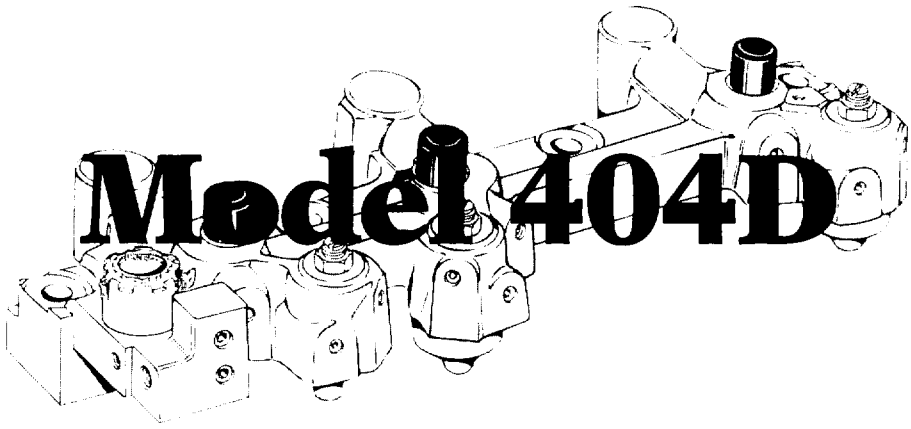
JAKE BRAKE®

Model 404D



INSTALLATION

The Model 404D Jake Brake® engine retarder is designed and approved for use on all Cummins automotive '91 and later L10 engines with either CELECT™ or STC injection timing control. Refer to Jacobs Form No. 3218 for additional application information. 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.

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Safety Precautions

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

⚠ WARNING

THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.

⚠ CAUTION

THIS SYMBOL REFERS TO POSSIBLE EQUIPMENT DAMAGE.

NOTE:

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

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

⚠ WARNING

SEE JACOBS® DRIVER'S MANUAL FOR PROPER ENGINE BRAKE DRIVER TECHNIQUES.

THE JAKE BRAKE® RETARDER IS A VEHICLE SLOWING DEVICE, NOT A VEHICLE STOPPING DEVICE. IT IS NOT A SUBSTITUTE FOR THE SERVICE BRAKING SYSTEM. THE VEHICLE'S SERVICE BRAKES MUST BE USED TO BRING THE VEHICLE TO A COMPLETE STOP.

CELECT™ is a trademark of Cummins Engine Co.

Section 1: Introduction

Housing Identification

Referring to Fig. 1, a nameplate (A) attached to the top surface of the housing identifies the model number, part number, front or rear housing and slave piston lash setting. The housing serial number (B) is stamped on the top surface of the center master piston boss.

For housing part number and other replacement part information, refer to the Parts Manual, P/N 017479.

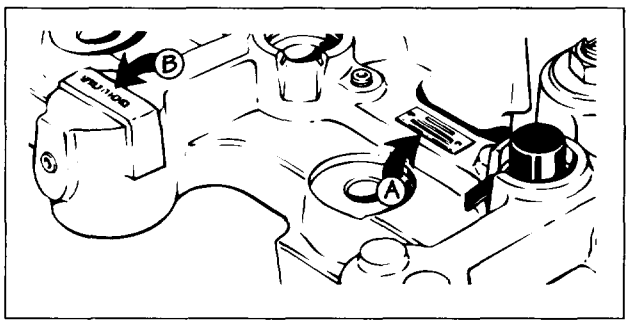


FIG. 1

Engine Identification

Prior to engine brake installation, verify that the engine is an L10 CELECT or STC. The engine identification is on the serial number plate located on the fuel pump side below the rocker cover.

Special Tools

The following special tools should be available for the installation.

Cummins Tools	Part Number
Injector Adjusting Screw "C" Wrench 3/4" (CELECT)	3823756
Injector Adjusting Tool Torque Wrench	3376592
STC Tappet Tool	3622648
Crowfoot	3823820
Cummins L10 Maintenance Manual	

Jacobs Tools	Part Number
Slave Piston Feeler Gage (0.015")	014341
Slave Piston Removal Tool	017397

Torque Values

Rocker lever adjusting screw locknuts	45 lb.-ft. (61 N•m)
Engine brake hold-down cap screws	95 lb.-ft. (130 N•m)
Slave piston adjusting screw locknuts	25 lb.-ft. (34 N•m)
"O" ring adapter nut	15 lb.-ft. (20 N•m)
Cap screws, Jacobs spacer	15 lb.-ft. (20 N•m)

NOTE:

UNLESS OTHERWISE SPECIFIED, THE TORQUE VALUES LISTED HERE AND IN THE TEXT ARE DIRECT VALUES USING NO TORQUE WRENCH ADAPTERS OR EXTENSIONS. WHEN ADAPTERS OR EXTENSIONS ARE USED WITH A TORQUE WRENCH, THE TORQUE VALUES MUST BE ADJUSTED FOR THE SPECIFIC TOOLS BEING USED. FOLLOW THE MANUFACTURER'S RECOMMENDED PROCEDURES FOR THE TORQUE WRENCH AND ADAPTER BEING USED.

Automatic Transmissions

⚠CAUTION

PRIOR TO INSTALLATION OF THE ENGINE BRAKE ON VEHICLES WITH AUTOMATIC TRANSMISSIONS, JACOBS RECOMMENDS THAT THE TRANSMISSION MANUFACTURER'S REPRESENTATIVE (DEALER) BE CONSULTED TO BE SURE OF THE COMPATIBILITY OF THE ENGINE BRAKE WITH THE SPECIFIC AUTOMATIC TRANSMISSION BEING USED.

Section 2: Engine Preparation

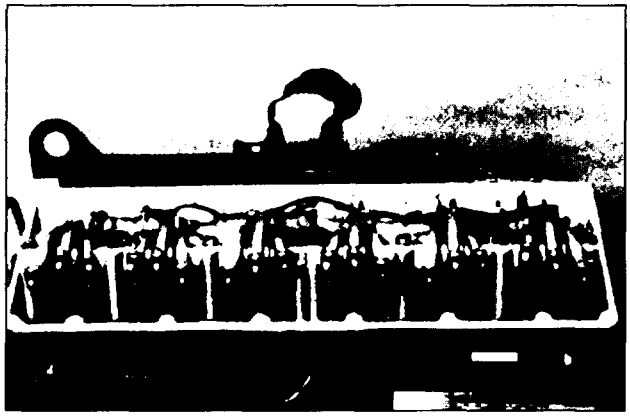


FIG. 2

Clean engine thoroughly. Remove valve cover and gasket. Retain all parts.

Valve and Injector Set Position

Before loosening the rocker arm adjusting screws, prepare the engine as follows for valve and injector adjustments to be made later.

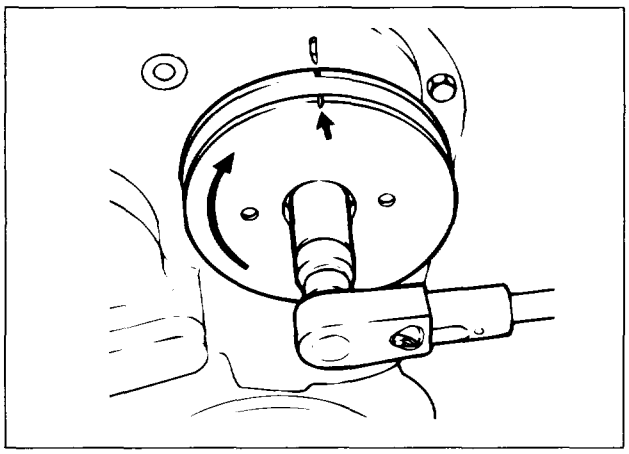


FIG. 3

Rotate the crankshaft by turning the accessory drive shaft in the direction of rotation (clockwise). Align the "A" valve set mark on the accessory drive pulley with the pointer on the gear cover. Check the intake and exhaust valves of cylinder No. 5 (STC engines) or cylinder No. 1 (CELECT engines). The valves must be closed (crossheads loose) to make adjustments. If the valves are not closed, rotate the engine one complete revolution. The engine is now ready for valve and injector adjustments that will be made later.

FIG. 4

Loosen the locknuts and adjusting screws on all the injector and valve rocker levers.

Exhaust Valve Crosshead Replacement

NOTE:

ALL 91 AND LATER L10 ENGINES USE GUIDELESS CROSSHEADS. EARLY ENGINES WITH GUIDED CROSSHEADS CAN USE JACOBS GUIDELESS CROSSHEADS.

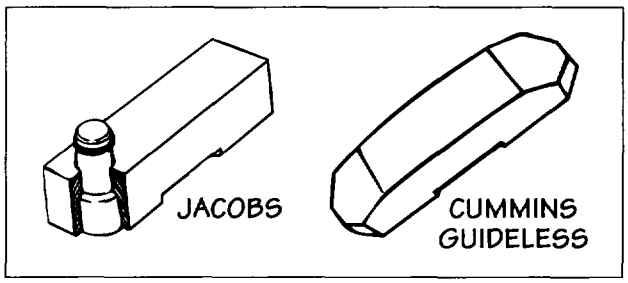


FIG. 5

Remove the eight (8) rocker shaft hold-down bolts and washers.

FIG. 6

The rocker lever for the exhaust valve crosshead is the longest of the three rocker levers in each cylinder.

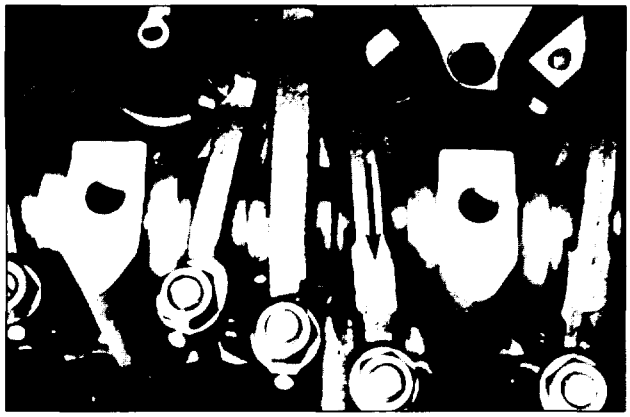


FIG. 7

Remove the rocker shaft assemblies and all push rods. Remove the Cummins guideless **exhaust** valve crosshead from each cylinder.

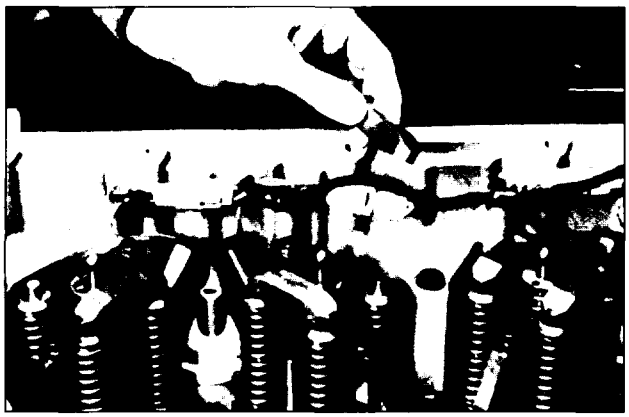


FIG. 8

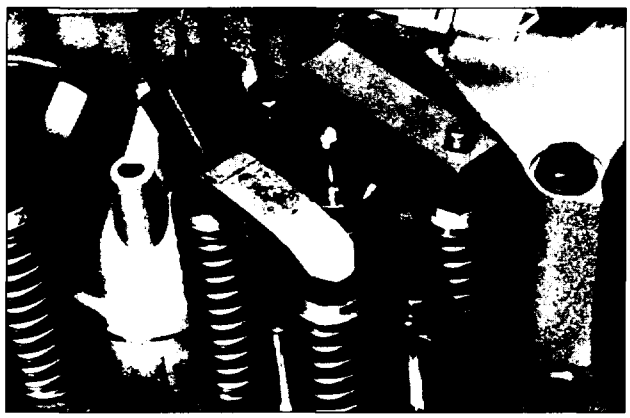


FIG. 9

⚠CAUTION

DO NOT DISASSEMBLE THE ACTUATOR PIN FROM THE JACOBS CROSSHEAD. THE ASSEMBLY IS NOT SERVICEABLE IN THE FIELD.

Lubricate the actuator pins and valve stems with clean lube oil and install the Jacobs crossheads over the exhaust valves. Locate the actuator pins on the exhaust valves closest to the push rod side of the engine.

The crosshead should move freely from side to side, pivoting on the side without the actuator pin. No leveling adjustment is required with guideless crossheads.

Injector Rocker Lever Adjusting Screws

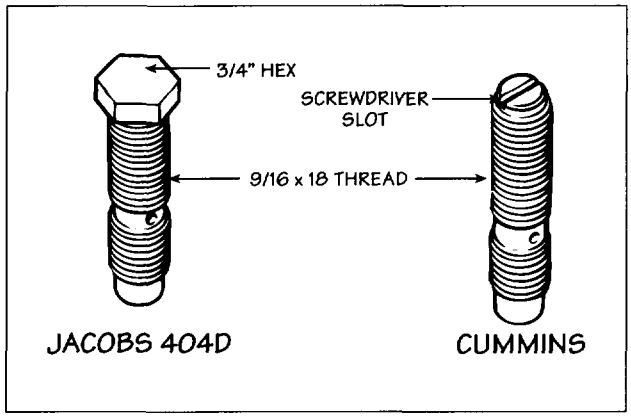


FIG. 10

Install the Jacobs injector rocker lever adjusting screws and **Jacobs** jam nuts in the injector rocker levers.

NOTE:

USE THE CUMMINS JAM NUT ONLY IF IT IS ABOUT 0.344" THICK. THE THICKER LOCKNUT USED ON EARLY PRODUCTION ENGINES WILL NOT PERMIT ENOUGH TRAVEL TO ADJUST THE INJECTORS. USE JACOBS JAM NUT, P/N 017134, IF THE CUMMINS JAM NUT IS THICKER THAN 0.344".

Spacer Installation

Install two (2) electrical lead-out assemblies into the spacer and torque to 10 lb.-ft. (14 N•m).

FIG. 11

Install the bulkhead fitting with seal into the hole in the spacer (see Fig. 12). The seal must be located on the outside of the spacer. Install the nut and torque to 20 lb.-ft. (27 N•m).

FIG. 12

Clean the rocker housing surface and install the Jacobs gasket. Install the spacer and cap screws.

Starting from the center and proceeding outward on both sides, torque the cap screws 15 lb.-ft. (20 N•m) following the sequence shown in Fig. 13.

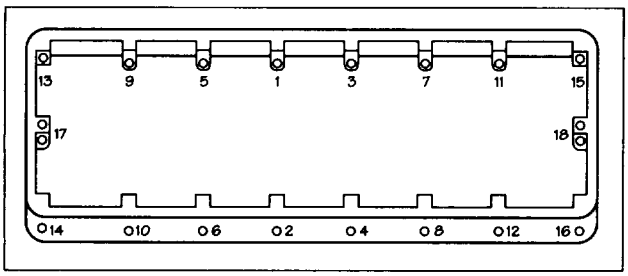


FIG. 13

WARNING

WEAR SAFETY GLASSES. PERSONAL INJURY CAN RESULT IF EYE PROTECTION IS NOT WORN WHILE BLOWING THE OIL FROM THE ROCKER SHAFT BOLT HOLES.

Using an air gun with an extension, blow out the oil from the rocker shaft bolt holes. This is done to prevent the cylinder head from cracking.

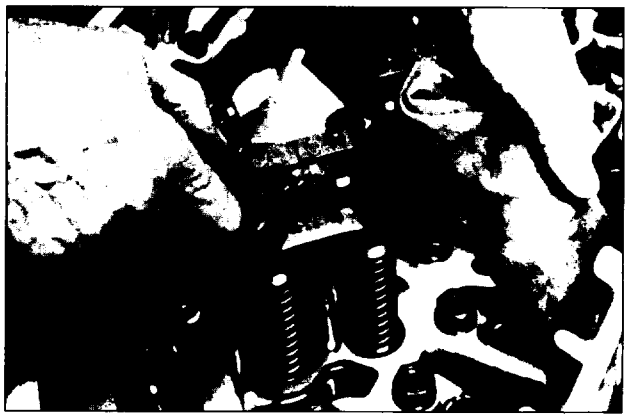


FIG. 14

Set the rocker shaft assemblies in place on the cylinder head. Do not install hold-down bolts or push rods at this time.

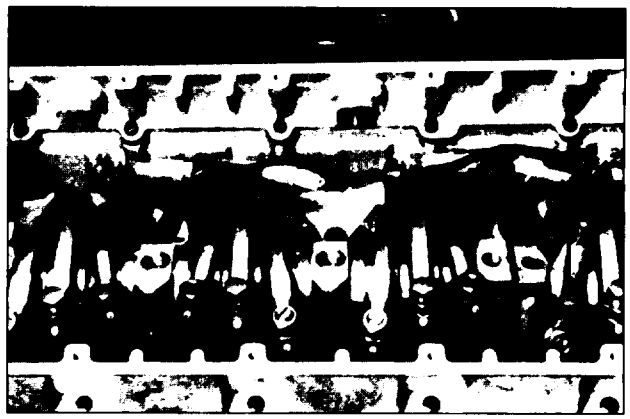


FIG. 15

Section 3: Brake Housing Installation

Oil Supply Tube

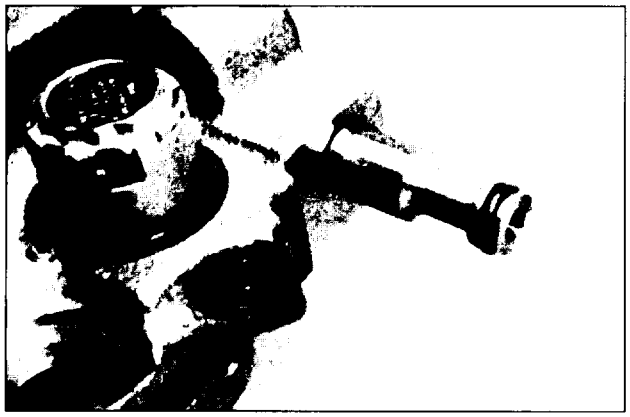


FIG. 16

Lubricate the "O" rings on the oil supply tube and install into the oil supply hole in the rear housing. Push the tube all the way in.

Oil Supply Fitting

Install the straight adapter into the front housing in the location shown in Fig. 17. Tighten to 150 lb.-in. (17 N•m).

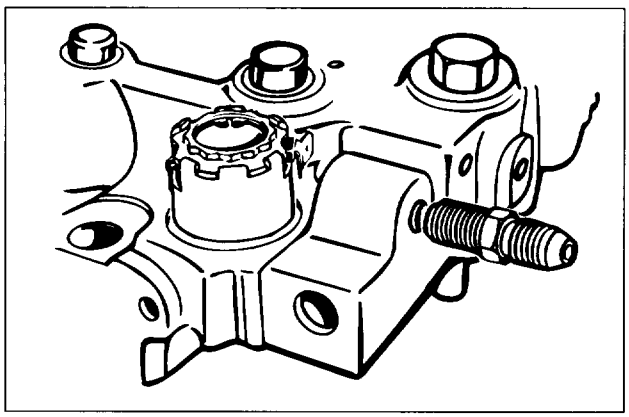


FIG. 17

Make sure the slave piston adjusting screws on both housings are backed out so that all the slave pistons are fully retracted (screws are loose) (see Fig. 18).

Place the rear brake housing on the rocker shaft supports for cylinders 4, 5 and 6. Install the front housing so that the oil supply tube fits into the oil supply hole of the front housing (see Fig. 19).

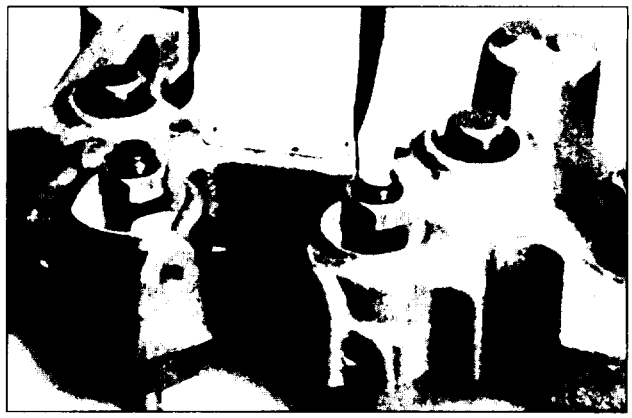


FIG. 18

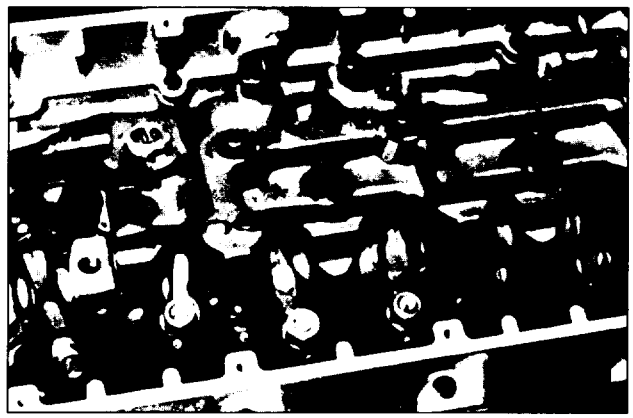


FIG. 19

Lubricate the threads and underside of the Jacobs hold-down cap screws with clean lube oil. Install the cap screws in the eight (8) locations but do not tighten.

NOTE:

NO WASHERS ARE USED WITH THE JACOBS CAP SCREWS.

Center the oil jumper tube between the housings.

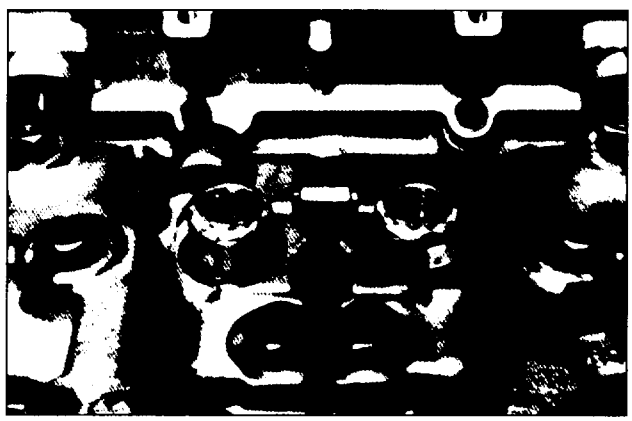


FIG. 20

Push-tube Installation (Special)

Application: 92L10 Fixed-time Industrial Engines

The 92L10 Fixed-time Industrial Engine does not leave enough clearance for the normal method of push tube installation. For these engine configurations, put the push tube in place prior to the brake housing and rocker lever alignment process before the brake housing is to be torqued down. This is done by "rocking" the brake housings and rocker levers upward to gain clearance for the installation of the push tubes. Continue with the standard brake housing and rocker lever alignment procedures. Remember that the push tubes are already installed, so make sure that all rocker lever adjusting screws are backed off to allow the push tubes to be loose during the torquing process to ensure full seating of brake housings and rocker shaft supports.

Brake Housing and Rocker Lever Alignment

The support numbers referred to in Fig. 21 begin with number 1 at the front of the engine.

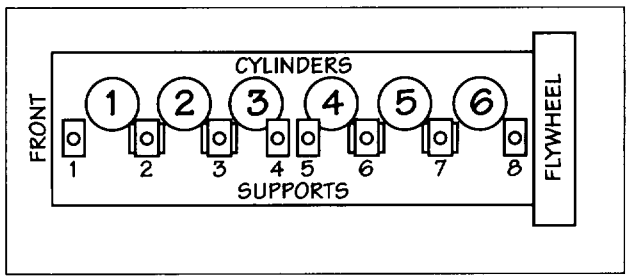


FIG. 21

Slide the number 5 support as far forward as possible.

Align the rear brake housing so that the slave pistons are over the Jacobs actuating pins in the exhaust crossheads on all three cylinders (4, 5 and 6).

All three Jacobs actuating pins should remain completely under the slave pistons (see Fig. 22). If required, tap the housings gently with a soft mallet to obtain proper alignment. Be sure that the No. 5 support remains in the most forward position.

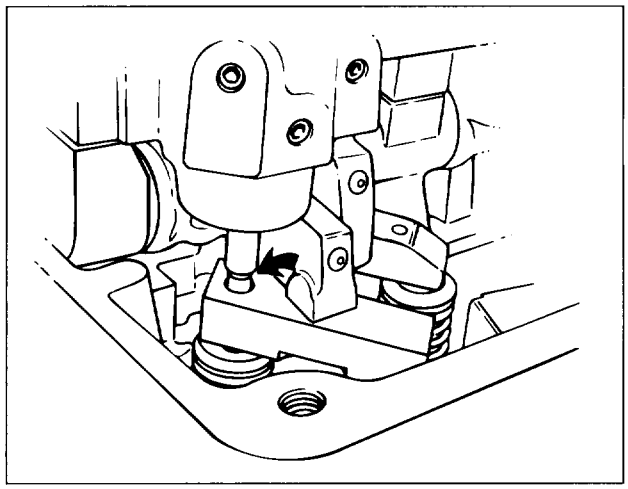


FIG. 22

NOTE:

THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED AS OUTLINED BELOW. PROPER SEQUENCING IS IMPORTANT TO ENSURE CORRECT ENGINE AND ENGINE BRAKE OPERATION.

1. Tighten No. 5 rocker lever support mounting cap screw to 60 lb.-in. (7 N•m) torque. Put a 0.022" (0.55 mm) feeler gage beside the No. 5 support and the rocker lever on No. 4 cylinder. Set the side clearance.

FIG. 23

2. With the feeler gage in position, slide the No. 6 support as far forward as possible. Tighten to 60 lb.-in. (7 N•m) torque. Put a 0.022" (0.55 mm) feeler gage between the No. 6 support and the rocker lever on No. 5 cylinder. Set the side clearance.
3. With the feeler gage in position, slide the No. 7 support as far forward as possible. Tighten to 60 lb.-in. (7 N•m) torque. Put a 0.022" (0.55 mm) feeler gage between the No. 7 support and the rocker lever on No. 6 cylinder. Set the side clearance.

4. With the feeler gage in position, slide the No. 8 support as far forward as possible. Tighten to 60 lb.-in. (7 N•m) torque.
5. Recheck the rear brake housing slave piston to exhaust crosshead actuating pin alignment.
6. Slide the No. 4 support as far back as possible.
7. Check the front brake housing alignment as previously outlined for the rear brake housing. After the brake housing is properly aligned, tighten the No. 4 mounting cap screws to 60 lb.-in. (7 N•m) torque.

   Put a 0.022" (0.55 mm) feeler gage between the No. 4 support and the rocker lever on No. 3 cylinder. Set the side clearance.
8. With the feeler gage in position, slide the No. 3 support as far back as possible. Tighten to 60 lb.-in. (7 N•m) torque.

   Put a 0.022" (0.55 mm) feeler gage between the No. 3 support and the rocker lever on No. 2 cylinder. Set the side clearance.
9. With the feeler gage in position, slide the No. 2 support as far back as possible. Tighten to 60 lb.-in. (7 N•m) torque.

   Put a 0.022" (0.55 mm) feeler gage between the No. 2 support and the rocker lever on No. 1 cylinder. Set the side clearance.
10. With the feeler gage in position, slide the No. 1 support as far back as possible. Tighten to 60 lb.-in. (7 N•m) torque.
11. Recheck all side clearances to be sure they are within 0.020" - 0.025" (0.51 - 0.64 mm)
12. Recheck the front brake housing slave piston to crosshead actuating pin alignment.

Complete the tightening of the housing hold-down cap screws on each housing in two steps, following the sequence in Fig. 24.

1. 45 lb.-ft. (60 N•m)
2. 95 lb.-ft. (130 N•m)
3. 45 lb.-ft. (60 N•m)
4. 95 lb.-ft. (130 N•m)

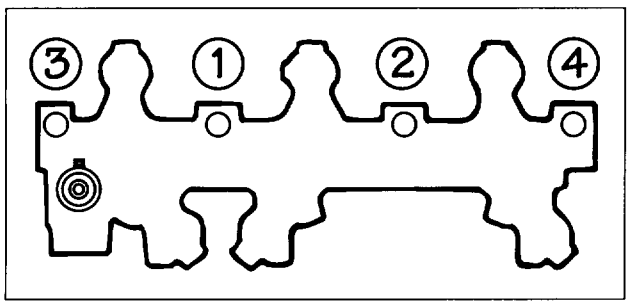


FIG. 24

Slave Piston Adjustment

⚠CAUTION

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

Slave piston adjustment is done before the replacement of the push rods to permit adjustment of all six cylinders without rotating the engine.

Slave Piston Lash Settings

Model	Engine	Setting
404D	L10 STC	0.015"
404D	L10 CELECT	0.015"

The slave piston lash setting is printed on the housing name plate.

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 closed.

Insert the 0.015" Jacobs feeler gage between the slave piston and the actuating pin in the crosshead. Turn the slave piston adjusting screw until a light drag on the feeler gage can be felt.

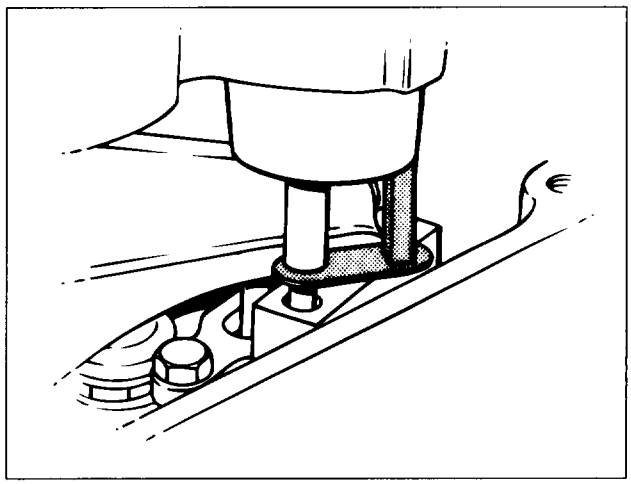


FIG. 25

Hold the screw in position with a screwdriver. Torque the locknut to 25 lb.-ft. (34 N•m).

⚠CAUTION

OVER TORQUING THE LOCKNUT COULD SEIZE RESET MECHANISM IN THE SLAVE PISTON ADJUSTING SCREW. THIS WILL RESULT IN POOR ENGINE BRAKE PERFORMANCE.

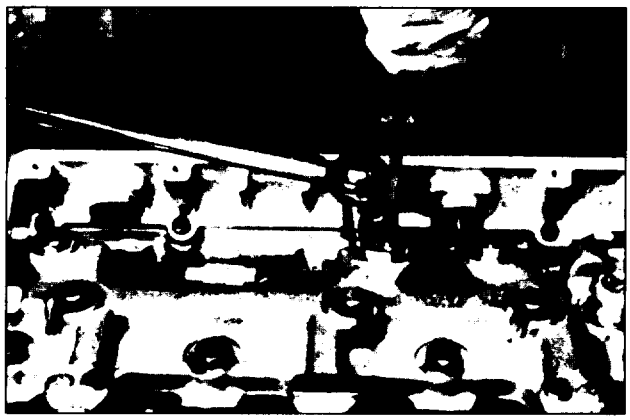


FIG. 26

NOTE:

AFTER TORQUING THE SLAVE PISTON ADJUSTING SCREW LOCKNUT, CHECK THE CLEARANCE WITH THE JACOBS FEELER GAGE. READJUST IF NECESSARY.

Replace the push rods under the rocker levers.

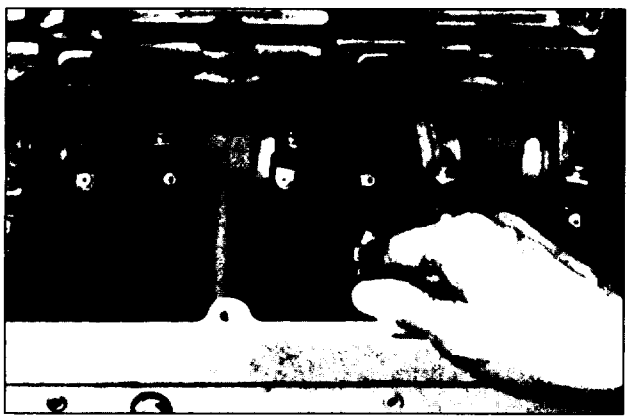


FIG. 27

NOTES:

THE INJECTORS ARE OPERATED BY PUSH **RODS** THAT ARE LARGER IN DIAMETER THAN THE VALVE PUSH **RODS**.

PUSH RODS WILL NOT FIT UNDER ROCKER LEVERS OF SOME CYLINDERS. IT MAY BE MORE CONVENIENT TO INSTALL THE PUSH RODS UNDER THE ROCKER LEVERS OF THE CYLINDERS TO BE ADJUSTED FOLLOWING THE VALVE AND INJECTOR ADJUSTMENT SEQUENCE. THIS WILL ALSO HELP IDENTIFY THE CYLINDERS THAT HAVE BEEN ADJUSTED.

Engine Overhead Adjustments

NOTE:

OVERHEAD ADJUSTMENTS MUST BE MADE WHEN THE ENGINE IS COLD (STABILIZED COOLANT TEMPERATURE 140° F., 60° C., OR BELOW).

Adjust the injectors and valves following the sequence in Chart 1 or Chart 2.

Exhaust and Intake Valve Adjustment

Place a 0.014" (0.36 mm) feeler gage between the rocker lever and the crosshead of the intake valve. Tighten the adjusting screw until a light drag can be felt on the feeler gage. Hold the adjusting screw and tighten the locknut to 45 lb.-ft. (61 N•m).

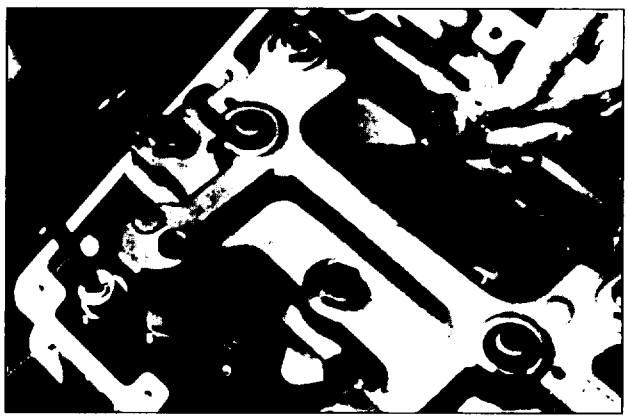


FIG. 28

Adjust the exhaust valves using the same procedure as with the intake valves using a 0.027 in. (0.69 mm) feeler gage. Tighten the locknut to 45 lb.-ft. (61 N•m).

NOTE:

THE STC INJECTOR ADJUSTING TOOL (TORQUE WRENCH) MAY BE USED TO ADJUST THE VALVE SETTINGS ON BOTH STC AND CELECT ENGINES. WITH THE PROPER FEELER GAGE INSERTED, SET THE PRE-LOAD ON THE VALVE ADJUSTING SCREW. THIS WILL ELIMINATE THE NEED TO "FEEL" THE DRAG ON THE FEELER GAGE. AFTER APPLYING THE PRE-LOAD, HOLD THE ADJUSTING SCREW AND TIGHTEN THE LOCKNUT.

L10 STC Injector Adjustment

Bar Engine Direction of Rotation	Pulley Position	Set Valves Cylinder No.	Set Injector Cylinder No.
Start	A	5	3
Advance to	B	3	6
Advance to	C	6	2
Advance to	A	2	4
Advance to	B	4	1
Advance to	C	1	5
Firing Order: 1 - 5 - 3 - 6 - 2 - 4			

CHART 1

1. Tighten the injector rocker adjusting screw until all the clearance is removed from the injector train.

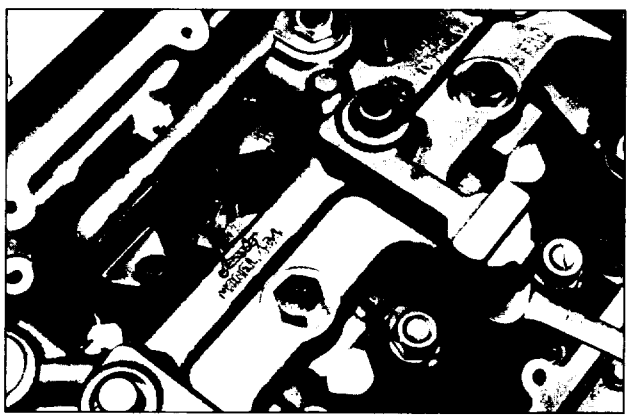


FIG. 29

2. Tighten the screw one additional turn to correctly seat link.
3. Loosen the injector adjusting screw until the STC tappet touches the top cap of the injector.

NOTE:

BE SURE TO LOOSEN THE ADJUSTING SCREW ENOUGH SO THERE IS NO PRE-LOAD ON THE INJECTOR. THIS WILL BE ACCOMPLISHED WHEN THE ROCKER LEVER IS LOOSE ENOUGH TO MOVE.

4. Place the STC tappet tool on the upper surface of the STC injector top-cap. Fit the tool's location pin into one of the four holes in the top of the tappet.

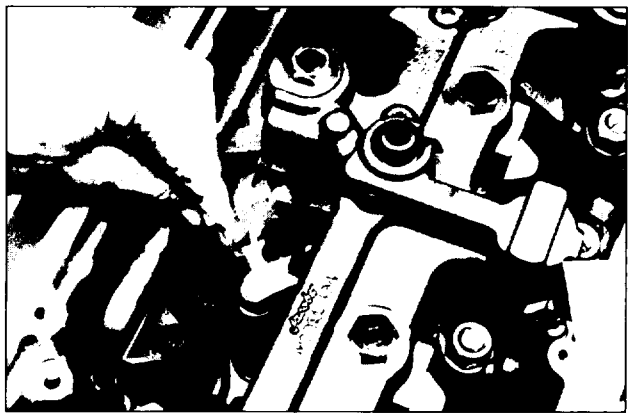


FIG. 30

5. Apply pressure to the tool handle to hold the tappet in the maximum upward position.

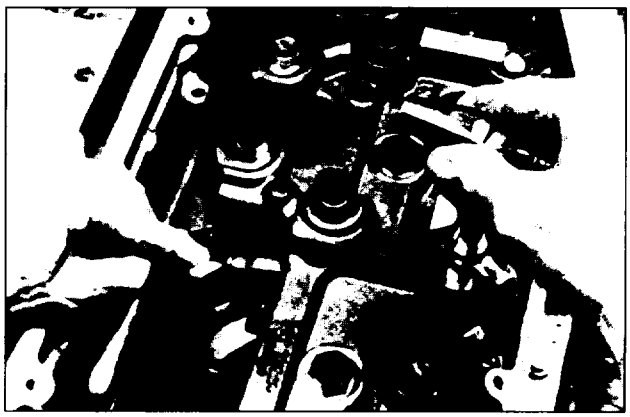


FIG. 31

6. Torque the adjusting screw to 5 - 6 lb.-in. with a Cummins torque wrench and a "C" wrench.
7. Torque the locknut to 45 lb.-ft. (61 N•m).

⚠CAUTION

THE TAPPET TOOL MUST BE REMOVED BEFORE ROTATING THE CRANKSHAFT TO PREVENT DAMAGE TO THE TAPPET.

8. Remove the tappet tool.
9. Continue adjustments according to sequence in Chart 1.

L10 CELECT Injector Adjustment

Bar Engine Direction of Rotation	Pulley Position	Set Valves Cylinder No.	Set Injector Cylinder No.
Start	A	1	1
Advance to	B	5	5
Advance to	C	3	3
Advance to	A	6	6
Advance to	B	2	2
Advance to	C	4	4
Firing Order: 1 - 5 - 3 - 6 - 2 - 4			

CHART 2

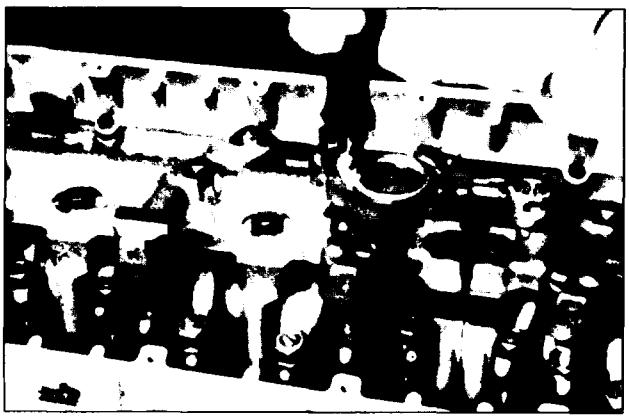


FIG. 32

⚠CAUTION

DO NOT TIGHTEN THE INJECTOR ADJUSTING SCREW MORE THAN 25 LB.-IN. (2.8 N•M) TO PREVENT DAMAGE TO THE INJECTOR.

1. Turn the injector adjusting screw in (25 lb.-in.) and bottom the injector plunger 3 - 4 times to remove fuel.
2. Tighten screw to bottom the plunger only.
3. Back out screw two flats (120°).
4. Hold the screw and torque the lock nut to 45 lb.-ft. (61 N•m).
5. Adjust the valves in the same cylinder following sequence in Chart 2.

Installation of Oil Supply

⚠CAUTION

DO NOT CONNECT THE ENGINE BRAKE OIL SUPPLY TO THE SAME LOCATION USED FOR THE TURBOCHARGER OIL SUPPLY. SERIOUS ENGINE DAMAGE MAY RESULT.

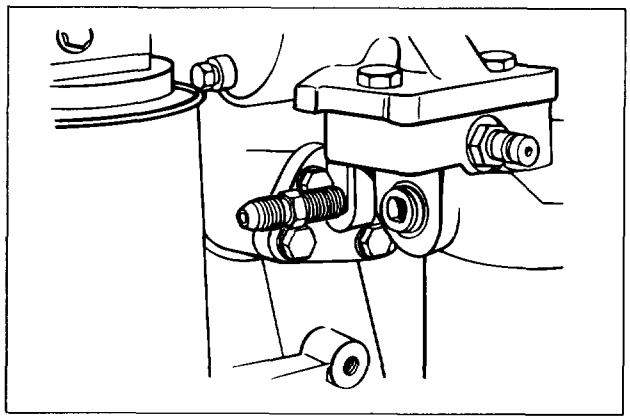


FIG. 33

Remove the plug fitting from the rear inboard filter head location and install the new fitting with seal ring. Tighten the fitting to 15 lb.-ft. (20 N•m).

⚠CAUTION

KEEP THE HOSE CLEAR OF ALL POTENTIAL HOT ENGINE COMPONENTS AND FREE FROM RUBBING ON THE ENGINE OR CHASSIS. A RUPTURED HOSE WILL SPRAY HOT OIL AND COULD CAUSE HEAVY SMOKE OR FIRE UPON HITTING HOT ENGINE COMPONENTS.

FIG. 34

Connect the external hose to the bulkhead fitting in the spacer. Install the hose clamp and attach the bolt in the intake manifold.

Route hose behind coolant filter and connect to the "O" ring adapter. Tighten the hose fittings to 9 lb.-ft. (12 N•m).

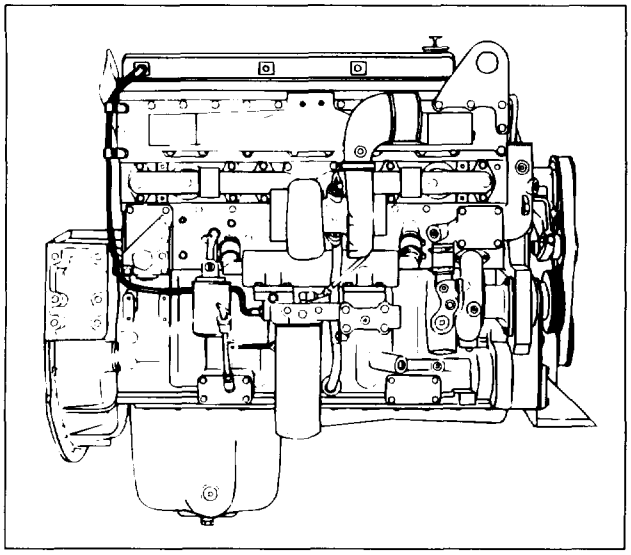


FIG. 35

Install the short hose between the housing adapter and the bulkhead fitting. Torque the fitting nuts to 12 lb.-ft. (16 N•m).

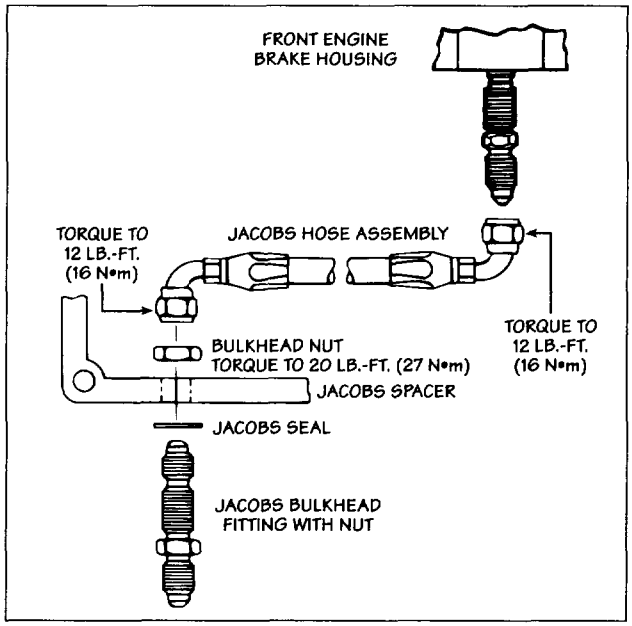


FIG. 36

Section 4: Electrical System Installation

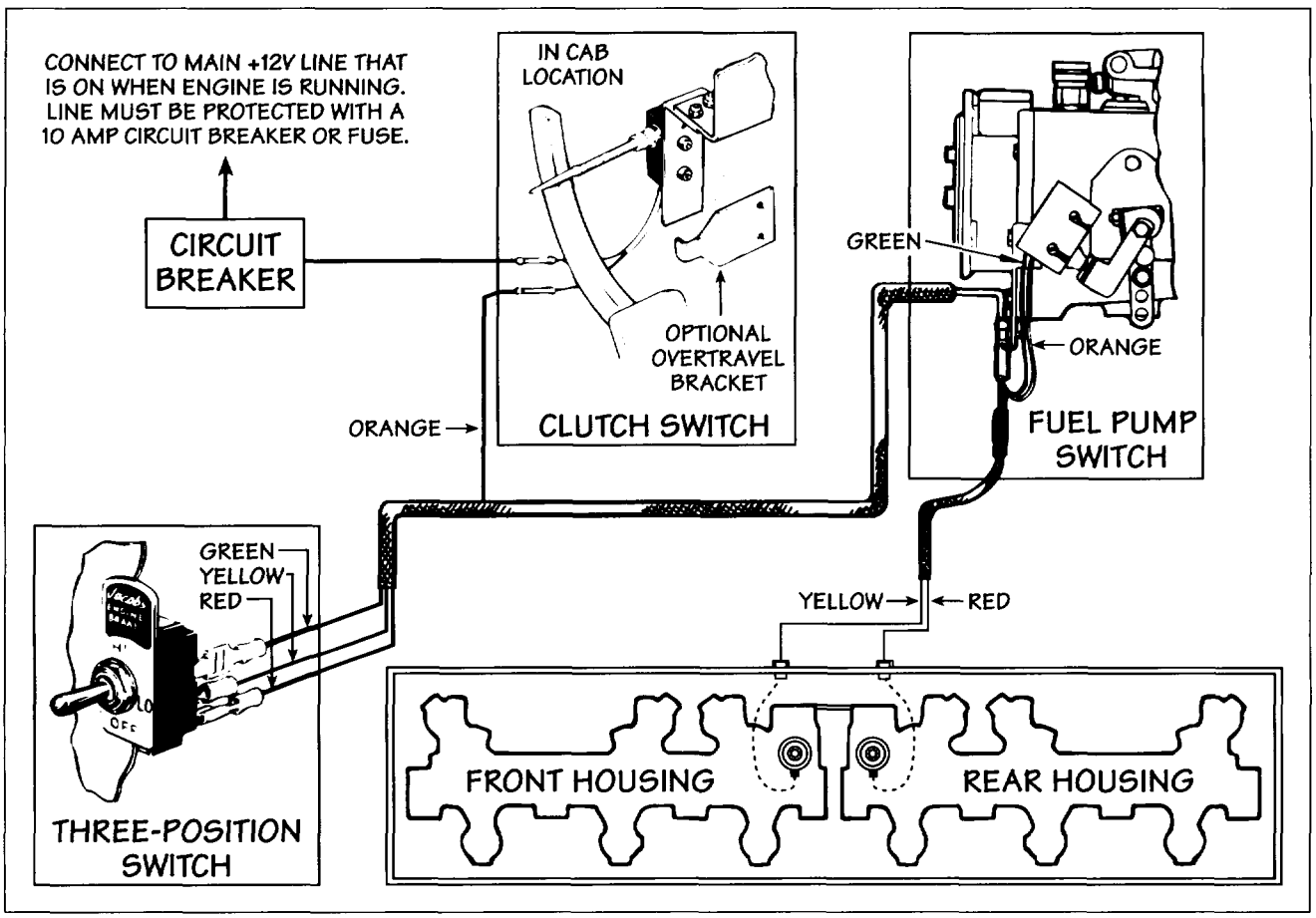


FIG. 37

NOTE:

VEHICLE OEM INSTALLED CONTROL SYSTEM COMPONENTS MAY DIFFER FROM JACOBS SUPPLIED PARTS.

Dash Switch

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

Clutch Switch

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

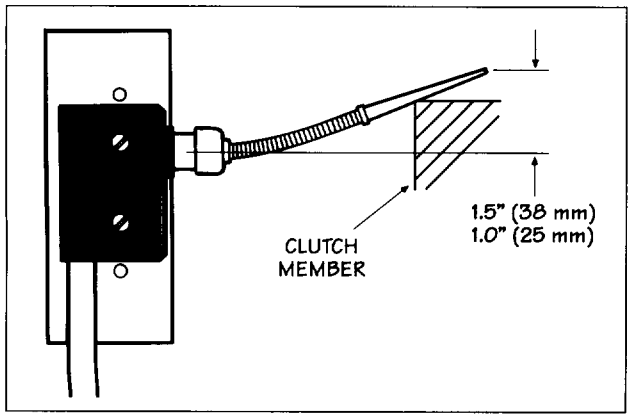


FIG. 38

4. Check the installation by moving the clutch pedal. The switch should click in the free-play motion of the clutch pedal before actual clutch disengagement takes place.

⚠CAUTION

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

5. Cut the wires to the proper length and secure them with ties. Connect the wires as shown in Fig. 37.

Fuel Pump Switch

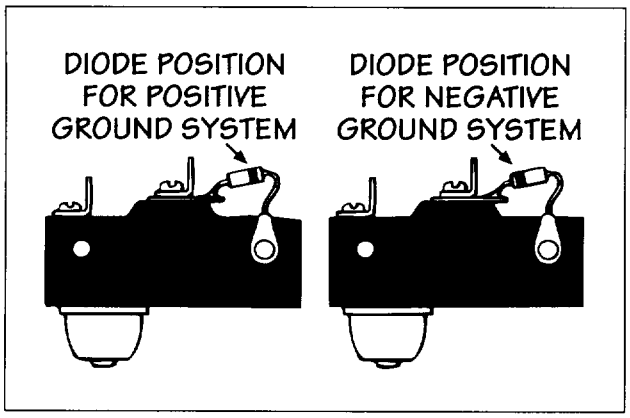


FIG. 39

NOTE:

THE 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.

1. Remove the two cap screws and washers from the pump as shown in Fig. 40.

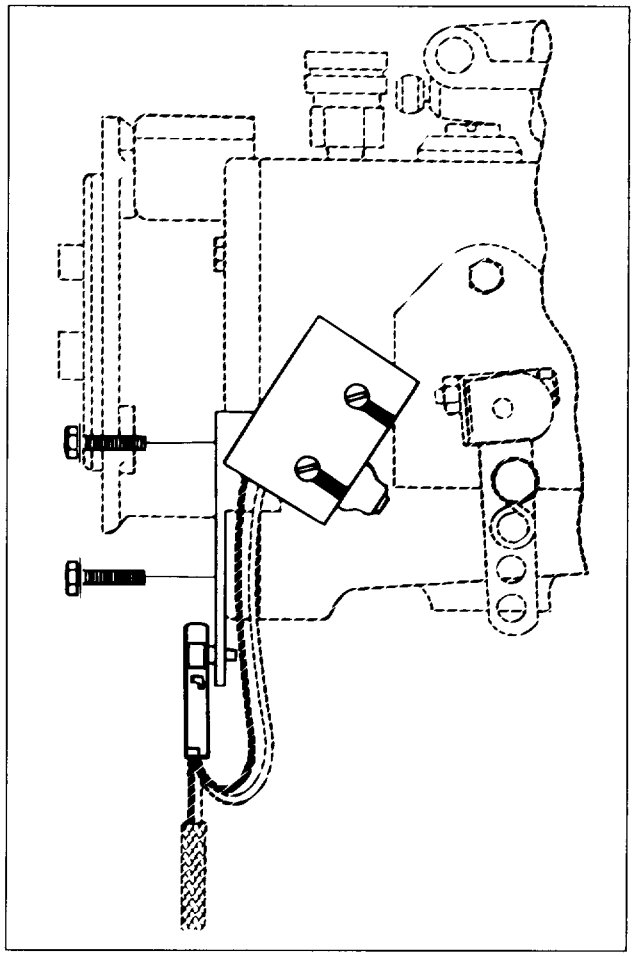


FIG. 40

2. Install the switch bracket and harness assembly with the two new screw and washer assemblies from the engine brake kit. Tighten to 10 lb.-ft. (14 N•m).
3. Remove the nut and washer from the throttle lever capscrew and install the switch actuating lever clamp.

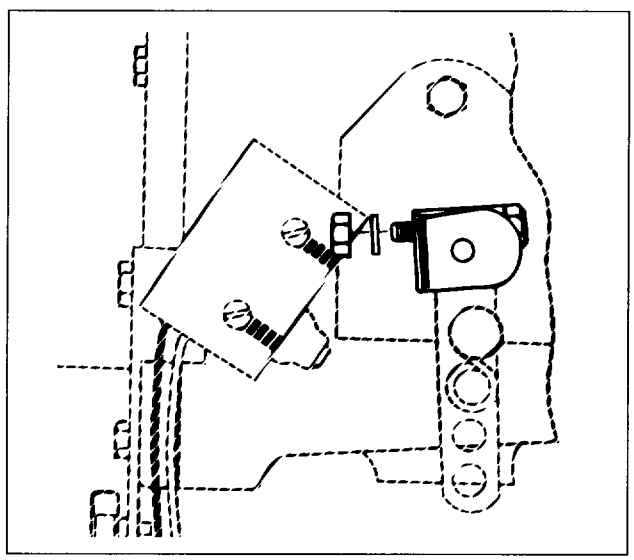


FIG. 41

4. Reinstall the throttle lever washer and nut and tighten to 10 lb.-ft. (14 N•m).
5. Attach the actuating lever to the clamp with the cap screw. Do not tighten.

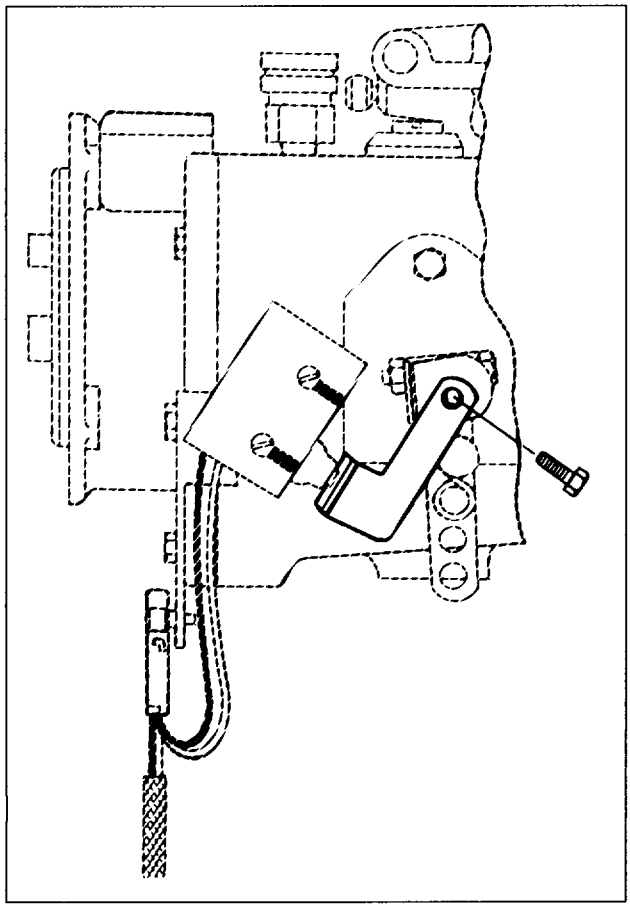


FIG. 42

6. Move the throttle to the low idle position and insert a 0.050" (1.27 mm) feeler gage between the switch plunger and actuating lever (A, Fig. 43). Push the switch lever against the switch plunger until the plunger bottoms. Tighten the cap screw to 7 lb.-ft. (10 N•m).

The pump switch actuating arm can be installed on pumps that have the throttle lever in either the up or down position (see Fig. 44).

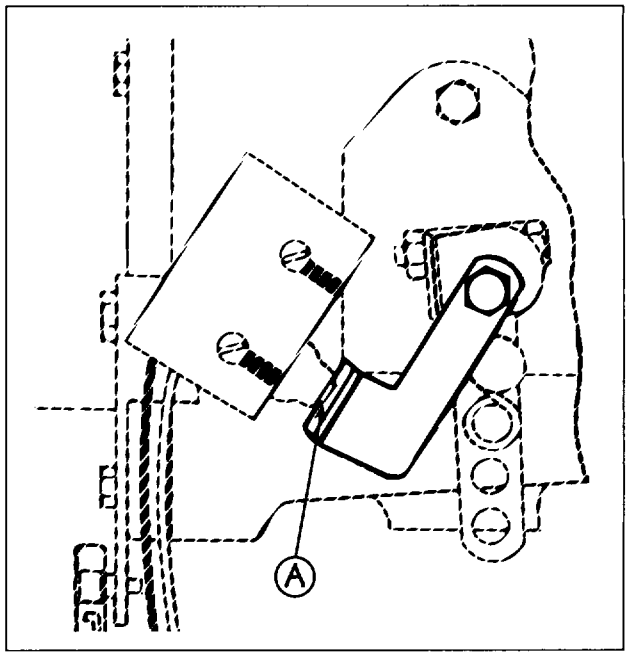


FIG. 43

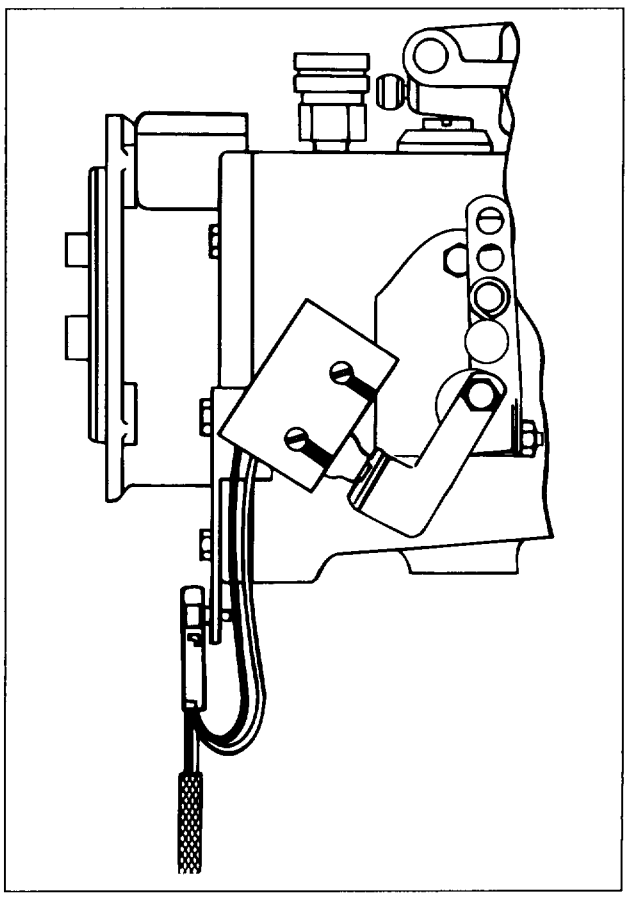


FIG. 44

Optional Controls

For L10 STC Engines with or without PACE or PT PACER

See the parts manual for part number information.

Foot Switch

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

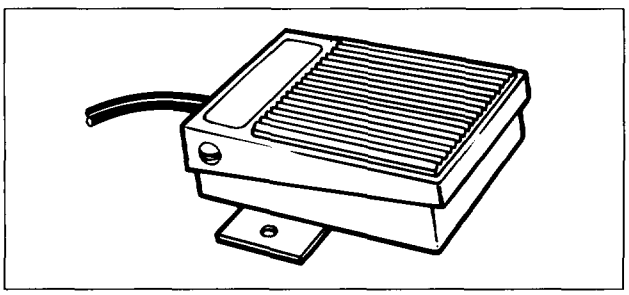


FIG. 45

Low Engine Speed Retarder Cutoff System

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

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

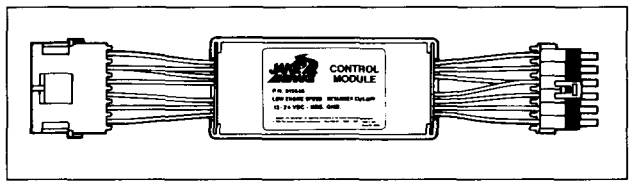


FIG. 46

NOTES:

SPECIFIC WIRING INFORMATION FOR ALL THE DIFFERENT VEHICLE MANUFACTURERS MAY BE INCOMPLETE. CONSULT CURRENT SERVICE LETTERS FOR UPDATED INFORMATION.

THE FOOT SWITCH AND LOW ENGINE SPEED RETARDER CUTOFF SYSTEM ARE OPTIONAL FOR ALL APPLICATIONS. THEY ARE NOT REQUIRED ON CELECT APPLICATIONS.

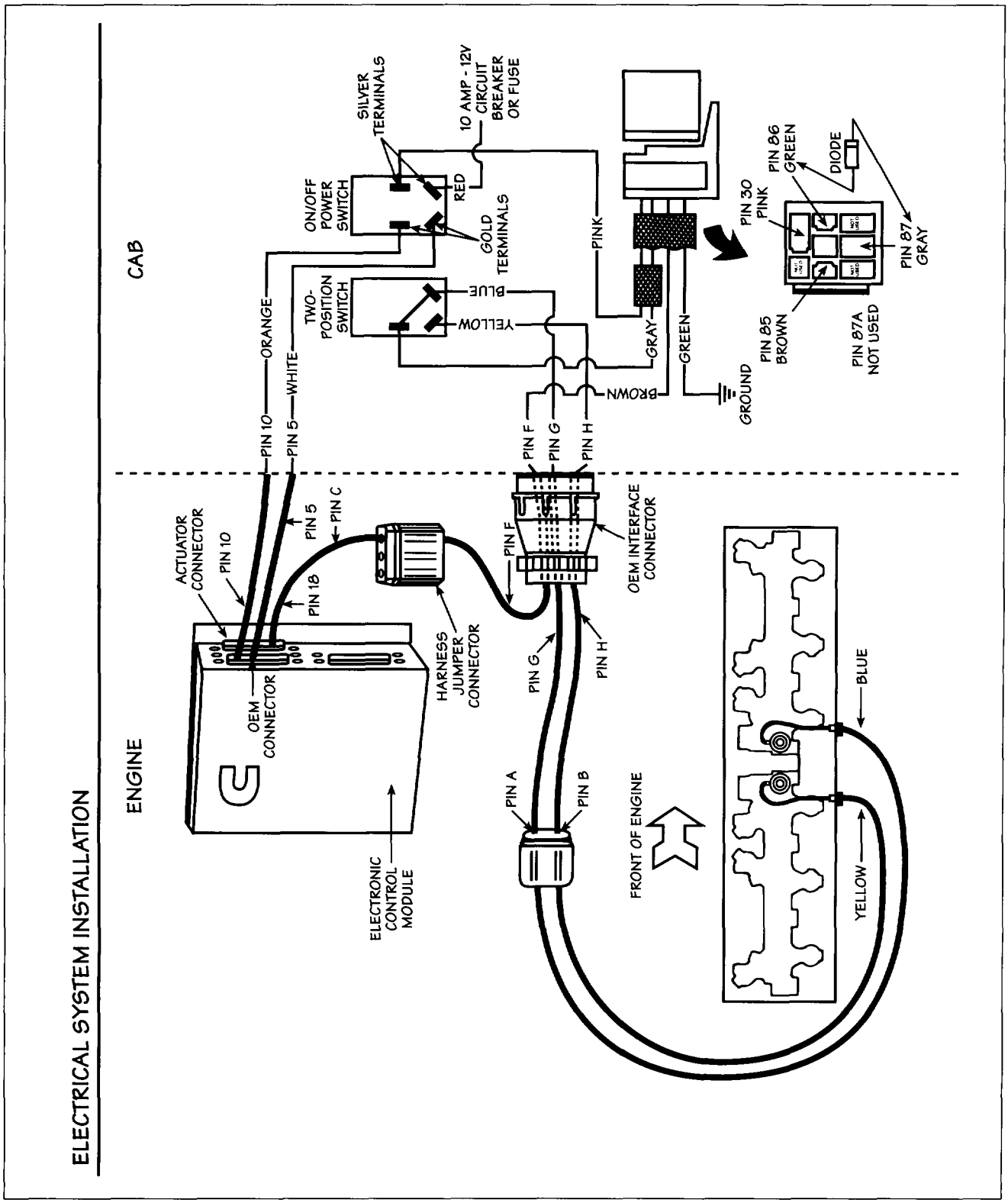

ELECTRICAL SYSTEM INSTALLATION
CAB
ENGINE
SILVER TERMINALS
10 AMP - 12V CIRCUIT BREAKER OR FUSE
ON/OFF POWER SWITCH
RED
GOLD TERMINALS
TWO-POSITION SWITCH
BLUE
YELLOW
ORANGE
WHITE
PIN 10
PIN 5
PINK
GRAY
GREEN
BROWN
GROUND
PIN 30 PINK
PIN 86 GREEN
DIODE
PIN 87 GRAY
PIN 85 BROWN
PIN 87A NOT USED
PIN F
PIN G
PIN H
ACTUATOR CONNECTOR
PIN 10
PIN 5
PIN C
PIN 18
OEM CONNECTOR
HARNESS JUMPER CONNECTOR
OEM INTERFACE CONNECTOR
ELECTRONIC CONTROL MODULE
PIN A
PIN B
FRONT OF ENGINE
BLUE
YELLOW

FIG. 47

CELECT Wiring Installation

017593 Harness Installation (see Fig. 47)

1. Install the relay base under the dash at a convenient location in order to make the following wiring connections:
2. Connect the GREEN wire to a good engine ground.

⚠ CAUTION

IT IS EXTREMELY IMPORTANT THAT A SECURE GROUND CONNECTION IS MADE. FAILURE TO DO SO WILL RESULT IN POOR BRAKE OPERATION.

3. Connect the PINK wire to the output side of the ON/OFF brake switch.
4. Connect the GRAY wire to the input terminal of the selector switch.
5. Connect the BROWN wire to the Cummins interface connector, pin "F".

Additional electrical connections

6. Connect the RED wire from the input terminal (silver coated) to a 10-amp, 12-volt circuit breaker electrical source.
7. The BLUE wire should be connected from the output side of the selector switch as shown in Fig. 47, to pin "G" of the Cummins interface connector.
8. Connect the YELLOW wire from the output side of the selector switch to pin "H" of the Cummins interface connector.
9. The ORANGE wire is connected from the output side of the ON/OFF switch (gold-plated terminal) to pin 10 of the Cummins electronic control module.
10. Connect the WHITE wire from the input side of the ON/OFF switch (gold-plated terminal) to pin 5 of the Cummins electronic control module.

Section 5: Engine Brake Operation Check

The Jacobs Engine Brake installation is now complete. 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.

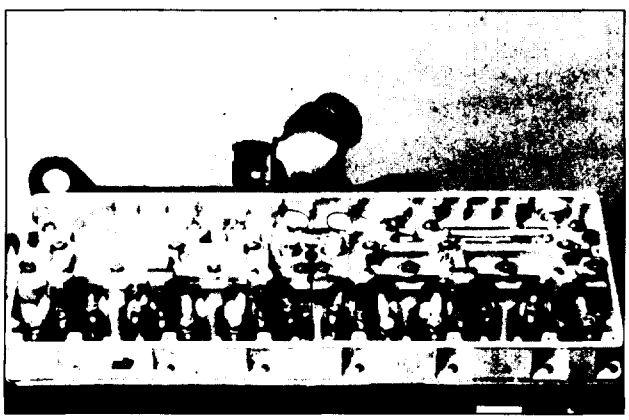


FIG. 48

Brake Housing Bleed and Operation Check

⚠ WARNING

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

WHEN THE ENGINE IS RUNNING AND VALVE COVERS ARE REMOVED, OIL SPLASHING IN THE ENGINE BRAKE AREA COULD CAUSE PERSONAL INJURY.

1. Connect the control wires to the terminal assemblies in the engine brake spacers.
2. Bleed the brake housings and check their operation. Start the engine and allow to run 5 to 10 minutes. Put the dash switch in the "LO" position. Accelerate the engine to approximately 1800 RPM and release the throttle. Only one solenoid valve should operate. Repeating this procedure for the "HI" position, both solenoids should operate. Repeat this procedure several times to bleed brake housings for immediate operation.

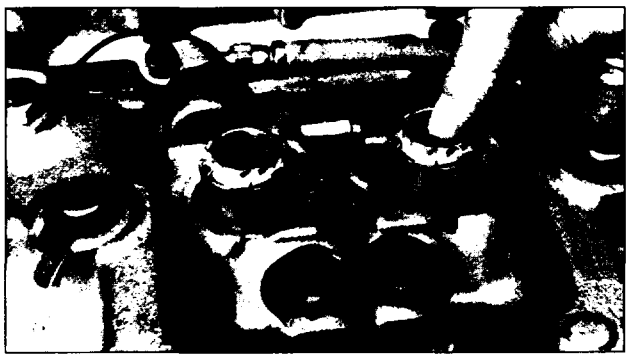


FIG. 49

Replace Rocker Lever Cover

1. Remove the gasket and inspect for damage.

NOTE:

THE GASKET CAN BE REUSED IF IT IS NOT DAMAGED.

2. If the gasket is not damaged, it can be used again. If the gasket is damaged, it must be discarded and a new one used.
3. Set the new Cummins gasket on the cover.
4. Install a flat washer, new sleeve and new noise isolator on the cap screw.

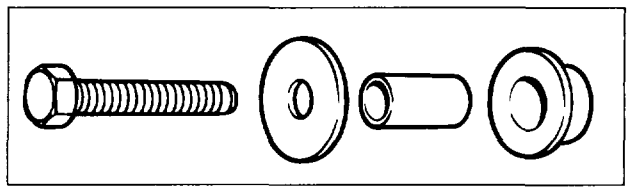


FIG. 50

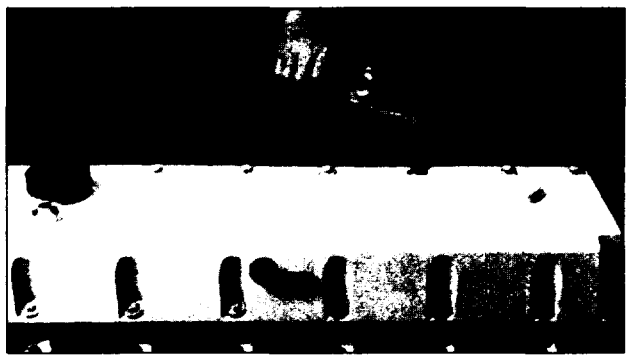


FIG. 51

5. Install the cap screw assemblies in the cover.
6. Install the cover on the Jacobs spacer and tighten the cover cap screws in the sequence shown in Fig. 52 to 130 lb.-in. (15 N•m).

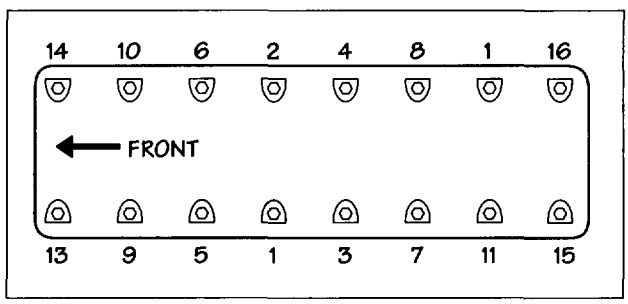


FIG. 52

Attach the Operating Warning decal in a convenient location on the dash.

Complete and mail the Engine Brake Warranty Card.

Section 6: Engine Brake Maintenance

Theory of Operation

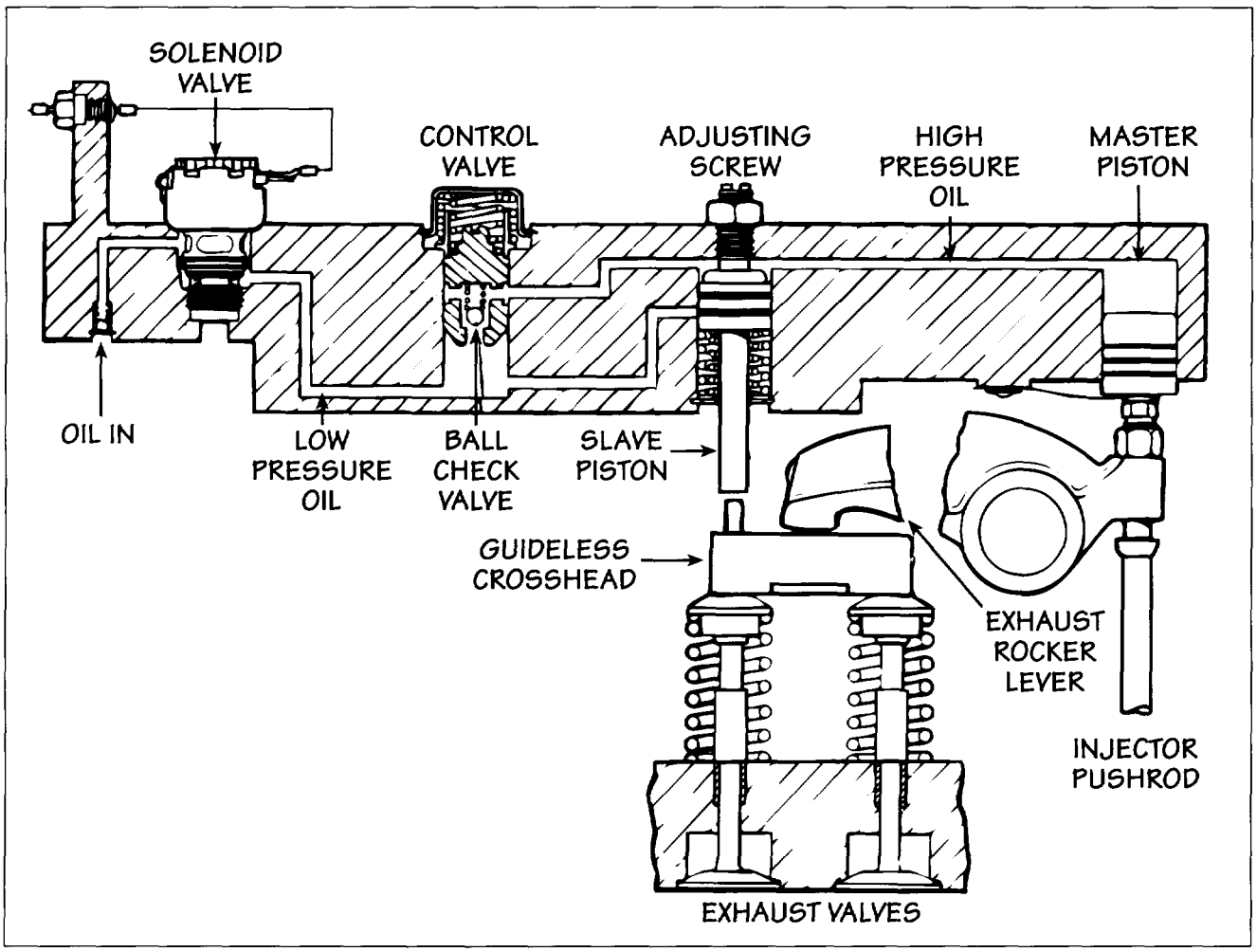
Energizing the engine brake effectively converts a power-producing diesel engine into a power-absorbing air compressor. This is accomplished through motion transfer using a master/slave piston arrangement which opens cylinder exhaust valves near the top of the normal compression stroke, releasing the compressed cylinder charge to exhaust.

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

Exhaust Blowdown

Referring to the schematic drawing below, exhaust blowdown occurs as follows:

1. The energized solenoid valve permits engine lube oil to flow under pressure through the control valve to both the master piston and the slave piston.
2. Oil pressure causes the master piston to move down, coming to rest on the injector rocker arm adjusting screw.
3. The injector rocker arm adjusting screw begins upward travel (as in normal exhaust cycle), forcing the master piston upward and directing high pressure oil to the slave piston. The ball check valve in the control valve imprisons high-pressure oil in the master/slave piston system.
4. The slave piston, under the influence of the high-pressure oil moves down, momentarily opens 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 out to the atmosphere, completing a compression braking cycle.



SCHEMATIC DRAWING

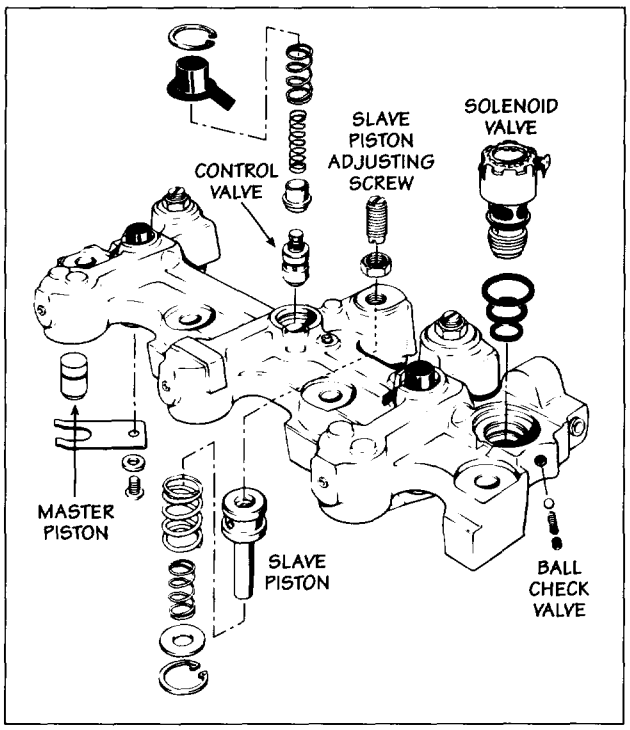


FIG. 53

⚠ WARNING

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

The Jacobs Engine Brake is a relatively trouble-free device. However, periodic inspections are necessary and some maintenance is required. Using the following procedures will help 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. Apply pressure on the control valve cover and remove the retaining ring using retaining ring pliers.

FIG. 54

2. Slowly remove the cover until spring pressure ceases, then remove the control valve springs and collar.

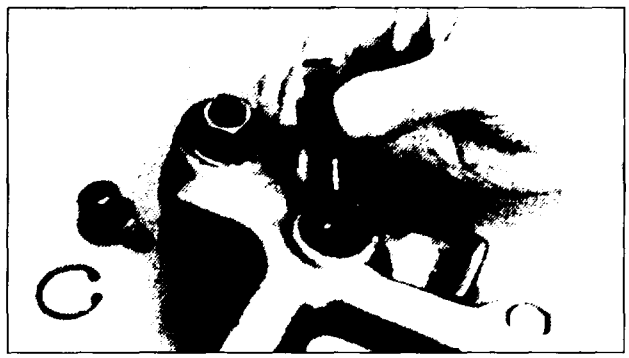


FIG. 55

3. Using needle-nose pliers, remove the control valve.

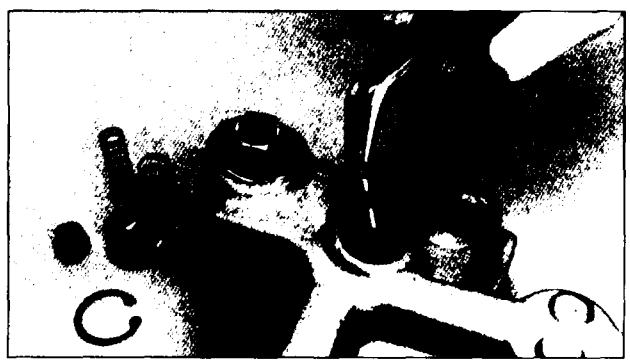


FIG. 56

4. Wash the control valve with an approved cleaning solvent.
5. Push a wire through the hole in the base of the valve to ensure that the ball check is free. The ball should lift with light pressure on the wire. If the ball is stuck or there is no spring pressure, replace the control valve. Dry the valve with compressed air and wipe clean with a paper towel.
6. Thoroughly clean the control valve bore in the housing, using clean paper towels. Dip the control valve in clean lube oil. Drop the valve into its bore. If binding occurs, the control valve should be replace.
7. Reassemble the parts, reversing the removal procedure. Be sure the retaining ring ears are positioned opposite the oil drain slot in the housing.

FIG. 57

⚠ CAUTION

BE SURE THE CONTROL VALVE COLLAR IS INSTALLED WITH THE LONGER SLEEVE AREA UP (SEE FIG. 58). IF THE COLLAR IS INSTALLED UPSIDE DOWN, THIS BRAKE CYLINDER WILL NOT OPERATE.

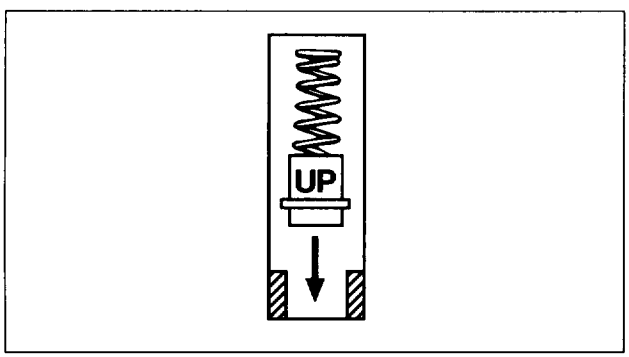


FIG. 58

Slave Piston Adjusting Screws (Reset)

1. Loosen the slave piston adjusting screw locknut and remove the adjusting screw from the housing.

FIG. 59

2. Clean the adjusting screw in an OSHA-approved cleaning solvent.
3. Inspect the slave piston adjusting screw. The plunger should protrude from the bottom of the screw, have light spring pressure apparent when depressed, and should move freely. Be sure the retaining ring is fully engaged in its groove. Replace the entire screw assembly if any defect is found.

⚠ CAUTION

DO NOT READJUST OR TAMPER WITH THE ADJUSTING SCREW ASSEMBLY. ENGINE DAMAGE COULD RESULT.

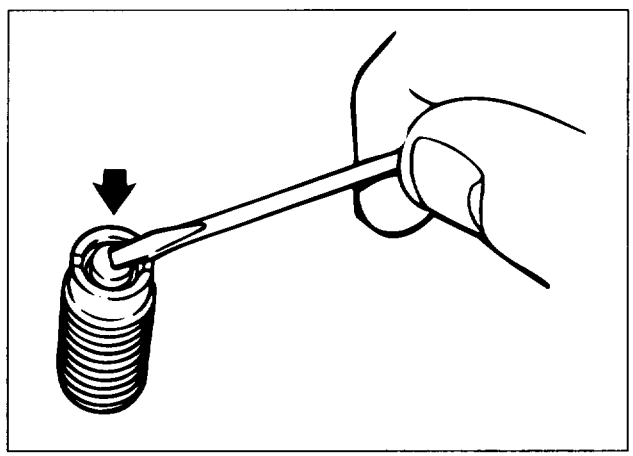


FIG. 60

Solenoid Valve

1. Disconnect the solenoid harness. Using a 7/8" socket and extension, unscrew the solenoid valve.

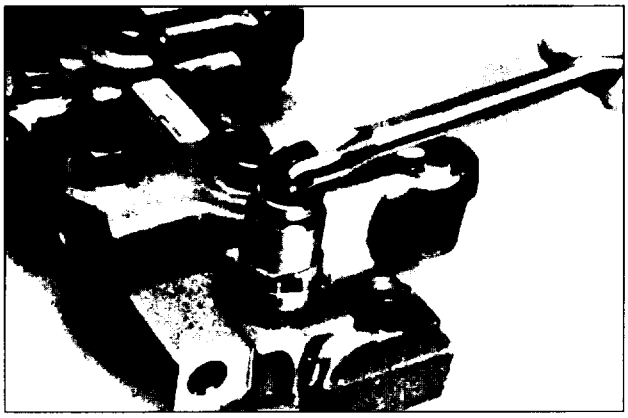


FIG. 61

⚠CAUTION

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

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.

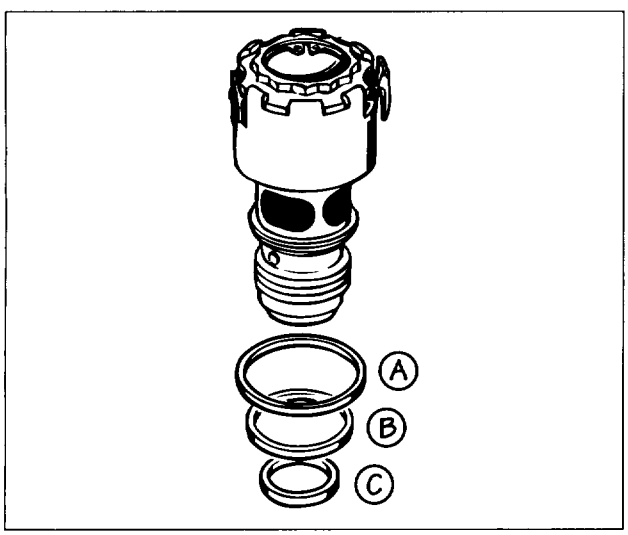


FIG. 62

3. Wash out the solenoid valve with an approved cleaning solvent. Use a brush to clean the oil screen. Clean and dry the valve with compressed air. Replace the oil screen if necessary.
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 oil passageways.
5. Reinstall the solenoid using new seal rings. Seat the lower seal ring in the base of the solenoid valve bore. Wipe clean lube oil into and around the bore. Place the upper and center seal rings on the solenoid valve body.

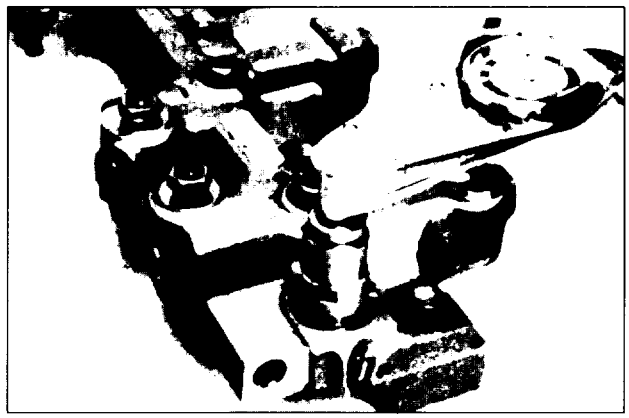


FIG. 63

6. Be sure the seals are seated properly. Carefully screw the solenoid into housing without unseating the seals. Torque the solenoid valve to 110 lb.-in. (12 N•m).

Ball Check Valve

1. Remove the hex-socket pipe plug. Be careful during final turns to avoid the loss of the spring and ball. Remove the spring and ball.
2. Inspect, clean in an approved cleaning solvent and replace as required.
3. Reassemble, inserting the ball first, then the spring and plug. Torque plug to 100 lb.-in. (11 N•m).

⚠CAUTION

INSTALL PARTS IN THE ORDER SHOWN. IMPROPER INSTALLATION MAY RESULT IN ENGINE DAMAGE.

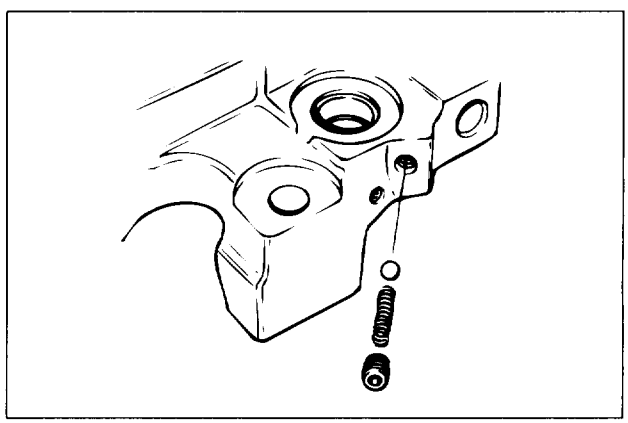


FIG. 64

Master Piston

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

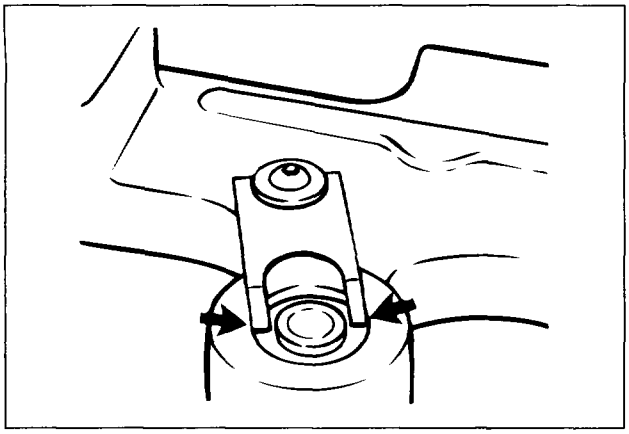


FIG. 65

2. Remove the master piston from its bore using needle-nose pliers. If binding occurs, check for burrs or contaminants in lube oil. Clean in an approved solvent.
3. Inspect the hard face surface. Pitted, chipped, cracked or galled pistons should be replaced. If the hard facing is damaged, inspect the corresponding rocker arm adjusting screws for excessive wear or pitting. Replace if damaged.
4. Reassemble in reverse order. When tightening the cap screw, make certain the two spring tabs do not interfere with the sides of the master piston center raised portion (see Fig. 66).

NOTE:

THE TABS SHOULD BE EQUALLY SPACED FROM THE RAISED PISTON AREA.

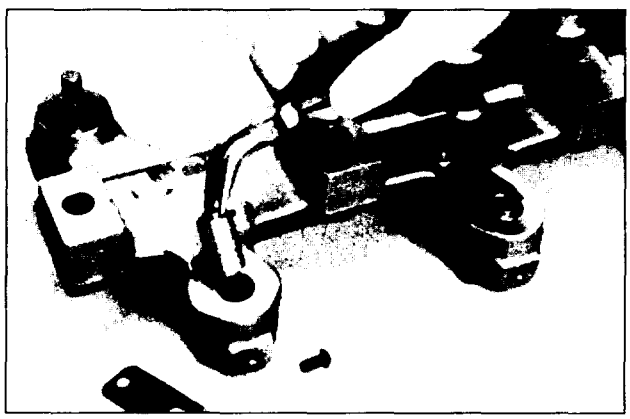


FIG. 66

Slave Piston

⚠ WARNING

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

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

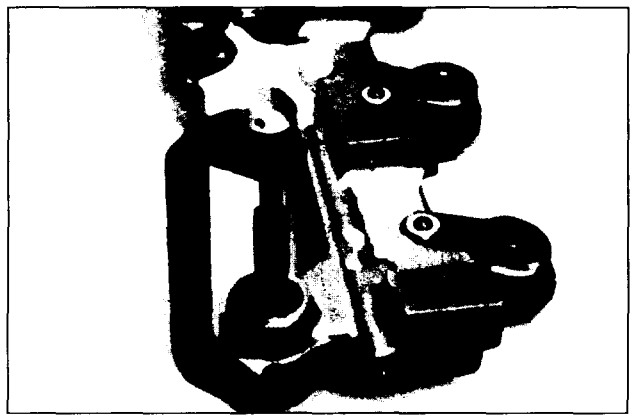


FIG. 67

2. Use the slave piston clamp fixture and the following procedure to remove and replace the slave piston.
3. Place the hole in the clamp fixture over the slave piston adjusting screw. While holding the fixture in position, screw the holder down over the slave piston stem until the retainer is contacted.

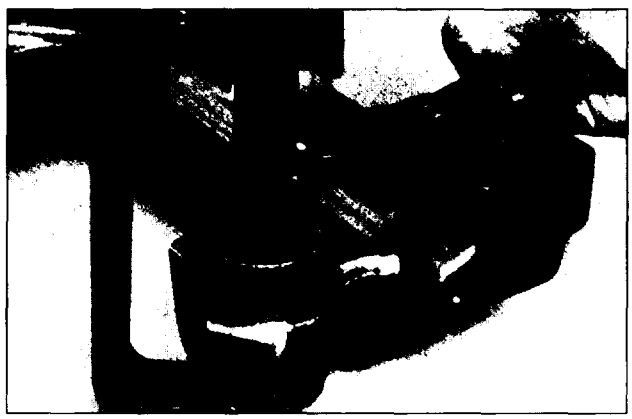


FIG. 68

4. Turn the handle slowly until the retainer is depressed about 1/32" (1 mm), relieving pressure against the retaining ring.
5. Remove the retaining ring using retaining ring pliers. Back out the holder until the springs are loose. Remove the fixture.
6. Remove the retainer, springs and slave piston. Check for nicks or burrs that could cause binding. Clean the slave piston in an approved cleaning solvent. Run a small wire through any holes. Replace the piston if the ground surface on the outside diameter is scratched or scored.

NOTE:

BE SURE ALL COMPONENTS ARE REASSEMBLED IN CORRECT ORDER.

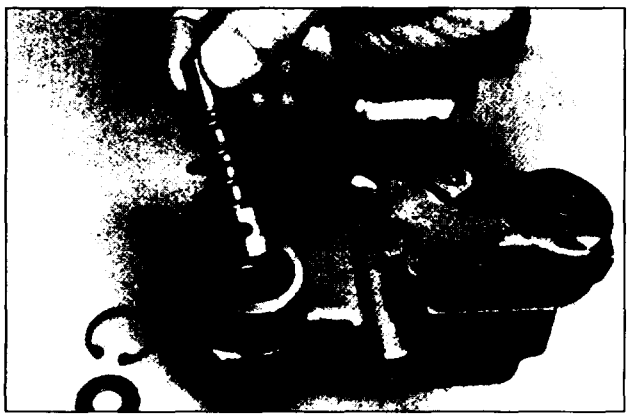


FIG. 69

7. Install the slave piston into the bore. Install the springs and retainer over the slave piston foot.
8. Use the clamp fixture to compress the slave piston and springs down until the retainer is about 1/32" (1 mm) below the retaining ring groove. Slide the retaining ring over the threaded rod of the clamp fixture and reinstall the retaining ring in its groove. Be sure the retaining ring is fully engaged in the groove. Remove the clamp fixture slowly to ensure proper seating of retaining ring.

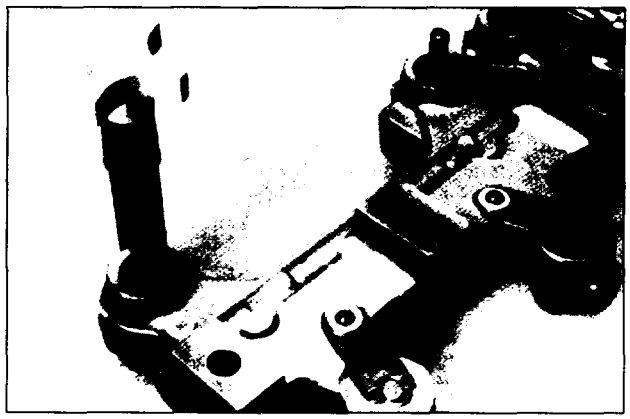


FIG. 70

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