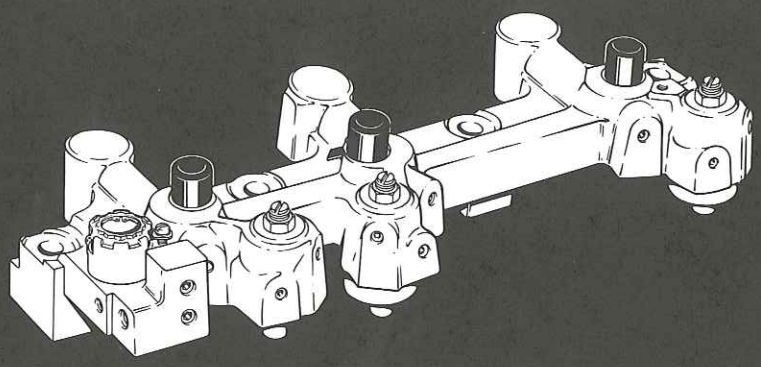
Installation Manual for Models 404-404B-404BG-404C

Jacobs® ENGINE BRAKE



The Model 404 Jake Brake® retarder is designed and approved for use on Cummins L-10 engines including 49 state "carb" (Calif.) and 88L10 engines. The Model 404 is not approved for use on 91L10 engines.

The Model 404 was superseded by the Model 404B. The Model 404B Jake Brake engine application is the same as the Model 404 which is: all L10 engines with guided exhaust valve crossheads except 91L10.

The Model 404BG kit contains guideless exhaust valve crossheads and replaces the Model 404B. Engine application is the same as the Models 404 and 404B.

The Model 404C is designed and approved for use on 91L10 engines both CELECT™ and STC, injection timing control.

The information contained in this manual was current at the time of printing and is subject to change without notice or liability.

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

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

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

THE JAKE BRAKE 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.

⚠ WARNING ***See Jacobs Driver's Manual for Proper Engine Brake Driver Techniques***

CELECT is a trademark of the Cummins Engine Company

JAKE BRAKE®

Jacobs® Vehicle Equipment Company
22 East Dudley Town Road
Bloomfield, CT 06002

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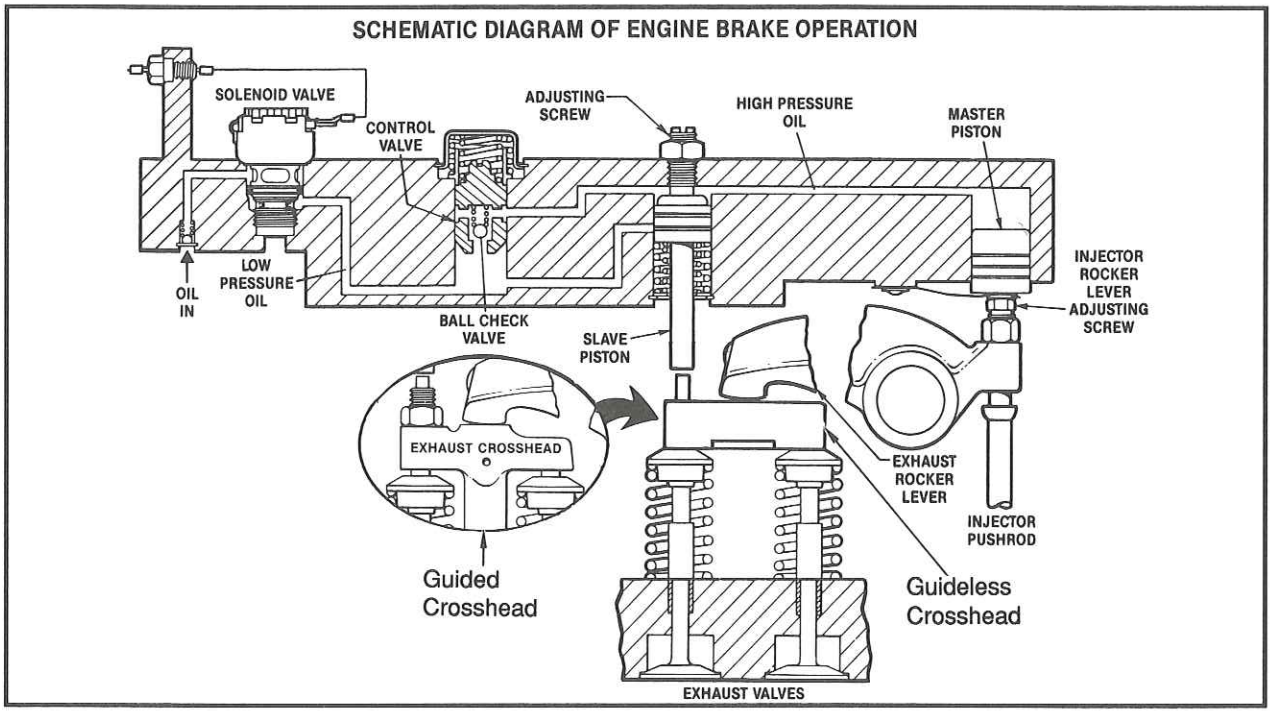


THEORY OF OPERATION - Simply stated, energizing the Engine Brake effectively converts a power producing diesel engine into a power absorbing air compressor. This is accomplished through motion transfer using a master-slave piston arrangement which opens cylinder exhaust valves near the top of the normal 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 being 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, exhaust blowdown occurs as follows:

1. Energizing the solenoid valve permits engine lube oil to flow under pressure through the control valve to both the master piston and the slave piston.

2. Oil pressure causes the master piston to move down, coming to rest on the injector rocker arm adjusting screw.

3. The injector rocker arm adjusting screw begins upward travel (as in normal injection 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 opening the exhaust valve, while the engine piston is near its top dead center position, releasing compressed cylinder air to the exhaust manifold.

5. Compressed air escapes to atomosphere, completing a compression braking cycle.

For information on driving with the Jake Brake retarder, read your Jacobs Driver's Manual. To get a detailed presentation on driving with the Jake Brake retarder, consult your Jacobs distributor.

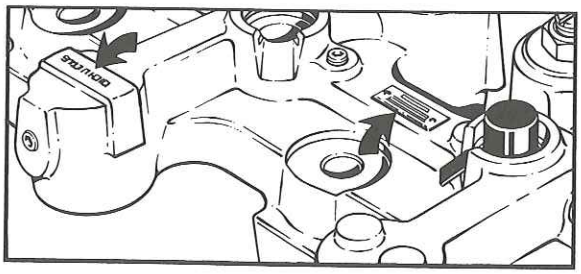
ENGINE BRAKE HOUSING IDENTIFICATION

Refer to figure on page 4. Model 404B-404BG and 404C have a nameplate(A) attached to the top suface of the housing identifies the Model number, part number, front or rear and slave piston lash setting. The 404C name plate is plain aluminum color, the Model 404B is red and the Model 404BG is yellow.

The Model 404 has the model number and front or rear identification cast into the top suface of the housing.

The housing serial number on all model housings is stamped on the top surface of the center master piston boss. (B)

For housing part number and other replacement part information refer to the parts manual part number 015746. Parts manuals may be obtained from Jacobs distributors or by contacting Jacobs Vehicle Equipment Co., 22 East Dudley Town Road, Bloomfield, CT 06002.



ENGINE IDENTIFICATION

Prior to engine brake installation verify that engine is correct for engine brake model being installed. The engine identification is on the serial number plate located on the fuel pump side of the engine block.

ROCKER LEVER SHAFT SUPPORT EXCHANGE REQUIREMENT

Early production L10 engines with serial numbers below 34500844 have been assembled with rocker lever supports that cannot be used for installation of the Jake Brake. New rocker shaft supports must be obtained as the first step in the installation of the Jake Brake on these early engines. New supports are not included in the Engine brake kit but can be obtained from Cummins distributors. See Section 7 for rocker shaft disassembly instructions.

SPECIAL TOOLS

The L10 Engine and the Models 404, 404B,BG and C Jacobs Engine Brakes, are primarily of metric design. Therefore, metric tools are required for installation and service work.

The following special tools should be available for the installation.

1. Injector Adj. Tool Kit
   (Non Top Stop Injectors) Cummins P/N - 3376648
2. Rocker Lever Actuator
   (Non Top Stop Injectors) Cummins P/N 3375790
3. Injector Adjusting Screw
   "C" Wrench 7/16" Cummins P/N ST1137A
4. Injector Adjusting Screw
   "C" Wrench 3/4" (CELECT) Cummins P/N 3823796
5. Injector Adjusting Tool
   Torque Wrench Cummins P/N 3376592
6. STC Tappet Tool Cummins P/N 3622648
7. Crowfoot 7/8" Cummins P/N 3823820
8. Cummins L10 Maintenance Manual
9. Feeler Gauge - Slave Piston (.015 in.) Jacobs P/N 014341

RECOMMENDED TORQUE VALUES	
Exhaust valve crosshead adjusting screw locknuts	25 lbft. (34 N·m)
Rocker lever adjusting screw locknuts	See instructions
Engine brake holddown capscrews	95 lbft (130 N·m)
Button Head screw (spacer)	80 lbin (9 N·m)
Slave piston adjusting screw locknuts	25 lbft (34 N·m)
Oil supply fitting (engine brake housing)	14 lbft (19N·m)
Oil supply fitting (filter head)	105 lbin (12 N·m)
Capscrews - Jacobs spacer	12 lbft (16 N·m)

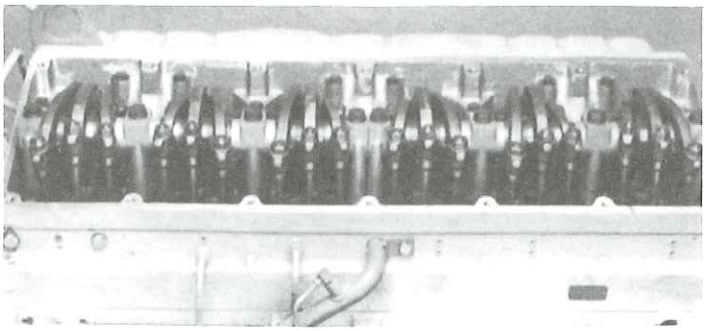
NOTE:
Unless otherwise specified, the torque values listed above and in the instruction manual are direct values using no torque wrench adapters or extensions. When adapters or extensions are used with a torque wrench, the torque values must be adjusted for the specific wrenches being used. Follow the manufacturers recommended procedures for the torque wrench and adapter being used.

AUTOMATIC TRANSMISSIONS

⚠WARNING

FOR VEHICLES WITH AUTOMATIC TRANSMISSIONS LOW SPEED SWITCH, P/N 015644, IS REQUIRED TO ENSURE SHUT OFF OF THE ENGINE BRAKE BEFORE ENGINE STALL SPEED, (RPM) IS REACHED. UNANTICIPATED ENGINE STALL AT LOW ROAD SPEED CAN RESULT IN LOSS OF VEHICLE CONTROL BY THE OPERATOR.

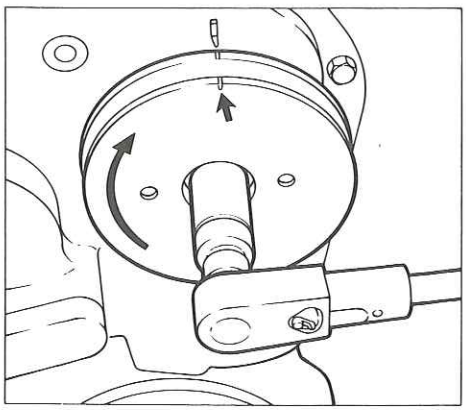
Refer to Jacobs service letters or contact your nearest distributor for additional automatic transmission information.



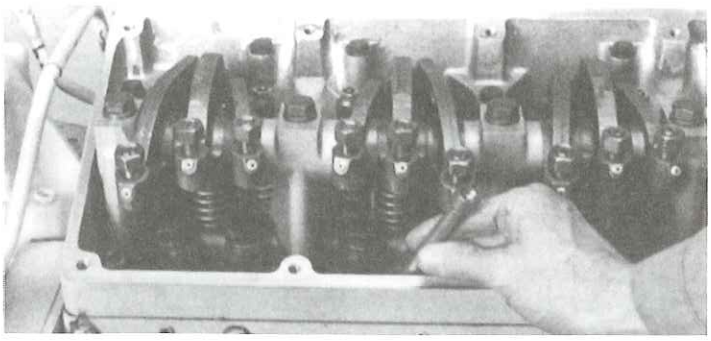
Clean engine thoroughly. Remove valve cover and gasket. Retain all parts.

VALVE AND INJECTOR SET POSITION

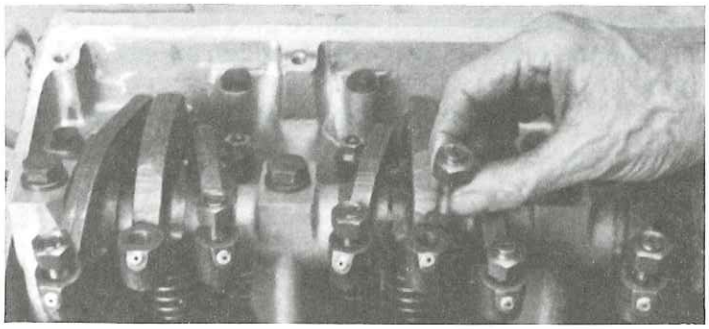
Before loosening the rocker arm adjusting screws prepare the engine as follows for valve and injector adjustments to be made later.



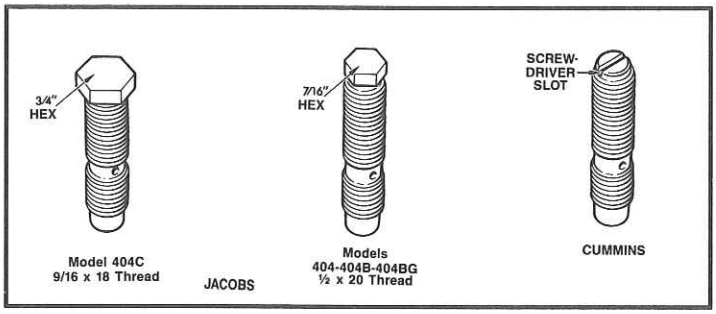
Rotate crankshaft by turning accessory drive shaft in direction of rotation (clockwise). Align the "A" valve set mark on the accessory drive pulley with the pointer on the gear cover. Check the intake and exhaust valves of cylinder No. 5 (STC engines) or cylinder No. 1 (CELECT engines). The valves must 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.



Loosen locknuts on all injector and valve rocker lever adjusting screws and remove all push rods.



Remove all injector rocker lever adjusting screws and locknuts. Discard Cummins injector rocker lever adjusting screws.



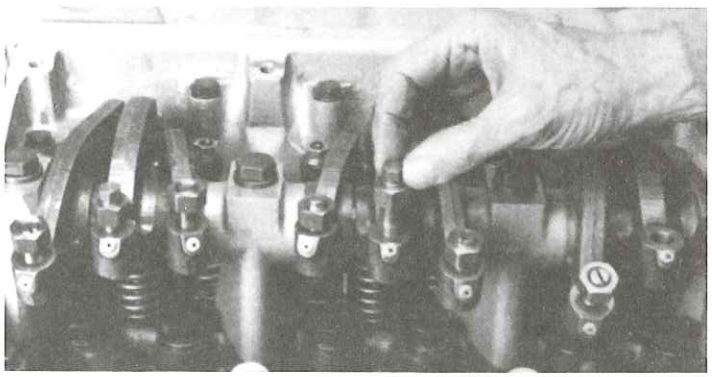
404C

NOTE:

Do not reuse the Cummins locknuts on the Model 404C injector adjusting screws as this will not allow enough travel to adjust the injectors.

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

MODELS 404-404B-404BG



Install the Jacobs rocker lever adjusting screws. **Reuse the** Cummins locknuts.

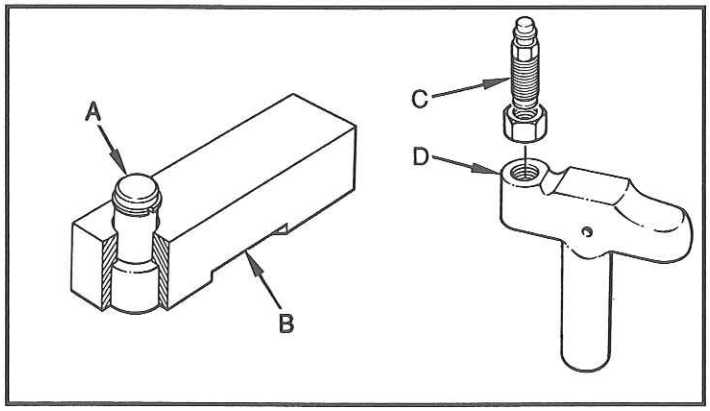
EXHAUST VALVE CROSSHEAD REPLACEMENT

NOTE:

There are currently two styles of crossheads in use on L10 engines, crossheads with guides and crossheads without guides (guideless crossheads).

Model 404BG and 404C engine brake kits include guideless exhaust valve crossheads. Guided exhaust valve crossheads used in Pre-91L10 engines may be replaced with Jacobs guideless crosshead assemblies.

All 91L10 engines use guideless crossheads. Installation procedures for both styles are discussed here.

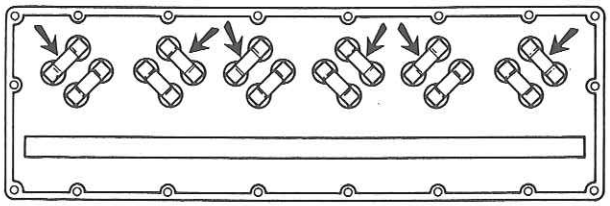


A. Jacobs retained actuator pin

B. Jacobs guideless crosshead assy

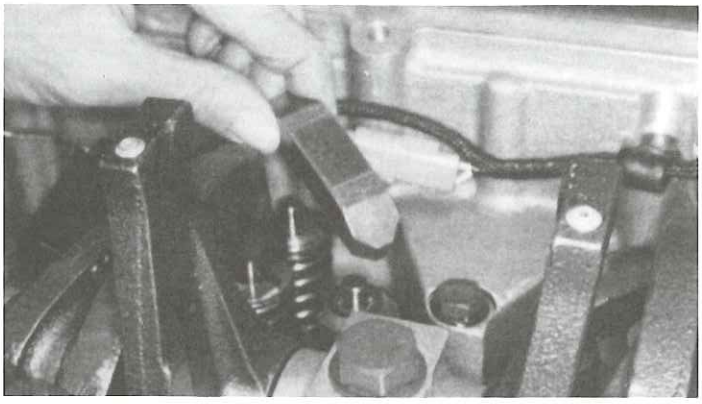
C. Jacobs screw & pin assembly

D. Cummins crosshead

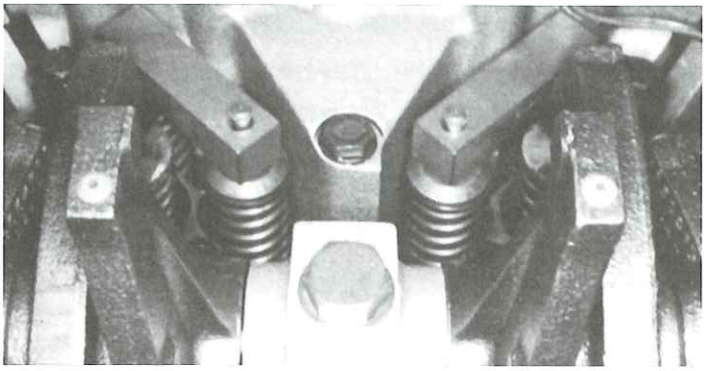


Note the locations of the exhaust valve crossheads.

GUIDELESS CROSSHEADS



Remove the Cummins guideless exhaust valve crosshead from each cylinder.



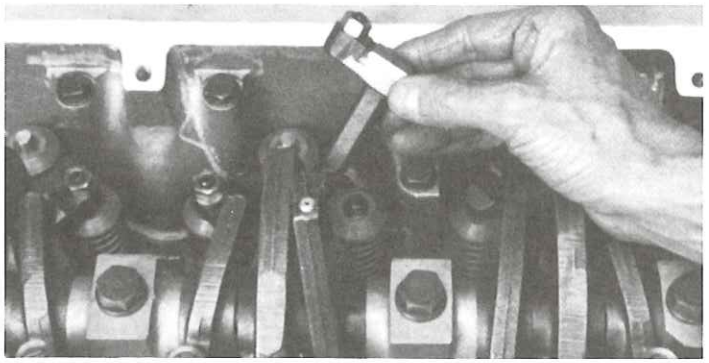
⚠CAUTION

DO NOT DISASSEMBLE THE ACTUATOR PIN FROM THE JACOBS CROSSHEAD. THE ASSEMBLY IS MADE UP OF MATCHED PARTS AND MUST NOT BE FIELD SERVICED.

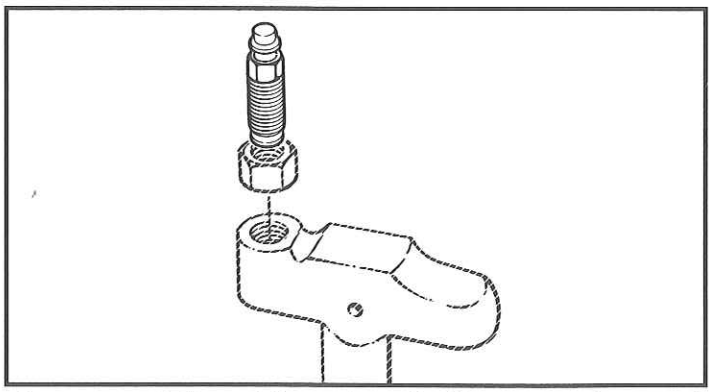
Lubricate the actuator pins and valve stems with engine oil and install the Jacobs crossheads over the exhaust valves. Locate the actuator pins on the exhaust valves closest to the rocker shaft.

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

CROSSHEADS WITH GUIDES



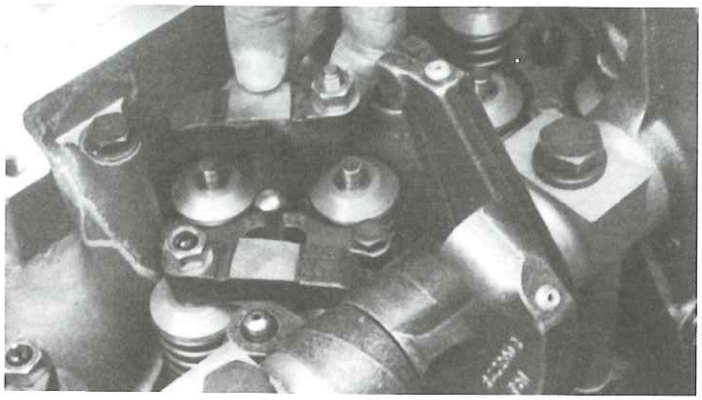
Rotate exhaust rocker levers upward from exhaust valve crossheads. Remove all exhaust valve crossheads from engine.



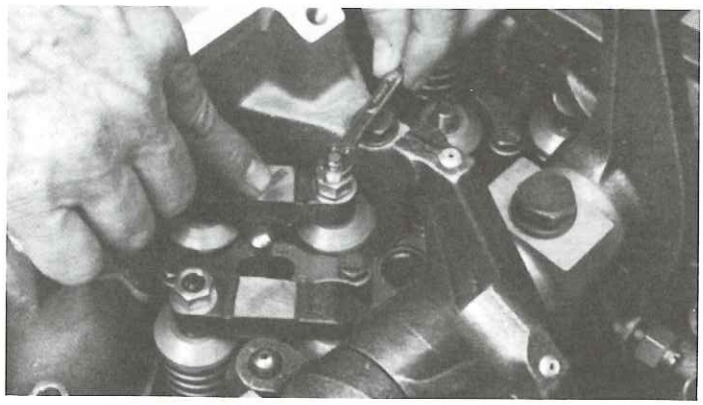
Remove and discard Cummins adjusting screws from each exhaust crosshead. Retain locknuts. Install Cummins locknut on Jacobs crosshead adjusting screw (screw and pin assembly). Dip assemblies into clean lube oil and install into each exhaust crosshead. The retaining ring in the screw assembly must be located on the top side of the crosshead.

⚠CAUTION

DO NOT REMOVE RETAINING RING WHICH HOLDS THE PIN IN THE ADJUSTING SCREW ASSEMBLY. THE ASSEMBLY IS MADE UP OF MATCHED PARTS AND MUST NOT BE FIELD SERVICED.



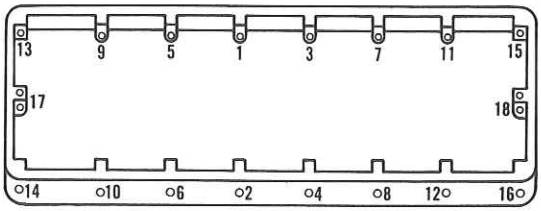
Lubricate the valve stem and crosshead guide and reinstall each exhaust crosshead being sure to rotate it 180 degrees from the original position (the crosshead adjusting screw located toward rocker shaft.)



Use light finger pressure at the rocker lever contact surface to hold the crosshead in contact with the outboard valve stem, turn the Jacobs adjusting screw clockwise until it contacts the inboard valve stem.

Hold the screw in position and torque the locknut to 25 lbft (34 N· m).

SPACER INSTALLATION - MODEL 404C



Clean housing surface and install the gasket. Install the spacer and capscrews. Starting from the center and proceeding outward on both sides torque the capscrews to 12 lbft (16 N·m) following the sequence shown.

SPACER INSTALLATION
MODELS 404, 404B, 404BG

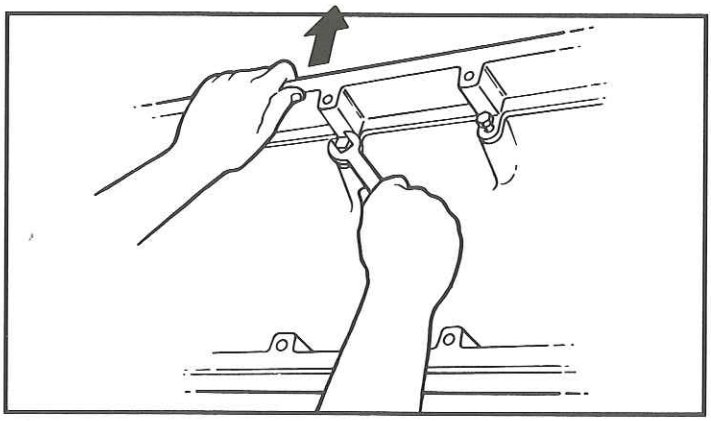
Die cast aluminum spacers are used on later production brakes and require the following special installation procedures. Die cast spacers can be identified by a smooth, bright appearance and "Jake Brake Model 404" cast in raised letters along the outer side of the spacer.

The following procedure must be used to insure proper alignment of the cover holes and tapped spacer holes.

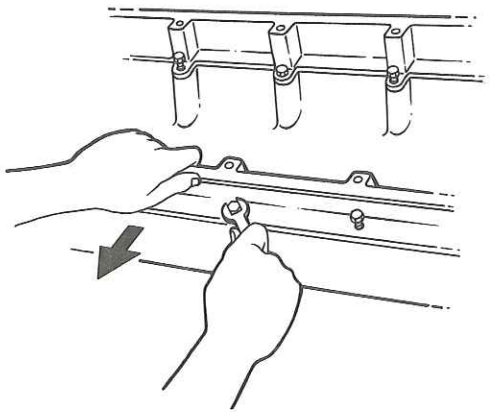
Clean the engine rocker housing top gasket surface and place a new Jacobs spacer gasket in position.

Install the Jacobs die cast spacer.

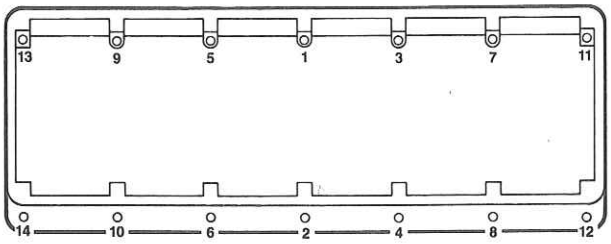
Start but do not tighten the Jacobs 8mm x 30mm long cap screws. A flat washer is used with each cap screw.



Working from the fuel pump side, push the spacer toward the outboard side of the engine. While pushing on the spacer tighten the center cap screw located on the top row of the spacer.



Pull downward on the spacer and tighten the center cap screw on the bottom row on the outside of the spacer. This will bow the spacer outward to counteract any inward distortion of the spacer.



Starting with the center capscrew on each side and proceeding outward on both sides, torque the capscrews to 12 lbft (16 N·m).

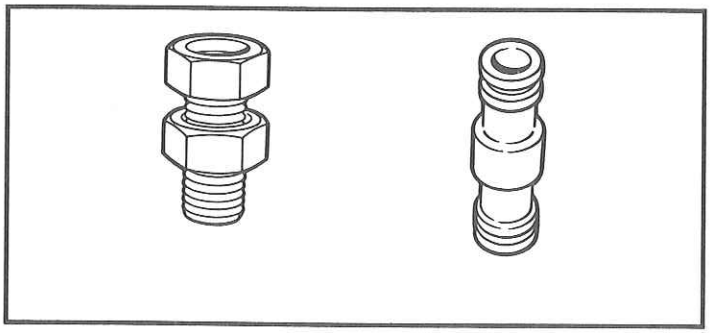
NOTE:

It may be necessary to use a crowfoot wrench for the capscrews on some early production spacers.

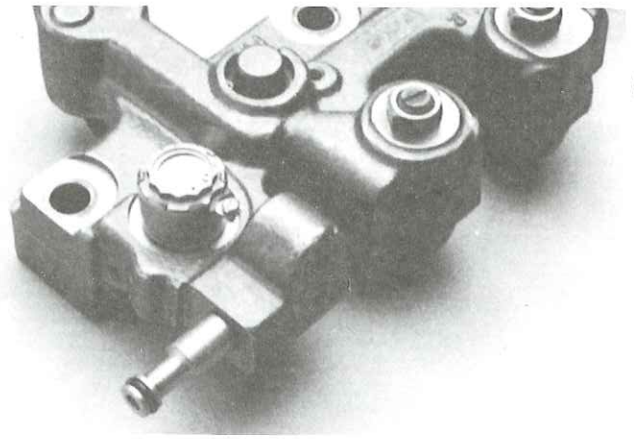
SECTION 3 BRAKE HOUSING INSTALLATION

NOTE:

Current style housings use a push-in oil supply tube to provide an oil passage to the rear housing. Early production housings used a threaded oil connector.

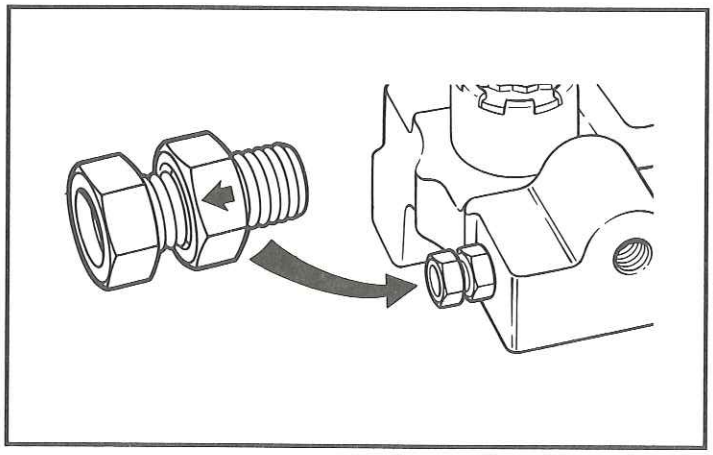


OIL SUPPLY TUBE

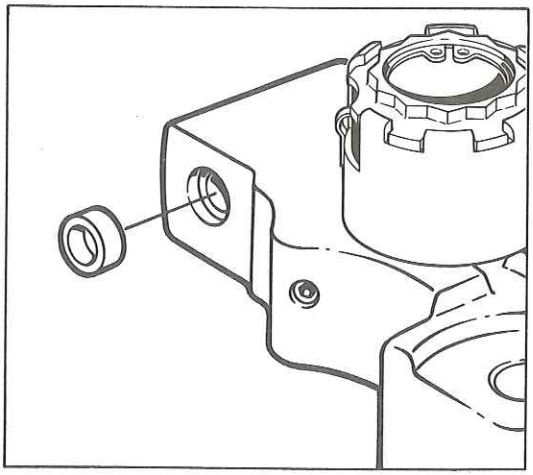


Lubricate and install O-rings on oil supply tube and install into front housing until it stops.

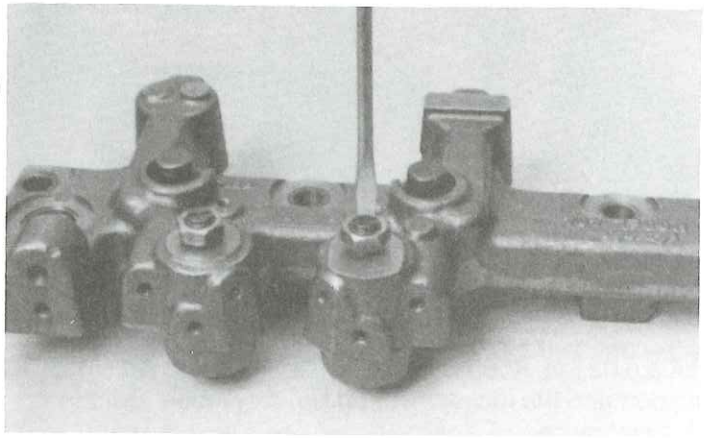
THREADED OIL CONNECTOR



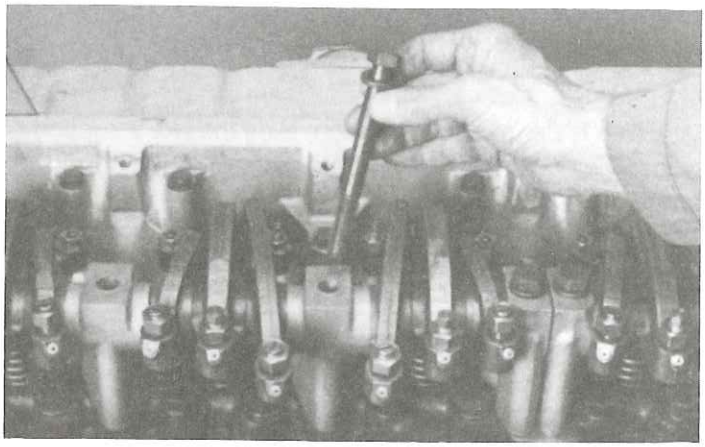
Install nut on oil connector screw as far as it will go and install oil connector screw into front housing as far as it will go (hand tight).



On housings with threaded oil connector install the lube seal ring into counter bore in rear housing.



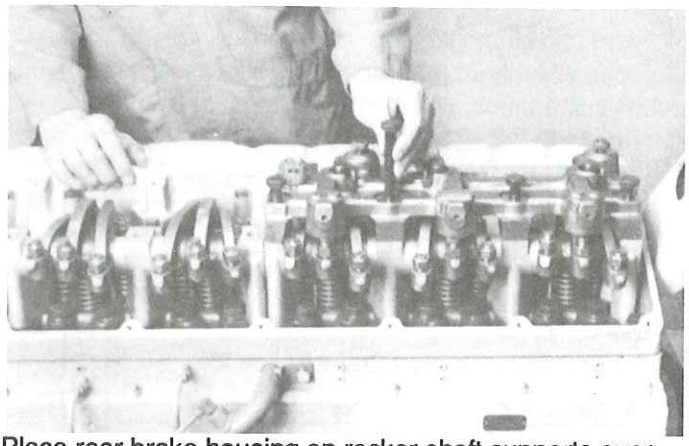
Make sure the slave piston adjusting screws on both housings are backed out so all slave pistons are fully retracted (screw is loose).



Remove the capscrews and washers retaining the rocker shaft assemblies. Discard capscrews and washers.

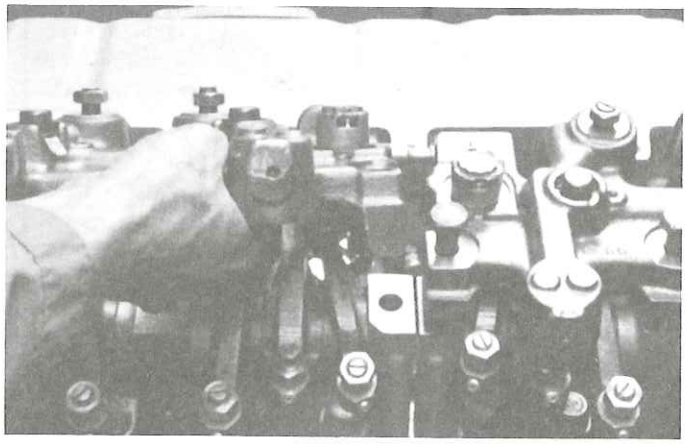
⚠WARNING

REMOVE THE OIL FROM THE HOLDDOWN BOLT HOLES. WHEN USING AN AIR GUN COVER THE HOLES WITH TOWELS TO PREVENT OIL SPRAY AND WEAR SAFETY GLASSES. PERSONAL INJURY CAN RESULT IF EYE PROTECTION IS NOT WORN. THE OIL IS REMOVED FROM THE HOLES TO PREVENT THE CYLINDER HEAD FROM CRACKING.



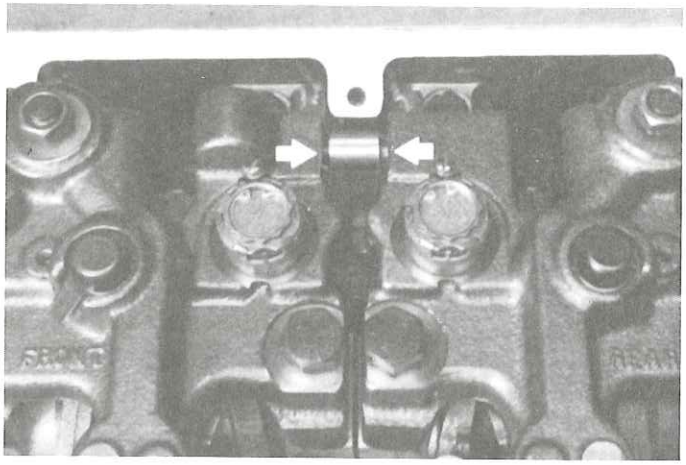
Place rear brake housing on rocker shaft supports over cylinders 4, 5, & 6. Lubricate threads and underside of the 4 Jacobs holddown capscrews with clean lube oil, and loosely install into housing and rocker shaft support.

NOTE:
No washers are used with the Jacobs capscrews.



Place front brake housing on rocker shaft supports for cylinders 1,2, and 3. Carefully insert the oil supply tube into the hole in the rear housing.

Lubricate threads and underside of Jacobs holddown capscrews with clean lube oil. Loosely install the cap-screws in the four locations.

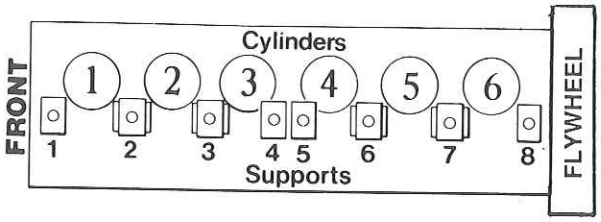


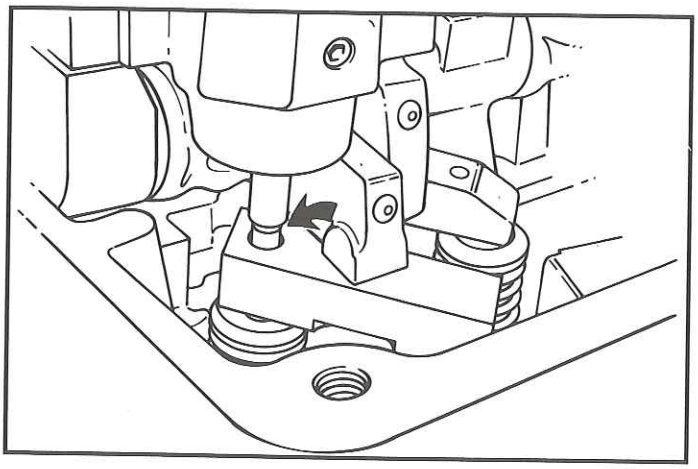
Center the oil supply tube between the housings.

BRAKE HOUSING AND ROCKER LEVER ALIGNMENT

The support numbers referred to below begin with number 1 at the front of the engine.

Slide the number 5 support as far forward as possible.





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

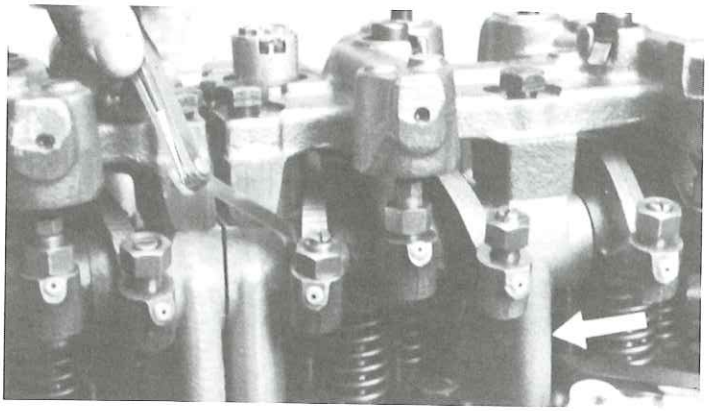
All three Jacobs actuating pins should remain completely under the slave pistons (see illustration). If required, tap housings gently with a soft mallet to obtain proper alignment. Be sure that No. 5 support remains in most forward position.

Check off following steps to be sure they are completed.

NOTE:

The following procedure should be followed as outlined below. Proper sequencing is important to ensure correct engine and engine brake operation.

_____ Tighten No. 5 rocker lever support mounting capscrew to 60lbin (7 N·m) torque.



Put a 0.022 in. (0.55 mm) feeler gauge beside the No. 5 support and the rocker lever on No. 4 cylinder. Set the side clearance.

_____ With the feeler gauge in position, slide the No. 6 support as far forward as possible. Tighten to 60 lbin (7 N·m) torque.

Put a 0.022 in. (0.55mm) feeler gauge between the No.6 support and the rocker lever on No. 5 cylinder. Set the side clearance.

____With feeler gauge in position, slide the No. 7 support as far forward as possible. Tighten to 60 lbin (7 N·m) torque.

Put a 0.022 in (0.55mm) feeler gauge between the No. 7 support and the rocker lever on No. 6 cylinder. Set the side clearance.

____With the feeler gauge in position slide the No. 8 support as far foward as possible. Tighten to 60 lbin (7 N·m) torque.

____Recheck rear brake housing slave piston to exhaust crosshead actuating pin alignment.

____Slide No. 4 support as far back as possible.

_____Check front brake housing alignment as previously outlined for rear brake housing. After the brake housing is properly aligned, tighten the No. 4 mounting capscrews to 60 lbin (7 N·m) torque.

Put a .022 in (0.55mm) feeler gauge between the No. 4 support and the rocker lever on No. 3 cylinder. Set the side clearance.

____With the feeler gauge in position, slide the No. 3 support as far back as possible. Tighten to 60 lbin. (7 N·m) torque.

Put a 0.022 in (0.55mm) feeler gauge between the No. 3 support and the rocker lever on No. 2 cylinder. Set the side clearance.

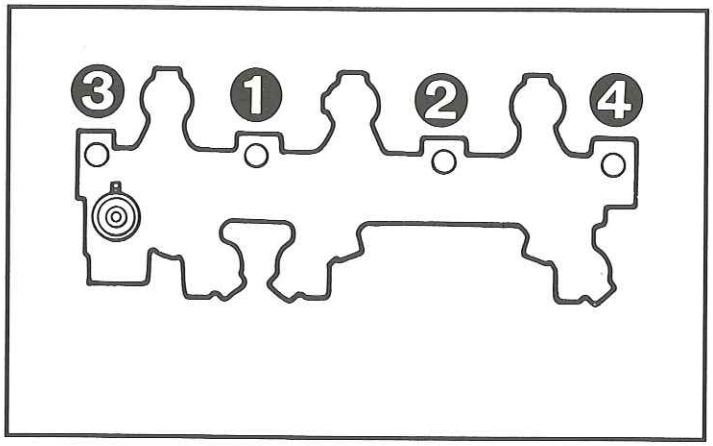
____With the feeler gauge in position, slide the No. 2 support as far back as possible. Tighten to 60 lbin (7 N·m) torque.

Put a 0.022 in (0.55mm) feeler gauge between the No. 2 support and the rocker lever on No 1 cylinder. Set the side clearance.

____With the feeler gauge in position, slide the No. 1 support as far back as possible. Tighten 60 lbin (7 N·m) torque.

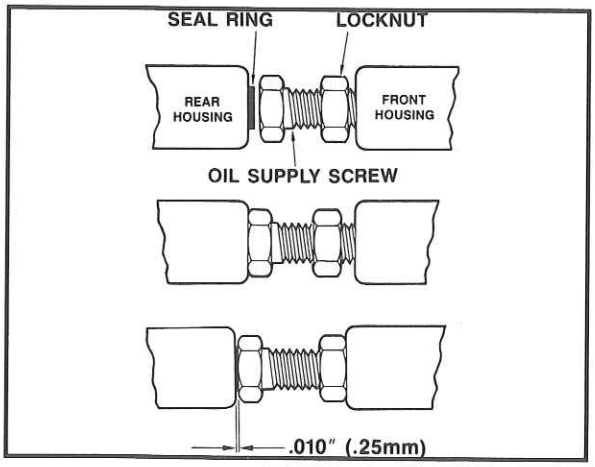
____Recheck all side clearances to be sure they are within 0.020-0.025 in (0.51-0.64mm)

____Recheck front brake housing slave piston to crosshead actuating pin alignment.



Complete the tightening of the housing holddown capscrews on each housing in two steps, following the sequence in the illustration.

1. 45 lbft (60 N·m)
2. 95 lbft (130 N·m)



Back out oil connector screw from front housing until it makes solid metal-to-metal contact with rear housing. The lube seal ring will be compressed.

When backing out the connector screw as shown, be sure the screw and seal ring are in alignment. Readjust housings, if required.

Back off the connector screw approximately one hex position on screw from contact point, to establish a working clearance of 0.010 in (0.25mm). Hold the connector screw in this position and tighten locknut to 25 lbft (34 N·m) torque.

After tightening the oil connector locknut check the gap between the end of the screw and the rear housing with a feeler gauge. A gap of 0.10 in (0.25mm) must be maintained.

SLAVE PISTON ADJUSTMENT

⚠CAUTION

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

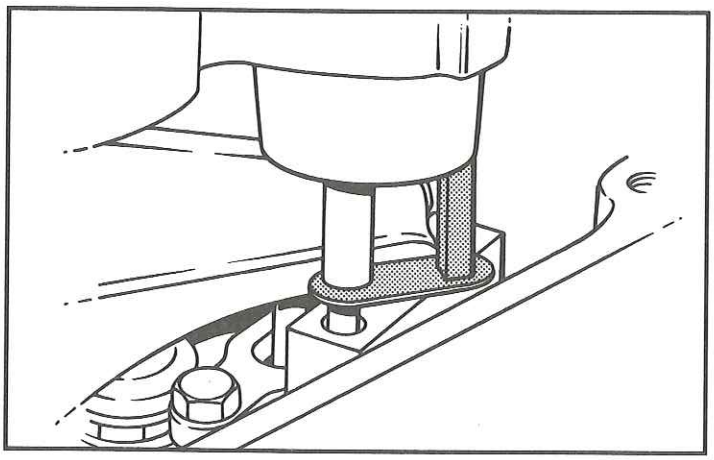
Slave piston adjustment is done before replacement of the push rods to permit adjustment of all six cylinders without the necessity of rotating the engine.

SLAVE PISTON CLEARANCE SETTINGS

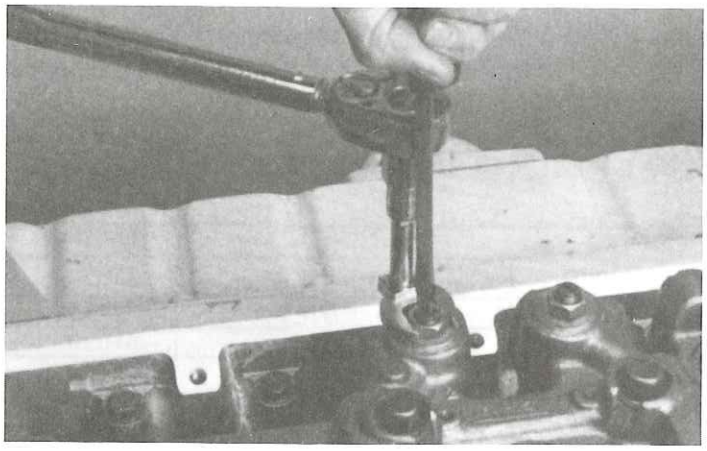
MODEL	ENGINE	SETTING
404-404B	All except 91L10	.015 in
404BG	All except 91L10	.015 in
404C	91L10 STC	.015 in
404C	91L10 CELECT	.015 in

Slave piston lash adjustment is printed on the housing name tag.

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



Insert the .015 in. Jacobs feeler gauge between the slave piston and the actuating pin in the crosshead. Turn the slave piston adjusting screw until a light drag on the feeler gauge can be felt.



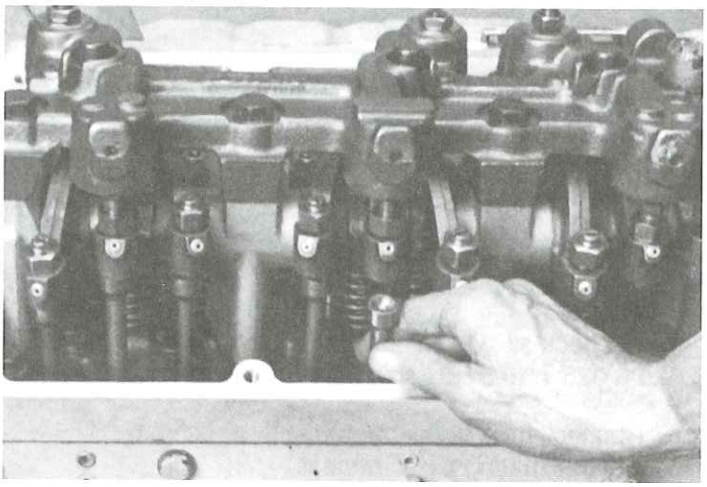
Hold screw in position with a screwdriver. Torque locknut to 25 lbft (34 N·m).

⚠CAUTION

OVER TORQUING LOCKNUT COULD SEIZE RESET MECHANISM IN SLAVE PISTON ADJUSTING SCREW. THIS WILL CAUSE ENGINE DAMAGE.

NOTE:
After torquing the slave piston adjusting screw locknut, check the clearance with the Jacobs feeler gauge. Readjust if necessary.

ADJUST ALL REMAINING CYLINDERS USING THIS PROCEDURE.



Replace push rods under rocker levers.

NOTE:
The injector push rods have a larger diameter than the valve push rods. The push rods for the intake and exhaust valves are the same.

NOTE:
Push rods will not fit under rocker levers of some cylinders. It may be more convenient to use the following procedures:

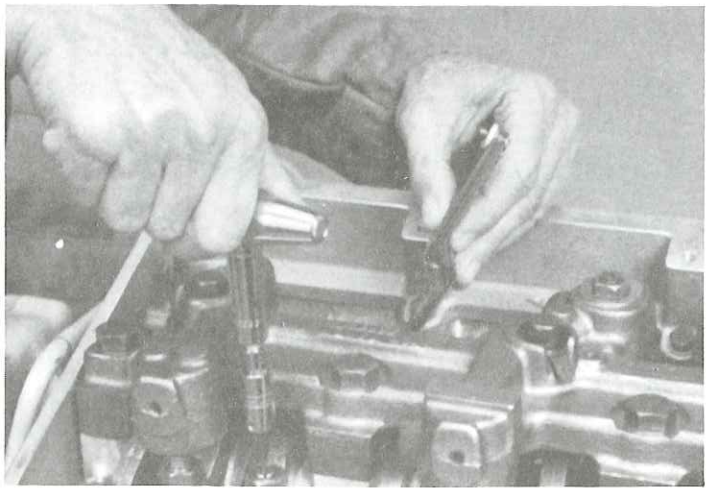
Install the pushrods under the rocker levers of the cylinders being adjusted following the valve and injector adjustment sequence. This will also help identify the cylinders that have been adjusted.

INJECTOR AND VALVE ADJUSTMENT

All overhead adjustments, crosshead, valve, injector and engine brake slave piston must be made when the engine is cold (stabilized coolant temperature 140 ° F [60° C] or below).

EXHAUST AND INTAKE VALVE ADJUSTMENT

NOTE:
The injector adjusting tool (torque wrench) may be used to adjust the valve settings. With the proper feeler gauge inserted, set the preload on the valve adjusting screw. This will eliminate the need to "feel" the drag on the feeler gauge. After applying the preload, hold the adjusting screw and tighten the locknut.



Install a 0.014 in. (0.36mm) feeler gauge 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 gauge.

Hold the adjusting screw and tighten the locknut to 50 lbft (65 N·m).

Adjust the exhaust valves using the same procedure as with the intake valves using a 0.027 in. (0.69 mm) feeler gauge. Tighten the locknut to 50 lbft (65 N·m).

Continue adjustment of the injectors and valves following the above procedures and the sequence in the tables.

Cummins recommends that after adjustment of all valves and injectors to continue through the rotation and reset all injectors.

ADJUST INJECTORS

Pre91L10 engines can be equipped with either top-stop or non-top stop injectors.

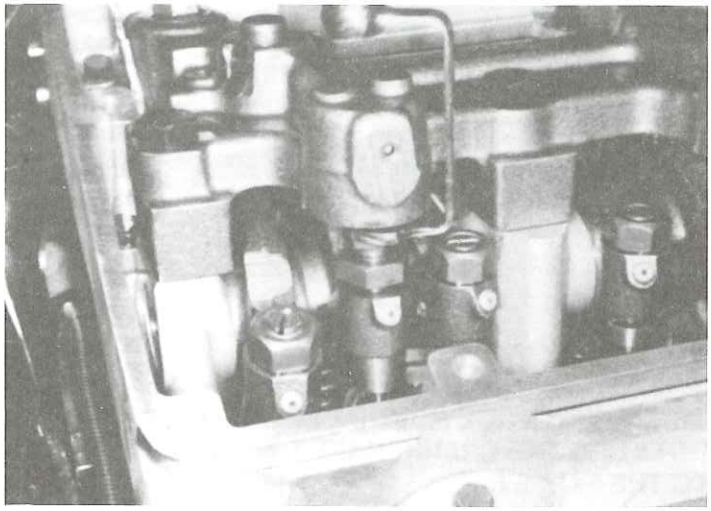
Present production engines will have "T.S. zero lash" stamped in the injector plunger travel space on the data-plate.

If earlier production engines have had non-top stop injectors replaced with top-stop injectors, the data plate will be stamped with "FF-104" in the E.C.S. space. The following instructions address each type of injector seperately.

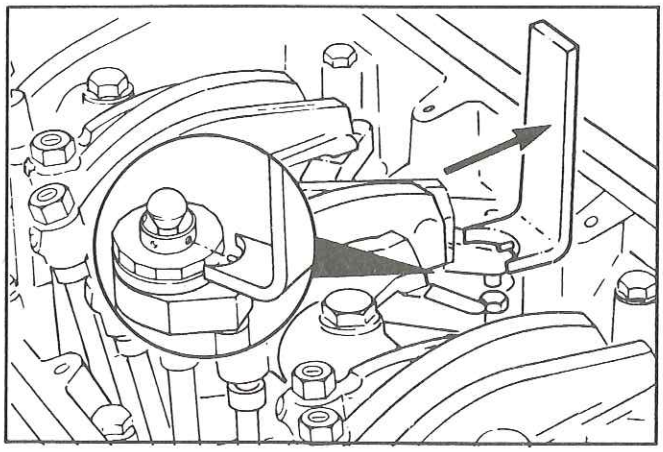
91L10 STC

Table 3-1

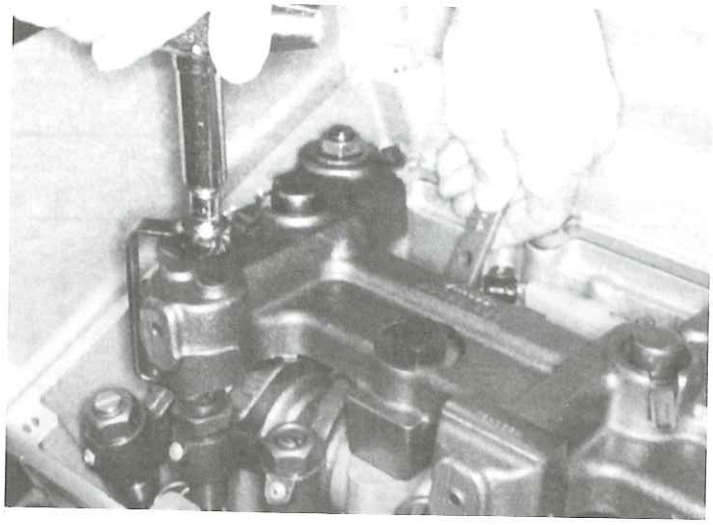
Bar engine Dir of rotation	Pulley Position	Set valves cyl. #	Set inj. cyl. #
Start	A	5	3
Adv. to	B	3	6
"	C	6	2
"	A	2	4
"	B	4	1
"	C	1	5



1. Tighten injector rocker adjusting screw until all clearance is removed from injector train.
2. Tighten screw one additional turn to seat link.
3. Loosen the injector adjusting screw until the STC tappet touches the top cap of the injector.



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



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

6. Torque adjusting screw to 5-6 lbin with Cummins torque wrench & "C" wrench.

7. Torque locknut to 45 lbft (61 N·m).

⚠CAUTION

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

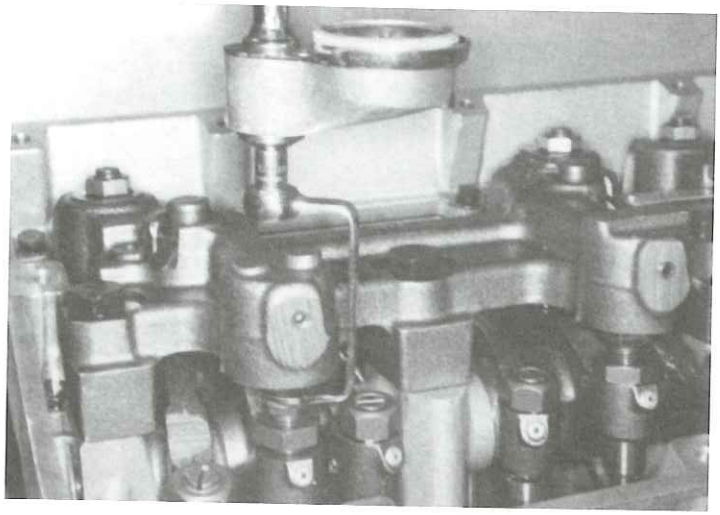
8. Remove tappet tool.

9. Adjust valves on apppropriate cylinder according sequence in table 3-1.

91L10 CELECT

Table 3-2

Bar engine Dir of rotation	Pulley Position	Set valves cyl. #	Set inj. cyl. #
Start	A	1	1
Adv. to	B	5	5
"	C	3	3
"	A	6	6
"	B	2	2
"	C	4	4



⚠CAUTION

DO NOT BOTTOM THE PLUNGER ANY TIGHTER THAN 25 LBIN (2.8 N·m) TO PREVENT DAMAGE TO THE INJECTOR.

1. Turn the injector adjusting screw in and bottom the injector plunger 3-4 times to remove fuel.

2. Torque adjusting screw to 25 lbin (2.8 N·m).

3. Back out screw two flats (120°)

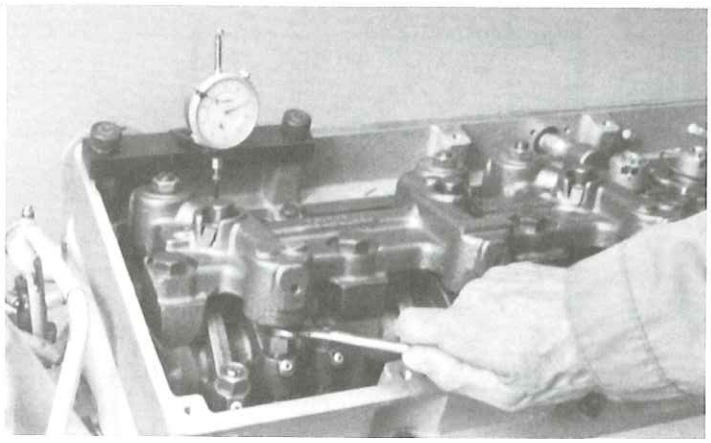
4. Torque lock nut to 45 lbft (61 N·m).

5. Adjust valves in the same cylinder following sequence in table 3-2.

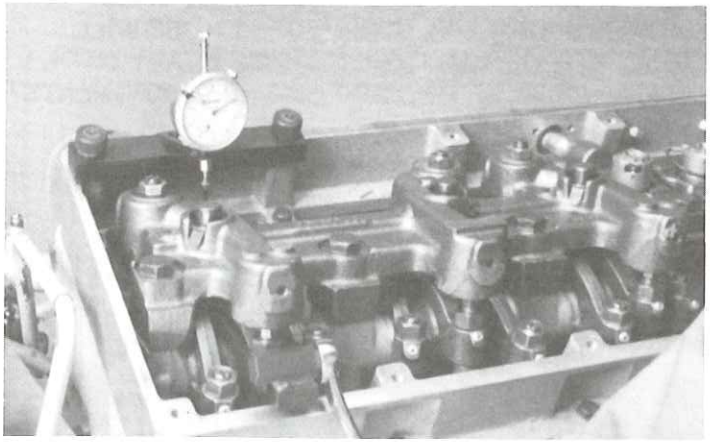
PRE 91L10
NON TOP STOP

Table 3-3

Bar engine Dir of rotation	Pulley Position	Set valves cyl. #	Set inj. cyl. #
Start	A	5	3
Adv. to	B	3	6
"	C	6	2
"	A	2	4
"	B	4	1
"	C	1	5



1. Install injector travel kit on cylinder to be adjusted.
2. Place stem of indicator (use long stem) on top of injector plunger.
3. Turn adjusting screw down until injector plunger touches injector cup.
4. Turn screw an additional 15° to squeeze fuel from cup.
5. Loosen screw 1/2 turn and turn screw down again.

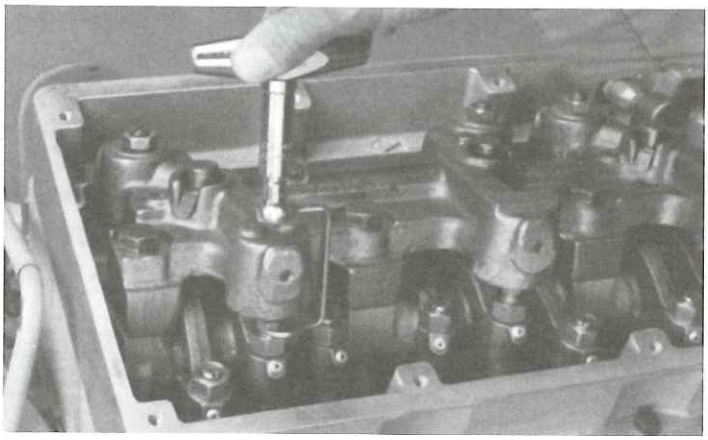


6. Set dial indicator to "0" (zero).
7. Turn screw counter clockwise to adjust injector plunger to 0.198 in.
8. Tighten locknut to 50 lbft (65 N·m).
9. Check adjustment with rocker lever actuator.
10. Adjust valves in appropriate cylinder (Table 3-3).

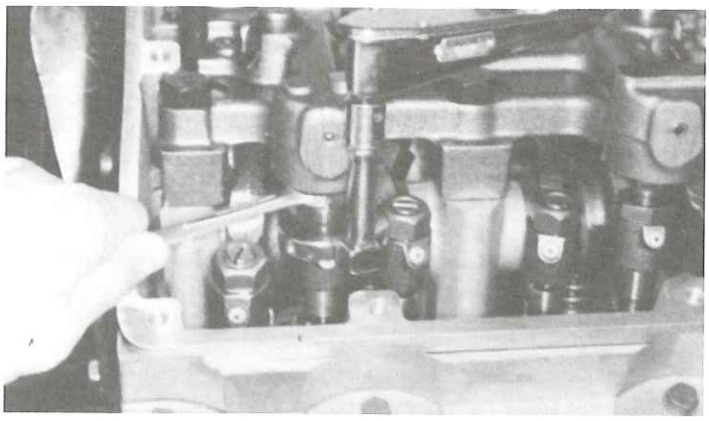
PRE91L10
TOP STOP

Table 3-4

Bar engine Dir of rotation	Pulley Position	Set valves cyl. #	Set inj. cyl. #
Start	A	5	3
Adv. to	B	3	6
"	C	6	2
"	A	2	4
"	B	4	1
"	C	1	5



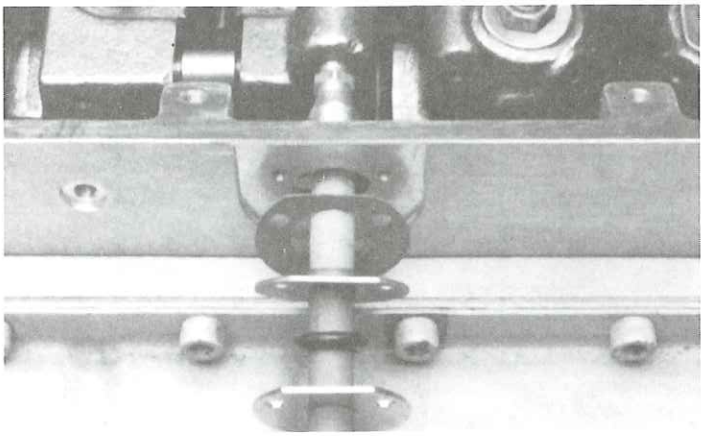
1. Tighten injector adjusting screw to take out clearance from injector train.
2. Tighten screw one additional turn.
3. Back out screw until loose.
4. Torque to 5-6 lbin. with torque wrench.



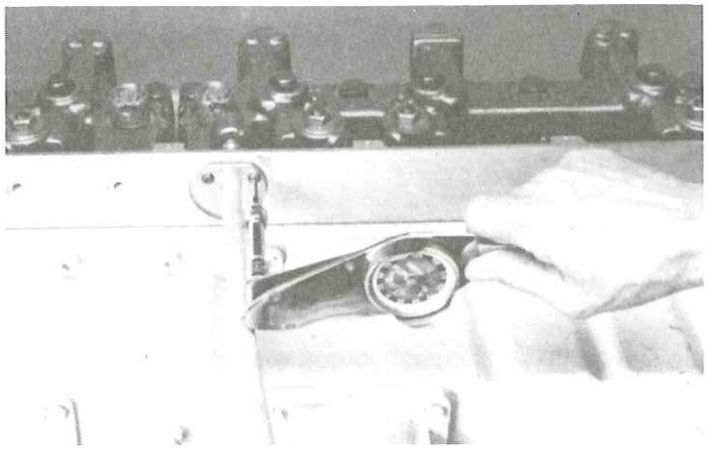
5. Torque lock nut to 45 lbft (60 N·m).
6. Adjust valves in appropriate cylinder . Refer to Table 3-4.

NOTE:
Always refer to Cummins latest publications and incorporate any changes to injector and valve adjustment procedures and values.

OIL SUPPLY CONNECTION MODELS 404, 404B AND 404BG



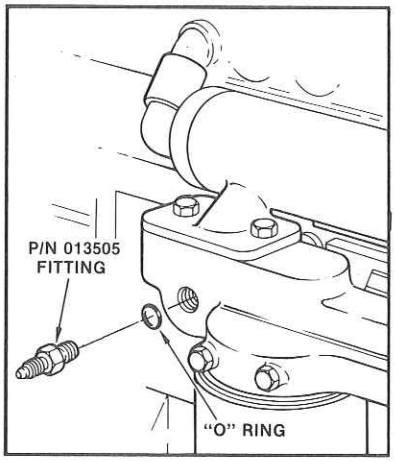
Slide Jacobs oil hose gasket over male end of Jacobs oil hose assembly. Insert male end of the oil hose assembly through hole in Jacobs spacer and install in front brake housing. Torque to 14 lbft (19 N·m). Do not use pipe sealant.



Slide gasket, O-ring and steel plates up to the spacer. Secure in place with button head screw. Tighten in steps to 80 lbin (9 N·m), being careful to draw plate up to gasket evenly.

⚠CAUTION

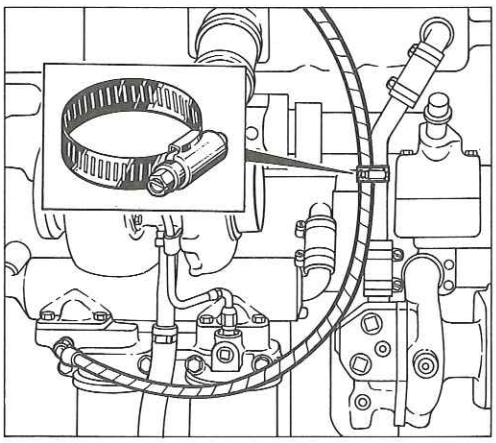
DO NOT CONNECT THE ENGINE BRAKE OIL SUPPLY TO THE SAME LOCATION USED FOR TURBOCHARGER OIL SUPPLY. SERIOUS ENGINE DAMAGE MAY RESULT.



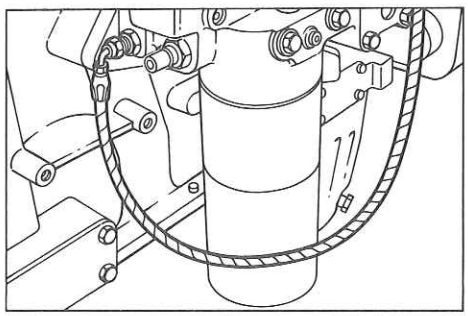
Lubricate the O-ring and install on the Jacobs fitting. On engines using dual filter heads install adapter into access hole in the rear oil filter head. Tighten to 105 lbin (12 N·m). Connect oil supply hose to adapter. Hold and tighten hose connection to 14 lbft (19 N·m).

⚠CAUTION

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

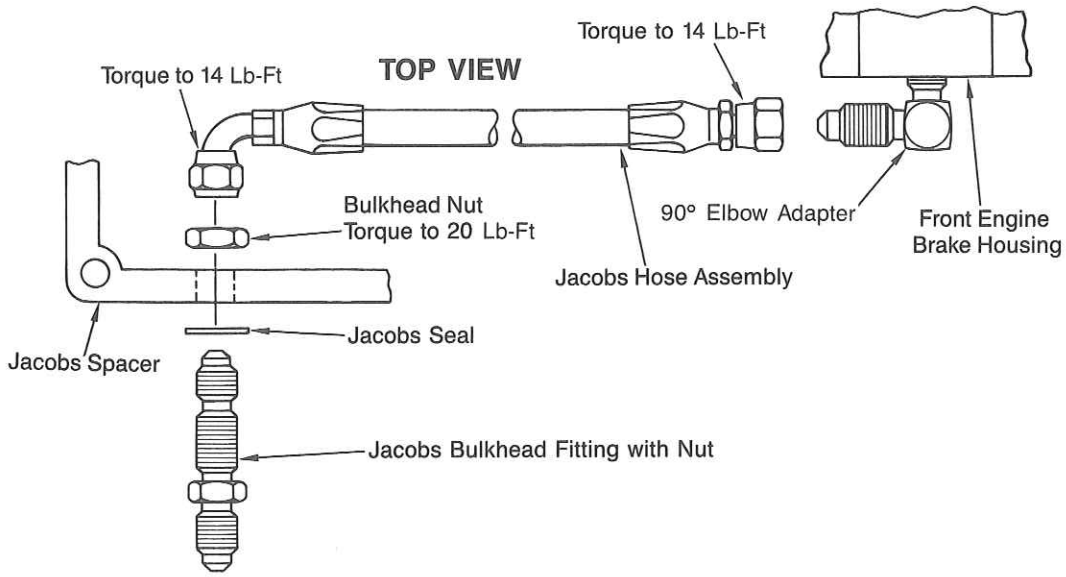


Route hose forward and clamp to aftercooler outlet pipe. Use clamp furnished in Jacobs kit.



On engines with single filter head, insert fitting into access hole located at the inboard side of the filter head as shown.

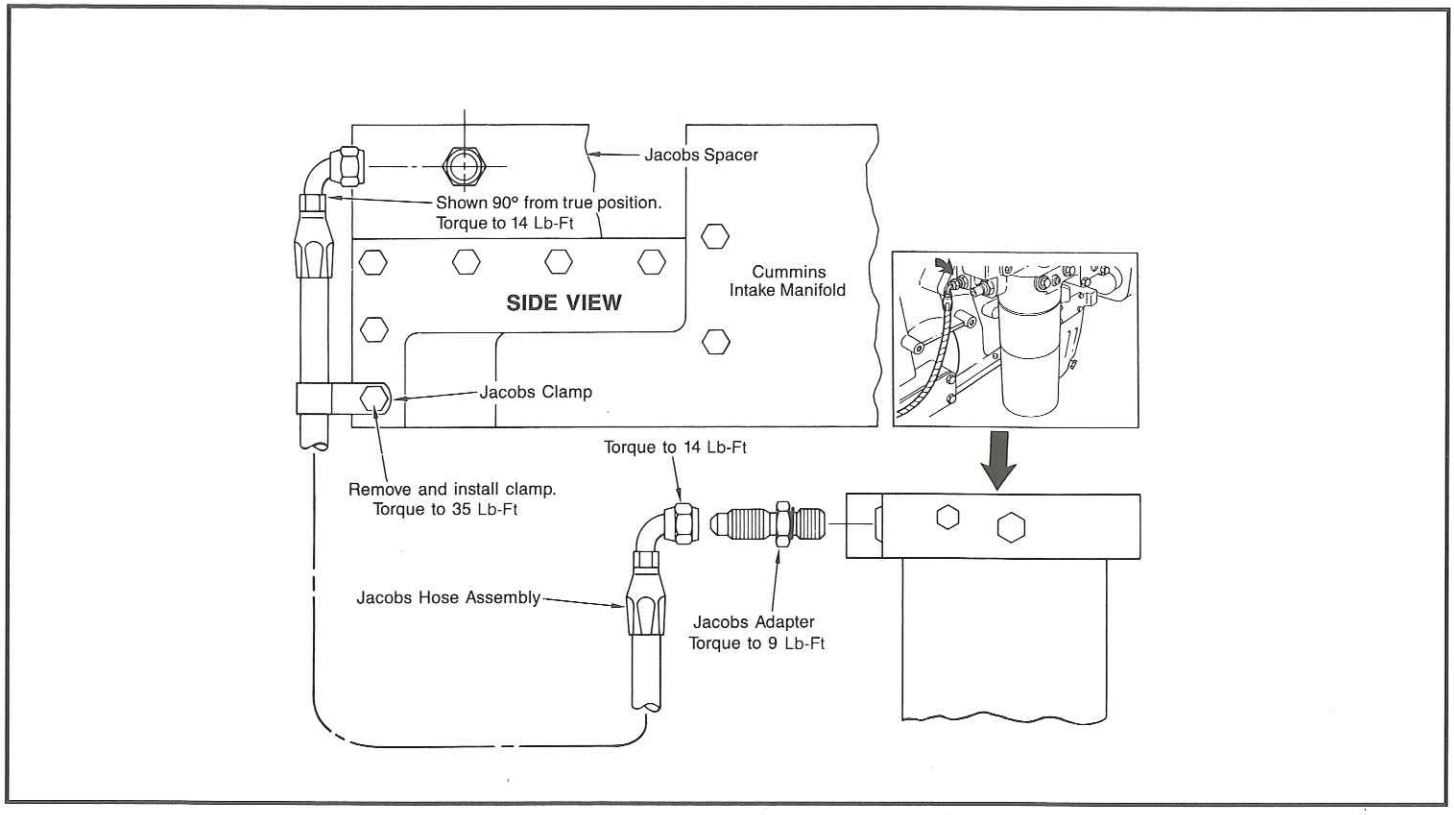
INTERNAL OIL SUPPLY HOSE INSTALLATION MODEL 404C



1. Install 90° elbow adapter into front housing. Tighten the adapter with the hose connection end aimed toward the rear of the engine.

2. Install the bulkhead fitting into the spacer as shown using the washer, seal and nut. Torque bulkhead nut to 20 lbft.

3. Install short hose between housing adapter and bulkhead fitting. Torque fitting nuts to 14 lbft (19 N·m).



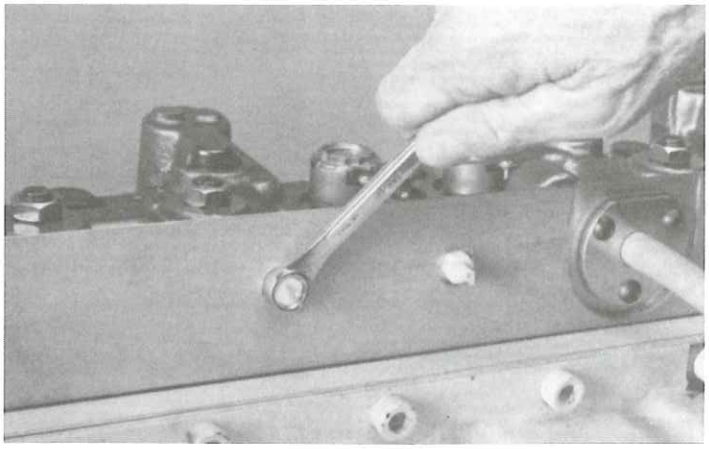
EXTERNAL OIL SUPPLY HOSE CONNECTION - MODEL 404C

4. Remove the plug from the rear, inboard access port of the combination filter head. Lubricate the O-ring and install the adapter. Torque to 9 lbft (12 N·m).

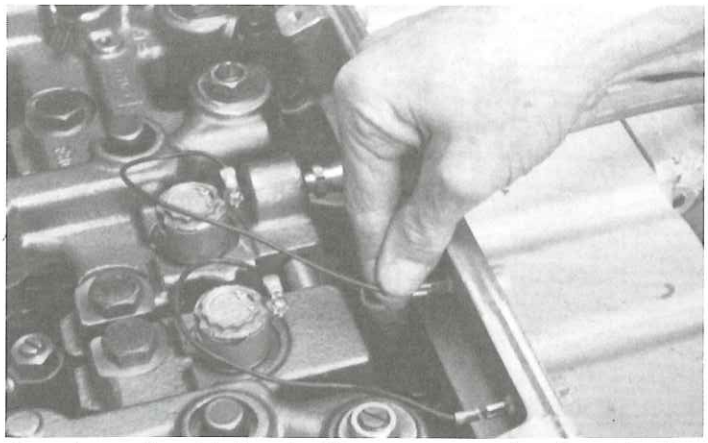
5. Connect the long hose (two 90° fittings) to the bulkhead fitting in spacer and the adapter in the filter head. Torque the fitting to 14 lbft (19 N·m).

6. Install the hose clamp and attach to the lower intake manifold capscrew as shown. Torque to 35 lbft (48 N·m).

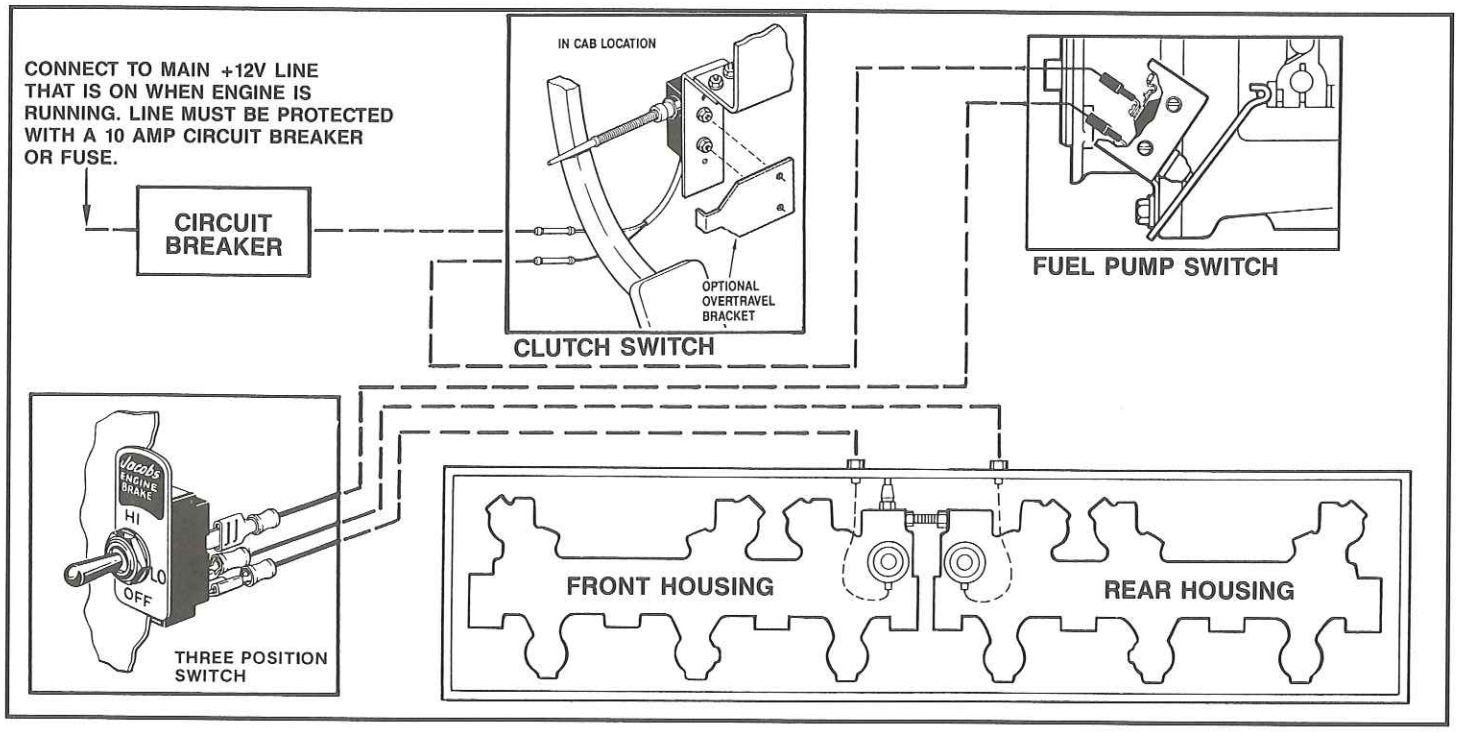
ELECTRICAL COMPONENT INSTALLATION



Install the two Jacobs electrical terminal assemblies in the tapped holes in the spacer. The holes are adjacent to the oil hose connection in the spacer. Use six point box wrench and tighten the terminal until the hex is seated against the spacer.



Attach a solenoid electrical harness to each solenoid valve. Connect the solenoid electrical harness from each solenoid to the closest terminal lead just installed in the spacer.



APPLICATION FOR ALL PRE-91L10 AND 91L10 STC ENGINES WITH AND WITHOUT PT PACER

NOTE:

Vehicle OEM installed control system components may differ from Jacobs supplied parts.

DASH SWITCH

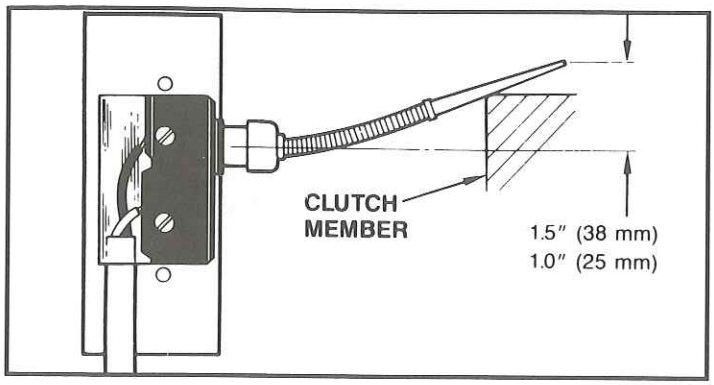
Install the dash switch in a convenient location in the cab. Carefully measure and cut all harnesses to proper length. Thread wires through the loom provided. Install receptacles at locations shown in wiring diagram furnished in the kit.

CLUTCH SWITCH

NOTE:

For automatic transmissions a pressure switch installed in the transmision, is used in place of the clutch switch. Contact a Jacobs distributors for details.

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.



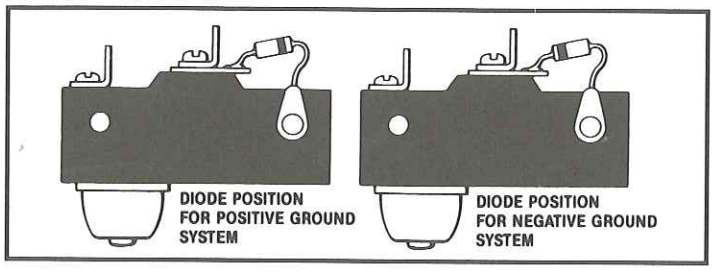
2. Install this switch with the switch actuator arm in contact with the clutch pedal arm or other clutch member.

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

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

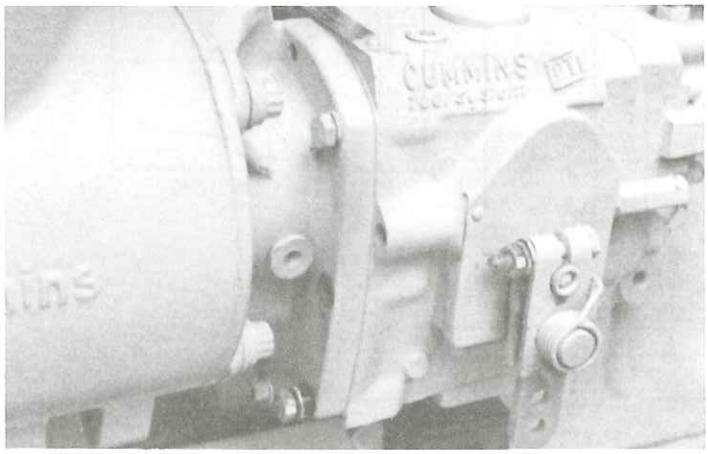
5. Cut wires to proper length and secure them with ties. Connect the wires as shown in the diagram.

FUEL PUMP SWITCH

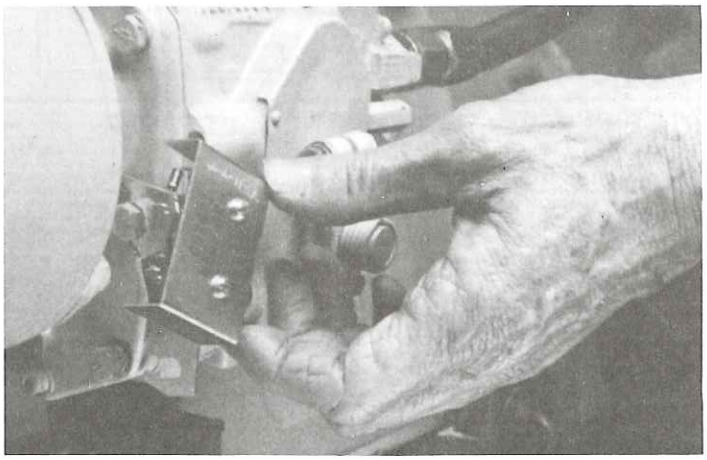


NOTE:

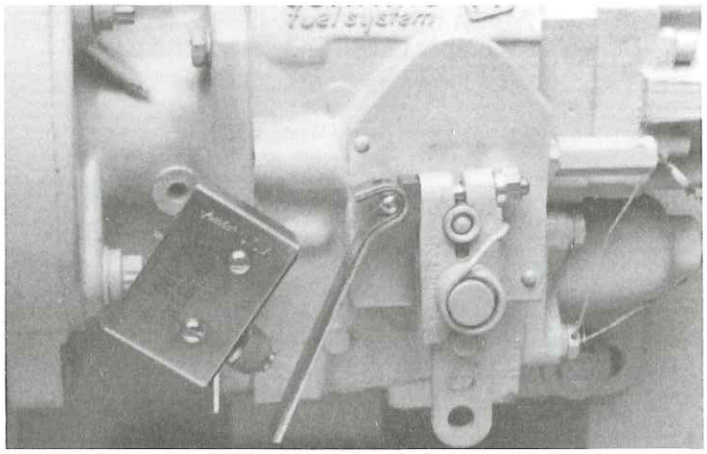
The fuel pump switch contacts are protected against arcing by a small diode connected between the load side switch terminal and ground. The engine brake must be connected to the load side terminal. If the vehicle has a positive ground electrical system, reverse the direction of the diode.



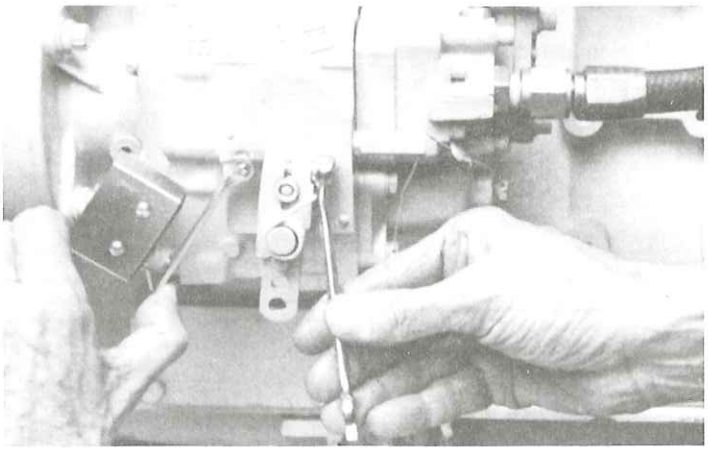
Loosen the two capscrews on the fuel pump housing as shown and remove the upper screw.



Install the Jacobs fuel pump switch. The slotted area in the switch bracket is for easier installation and for minor bracket adjustments. Tighten the cap screws.

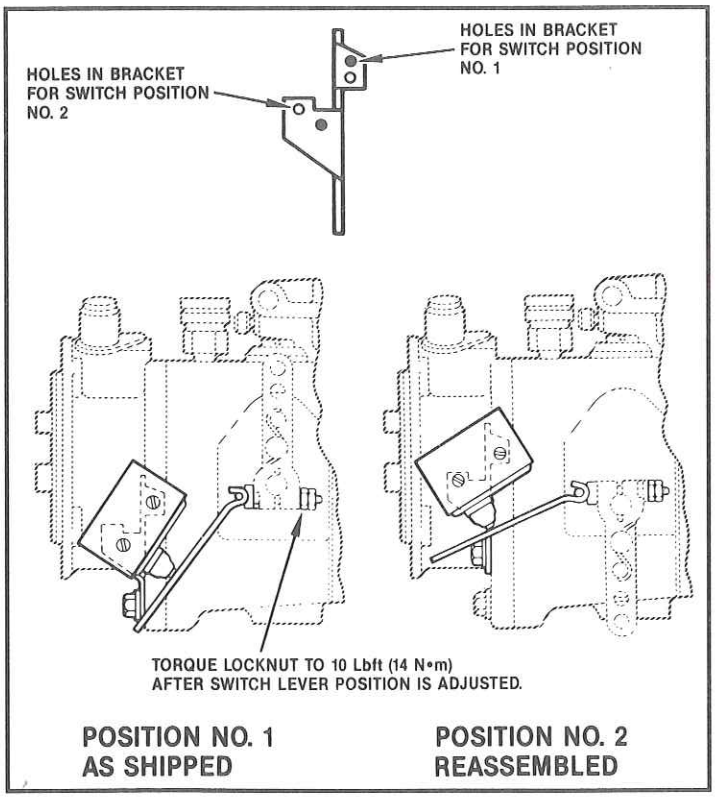


Remove Cummins nut, washers and cap screw and install the Jacobs tee bolt, guide, actuating lever and nut. Install parts in correct order as shown.



With the throttle shaft in the idle position, move actuating arm until switch actuates. Hold in this position and tighten nut to 10 lbft (14 N·m).

ALTERNATE SWITCH AND THROTTLE LEVER POSITIONS.



⚠CAUTION

CHECK THE FUEL PUMP THROTTLE SHAFT TO ENSURE THAT THE THROTTLE PEDAL WILL MOVE THE SHAFT TO THE FULL FUEL POSITION AFTER INSTALLING THE ACTUATING ARM.

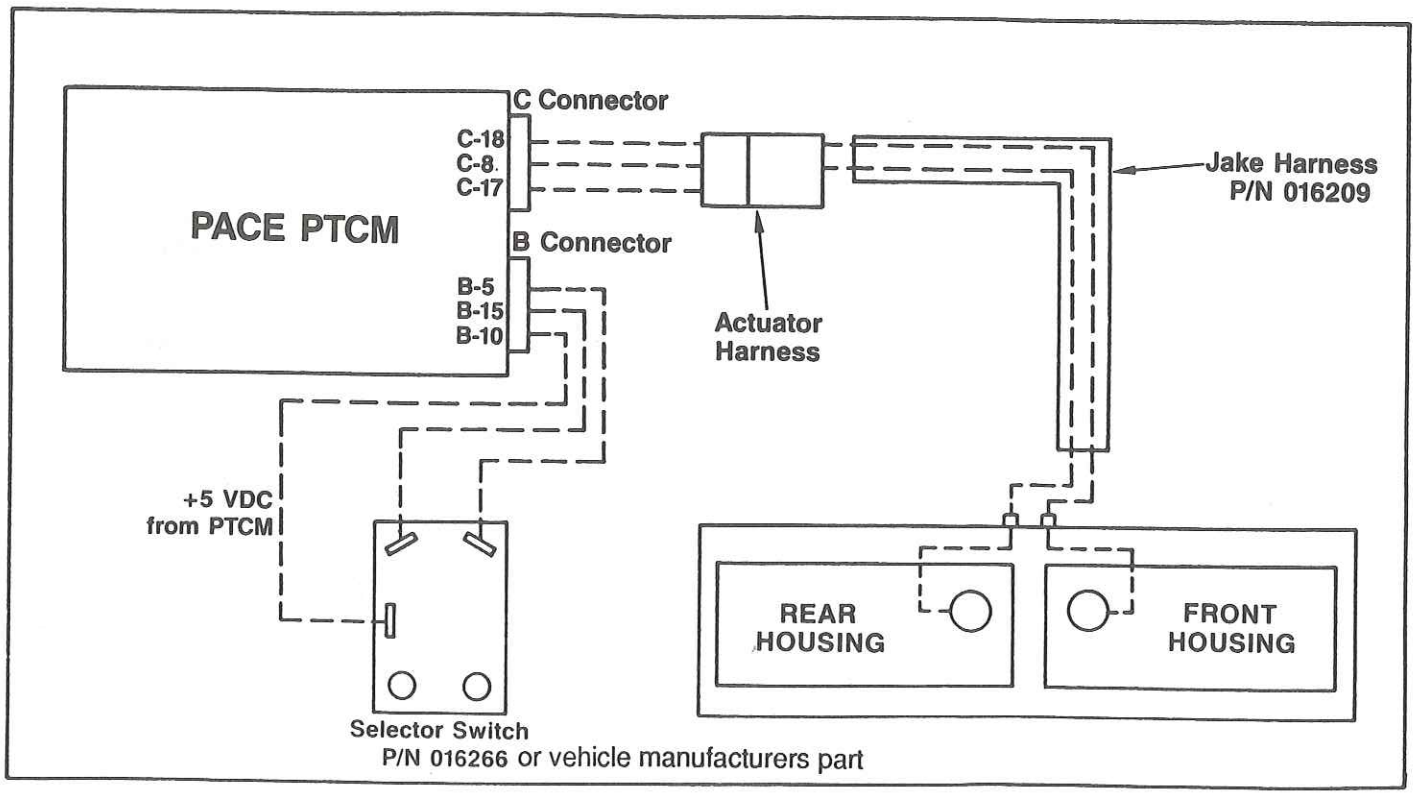
PACE Jake Brake Interface
Pre-91L10 and STC 91L10 Cummins Engines

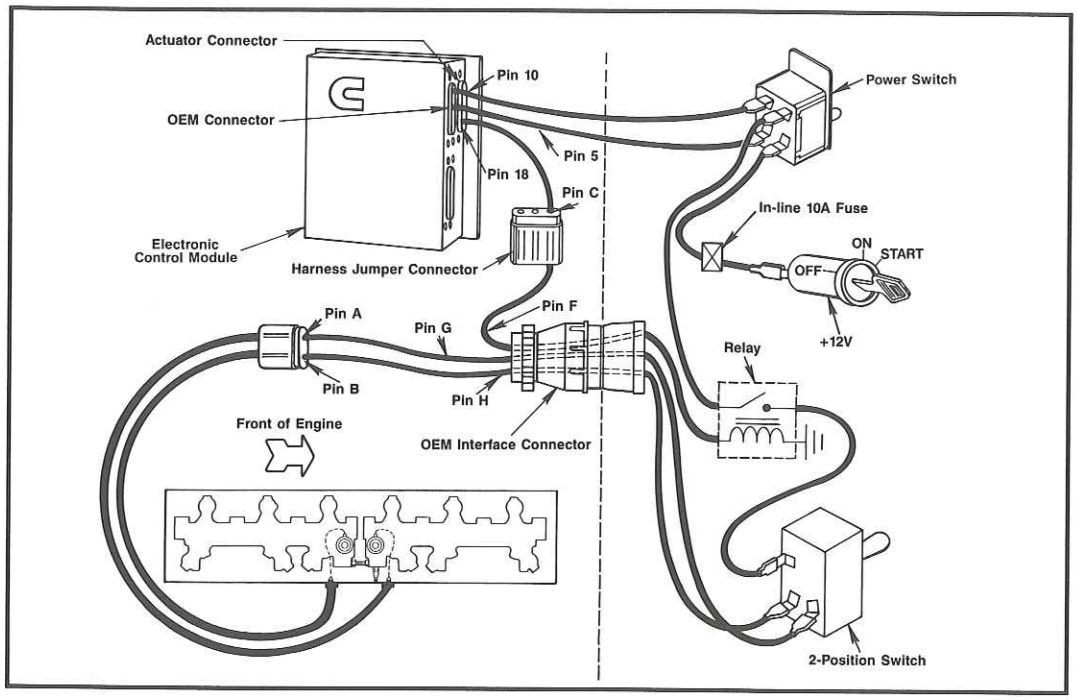
The Cummins Optional PACE Electronic Fuel Control System requires the following components for proper engine brake operation:

1. Jacobs wire harness, P/N 016209, used to connect the engine brake to the electronic controls.

2. Special dash switches as shown in diagram.

The Jacobs harness is connected to the PACE PTCM "C" connector harness and to the two engine brake housings. The B connector is connected to the dash switch as shown in the diagram With this system no fuel pump switch is required. A vehicle OEM clutch switch is supplied for operating vehicle controls and PACE control systems along with the engine brake controls.





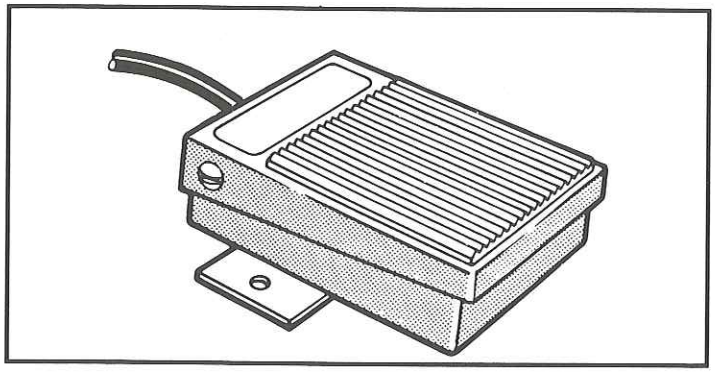
404C ENGINE BRAKE WIRING SCHEMATIC FOR 91L10 CELECT ENGINES

NOTE:

At the time of printing for this manual specific wiring information for the different vehicle manufacturers was incomplete. Consult current service letters for updated information.

OPTIONAL CONTROLS FOR PRE-91L10 AND 91L10 STC ENGINES WITHOUT PACE

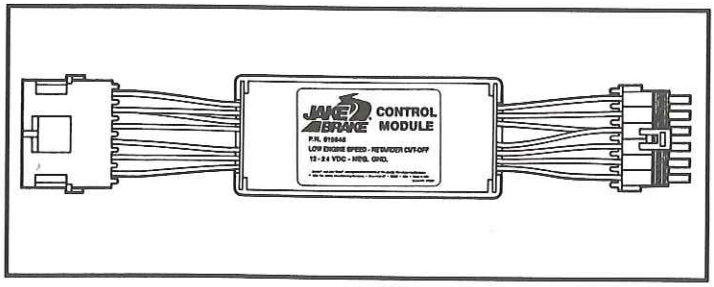
See parts manual for part number information.



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. The throttle switch remains in the system to ensure that fueling and engine braking do not occur at the same time.

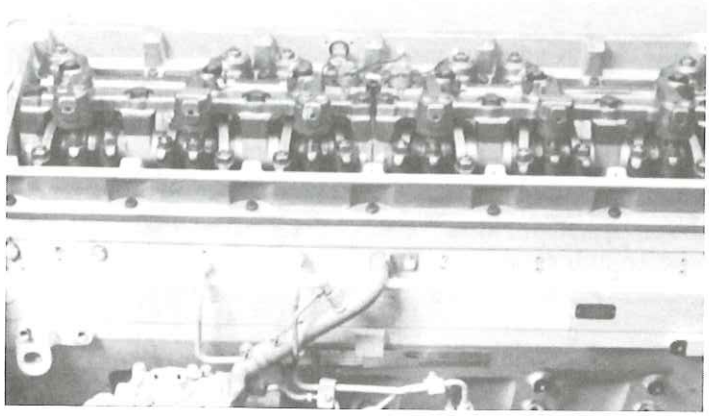
LOW ENGINE SPEED RETARDER CUT-OFF SYSTEMS

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



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

FINAL CHECKS



The Jacobs Engine Brake installation is now complete. The following checks should be made.
Recheck the housing installation. Be certain no foreign objects have been left behind and all correct clearance requirements have been met.

BRAKE UNIT BLEED AND OPERATION CHECK

⚠WARNING

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

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

1. Bleed brake units and check their operation. Start engine and allow to run 5 to 10 minutes. Accelerate engine to approximately 1800 rpm. Release throttle and then manually depress each solenoid armature. Repeat this procedure five or six times to permit engine oil to fill the brake housing passages completely.

2. Connect control wires to terminal leadout assemblies in Engine Brake spacer.

NON PACE & CELECT ENGINES ONLY

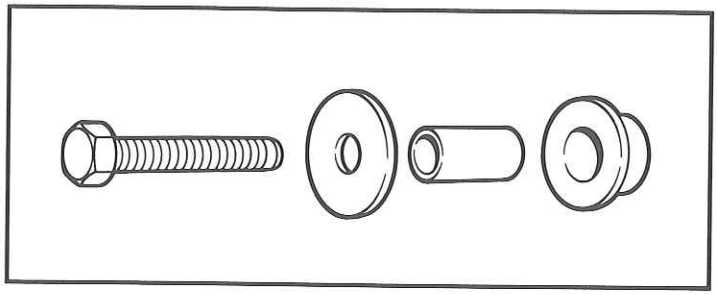
3. With the engine shutdown, check electrical system by turning on ignition switch and moving Jacobs dash switch from OFF to LO to HI. In LO, only one brake housing solenoid valve should activate. In HI, both front and rear solenoids should activate.

After final adjustments to engine and engine brake have been completed, replace valve cover as follows:

1. Remove old cover gasket.

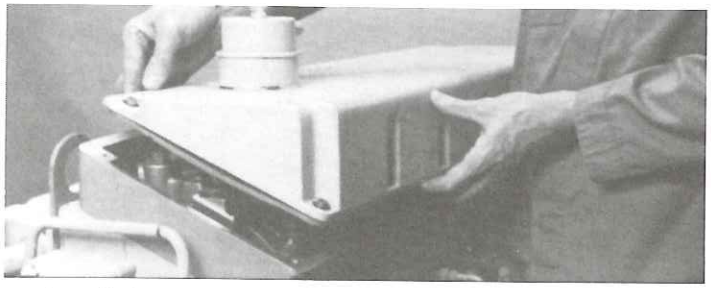
2. Apply a 1/16 in. (2 mm) bead of Cummins black RTV sealant, or equivalent, to the gasket sealing surface on the valve cover.

3. Set the new Cummins gasket on the valve cover.

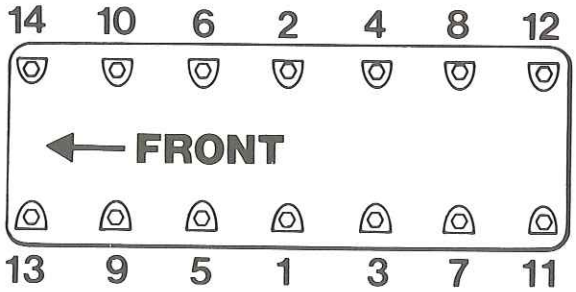


4. Install flat washer, new sleeve and new noise isolator on the capscrew.

5. Install the capscrew assemblies in the cover.

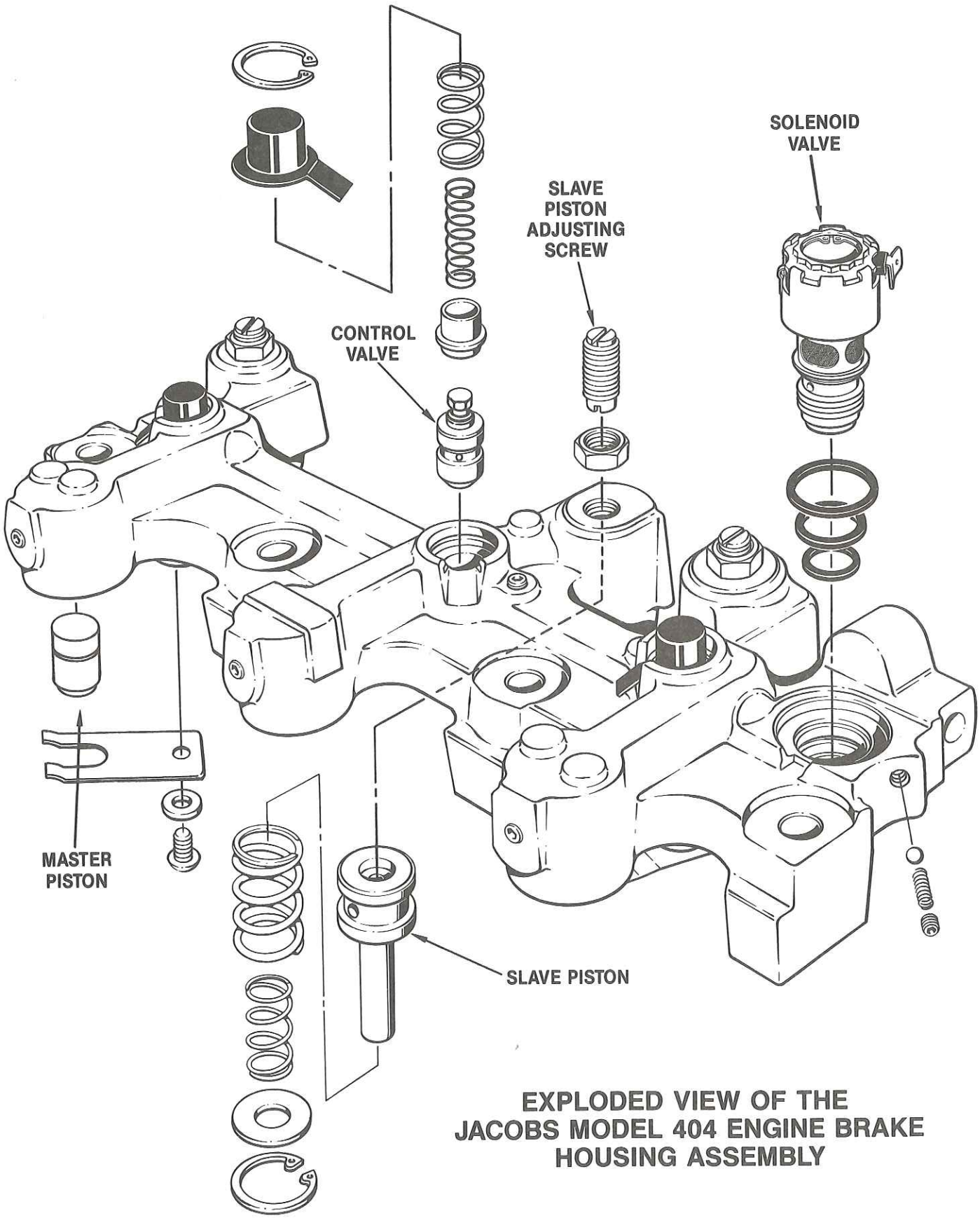


6. Install the cover on the Jacobs Spacer and tighten the cover capscrews in the sequence shown to 130 lbin (15 N·m)



Cover capscrew torque sequence.

Attach the Drivers Warning decal close to the Jake Brake Switch on the dash. Complete and mail the Engine Brake Warranty Card.



EXPLODED VIEW OF THE JACOBS MODEL 404 ENGINE BRAKE HOUSING ASSEMBLY

⚠WARNING

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

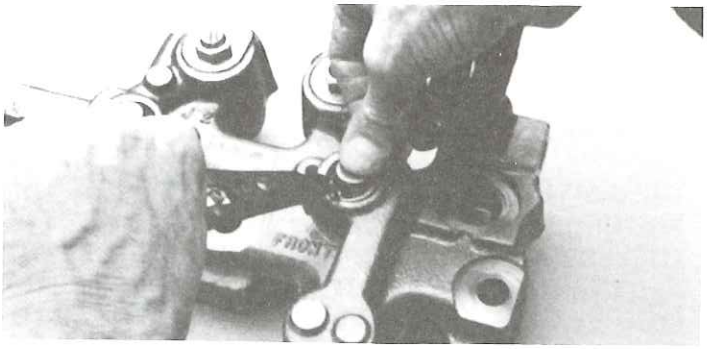
The Jacobs Engine Brake is a relatively trouble free and maintenance free device. However, inspections and part replacement will need to be made from time to time. Use the following procedures to keep the engine brake in top condition.

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

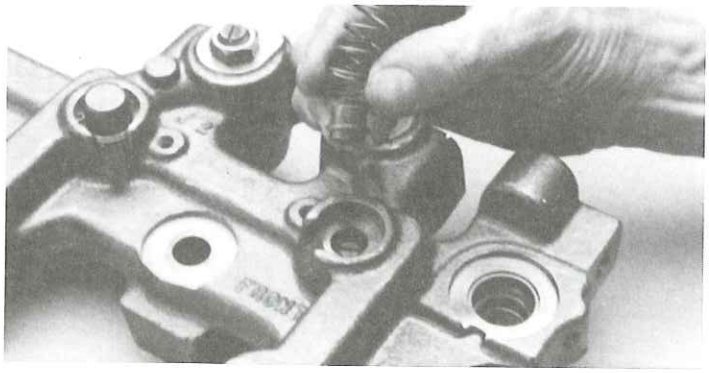
CONTROL VALVE

⚠WARNING

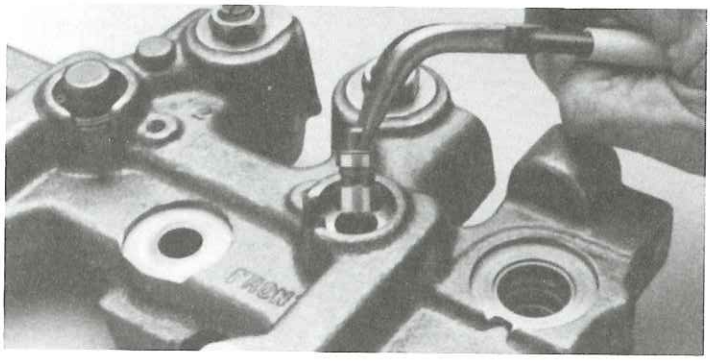
REMOVE CONTROL VALVE COVERS CAREFULLY. CONTROL VALVE COVERS ARE UNDER LOAD FROM THE CONTROL VALVE SPRINGS. REMOVE WITH CARE TO AVOID PERSONAL INJURY.



Apply pressure on the control valve cover and remove using retaining ring pliers.



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

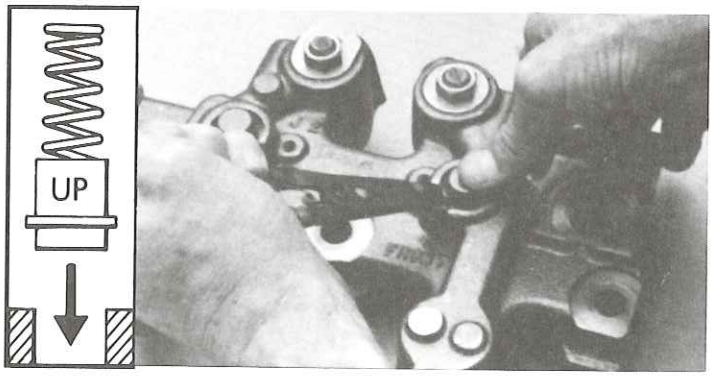


Using needle-nose pliers, remove the control valve.

Wash the control valve with approved cleaning solvent. 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.

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 replaced.

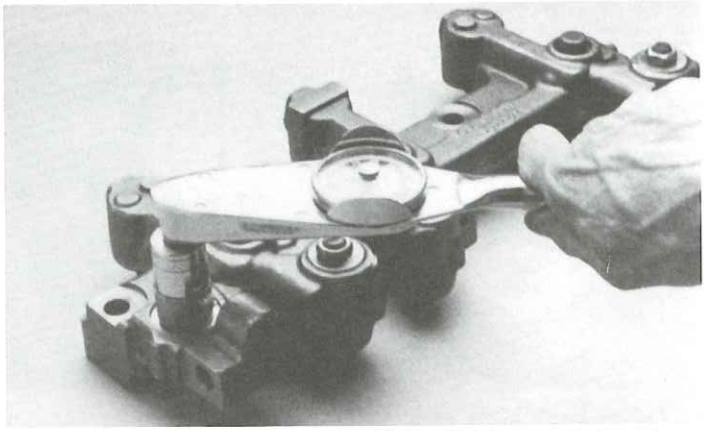


Reassemble the parts reversing removal procedure. Be sure retaining ring ears are positioned opposite the oil drain slot in the housing.

⚠CAUTION

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

SOLENOID VALVE

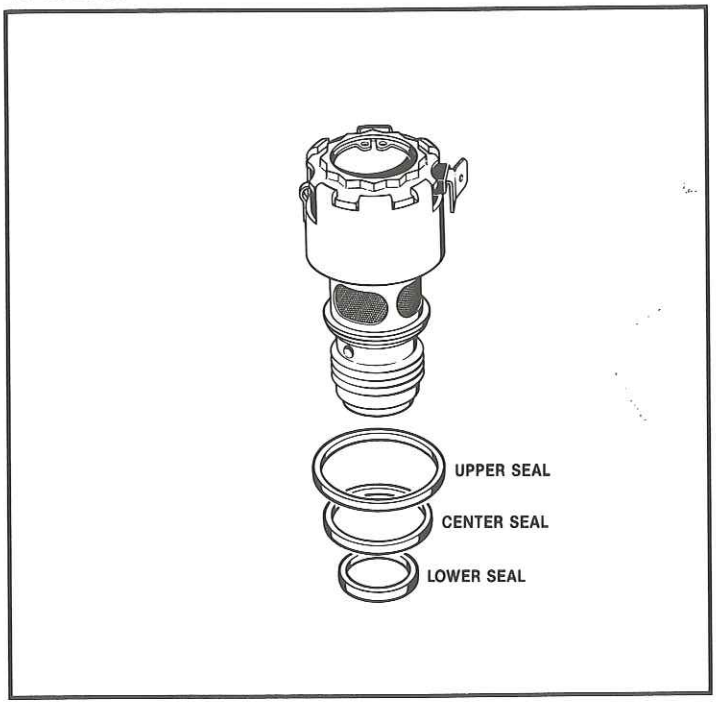


Disconnect solenoid harness. Using 7/8 in. socket and extension, unscrew solenoid valve.

NOTE:
Early style solenoid valves require a Jacobs solenoid wrench.

⚠CAUTION

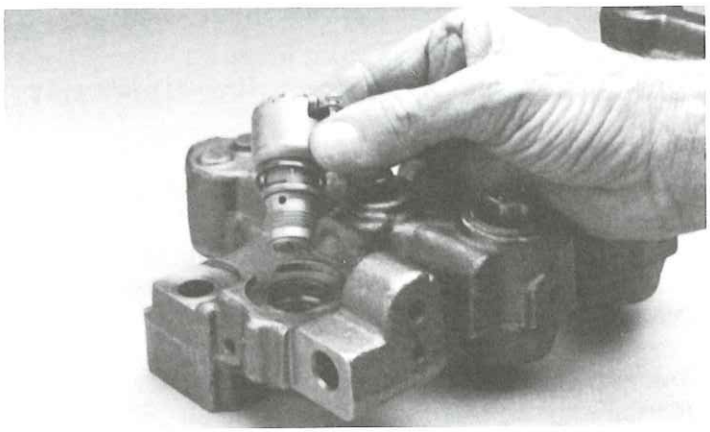
DO NOT DISASSEMBLE OR TAMPER WITH THE SOLENOID VALVE. ENGINE DAMAGE COULD RESULT.



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.

Wash out the solenoid valve with approved cleaning solvent. Use a brush to clean the oil screen. Clean and dry the valve with compressed air. Replace oil screen, if necessary.

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.



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

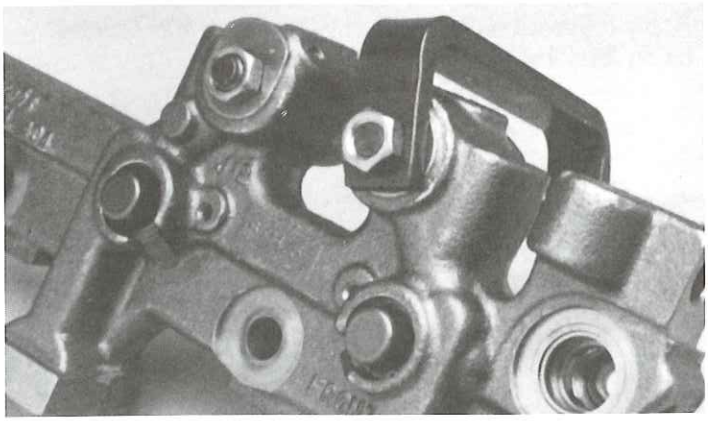
Be sure the seals are seated properly and carefully and screw the solenoid into housing without unseating the seals. Torque the valve to 60 lbin (7 N·m).

SLAVE PISTON

⚠WARNING

WEAR SAFETY GLASSES. REMOVE SLAVE PISTON CAREFULLY.

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



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

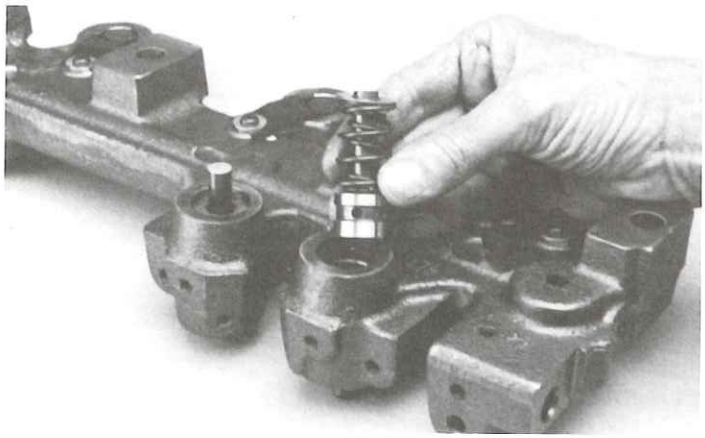
Use the slave piston clamp fixture, and the following procedure to remove and replace the slave piston.

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

While holding the fixture in position, screw the holder down over the slave piston stem until the retainer is contacted.

Turn the handle slowly until the retainer is depressed about 1/32 in. (1mm) relieving pressure against the retaining ring.

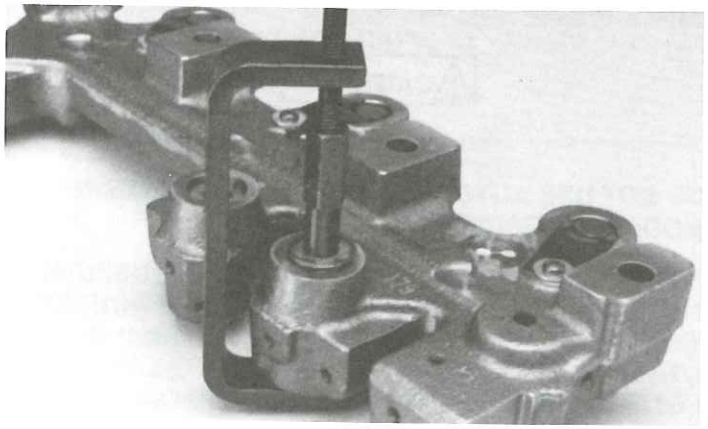
Remove the retaining ring. Use retaining ring pliers. Back out the holder until the springs are loose. Remove the fixture.



Remove the retainer, springs and slave piston. Check for nicks or burrs that could cause binding. Clean piston in an approved cleaning solvent. Run a small wire through any holes. Replace the piston if the ground surface on the outside diameter is scratched or scored.

NOTE:

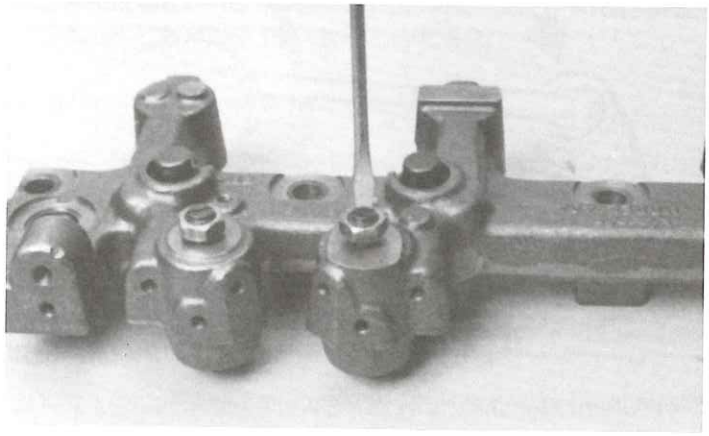
Be sure all components are reassembled in correct order.



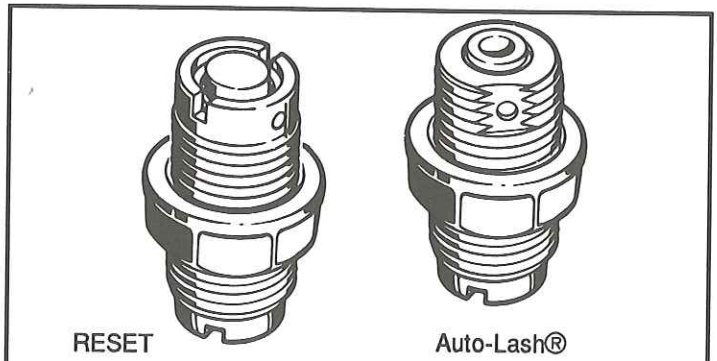
Use clamp fixture to reinstall piston and springs. Insert the slave piston and springs into the housing bore. Install retainer.

Use the clamp fixture to compress the slave piston and springs down until the retainer is about 1/32 in. (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.

SLAVE PISTON ADJUSTING SCREWS (RESET)



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



SLAVE PISTON ADJUSTING SCREWS

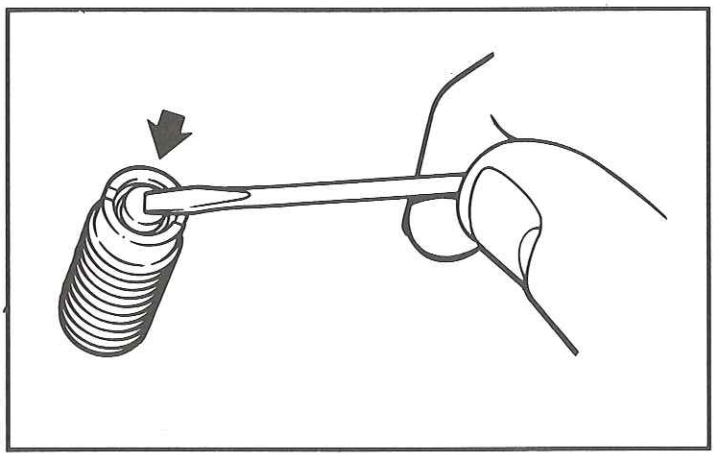
⚠CAUTION

DO NOT USE AUTO-LASH OR SOLID SCREWS IN MODEL 404 SERIES ENGINE BRAKES.

THE SLAVE PISTON ADJUSTING SCREWS USED IN THE MODEL 404 SERIES ENGINE BRAKES ARE NOT THE AUTO-LASH ADJUSTING SCREWS USED IN OTHER ENGINE BRAKES. USE OF AUTO-LASH OR SOLID SCREWS IN MODEL 404s COULD CAUSE ENGINE DAMAGE.

NOTE:

The Model 404 series slave piston adjusting screws (reset) are not the same as those use in other engine brakes. For proper identification, refer to the parts manual and the part number stamped on the top of the screw assembly.



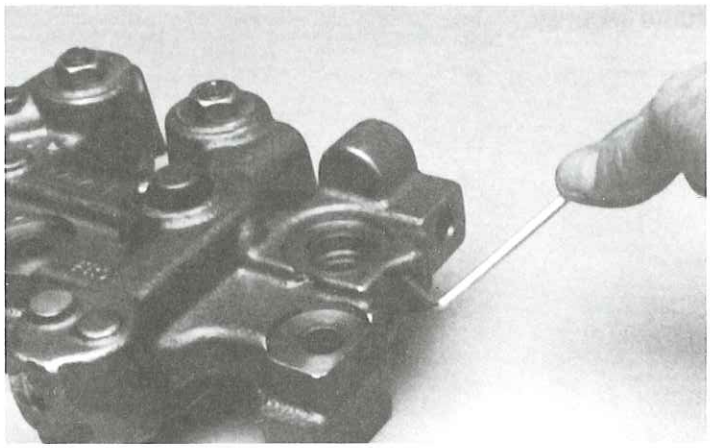
Clean in an approved OSHA cleaning solvent.

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

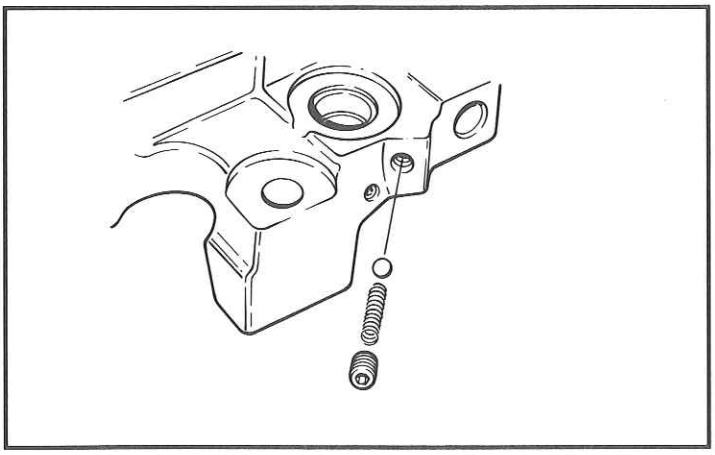
⚠CAUTION

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

BALL CHECK VALVE



Remove hex socket pipe plug. Be careful during final turns to avoid loss of spring and ball. Remove spring and ball.



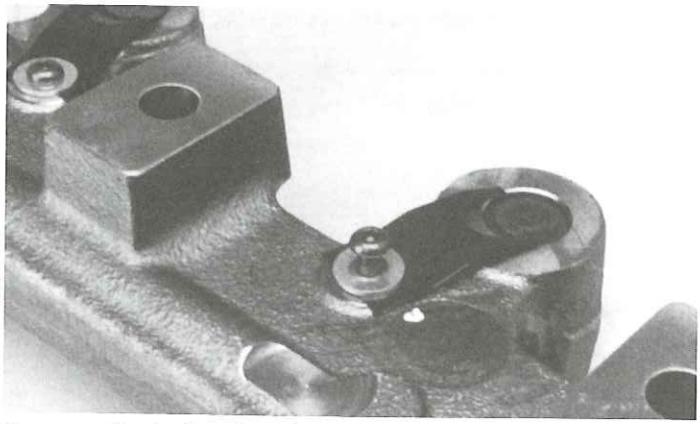
Inspect, clean in an approved cleaning solvent and replace as required.

Reassemble, inserting first the ball, then spring, and plug. Torque plug to 106lbin (12N·m).

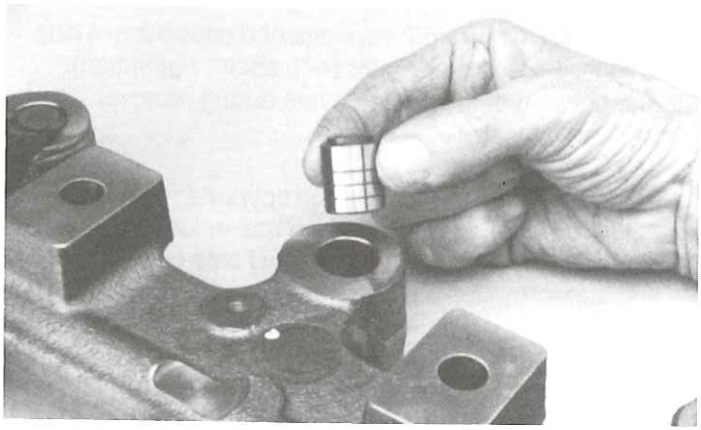
⚠CAUTION

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

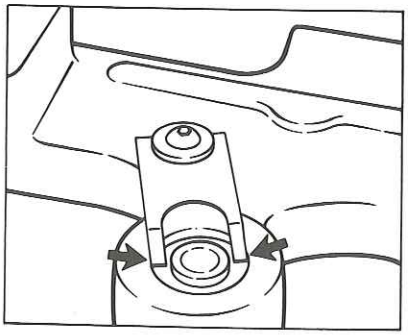
MASTER PISTON



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



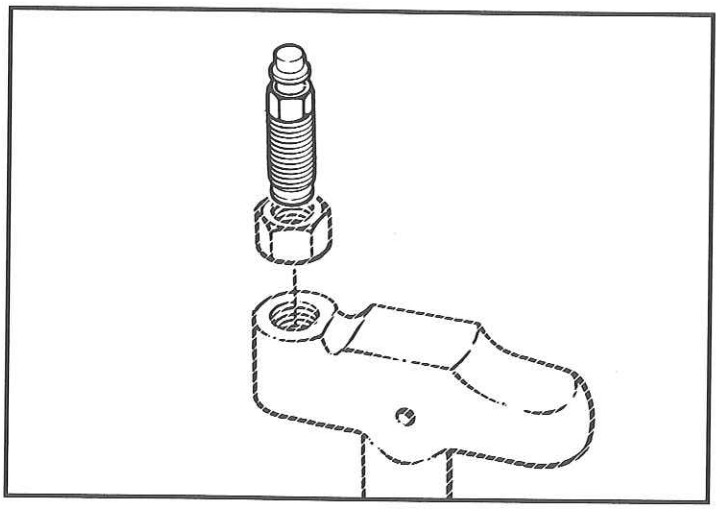
Remove master piston from its bore using needle nose pliers. If binding occurs, check for burrs or contaminants in lube oil. Clean in an approved solvent. Inspect the hard face surface. Pitted, chipped, cracked or galled pistons should be replaced. If hard facing is damaged, inspect the corresponding rocker arm adjusting screws for excessive wear or pitting. Replace if damaged.



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 illustration.

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

CROSSHEAD ADJUSTING SCREW MODELS 404, 404B



Loosen the crosshead adjusting screw locknut and remove the adjusting screw from the crosshead. Inspect the assembly.

⚠CAUTION

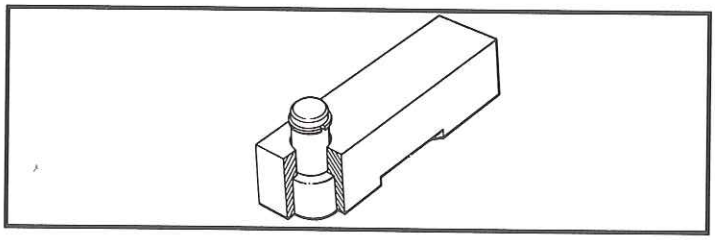
DO NOT REMOVE RETAINING RING WHICH HOLDS THE PIN IN THE ADJUSTING SCREW ASSEMBLY. THE ASSEMBLY IS MADE UP OF MATCHED PARTS AND MUST NOT BE FIELD SERVICED.

Clean in an approved cleaning solvent.

The pin should move freely in the screw body. Replace the screw assembly if any peening, mushrooming or cracks can be seen on either end of the pin.

Lubricate the screw assembly with clean engine oil and reinstall into crosshead. See page 7 for adjustment procedures.

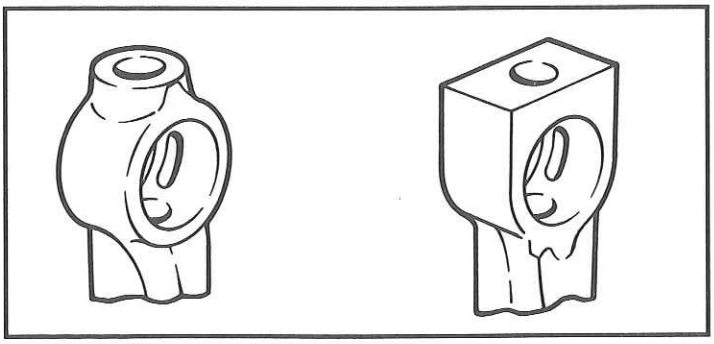
GUIDELESS CROSSHEAD ASSY 404BG AND 404C



⚠CAUTION

DO NOT DISASSEMBLE THE ACTUATOR PIN FROM THE JACOBS CROSSHEAD. THE ASSEMBLY IS MADE UP OF MATCHED PARTS AND MUST NOT BE FIELD SERVICED.

PRE91L10 ENGINES



EARLY CURRENT

POSITION	QTY PER ENGINE	EARLY SUPPORT PART NUMBER	NEW SUPPORT PART NUMBER
FRONT	2	3026533	3036917
CENTER	4	3027504	3036818
REAR	2	3026532	3036916

The figure above shows the difference between the early and current support designs.

The new supports have a large flat top surface which becomes the mounting surface for the Jake Brake housing.

The following installation procedure must be followed when a support exchange is required.

DISASSEMBLY OF ROCKER SHAFTS FOR SUPPORT EXCHANGE

⚠CAUTION

SHAFT ORIENTATION IS CRITICAL. IF SUPPORTS ARE INSTALLED INCORRECTLY ON SHAFTS, THE OIL SUPPLY TO THE OVERHEAD WILL BE CUT OFF.

1. Examine supports and shaft to determine location of arrows.

a. Each rocker lever shaft is marked FRONT and REAR and has arrows for alignment with the supports. The arrows on the end supports must line up with the arrows on the shaft.

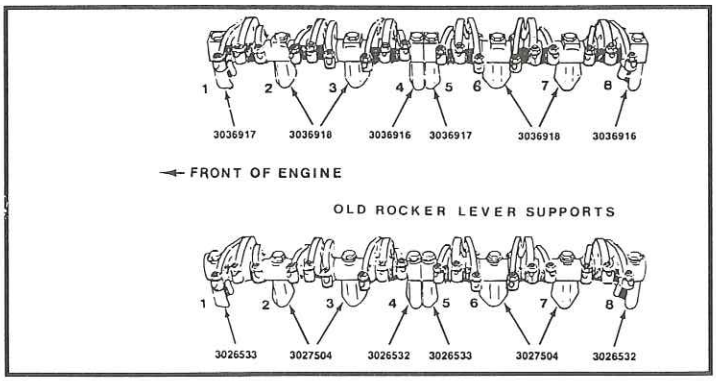
⚠CAUTION

THE FRONT AND REAR END SUPPORTS ARE NOT INTERCHANGEABLE.

b. The FRONT marking on each shaft will face the front of the engine when installed.

2. Loosen each rocker lever adjusting screw and locknut. Remove push rods (3 each cylinder).

NOTE:
Some push rods will remain tight.



3. Loosen the rocker support capscrews slowly while removing any remaining push rods. When all push rods are removed, finish loosening the capscrews but do not remove them. The capscrews prevent the rocker lever assemblies from sliding apart during removal.

4. Remove No.1 and No.2 supports and capscrews along with cylinder No.1 rocker levers (see above illustration). Note the position of the rocker levers during removal. They are not interchangeable.

5. Install the No.1 and No.2 flat top supports (see above illustration for PNs), capscrews and rocker levers. The support "feet" must point to the exhaust side of the engine. The end support must also have the alignment arrow on the outside.

6. Replace the remaining supports within the front assembly. Set the front shaft assembly aside.

7. Using the same procedure, exchange supports on the rear rocker assembly. Set the rear shaft assembly aside.

8. Complete the Exhaust Crosshead Adjustment procedure (See Section 2, page 7).

9. Install the oil connector screw in the front housing and check that slave pistons are retracted.

REINSTALLATION OF ROCKER SHAFTS

1. Remove all injector rocker lever adjusting screws and locknuts.

2. Install Cummins locknuts on the Jacobs injector rocker lever adjusting screws and install the screws in the injector rocker levers.

NOTE:
Use Jacobs locknuts with the Model 404C.

3. Reinstall both rocker assemblies. Engage the capscrews only enough to maintain location. (The capscrew will be replaced when the housings are installed)

4. Continue housing installation beginning with capscrew removal. See section 3 installation.

P/N 011948 25M

New 3/90