifold.

Compressed air escapes into the atmosphere, completing a compression braking cycle.



ENGINE BRAKE SCHEMATIC DRAWING



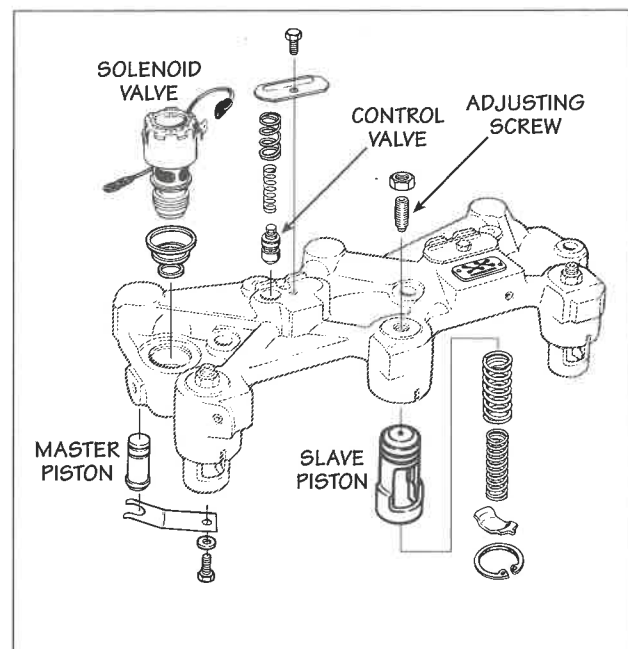


FIG. 33



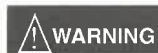
**WARNING**

NEVER REMOVE ANY ENGINE BRAKE COMPONENT WITH ENGINE RUNNING. PERSONAL INJURY MAY RESULT.

The Jacobs Engine Brake is a relatively trouble-free device. However, inspections and routine maintenance are necessary to assure proper operation. 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.

## Solenoid Valve



**WARNING**

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

1. Disconnect solenoid harness. Using a 12-point 7/8" socket and extension, unscrew solenoid valve.
2. Remove and discard the three rubber seal rings. If the lower ring stays in the bottom of the housing solenoid bore, remove with a seal pick.

3. Wash out the solenoid valve with approved cleaning solvent. Use a brush to clean the oil screen. When clean, dry the valve with compressed air.
4. Clean out the solenoid valve bore in the housing. Use clean paper towels. Never use rags as they may leave lint and residue which can plug the oil passageways.
5. Using new solenoid seal rings, coat them with clean lube oil. Install the upper (A) and center (B) seal rings on the solenoid body and the lower (C) seal ring into the bottom of the solenoid bore in the housing (see Fig. 34).

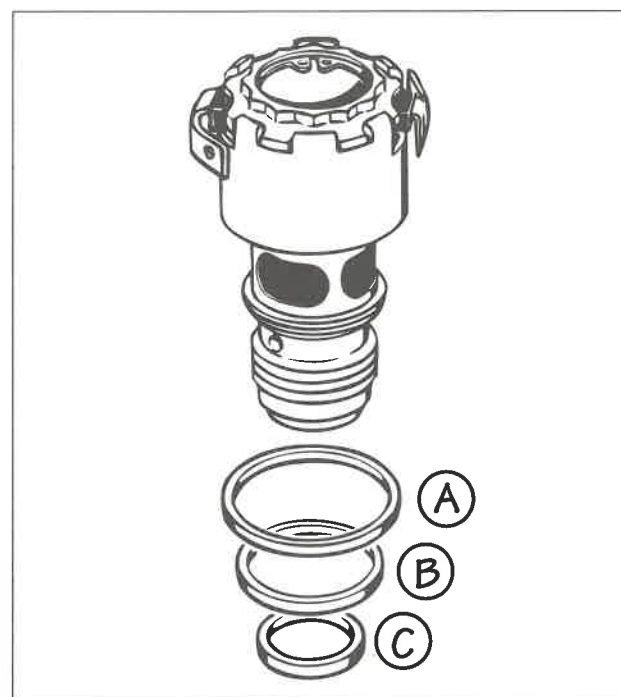


FIG. 34

6. Be sure the seals are seated properly and carefully screw the solenoid into the housing without unseating the seals. Torque the valve to 9 lb.-ft. (12 N•m). Be careful not to twist the seals while installing.

## Control Valve



**WARNING**

REMOVE CONTROL VALVE COVERS CAREFULLY TO AVOID PERSONAL INJURY. CONTROL VALVE COVERS ARE UNDER LOAD FROM THE CONTROL VALVE SPRINGS.

1. Apply pressure on the control valve cover and remove the hex head capscrew.

2. Slowly remove cover until spring pressure ceases (see Fig. 35), then remove the two control valve springs.



FIG. 35

3. Using needle-nose pliers, reach into the bore and grasp the stem of the control valve. Remove the control valve (see Fig. 36).



FIG. 36

4. Wash the control valves with approved cleaning solvent. Push a wire into 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.
5. Thoroughly clean the control valve bore in the housing using clean paper towels.
6. Dip the control valves in clean lube oil and replace each valve in its bore. If binding occurs, the control valve should be replaced.
7. Reassemble parts, reversing the removal procedure. Tighten the hex head capscrew to 7 lb.-ft. (10 N•m).

## Master Piston

1. Remove the capscrew, washer, spring and master piston from the brake housing (see Fig. 37).



FIG. 37

NOTE:

IF THE HARD FACING IS DAMAGED, INSPECT THE CORRESPONDING ROCKER ARM ADJUSTING SCREWS FOR EXCESSIVE WEAR OR PITTING. REPLACE IF DAMAGED.

2. If binding occurs, check for damage to the master piston or bore. Replace as needed. Clean in an approved solvent. Inspect the hard face surface. Pitted, chipped, cracked or galled pistons should be replaced.
3. Reassemble in reverse order. When tightening the capscrew, make certain the two spring tabs do not interfere with the sides of the master piston center raised portion (see Fig. 38).

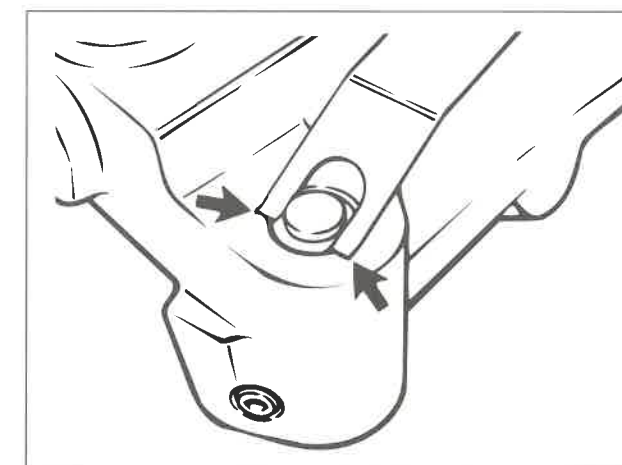
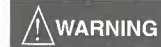


FIG. 38

# Slave Piston



**WARNING**

WEAR SAFETY GLASSES.

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 SPRINGS WILL BE DISCHARGED WITH ENOUGH FORCE TO CAUSE PERSONAL INJURY.

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

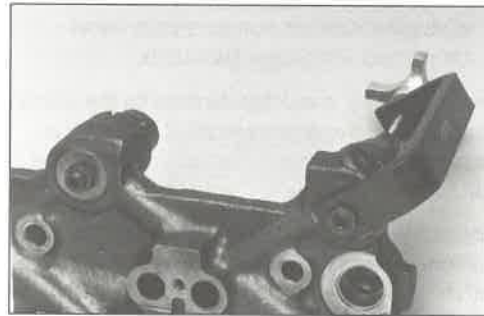


FIG. 39

3. While holding the fixture in position, screw the holder down over the slave piston until the spring retainer is contacted.
4. Turn the handle slowly until the retainer is depressed to about 1/32" (1 mm), relieving pressure against the retaining ring.

5. Remove the retaining ring using retaining ring pliers (see Fig. 40). Back out the holder until the springs are loose. Remove the fixture.

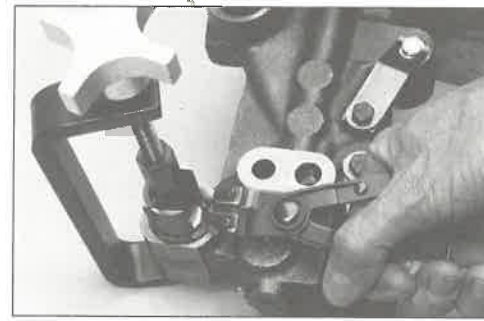


FIG. 40

6. Remove all components, ensuring there is no binding or burrs (see Fig. 41). Clean in an approved cleaning solvent. Inspect parts and replace as necessary.

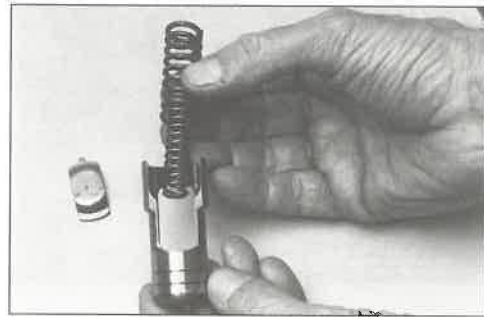


FIG. 41

**NOTES:**

BE SURE COMPONENTS ARE REASSEMBLED IN PROPER ORDER.

THE RETAINER MUST BE INSTALLED WITH THE KEY THROUGH THE SLOT IN THE SLAVE PISTON. INSTALL THE SLAVE PISTON WITH THE OPEN AREA TOWARD THE CENTER OF THE HOUSING. THE OPEN AREA OF THE SLAVE PISTON IS FOR ROCKER ARM CLEARANCE (SEE FIG. 42).



FIG. 42

7. Use the clamp fixture to reinstall the piston and springs. Be sure the retaining rings are placed on the retainer before screwing the clamp-holder down.
8. Compress the slave piston springs down until the retainer is about 1/32" (1 mm) below the retaining ring groove. Reinstall the retaining ring. Be sure the retaining ring is fully seated in the groove.
9. Rotate the retaining ring ears 90° counterclockwise from the large rocker arm clearance gap (A) in the housing (see Fig. 43).
10. Remove the clamp fixture slowly to ensure proper seating of retaining ring.

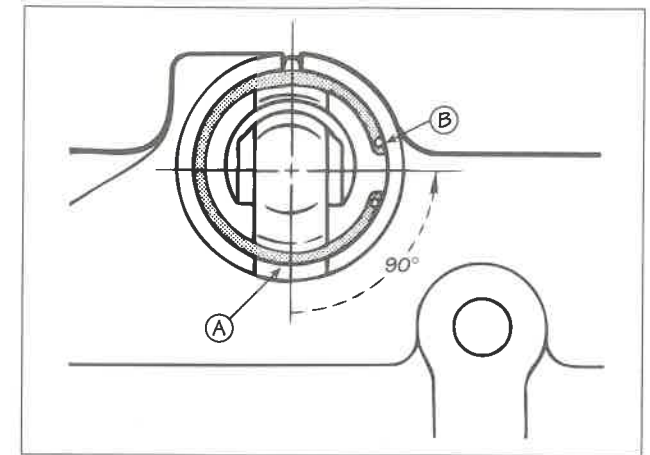


FIG. 43



**CAUTION**

MAKE SURE THE RETAINING RING IS POSITIONED AS SHOWN IN B, FIG. 43. FAILURE TO DO SO MAY RESULT IN ENGINE AND ENGINE BRAKE DAMAGE.



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