

The Models 750 Jake Brake® engine retarder is designed and approved for use on Detroit Diesel® Series 50 engines. For specific engine application information, see page 3 of this manual. Information in this manual was current at the time of printing and is subject to change without notice or liability. Jacobs service materials should be consulted for additional applications and updated information.

# INSTALLATION

# Table of Contents

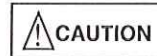
<b>Section 1: Introduction</b> .....	<b>3</b>
Housing Identification .....	3
Engine Identification .....	3
Special Tools .....	3
Recommended Torque Values .....	3
Engine Covers .....	3
Application and Adjustment Information .....	3
<b>Section 2A: Engine Preparation</b>	
<b>Series 50 Engines with DDEC II</b> .....	<b>4 - 5</b>
Undercover Wire Harness Installation .....	4
<b>Section 2B: Engine Preparation</b>	
<b>Series 50 Engines with DDEC III</b> .....	<b>6 - 7</b>
Undercover Wire Harness Installation (Retrofit) .....	6
<b>Section 3: Brake Housing Installation</b> .....	<b>8 - 10</b>
Slave Piston Adjustment .....	9
<b>Section 4A: Control System Installation</b>	
<b>Series 50 Engines with DDEC II</b> .....	<b>11 - 14</b>
Wire Harness, P/N 015708 .....	11
Harness, P/N 015709 .....	11
Undercover Wiring .....	11
Engine Brake/WABCO ABS Interface with DDEC II .....	12
Wiring Diagram .....	13
<b>Section 4B: Control System Installation</b>	
<b>Series 50 Engines with DDEC III</b> .....	<b>14 - 17</b>
Wiring Diagram .....	14
Dash Switch .....	15
Undercover Wiring .....	16
Allison World Transmission Wiring .....	16
DDEC III Wiring .....	17
<b>Section 5: Engine Brake Operation Check</b> .....	<b>18 - 19</b>
Rocker Cover Installation .....	18
<b>Section 6: Engine Brake Maintenance</b> .....	<b>20 - 28</b>
Theory of Operation .....	20
Exhaust Blowdown .....	20
Control Valve .....	21
Slave Piston Adjusting Screw (Reset Screw/Power-Lash™ Assembly) .....	22
Solenoid Valve .....	22
Accumulator .....	23
Master Piston .....	23
Slave Piston .....	24
Master Piston Pin/Roller .....	25
Using the Timing Circle Method .....	27

# 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

The model, part number and serial number (A) are located on the nameplate at the top of each housing (see Fig. 1).

## Engine Identification

Engine model identification, serial number (A) and model number (B), is on the name tag located on the side of the valve cover and stamped on the cylinder block beneath the intake manifold (see Fig. 2).

## Special Tools

15 mm - 12 point Socket  
12 mm - 12 point Socket  
3/16" Hex Wrench  
Kent Moore Expander Tool, P/N J-36347  
Detroit Diesel Series 50 Engine Service Manual  
Jacobs Feeler Gage, 0.026" (0.660 mm), P/N 017671

## Recommended Torque Values

Housing Hold-down Cap Screws (lubricated with engine oil)	100 lb.-ft. (136 N•m)
Slave Piston Adjusting Screw Locknut	25 lb.-ft. (35 N•m)
Slave Piston Leveling Screw Locknut	35 lb.-ft. (47 N•m)
Solenoid Valve	110 lb.-in. (12.4 N•m)
Master Piston Spring Cap Screw	100 lb.-in. (10 N•m)

## Engine Covers

The engine brake has been designed to fit on the Series 50 engine with no additional valve cover spacers. There are three styles of valve covers for the Series 50 engine. On engines equipped with a two-piece aluminum valve cover, it is NOT necessary to remove the lower valve cover to install the engine brake. However, one style upper valve cover may require modification at the breather housing location (inside) for engine brake clearance. See pages 20 - 21 for styles and instructions.

## Application Information

The Jake Brake Model 750 engine brake is designed and approved for use on all Detroit Diesel Series 50 engines with engine model numbers 6047GU28, 6047GU60, 6047GK28 and 6047GK60.

**NOTE:**  
IT MAY BE NECESSARY TO REPROGRAM THE  
DDEC III MODULE FOR JAKE BRAKE  
OPERATION.

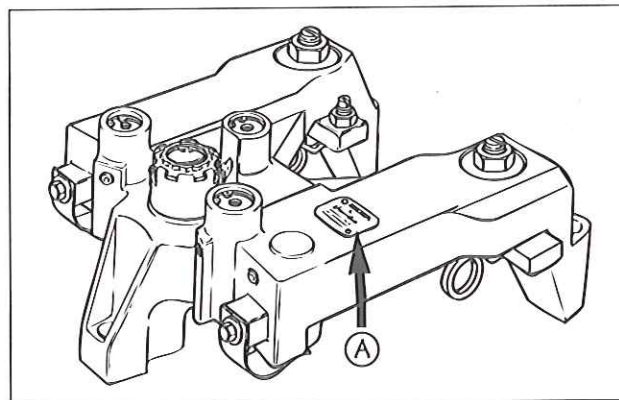


FIG. 1

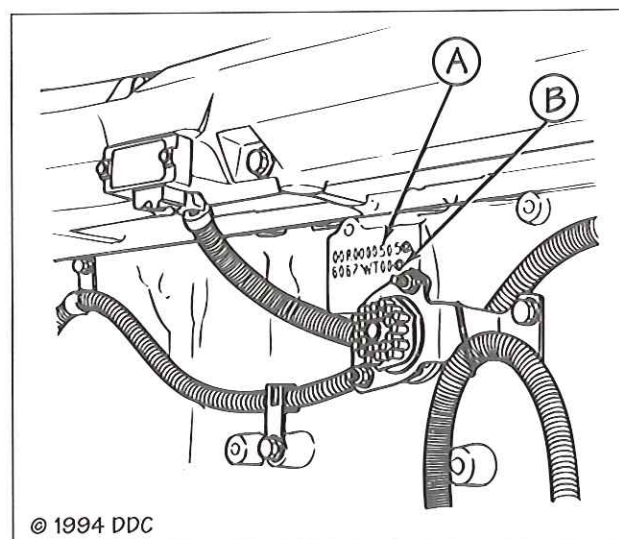


FIG. 2

# Section 2A: Engine Preparation

## Series 50 Engines with DDEC II

Clean the engine thoroughly and remove the rocker cover and gasket. Note the location of the rocker arm shaft (A), the exhaust valve rocker arm (B), the fuel injector rocker arm (C), and the intake valve rocker arm (D) (see Fig. 3).

**NOTE:**

IF THE ENGINE IS EQUIPPED WITH AN ALUMINUM TWO-PIECE VALVE COVER, REMOVE ONLY THE UPPER VALVE COVER TO INSTALL THE ENGINE BRAKE.

### Undercover Wire Harness Installation

Before installing the engine brake housings, install the undercover wire harness (see Fig. 4). Letters in the illustrations refer to specific components explained in detail below.

1. Remove the mounting flange cover (A) for the Electronic Unit Injector (EUI) harness (see Fig. 5).
2. Insert the blue wire and the yellow wire from the wire harness, Jacobs P/N 017393, through two of the access holes in the grommet (B) located at the rear of the cylinder head. Insert wires from outside in.

**NOTES:**

ONCE THE WIRES ARE INSERTED THROUGH THE GROMMET, THEY CANNOT BE REMOVED DUE TO THE TERMINAL LOCKING TANGS. TO PREVENT OIL LEAKAGE, APPLY A SMALL QUANTITY OF RTV (OR EQUIVALENT) ON THE OUTBOARD SIDE OF THE GROMMET WHERE THE PLUGS WERE REMOVED FROM THE ACCESS HOLES.

3. Install the solenoid wire harness, Jacobs P/N 019098 (blue wire and yellow wires). Lay the harness along side of the injector wire harness. Locate the end connector on the outboard side of the standoff at the rear of the cylinder head.

**NOTE:**

DETROIT DIESEL FACTORY INSTALLED HARNESSES HAVE WHITE WIRES FOR THE SOLENOID VALVES INSTEAD OF THE YELLOW AND BLUE WIRES IN THE JACOBS HARNESS.

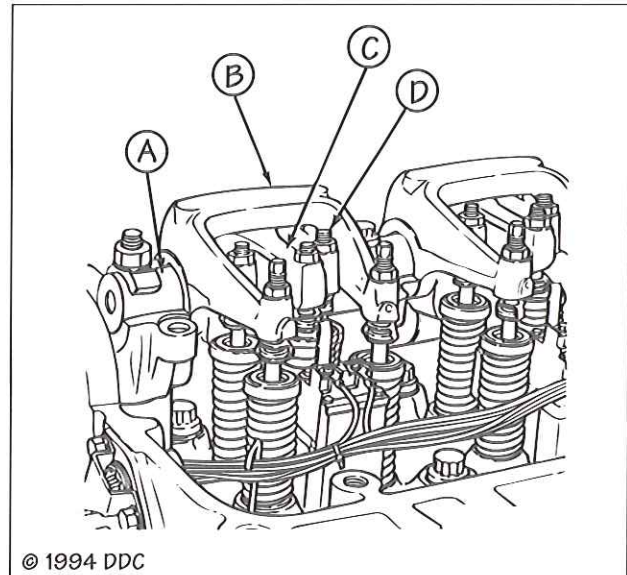


FIG. 3

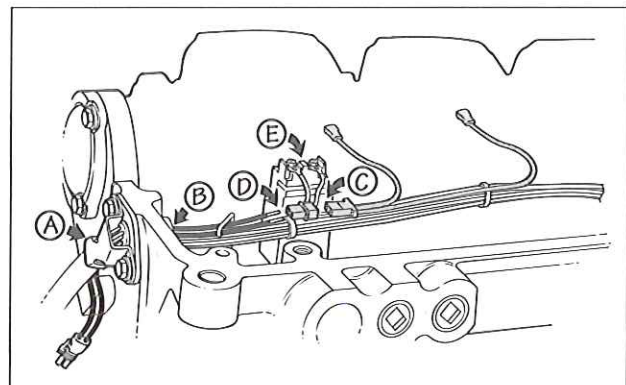


FIG. 4

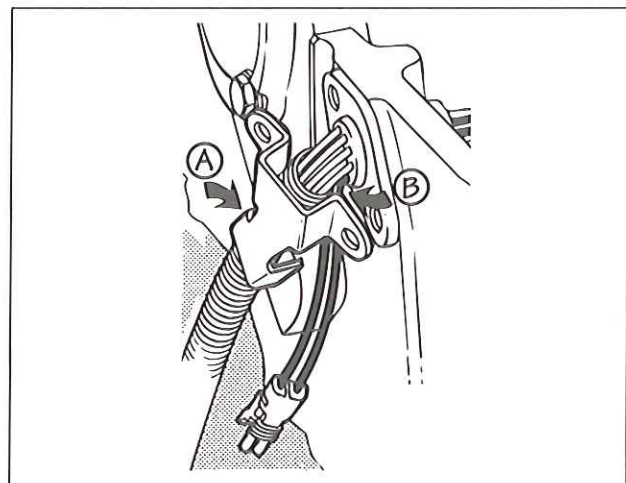


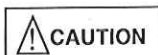
FIG. 5

4. Install the pin housing onto the connector at the end of the solenoid harness (C). Push the pin housing until it "clicks" (see Fig. 6).

**NOTES:**

THE PIN HOUSING WILL FIT ONTO THE CONNECTOR IN ONLY ONE DIRECTION. HARNESSES INSTALLED AT DETROIT DIESEL CORPORATION WILL NOT HAVE THE PIN HOUSING AND CONNECTOR.

5. Insert the yellow wire from the harness, Jacobs P/N 019098, into the pin housing on the same side as the yellow wire on the solenoid harness. Insert the blue wire into the other hole so that the blue wires are connected together (D) (see Fig. 7).



THE WIRES MUST BE CONNECTED AS INSTRUCTED. IF THE WIRES ARE REVERSED, IMPROPER ENGINE BRAKE SEQUENCING WILL OCCUR.

6. Check electrical terminals at the injectors to make sure the terminals are bent up 90° to provide clearance for the engine brake housings (see Fig. 8).

**NOTE:**

NEWER MODEL SERIES 50 ENGINES ALREADY HAVE THE TERMINALS BENT UP.

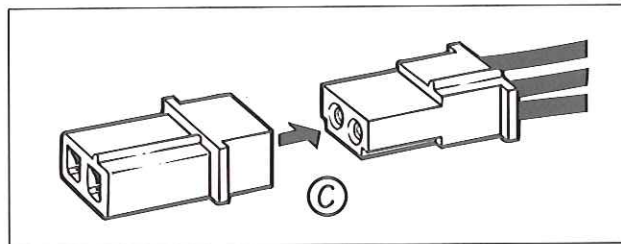


FIG. 6

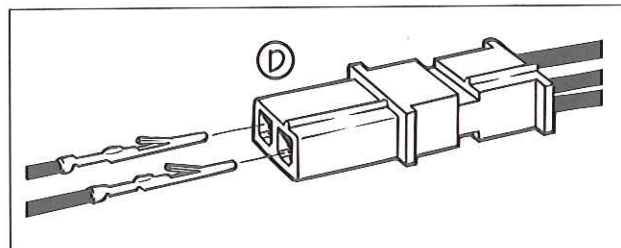


FIG. 7

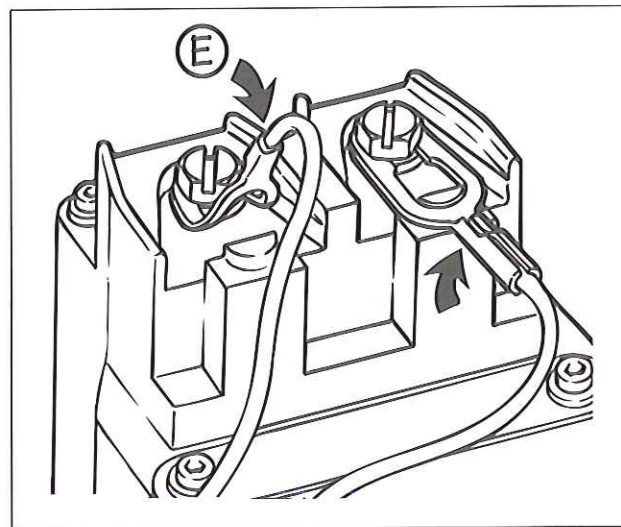


FIG. 8  
OLDER MODEL SERIES 50 ENGINES

# Section 2B: Engine Preparation

## Series 50 Engines with DDEC III

Clean the engine thoroughly and remove the rocker cover and gasket. Note the location of the rocker arm shaft (A), the exhaust valve rocker arm (B), the fuel injector rocker arm (C), and the intake valve rocker arm (D) (see Fig. 9).

**NOTE:**

IF THE ENGINE IS EQUIPPED WITH AN ALUMINUM TWO-PIECE VALVE COVER, REMOVE ONLY THE UPPER VALVE COVER TO INSTALL THE ENGINE BRAKE.

### Undercover Wire Harness Installation (Retrofit)

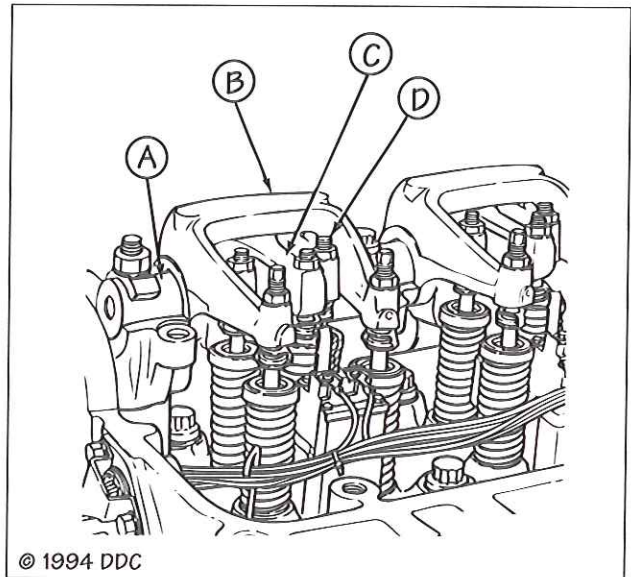
Before installing the engine brake housings, install the undercover wire harness (see Fig. 10). Letters in the illustrations refer to specific components explained in detail below.

1. Remove the mounting flange cover (A) from the Electronic Unit Injector (EUI) harness (see Fig. 11).
2. Insert the blue and yellow wires from the wire harness, Jacobs P/N 020217, through two of the access holes in the grommet (B) located at the rear of the cylinder head. Insert the wires from the outside in.

**NOTE:**

ONCE THE WIRES ARE INSERTED THROUGH THE GROMMET, THEY CANNOT BE REMOVED DUE TO THE TERMINAL LOCKING TANGS. TO PREVENT OIL LEAKAGE, APPLY A SMALL QUANTITY OF RTV (OR EQUIVALENT) ON THE OUTBOARD SIDE OF THE GROMMET WHERE THE PLUGS WERE REMOVED FROM THE ACCESS HOLES.

3. Install the solenoid wire harness, Jacobs P/N 019098 (blue and yellow wires). Lay the harness along side of the injector wire harness. Locate the end connector on the outboard side of the standoff at the rear of the cylinder head.



© 1994 DDC

FIG. 9

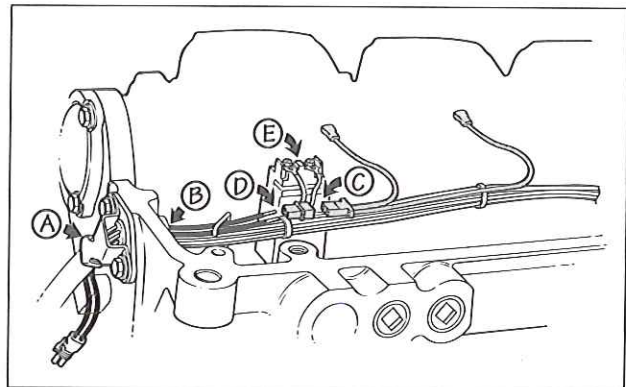


FIG. 10

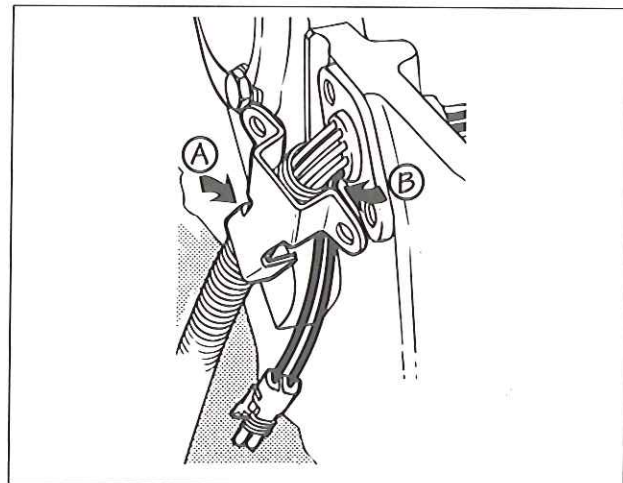


FIG. 11

4. Install the pin housing onto the connector at the end of the solenoid harness (C). Push the pin housing until it "clicks" (see Fig. 12).

**NOTES:**

THE PIN HOUSING WILL FIT ONTO THE CONNECTOR IN ONLY ONE DIRECTION.

HARNESSES INSTALLED AT DETROIT DIESEL CORPORATION WILL NOT HAVE THE PIN HOUSING AND CONNECTOR.

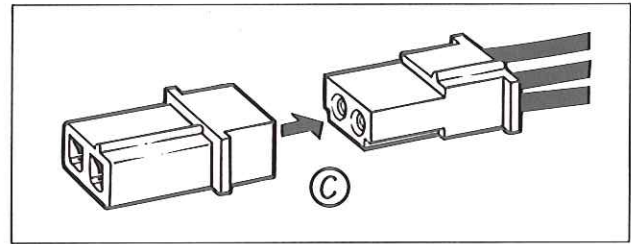
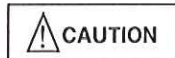


FIG. 12

5. Insert the yellow wire from the harness, Jacobs P/N 020217, into the pin housing on the same side as the yellow wire on the solenoid harness. Insert the blue wire into the other hole so that the blue wires are connected together (D) (see Fig. 13).



THE WIRES MUST BE CONNECTED AS INSTRUCTED. IF THE WIRES ARE REVERSED, IMPROPER ENGINE BRAKE SEQUENCING WILL OCCUR.

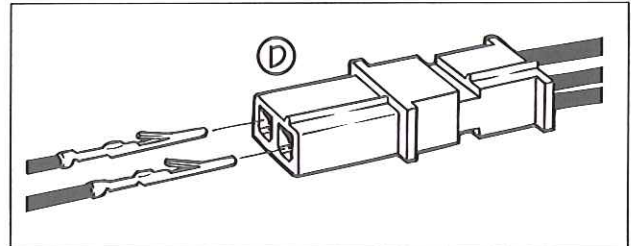


FIG. 13

6. Connect the Metri-Pack 150 connector end of the Jacobs P/N 020217 into its mating DDC-provided connector. The DDC connector may be identified by its wires:

Label	Wire No.	Color	Engine Conn.
Engine Brake Low Ctl.	562	Orange	B
Engine Brake High Ctl.	561	Red	A

**NOTE:**

IT MAY BE NECESSARY TO REPROGRAM THE DDEC III MODULE FOR JAKE BRAKE OPERATION.

# Section 3: Brake Housing Installation

1. Remove the two bearing cap bolts shown on the intake manifold side, as shown by the arrows in Fig. 14.



ATTACH A LENGTH OF TUBING TO A BLOW GUN NOZZLE AND BLOW OUT THE OIL FROM THE BOLT HOLES. COVER THE HOLES WITH HAND TOWELS TO MINIMIZE OIL SPRAY. REMOVING THE OIL FROM THE BOLT HOLES PREVENTS THE CYLINDER HEAD FROM CRACKING WHEN TIGHTENING THE BOLTS.



EYE PROTECTION MUST BE WORN WHILE BLOWING THE OIL FROM THE BOLT HOLES. PERSONAL INJURY MAY RESULT IF SAFETY GLASSES ARE NOT WORN.

2. Place the spacer bar on the exhaust manifold side of the cylinder head with the center notch facing the exhaust manifold (see Figs. 15 and 16).
3. Place the two engine brake housings over the rocker shafts with the solenoid valves toward the camshaft side of the engine.

**NOTE:**

BE SURE HOUSINGS DO NOT INTERFERE WITH WIRING HARNESS BY TUCKING THE WIRE HARNESS IN THE CHANNEL BETWEEN THE ELECTRONIC INJECTOR BODIES AND THE SPACER (SEE FIG. 17).

4. All the housing mounting bolts for Model 750 are the same length. Install a washer on each bolt and install into housings, three bolts per housing.

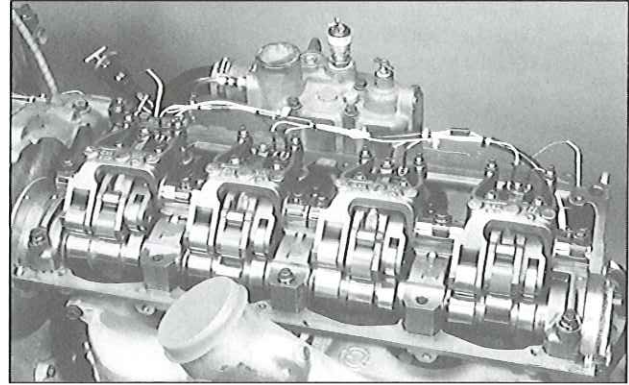


FIG. 14

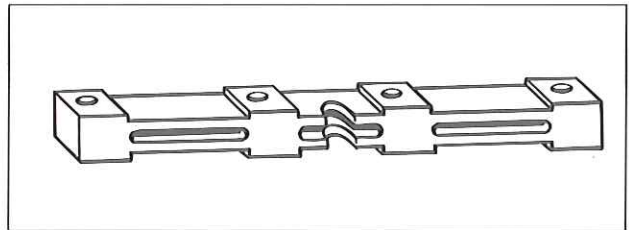


FIG. 15



FIG. 16

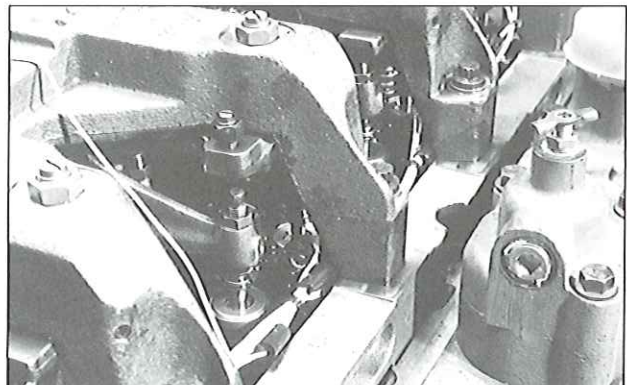


FIG. 17



5. Before tightening the engine brake hold-down bolts, move the housing from side to side and then locate the housing in the center position of the movement (see Fig. 18).
6. Tighten the engine brake hold-down bolts using the following sequence:
  - a. Tighten the two bolts on the camshaft side of the engine to 40 lb.-ft. (55 N•m).
  - b. Tighten the four bolts on the exhaust manifold side of the engine to 40 lb.-ft. (55 N•m).
  - c. Repeat the tightening sequence and re-torque all bolts to 100 lb.-ft. (136 N•m).
  - d. Recheck the torque to 100 lb.-ft. (136 N•m).
7. Secure wire harness to spacer bars with plastic ties.

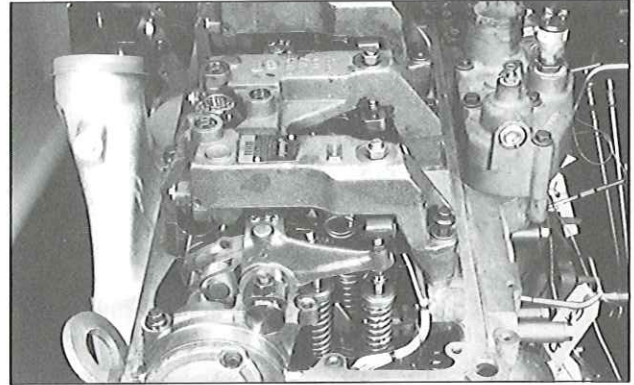


FIG. 18

## Slave Piston Adjustment



SEE PAGE 3 FOR ENGINE IDENTIFICATION INFORMATION.

THE SLAVE PISTON ADJUSTMENT PROCEDURE MUST BE STRICTLY FOLLOWED. FAILURE TO USE THE PROPER ADJUSTMENT PROCEDURE WILL RESULT IN POOR ENGINE BRAKE PERFORMANCE AND/OR SERIOUS ENGINE DAMAGE.

IF YOUR VEHICLE IS EQUIPPED WITH AN ALLISON WORLD TRANSMISSION, SEE NOTE AND CAUTION ON PAGES 16 AND 17.

The slave piston adjustments shown here are current as of the date of this manual and supersede all previous adjustments.

Engine Model No.	Size in Liters	Brake Model	Slave Piston Adjustment
6047GU28	8.5	750	0.026" (0.660 mm)
6047GU60	8.5	750	0.026" (0.660 mm)
6047GK28	8.5	750	0.026" (0.660 mm)
6047GK60	8.5	750	0.026" (0.660 mm)

**NOTE:**

MAKE THE FOLLOWING ADJUSTMENT WITH THE ENGINE STOPPED AND COLD, OIL TEMPERATURE 140° F (60°C) OR BELOW. THE EXHAUST VALVES ON THE CYLINDER TO BE ADJUSTED MUST BE IN THE CLOSED POSITION (ROCKER ARM ROLLER ON THE BASE CIRCLE OF THE CAMSHAFT).

1. Back out the leveling screw (Fig. 19) in the slave piston assembly until the end of the screw is beneath the surface of the bridge in the slave piston assembly.

**NOTE:**

THE LEVELING SCREW IS THE SCREW LOCATED IN THE BRIDGE MEMBER OF THE SLAVE PISTON ASSEMBLY.

2. Place the feeler gage between the solid side of the bridge (the side without the leveling screw) and the exhaust rocker arm adjusting screw.
3. Turn the slave piston adjusting screw clockwise until a slight drag is felt on the feeler gage (see Fig. 20).
4. Hold the screw in this position and tighten the locknut to 25 lb.-ft. (35 N•m).
5. Follow the same procedure and set the same clearance between the slave piston leveling screw and the rocker arm adjusting screw (see Fig. 21).
6. Hold the leveling screw in this position and tighten the locknut to 35 lb.-ft. (47 N•m). Check adjustment and reset, if necessary. The slave piston adjusting screws are not to be disassembled.
7. Repeat the adjustment procedures in steps 1 through 6 for the remaining cylinders. Bar over the engine when necessary to put the exhaust valves in the closed position for slave piston adjustment.

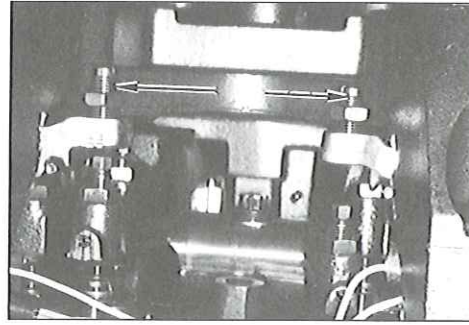


FIG. 19

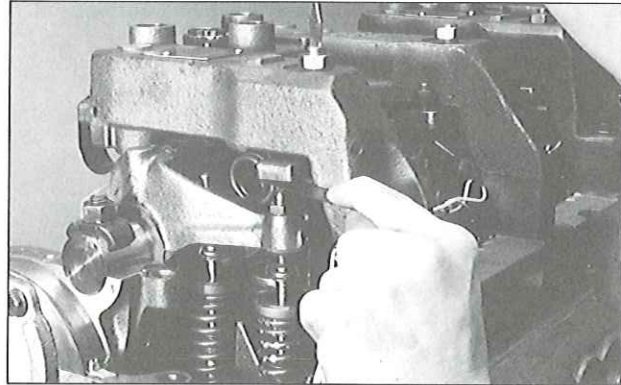


FIG. 20

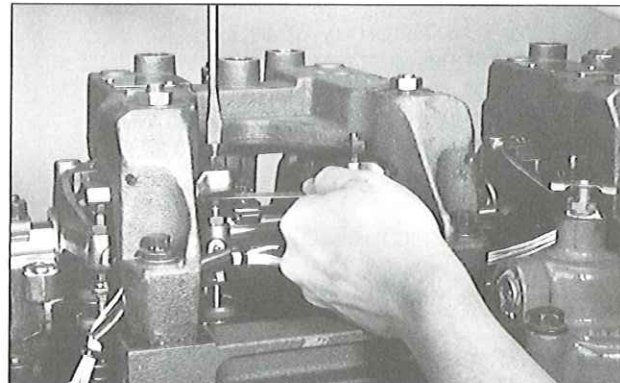


FIG. 21

# Section 4A: Control System Installation Series 50 Engines with DDEC II

Refer to the wiring diagram on page 13 for the following electrical connections.

## Wire Harness, P/N 015708

1. Connect the wire harness, P/N 015708, to the Weatherpack<sup>®</sup> connector on the in-line harness, P/N 017370. Connect the other side of the in-line harness to the Weatherpack connector on the control module.
2. Connect the GREEN wire to the negative (-) battery terminal.



IT IS VERY IMPORTANT THAT THE GREEN WIRE BE CONNECTED TO A GOOD GROUND. PROPER OPERATION OF THE JAKE BRAKE ENGINE RETARDER ELECTRICAL CONTROL SYSTEM IS DEPENDENT ON SECURING A GOOD GROUND CONNECTION. THE GREEN WIRE MUST BE ATTACHED TO THE NEGATIVE (-) BATTERY TERMINAL. DO NOT USE BODY BOLTS OR SCREWS ON THE DASH. A POOR GROUND WILL CAUSE INTERMITTENT ENGINE BRAKE OPERATION AND DAMAGE TO THE CONTROL MODULE.

3. Connect the RED wire to a 10-amp circuit breaker that is controlled by the key switch.
4. The ORANGE wire is provided for use on ABS applications. If the vehicle is not equipped with ABS, insulate the end and store the wire.
5. For a good ground connection, connect the GREEN/YELLOW wire to the negative (-) terminal on the battery.
6. If the optional dash switches are used in place of the Jacobs dash switch assembly, connect the PURPLE and GRAY wires as shown in the wiring diagram for "optional dash switches".

**NOTE:**

THE 017263 HARNESS IS NOT REQUIRED WITH THE OPTIONAL DASH SWITCHES. CONNECT THE 15708 HARNESS DIRECTLY TO THE 017179 CONTROL MODULE.

## Harness, P/N 015709

1. Connect harness, P/N 015709, to the control module.
2. BLUE/WHITE wire: For installations with standard transmissions, insulate the end and store the wire. If an automatic transmission is used, connect the BLUE/WHITE wire to the ATEC wire number 211.

**NOTES:**

FOR ALLISON ELECTRONIC TRANSMISSION APPLICATIONS (ATEC), CHECK THAT THE BLUE/WHITE WIRE ON WIRE HARNESS 015709 IS CONNECTED TO ATEC ECM WIRE NUMBER 211.

FOR NON-ELECTRONIC ALLISON AUTOMATIC TRANSMISSION APPLICATIONS, A PRESSURE SWITCH MUST BE USED TO SENSE LOCK-UP IN THE TRANSMISSION. THE PRESSURE SWITCH TAKES THE PLACE OF THE CLUTCH SWITCH. THE BLACK WIRE AND WHITE WIRE SHOULD BE CONNECTED TO THE PRESSURE SWITCH TO SENSE TRANSMISSION LOCKUP.

3. Connect the BROWN wire to the DDEC ECM wire number 508.
4. The WHITE wire and BLACK wire are connected to the clutch switch.
5. The DARK BLUE wire and YELLOW wire are connected to a shroud which connects to the solenoid external wire harness, P/N 017393. The solenoid internal wire harness was installed earlier (see page 4).

## Undercover Wiring

Connect the two wires to the solenoid valves.

- YELLOW wire to the rear housing.
- BLUE wire to the front housing.

**NOTE:**

THE DDC FACTORY INSTALLED LONG AND SHORT WIRES ARE RED. THE JACOBS WIRES ARE YELLOW.

Store any excess wire along the injector wire harness and secure with plastic wire ties.

# Engine Brake/WABCO ABS Interface with DDEC II

**NOTE:**

THE VEHICLE MAY BE PRE-WIRED FOR ENGINE BRAKE INTERFACE. BEFORE MAKING ANY CHANGES TO THE VEHICLE CONTROLS, CHECK WITH THE VEHICLE MANUFACTURER.

USE THE VEHICLE MANUFACTURER'S RECOMMENDED ENGINE BRAKE RELAY OR JACOBS RELAY, P/N 018257 (+12 VDC).

The engine brake relay is located on the relay/fuse panel as shown below. The relay/fuse panel, along with the ABS Electronic Control Unit (ECU), may be located in one of the following locations, depending on vehicle configuration:

- Behind the passenger's seat in the bunk area
- Under the passenger's seat
- In the cab area by the radio
- In the engine compartment

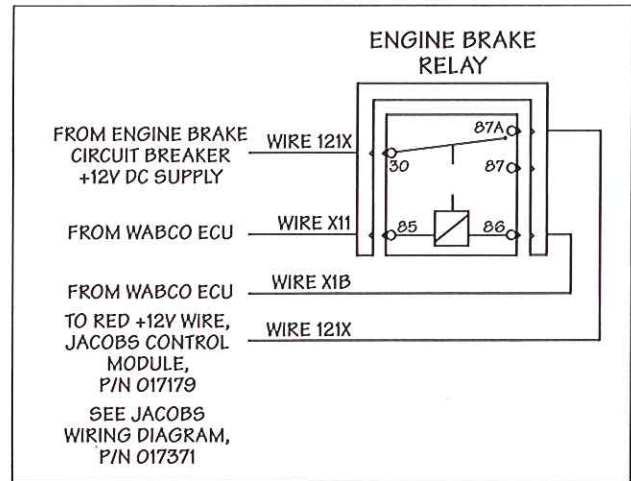


FIG. 22

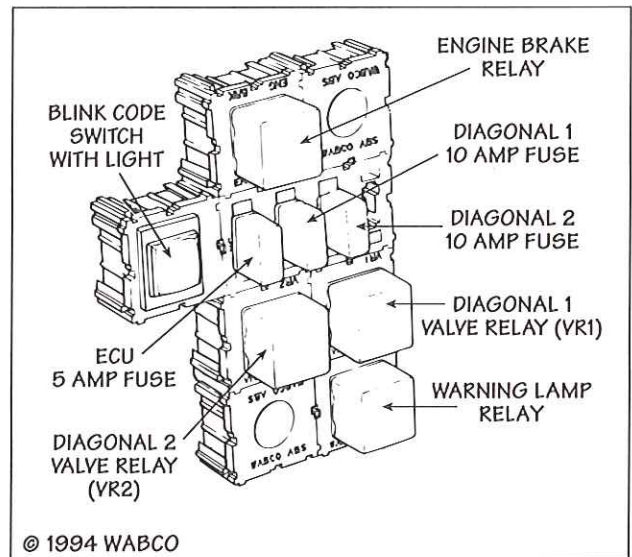
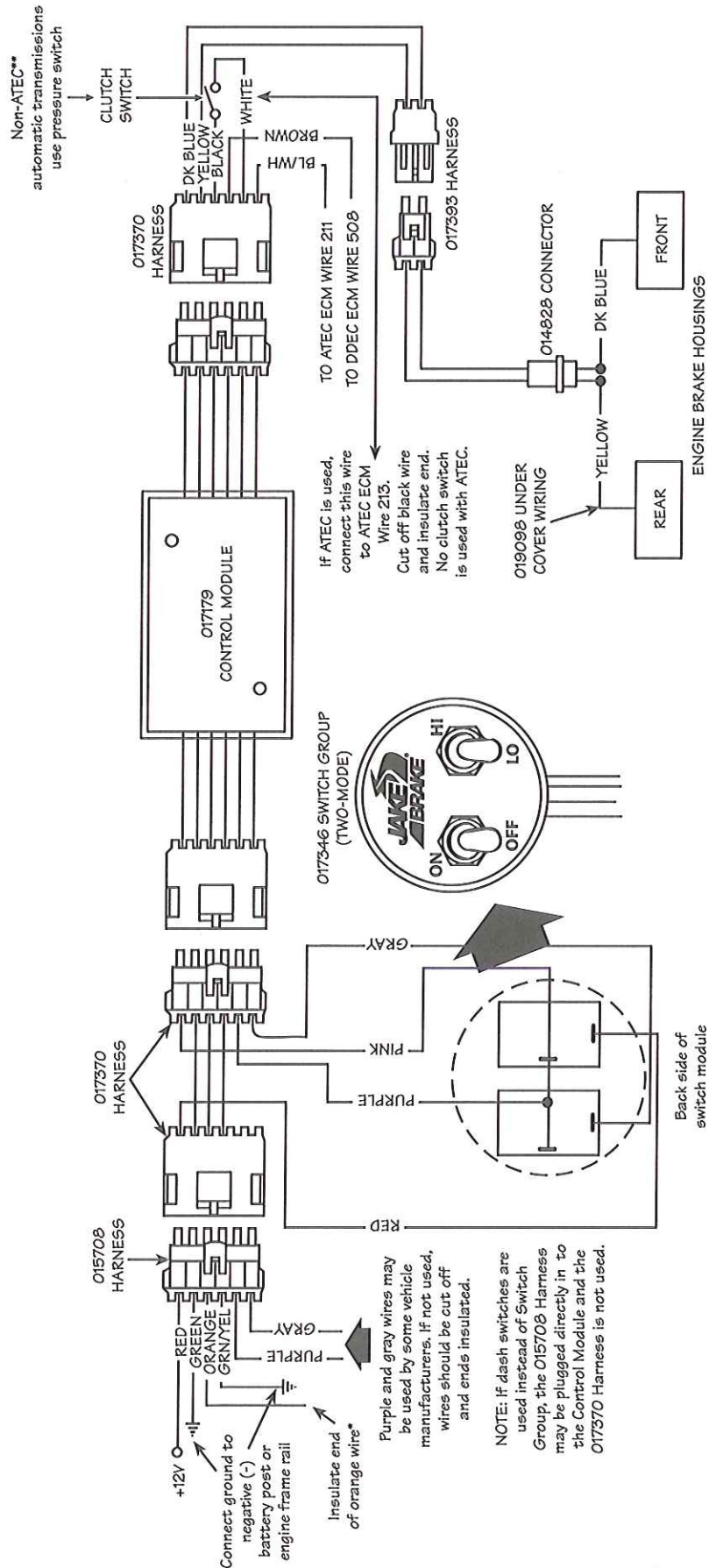


FIG. 23

# MODEL 750 WIRING DIAGRAM DDEC SERIES II (2 MODE)

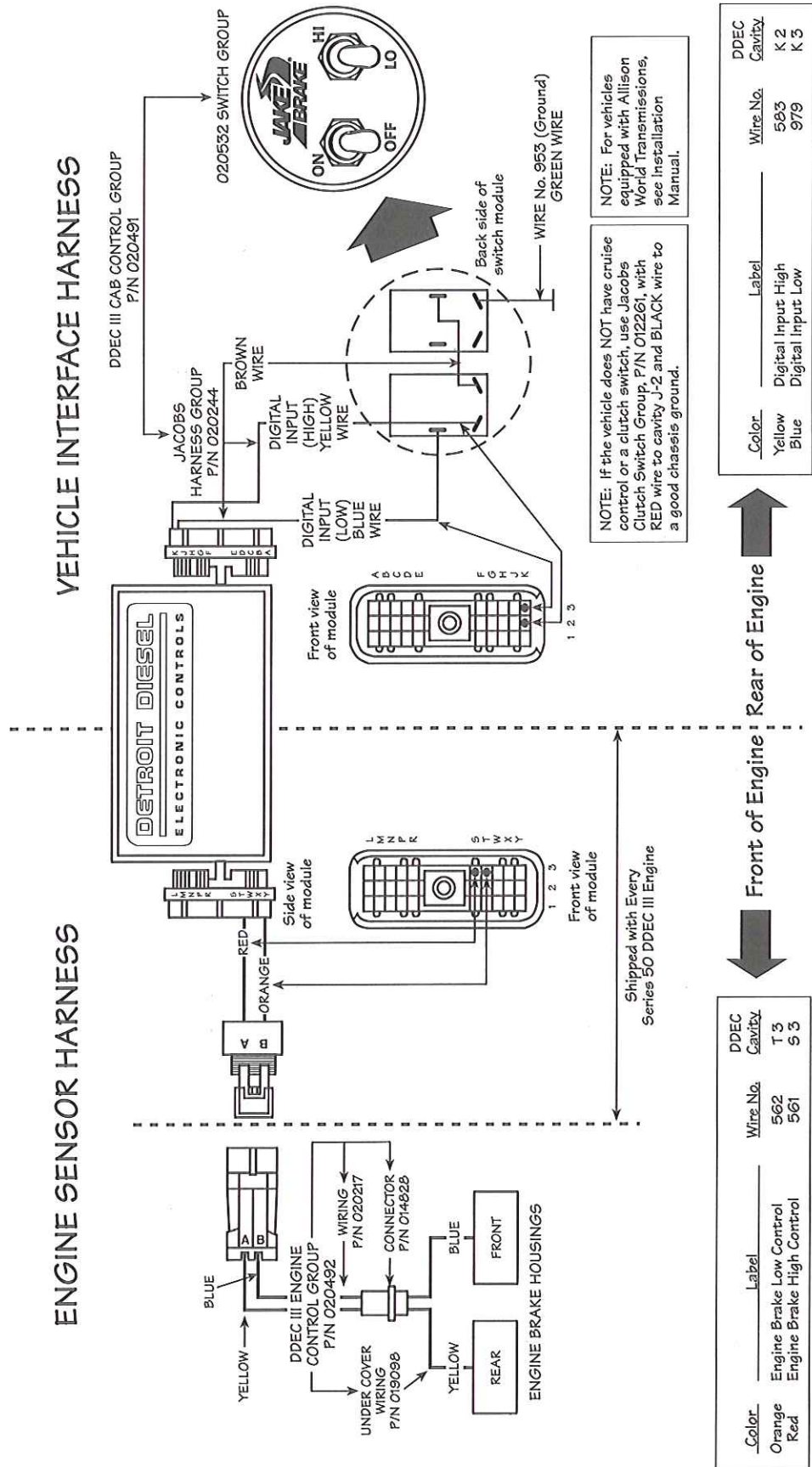
## RETROFIT/AFTERMARKET INSTALLATION



\* Orange wire for ABS. If no ABS is present, insulate end of wire.  
\*\* ATEC: Automatic Transmission Electronic Controlled

FIG. 24

# JAKE BRAKE® MODEL 750 DDEC SERIES III WIRING DIAGRAM



## VEHICLE INTERFACE HARNESS

## ENGINE SENSOR HARNESS

NOTE: If the vehicle does NOT have cruise control or a clutch switch, use Jacobs Clutch Switch Group, P/N 012261, with RED wire to cavity J-2 and BLACK wire to a good chassis ground.

NOTE: For vehicles equipped with Allison World Transmissions, see Installation Manual.

Color	Label	Wire No.	DDEC Cavity
Orange	Engine Brake Low Control	562	T 3
Red	Engine Brake High Control	561	S 3

Color	Label	Wire No.	DDEC Cavity
Yellow	Digital Input High	583	K 2
Blue	Digital Input Low	979	K 3

FIG. 25

# Section 4B: Control System Installation

## Series 50 Engines with DDEC III

### NOTES:

ON SERIES 50 ENGINES EQUIPPED WITH DDEC III, THE ENGINE BRAKE IS CONTROLLED BY THE DDEC III ECM. USE OF A JACOBS' SUPPLIED CONTROL MODULE IS NOT REQUIRED.

MOST VEHICLES EQUIPPED WITH DDEC III ALREADY HAVE A VEHICLE OEM INSTALLED CLUTCH SWITCH TO USE WITH CRUISE CONTROL. IF THIS IS THE CASE, A JACOBS' SUPPLIED CLUTCH SWITCH IS NOT REQUIRED. IF FOR SOME REASON THE VEHICLE DOES NOT HAVE A CLUTCH SWITCH, FOLLOW THE INSTALLATION INSTRUCTIONS FOR "CLUTCH SWITCH" IN THE DDEC II PORTION OF THIS MANUAL.

## Dash Switch

### NOTE:

DDEC III CAB CONTROL GROUP, JACOBS P/N 020491, CONTAINS THE SWITCH GROUP, P/N 020532, AND THE HARNESS GROUP, P/N 020244 .

1. Locate an area on the dash for the dash Switch Group, P/N 020532, and drill a 2" hole.
2. Pass the loose wires of the in-line wire harness, P/N 020244, through the 2" hole from the back to the front.
3. Attach the flag connectors (YELLOW, BLUE and GREEN wires) to the switch terminals on the switch group, P/N 020035, as shown in the wiring diagram (Fig. 25). Note on the wiring diagram that the brown wire is used between terminals on the switch group, P/N 020532.
4. Install the switch assembly with the bracket, lock washers and wing nuts (see Fig. 26).



DO NOT OVER TIGHTEN NUTS. SWITCH FAILURE COULD RESULT!

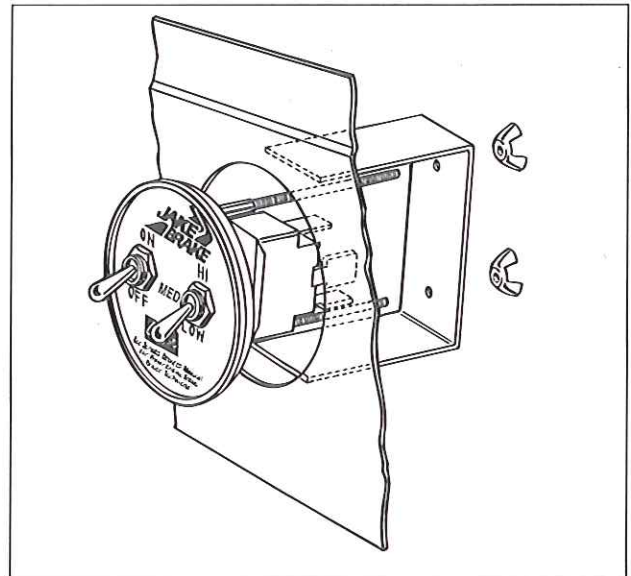


FIG. 26

Refer to the wiring diagram on page 14, Fig. 25, for the following electrical connections.

5. **YELLOW Wire:** Push the YELLOW wire all the way through cavity K2 of the Detroit Diesel connector on the vehicle interface harness and attach the DDC terminal, P/N 12103881, to the wire. Pull the wire until the terminal locks into the DDC connector.
6. **BLUE Wire:** Push the BLUE wire all the way through cavity K3 of the Detroit Diesel connector on the vehicle interface harness and attach the DDC terminal, P/N 12103881, to the wire. Pull the wire until the terminal locks into the DDC connector.
7. **GREEN Wire:** Connect the GREEN wire to a good chassis ground.

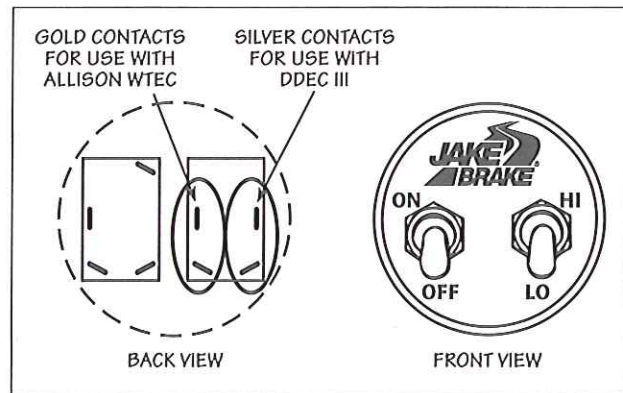


FIG. 27

## Undercover Wiring

1. Connect the two wires to the solenoid valves.
  - YELLOW wire to the rear housing,
  - BLUE wire to the front housing,
2. Store any excess wire along the injector wire harness and secure with plastic wire ties.

### NOTES:

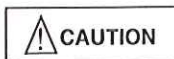
THE DDC FACTORY INSTALLED LONG AND SHORT WIRES ARE WHITE.

IF THE VEHICLE IS EQUIPPED WITH A MANUAL TRANSMISSION, PLEASE PROCEED TO SECTION 5: ENGINE BRAKE OPERATION CHECK. IF THE VEHICLE IS EQUIPPED WITH AN ALLISON WORLD TRANSMISSION PLEASE PROCEED WITH THE FOLLOWING "SPECIAL INSTRUCTIONS FOR ALLISON WORLD TRANSMISSIONS".

## Allison World Transmission Wiring

Both DDEC III and the Allison World Transmission must be programmed to interface with the engine brake. For information on programming the Allison World Transmission and Detroit Diesel DDEC III, please contact your local authorized Allison and Detroit Diesel service facility. The Allison World Transmission inputs and outputs are field programmable, therefore, no standard configuration is available. Identification of your configuration is also available from your authorized Allison Transmission service facility.





IF THE DDEC III AND ALLISON WORLD TRANSMISSION ECMS ARE NOT PROPERLY PROGRAMMED TO INTERFACE WITH THE ENGINE BRAKE, THE ENGINE BRAKE MAY NOT FUNCTION PROPERLY AND ENGINE AND ENGINE BRAKE DAMAGE MAY RESULT!

1. Once you have identified the specific Allison World Transmission configuration, identify the engine brake request and engine brake enable signal.
2. If the engine brake request requires a positive signal, connect the engine brake request wires to the gold contacts on the ON/OFF portion of the switch group to a positive switched voltage source (+VDC) as shown in Fig. 27 (previous page).
3. If the engine brake request requires a ground signal, connect the engine brake request wires through the gold contacts of the on/off switch to wire 161B signal ground of the Allison World Transmission as shown in Fig. 28.
4. Wire the engine brake enable signal wire to the VIM relay or DDEC III engine brake disable as shown on Fig. 28 or 29.

## DDEC III Wiring

### NOTE:

THE WIRING FOR THE DDEC III WAS DONE PREVIOUSLY WITH THE EXCEPTION OF THE DIGITAL INPUT FOR THE CLUTCH SWITCH.

1. The digital input for the clutch switch is a standard default for all application codes (except fire trucks) whenever the cruise control option is selected. Since the Allison World Transmission is an automatic transmission, the digital input for the clutch switch must be grounded or the digital input must be reprogrammed to eliminate the clutch switch input for the proper engine brake and cruise control operation.
2. For installation in fire trucks, contact your local Allison World Transmission service facility or refer to the Allison World Transmission manual (Allison Technical Document 110).

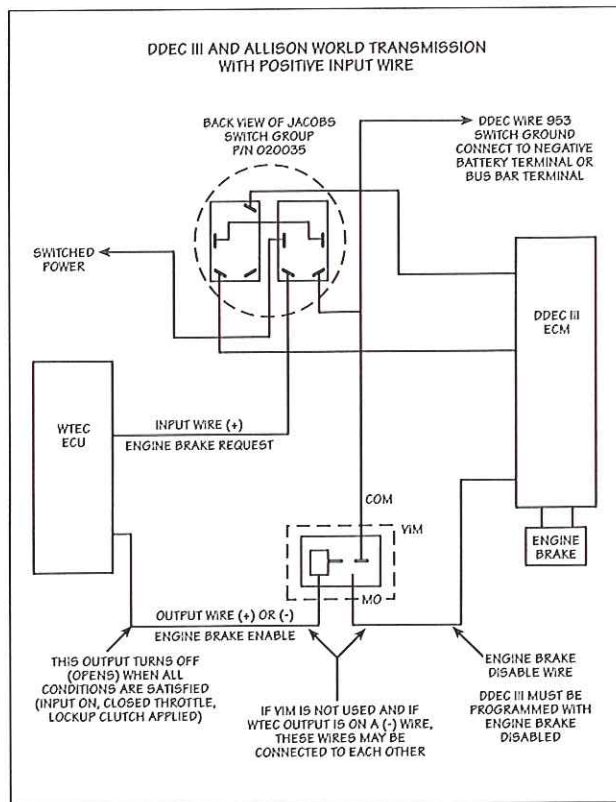


FIG. 28

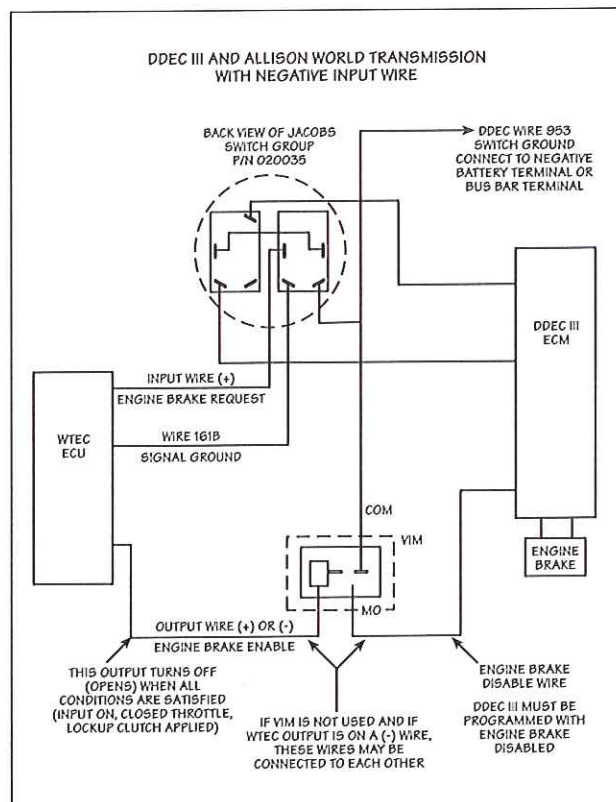


FIG. 29

# Section 5: Brake Operation Check



WEAR EYE PROTECTION AND DO NOT EXPOSE YOUR FACE OVER THE ENGINE AREA. TAKE PRECAUTIONS TO PREVENT OIL LEAKAGE ONTO THE ENGINE. COVER CONTROL VALVE AREAS SUFFICIENTLY TO PREVENT OIL SPLASH.

Whenever the engine is running with the valve covers removed, oil splashing in the engine area could cause personal injury.

Bleed the engine brake housings.

1. Start the engine and allow to run for a few minutes.
2. Depress and release the engine brake solenoid armature (A, Fig. 30) several times to allow the housing to be filled with oil.
3. Watch the master piston (B) to be sure it is moving down onto the roller in the injector rocker arm.
4. Watch the slave piston assembly (C). It should move down to contact the exhaust valve rocker arm adjusting screws.
5. Check each housing to be sure it is functioning.
6. Shut down engine. Be sure the wires are away from moving parts.

## Rocker Cover Installation

1. Lubricate the valve cover limiting sleeves (D) with clean silicone spray. Insert the sleeves into the isolators (B) until the end of the sleeve is flush with the isolator (E) (see Fig. 32).
2. Install the hold-down bolts (A, Fig. 32), with washers (C) installed, to the limiting sleeves (D).
3. Install the hold-down bolt assemblies (A, B, C, D) to the rocker cover base, and thread the bolts two to three threads into the cylinder head.

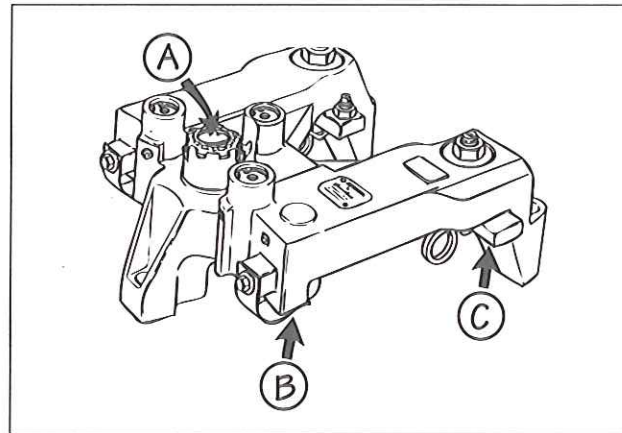


FIG. 30

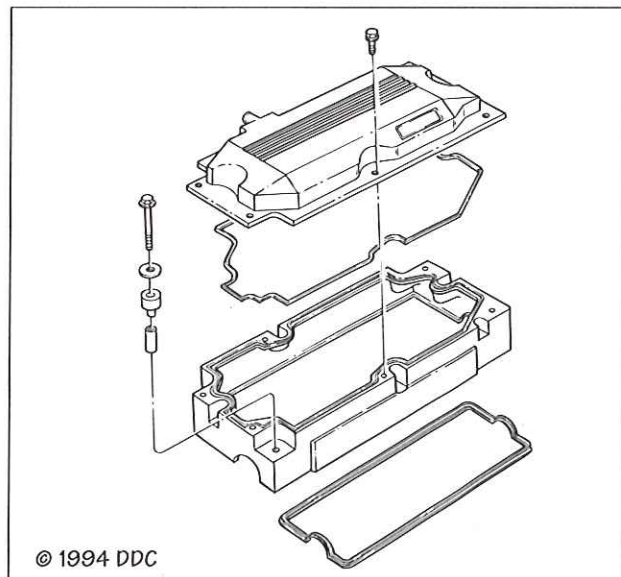


FIG. 31

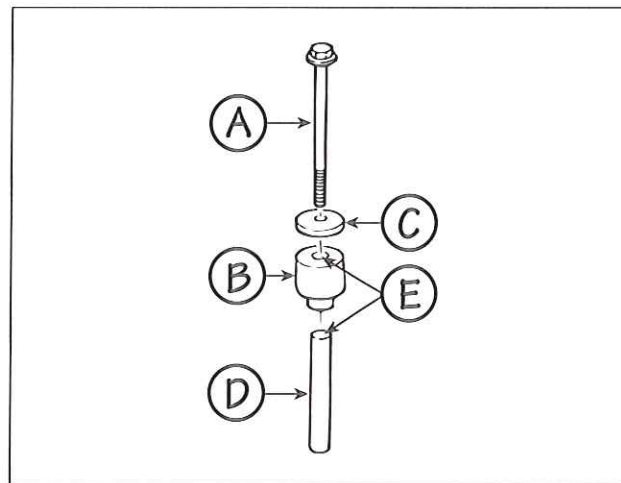


FIG. 32

**NOTE:**

USE CARE WHEN TIGHTENING THE ROCKER COVER BASE HOLD-DOWN BOLTS THAT THE INJECTOR WIRES DO NOT GET CAUGHT BETWEEN THE LIMITING SLEEVE AND THE CYLINDER HEAD (FIG. 33).

4. Torque the ten rocker cover base hold-down bolts to 25 lb.-ft. (35 N•m) using the tightening sequence shown in Fig. 34. Tighten the bolts in two stages, using half-torque value first.
5. Be sure the groove in the top of the rocker cover base and its mating, diamond-shaped seal are clean and dry. Install the diamond-shaped seal to the groove by pressing the seal into the groove. Use care not to stretch or twist the seal. The seal has a definite shape and should be installed exactly as removed from the base. If the seal cannot be installed to its groove without bunching or looping, the seal is stretched and must be replaced.
6. Install the rocker cover cap to the base. Install the 8 screws that attach the cap to the base and tighten to 20 lb.-ft (25 N•m) torque in 2 stages, using half-torque value first. Use the torque sequence shown in Fig. 35.

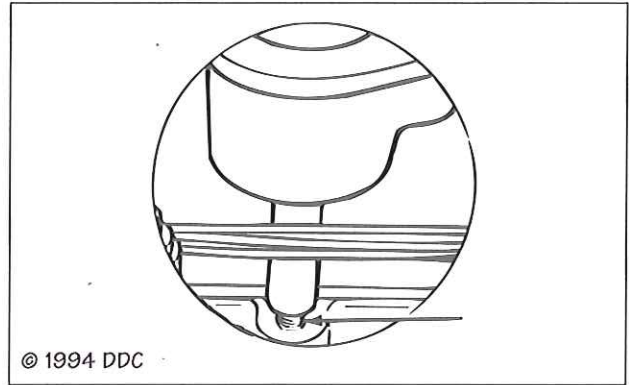


FIG. 33

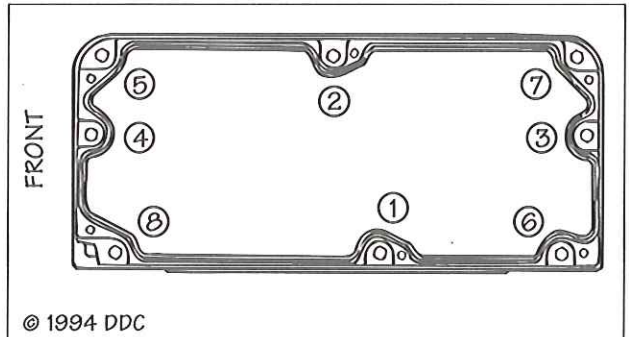


FIG. 34

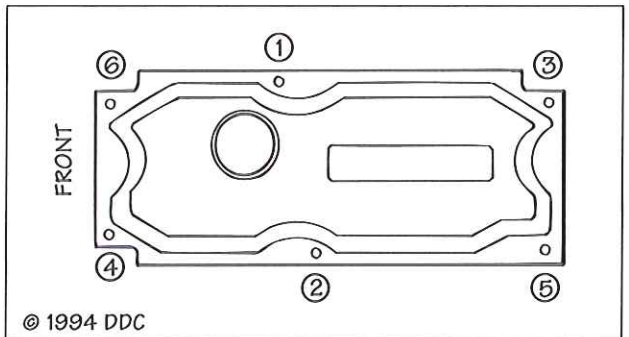


FIG. 35

# 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.

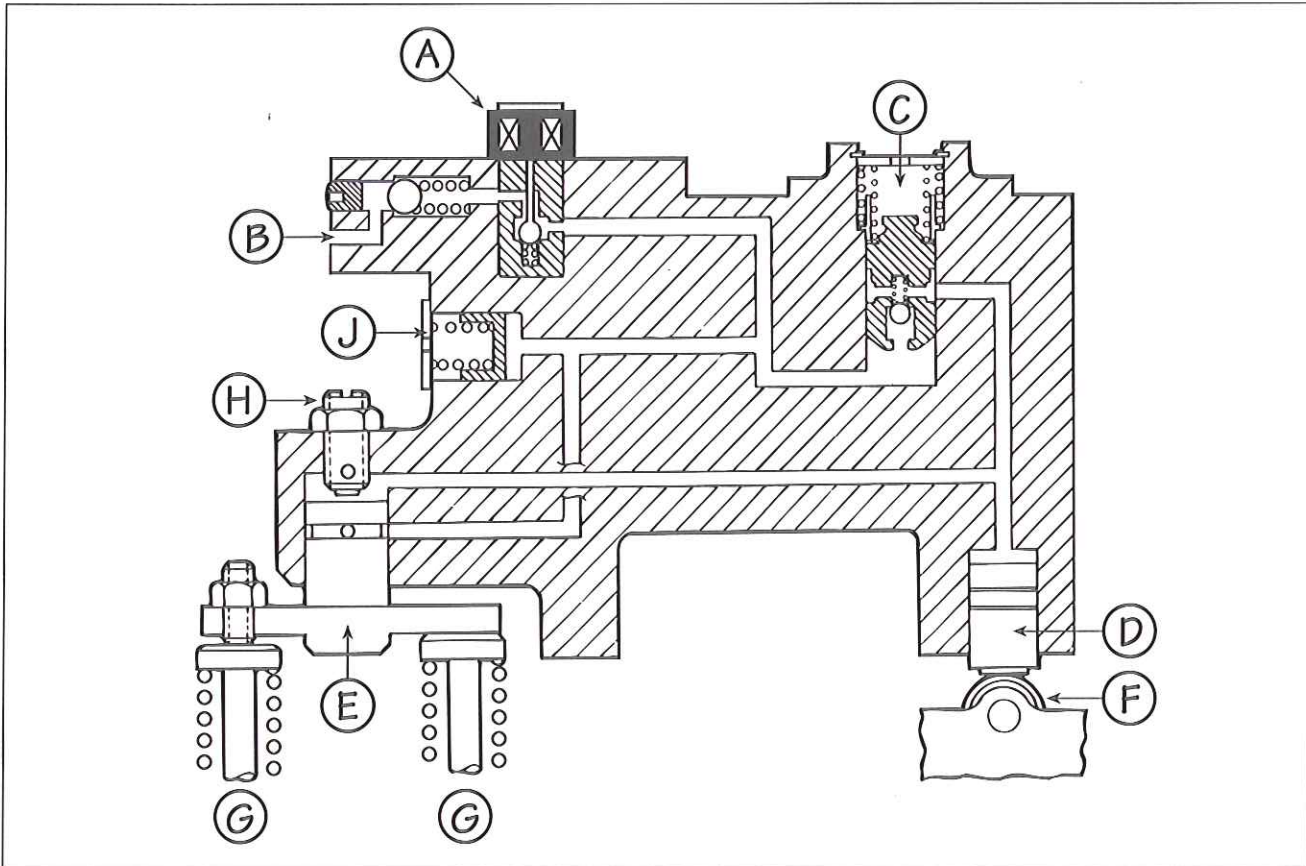
The blowdown of compressed air to atmospheric pressure prevents the return of energy to the engine piston on the expansion stroke. The effect of this action is a net energy loss, since the work done in compressing the cylinder charge is not returned during the expansion process.

## Exhaust Blowdown

Refer to the schematic drawing below:

1. The energized solenoid valve (A) permits engine lube oil (B) to flow under pressure through the control valve (C) to both the master piston (D) and the slave piston (E).
2. Oil pressure causes the master piston to move down, coming to rest on the injector rocker arm roller (F).

3. The injector rocker arm begins its travel as in the normal injection cycle, moving 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. High pressure oil causes the slave piston to move down, momentarily opening the exhaust valves (G), while the engine piston is near its top dead center position, releasing compressed air to the exhaust manifold.
5. At the bottom of its stroke, the slave piston separates from the valve in the slave piston adjusting screw (H) allowing high pressure oil to flow into the accumulator (J). This reduces the pressure in the high pressure circuit, permitting the slave piston to retract and the exhaust valves to close in preparation for the normal exhaust valve cycle. The oil pressure reserved in the accumulator insures that the hydraulic circuit is fully charged for the next cycle.
6. Compressed air escapes to the atmosphere, completing a compression braking cycle.



SCHEMATIC DRAWING



### WARNING

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

The Jacobs Engine Brake is typically a trouble-free device. However, inspections are necessary and some maintenance is required. Use the following procedures to keep the engine brake in top condition.

This section covers 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



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

1. Press down on control valve washer using an appropriate diameter rod to relieve spring pressure (see Fig. 37).
2. Remove retaining ring using retaining ring pliers.
3. Slowly remove cover until spring pressure ceases, then remove the two control valve springs and collar (see Fig. 38).
4. Using needle-nose pliers, reach into the bore and grasp the stem of the control valve. Remove control valve.
5. 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 insure that the ball check is free. The ball should lift with light pressure on the wire. 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.

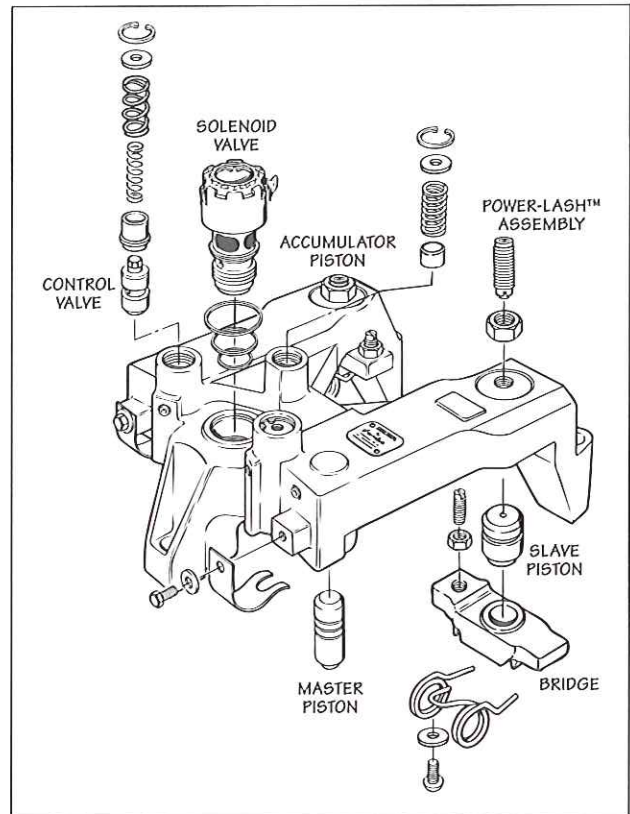


FIG. 36

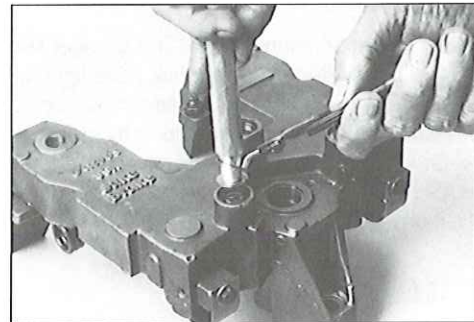


FIG. 37

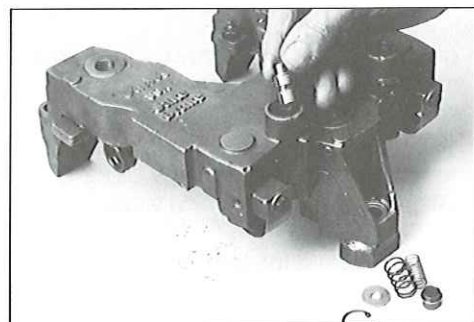


FIG. 38

7. Dip the control valves in clean lube oil. Holding the valve by the stem, let the valve drop into its bore. If binding occurs or if the ball is stuck in the valve, the control valve should be replaced. Reassemble parts reversing the removal procedure. Be sure retaining ring ears are rotated 90° after installation.

**NOTE:**

BE SURE THE CONTROL VALVE COLLAR IS INSTALLED WITH THE LONGER SLEEVE AREA UP (SEE FIG. 39). IF THE COLLAR IS INSTALLED UPSIDE DOWN, THE ENGINE BRAKE CYLINDER WILL NOT OPERATE.

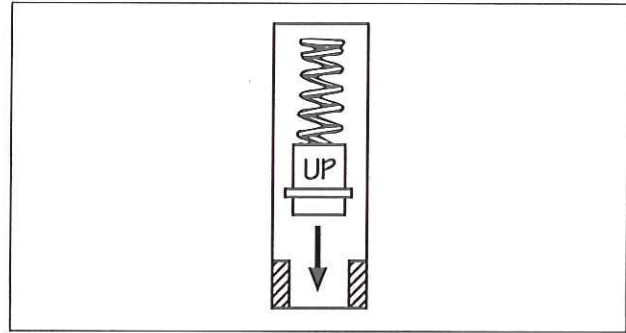


FIG. 39

## Slave Piston Adjusting Screw (Reset Screw/Power-Lash™ Assembly)



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

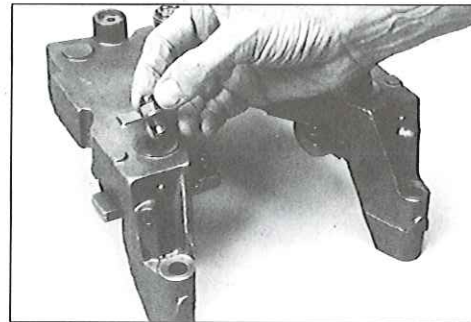


FIG. 40

Loosen slave piston adjusting screw locknut and remove adjusting screw from housing (see Fig. 40). Clean in an approved cleaning solvent.

Inspect slave piston adjusting screw. The plunger should protrude from the bottom of the screw, have light spring pressure apparent when depressed, and move freely. Be sure the retaining ring is fully engaged in its groove (groove is located on the bottom of the reset screw and top of the POWER-LASH assembly). Replace the entire screw assembly, if any defect is found (see Fig. 41).

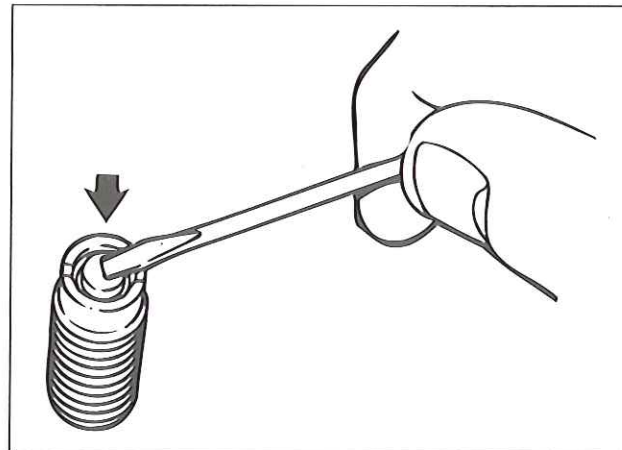
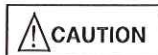


FIG. 41

## Solenoid Valve

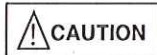


DO NOT DISASSEMBLE OR TAMPER WITH THE SOLENOID VALVE. ENGINE DAMAGE COULD RESULT.

1. Disconnect solenoid valve harness. Using 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 bore, remove with a piece of wire.
3. Wash out the solenoid valve with approved cleaning solvent. Use a brush to clean the oil screen. Rinse the solenoid valve in cleaning solvent.

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. Coat new solenoid valve seal rings with clean lube oil. Install the upper (A) and center (B) seal rings on the solenoid valve body and the lower (C) seal ring into the bottom of the bore in the housing (see Fig. 42).
6. Be sure the seals are seated properly. Carefully screw the solenoid valve into the housing without unseating the seals. Torque the valve to 110 lb.-in. (12.4 N•m). Be careful not to twist the seals while installing.

## Accumulator



THE ACCUMULATOR SPRING IS UNDER STRONG COMPRESSION. USE CAUTION WHEN REMOVING THE RETAINING RING AND COVER. WEAR SAFETY GLASSES. IF THE SPRING IS ACCIDENTALLY DISCHARGED, PERSONAL INJURY MAY RESULT.

1. Push down on the accumulator cover using the appropriate diameter rod and remove the retaining ring (see Fig. 43).
2. Relieve pressure on the accumulator cover; remove the cover and spring.
3. Use a magnet to remove the piston from the accumulator bore (Fig. 44).
4. Inspect the parts for wear or damage; replace if needed.
5. Reassemble by installing the piston, spring, cover and retaining ring.

## Master Piston

1. Remove the screw, washer and master piston spring from the housing.
2. Remove the master piston (see Fig. 45). Use needle-nose pliers if necessary.

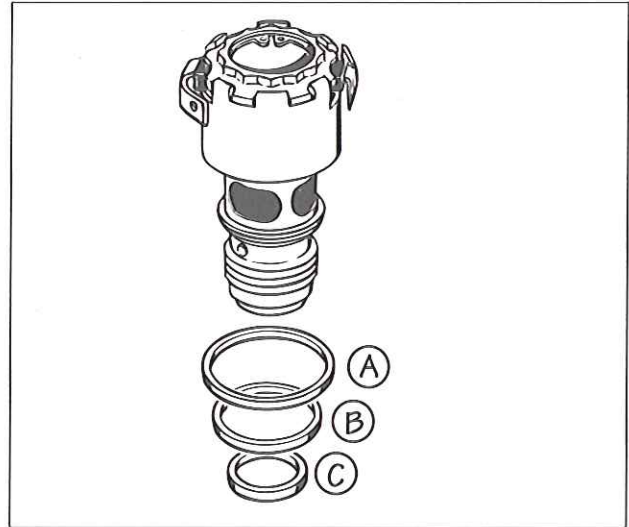


FIG. 42

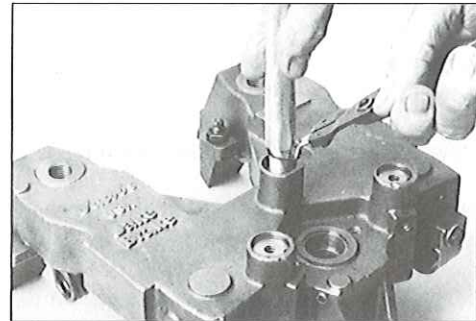


FIG. 43

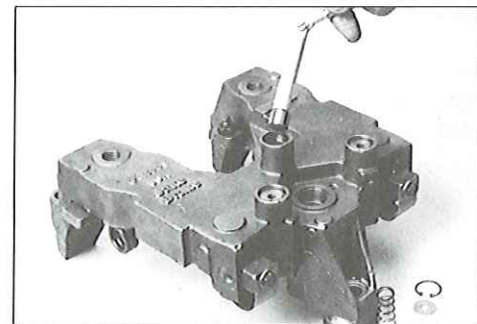


FIG. 44

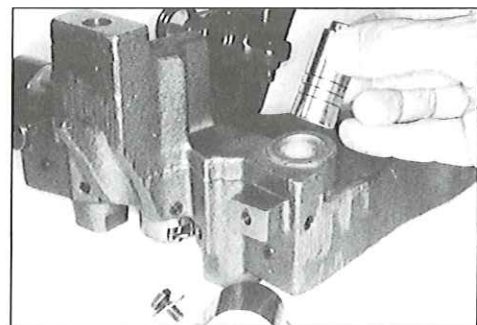


FIG. 45

3. Clean the master piston in approved cleaning solvent. Inspect for excessive wear or damage. Replace if necessary. Inspect the master piston bore. Some wear marks are permissible. Apply clean lube oil to the piston and insert into bore. Master piston should move in and out freely with no binding. If binding occurs, replace master piston and/or housing.
4. Reassemble the master piston, spring, washer and screw to the housing. Tighten the screw to 100 lb.-in. (10 N•m).

The spring should hold the master piston completely in the housing. If not, the spring has relaxed and must be replaced.

**NOTE:**

BE SURE SPRING LEGS ARE CENTERED AROUND MASTER PISTON BOSS.

## Slave Piston

1. Remove the screw and spring that retains the slave piston return spring.
2. Remove the bridge and the slave piston (see Fig. 46).
3. Loosen the leveling screw locknut and remove the leveling screw from the bridge (Fig. 47).
4. Inspect all components for excessive wear or damage. Replace parts if necessary.
5. Reinstall the screw from the slave piston side of the bridge as shown.
6. Reinstall all components. Install the bridge with the leveling screw toward the center of the housing (see Fig. 48).

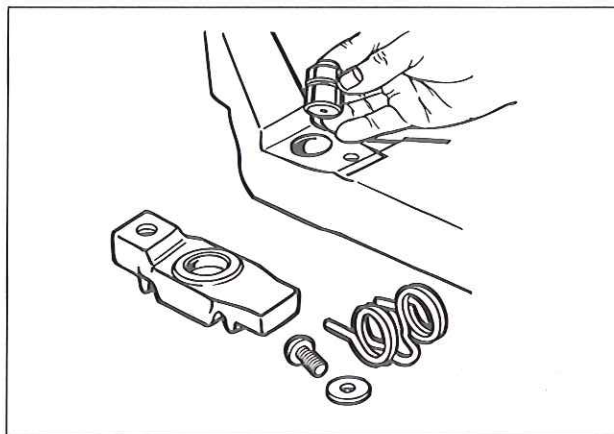


FIG. 46

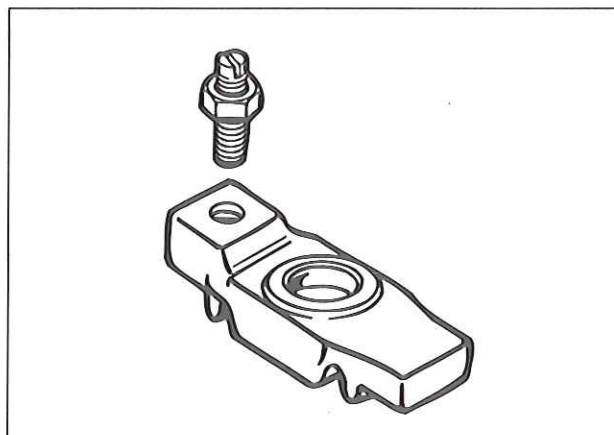


FIG. 47

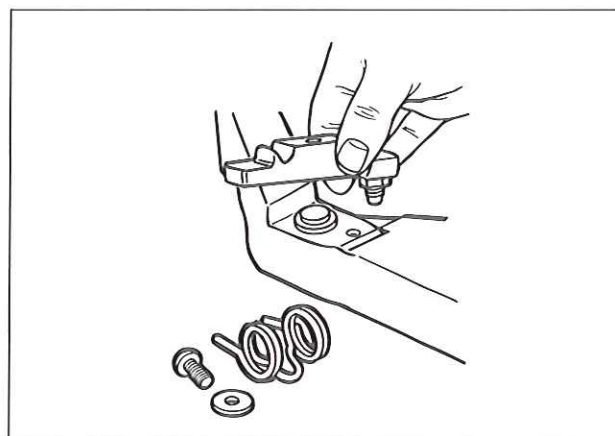


FIG. 48



7. Install the slave piston assembly torsion spring with the ends over the bridge (see Fig. 49).



WHILE TIGHTENING THE SCREW ON THE TORSION SPRING, PUSH THE SPRING TOWARDS THE SLAVE PISTON ASSEMBLY. FAILURE TO DO SO MAY RESULT IN CONTACT BETWEEN THE INTAKE VALVE ADJUSTING SCREW AND TORSION SPRING. SERIOUS ENGINE DAMAGE MAY RESULT.

8. Install the screw over the center part of the spring.
9. Tighten the screw to 15 lb.-ft. (20 N·m).

## Master Piston Pin/Roller

The injector rocker arm contains a pin and roller for actuating the engine brake master piston. If excessive wear or damage to the roller is present, the injector rocker arm assembly must be replaced according to the following instructions:

1. Remove the engine brake housings.
2. Loosen the locknuts on the intake, exhaust and injector adjusting screws.
3. Remove the bolts, spacers and nuts from the rocker shaft.
4. Lift off the rocker arm assembly (see Fig. 51).
5. Slide the rockers off the shaft (Fig. 52), marking the parts so they may be reinstalled in the same position.
6. Clean the rocker arms and rocker arm shafts in an approved cleaning solvent. Blow dry with compressed air.

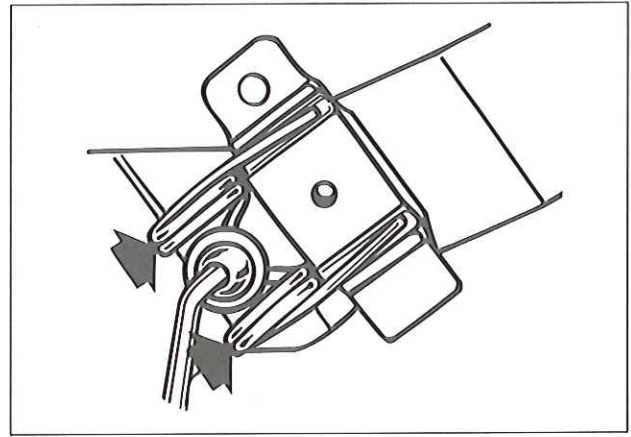


FIG. 49

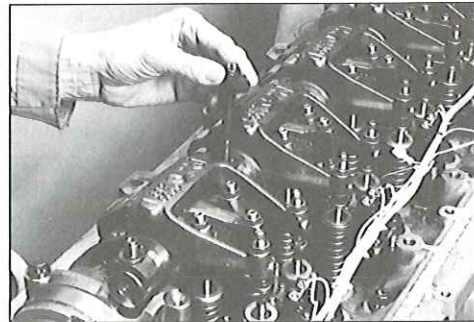


FIG. 50

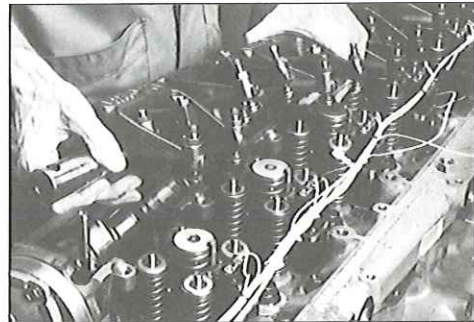


FIG. 51

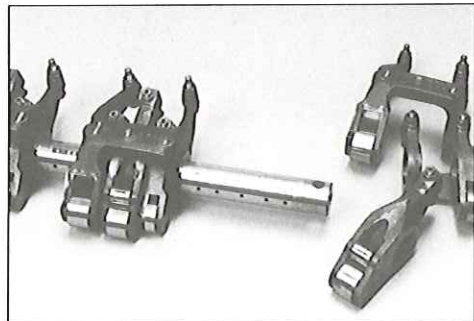


FIG. 52

7. Replace the injector rocker arm assembly that has the damaged roller with a new part. Reassemble the parts in the same order as they were removed (see Fig. 53).
8. Check the torque on the rocker shaft studs to be sure they were not loosened when the nuts were removed (Fig. 54). Tighten the studs to 80 lb.-ft. (110 N•m).

To replace the valve button (A, Fig. 55) or valve button retaining clip (B), the valve adjuster screw (C) must be removed from the rocker arm.

To remove, spread the retaining clip with the Kent Moore expander (D), P/N J-36347, and remove the valve button.

**NOTE:**

REPLACEMENT ADJUSTER SCREWS ARE AVAILABLE FROM DETROIT DIESEL CORP.

To replace, slide the retaining clip, open end first, down the adjusting screw. It is necessary to spread the clip slightly so that the open end can pass over the ball head of the adjuster screw. Insert the tips of the Kent Moore expander between the legs of the retaining clip; expand the clip. Insert the groove on the valve button into the legs of the retainer clip. Remove the expander tool and hold the legs of the retainer with the thumb and index finger. Press the valve button toward the screw to seat both legs of the retainer completely in the groove (see Fig. 55).

**NOTE:**

THE VALVE BUTTON RETAINER MUST NOT BE EXPANDED MORE THAN 0.610" (15.5 MM). A LIMITING SCREW IS PROVIDED ON THE EXPANDER TOOL TO RESTRICT THE AMOUNT OF TRAVEL.

9. Install the rocker shaft assembly using the bolts, end spacers and nuts (see Fig. 56).

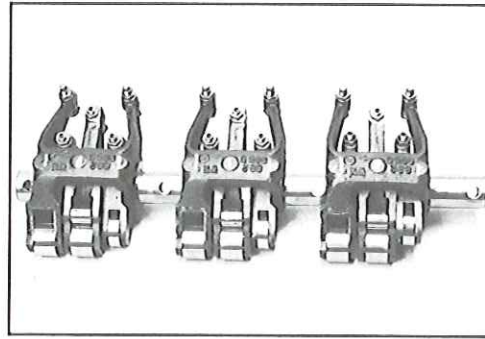


FIG. 53

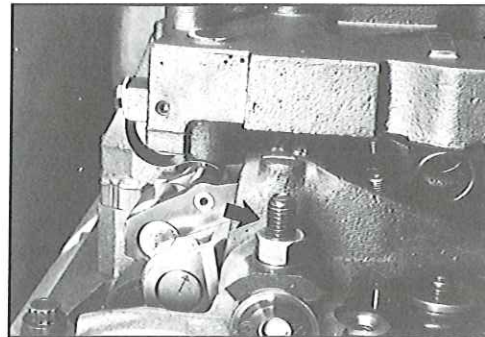
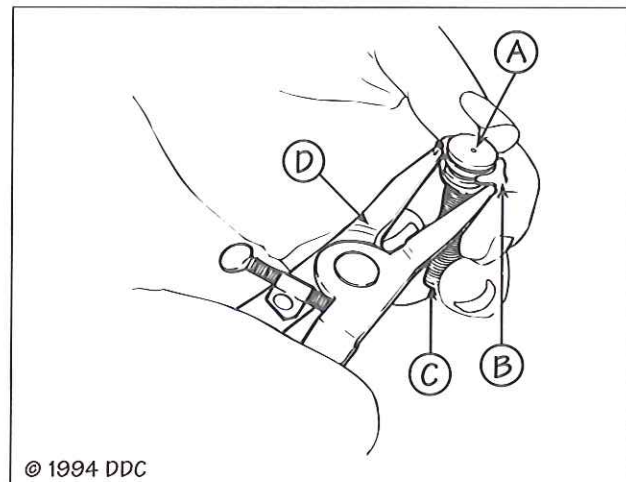


FIG. 54



© 1994 DDC

FIG. 55

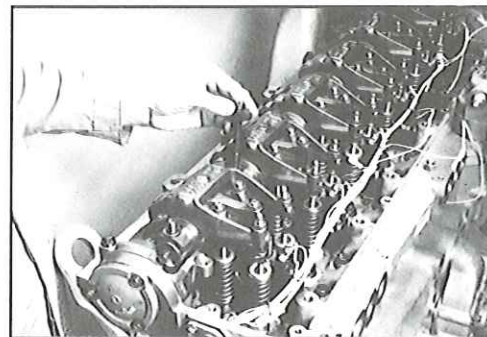


FIG. 56

- Tighten the bolts and nuts to 80 lb.-ft. (110 N•m) following the sequence shown in Fig. 57.

## Using the Timing Circle Method

It will be necessary to bar the engine over only two complete revolutions. On each revolution, two cylinders will have valves adjusted and two other cylinders will have injector height adjusted.

- Disconnect starting power for engine.
- Remove the engine valve rocker cover.
- Bar the engine over by inserting a 3/4" drive breaker bar or ratchet into the square hole in the center of the crankshaft pulley. Stop engine rotation when any one of the fuel injector followers has just begun its downward stroke. Note number of this cylinder.
- Refer to the Timing Circle Chart in Fig. 58 and locate the cylinder. The Timing Circle can be started with any cylinder.
- Adjust the intake valves on that cylinder by inserting a 0.008" (0.203 mm) feeler gage between the tip of the valve stem and the valve button at the end of the rocker arm.
- Loosen the locknut and turn the adjusting set screw (Fig. 59) until the feeler gage produces an even or smooth pull between the valve stem and the valve button.
- Torque the locknut to 35 lb.-ft. (47 N•m) and remove the feeler gage. Reinsert the feeler gage to check that the adjustment did not change when the locknut was tightened. Readjust as necessary.
- Adjust exhaust valves the same way as the intake valves, except use a 0.026" (0.660 mm) feeler gage.

**NOTE:**

ALWAYS SET VALVE LASH CLEARANCE OR INJECTOR HEIGHT TO THE SPECIFIC DIMENSIONS GIVEN IN THE TEXT (SETTING DIMENSIONS).

- Complete the adjustment of all four valves (two intake, two exhaust) for that cylinder before proceeding to Step 10.
- Refer to the Timing Circle Chart in Fig. 58. Note which cylinder number is listed in the parentheses directly under the cylinder that just received valve adjustment.

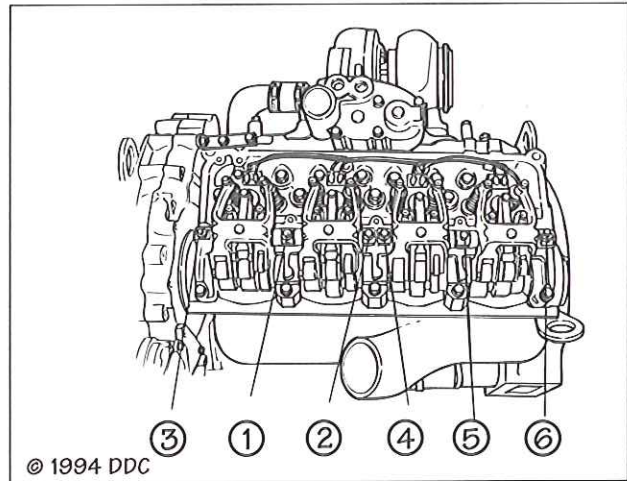


FIG. 57

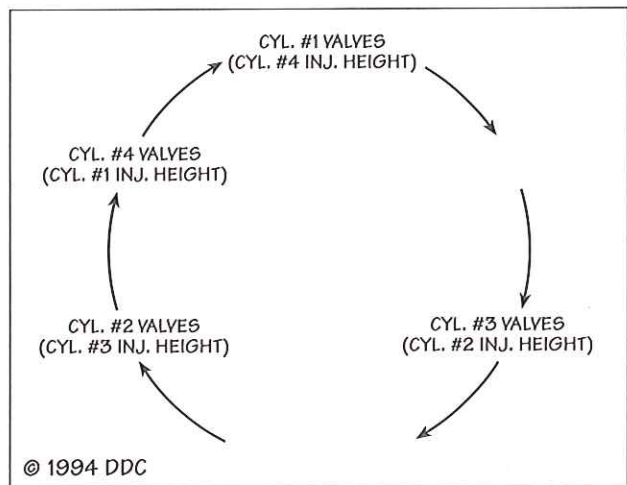


FIG. 58

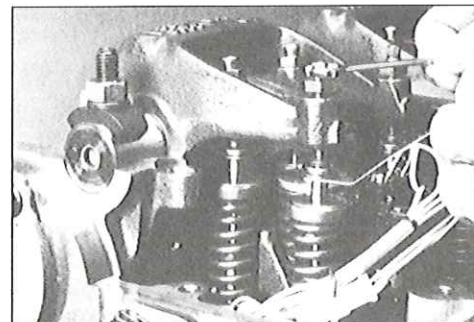


FIG. 59

11. Adjust the fuel injector height for the cylinder, indicated on the Timing Chart in parentheses ( ), by placing the small end of the Height Gage (A, Fig 60), J35637-A, in the pilot hole (B) provided in the fuel injector body (C), with the flat of the gage toward the fuel injector plunger as shown.
12. Loosen the fuel injector rocker arm locknut (E, Fig. 61) and turn the adjusting set screw (D) until the extended part (flag) (B) of the gage will just pass over the top of the injector follower (G). An accurate "feel" should be developed. The objective will be to adjust all six injectors to the same feel.
13. Tighten the locknut to 35 lb.-ft. (47 N•m). Check the adjustment with the Height Gage (A) and, if necessary, readjust the set screw (D). Remove the Height Gage.

**NOTE:**

BE SURE THE HEIGHT GAGE SEATS ON THE MACHINED SURFACE WITH THE TIP IN THE PILOT HOLE. FOREIGN MATERIAL IN THE PILOT HOLE OR ON THE MACHINED SURFACE MAY PREVENT ACCURATE SETTING OF THE INJECTOR HEIGHT.

14. Follow the arrow on the Timing Circle Chart to find the next cylinder in the adjustment sequence. Bar the engine over in the direction of normal rotation until the injector follower of the NEXT cylinder in the adjustment sequence begins its downward motion.
15. Repeat the valve adjustment and fuel injector height adjustment procedures until all of the valves and fuel injectors have been adjusted.

**NOTE:**

IT IS NORMAL FOR TUNE-UP SETTINGS TO VARY, EVEN WHEN USING THE CORRECT SETTING PROCEDURES. SOME ITEMS INFLUENCING TUNE-UP MEASUREMENTS ARE DIFFERENCES IN GAGES, INDIVIDUALS AND MECHANICAL VARIATIONS. THE ADJUSTMENT CHART INDICATES ACCEPTABLE CHECKING TOLERANCES DETERMINED TO ASSURE ENGINE PERFORMANCE AND ALLOW FOR NORMAL VARIABILITY.

16. Install and adjust engine brake housings as outlined in Section 3. Replace the engine rocker cover and reconnect starting power to the engine.

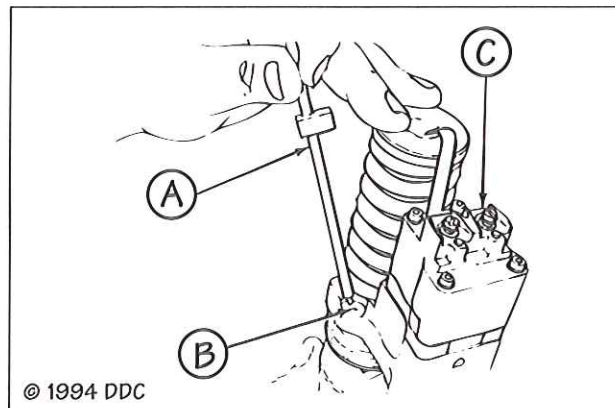


FIG. 60

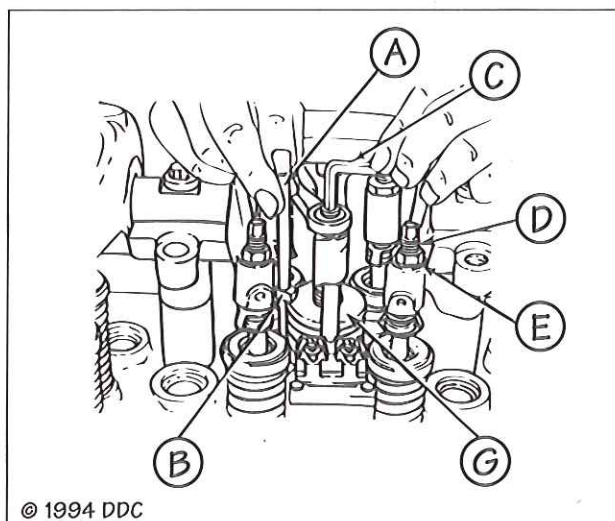


FIG. 61

**Jacobs®**

Jacobs® and Jake Brake® are registered trademarks and Power-Lash™ is a trademark of  
 Jacobs Vehicle Equipment Company  
 22 East Dudley Town Road  
 Bloomfield CT 06002