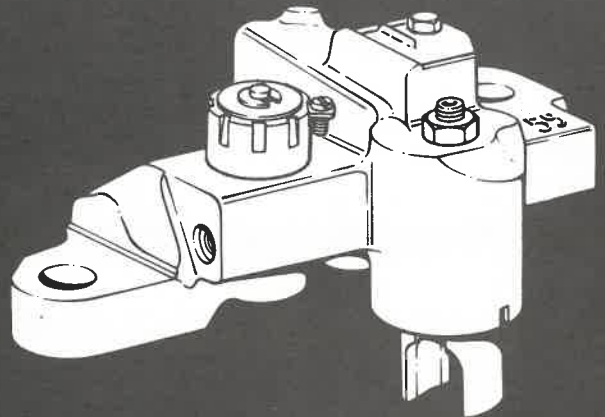


Installation Manual for

Jacobs®
**ENGINE
BRAKE**



Model 59, 59A & Model 59B

GENERAL APPLICATION INFORMATION

- The information in this manual covers the Models 59, 59A and Model 59B Jacobs Engine Brakes.
- The **MODELS 59 AND 59A** are designed and approved for use on Cummins small VEE **SMALL CAM ENGINES ONLY**.
- The **MODEL 59B** is designed and approved for use on Cummins small VEE **BIG CAM AND SMALL CAM Engines**.
- Specific application information is explained on page one.
- Special attention must be paid to Engine Brake adjustment: Engine Brake adjustment is different for BIG CAM and SMALL CAM engines.
- Jacobs service letters should be consulted for additional applications and updated information.

SAFETY PRECAUTIONS

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

⚠ WARNING THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.

⚠ CAUTION THIS SYMBOL REFERS TO POSSIBLE EQUIPMENT DAMAGE.

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

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

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



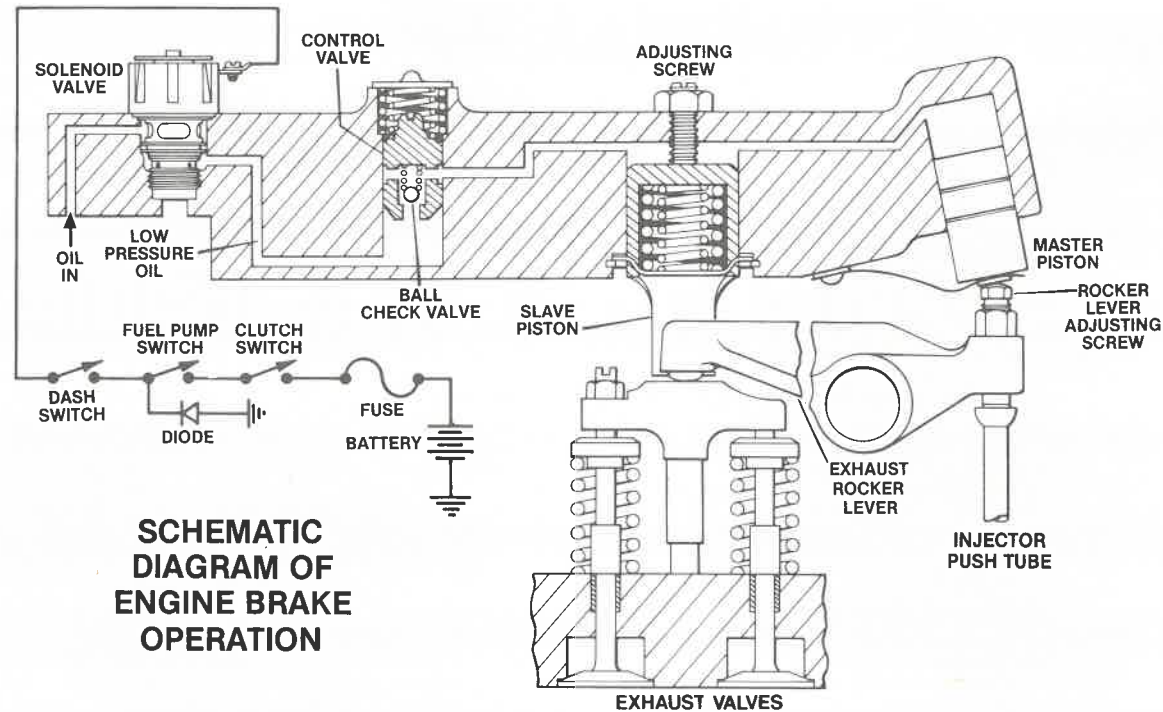
The Jacobs Manufacturing Company
Vehicle Equipment Division
Bloomfield, CT 06002 U.S.A.

METHOD OF DRIVING A VEHICLE EQUIPPED WITH A JACOBS ENGINE BRAKE

The proper method of driving a vehicle equipped with a Jacobs Engine Brake will be simple for an operator to learn. Since the Engine Brake is most effective at rated engine speeds, gear selection is very important. Gearing down the vehicle, within the limits of rated engine speed, makes the Engine Brake a more effective retarder. Maximum retarding occurs with the selection of the lowest gear that prevents exceeding rated engine speed.

The Models 59, 59A & 59B Engine Brake kit contains a progressive switch that provides three- and six-cylinder or four- and eight-cylinder operation of the Engine Brake. This switch provides the operator with greater flexibility in selecting the amount of retarding needed for various road and load conditions.

For more information on driving with the Jake Brake, consult your drivers' manual. For a detailed presentation of driving with the Jake Brake, consult your local Jacobs Distributor.



**SCHEMATIC
DIAGRAM OF
ENGINE BRAKE
OPERATION**

THEORY OF OPERATION—Simply stated, energizing the Engine Brake effectively converts a power producing diesel engine into a power absorbing air compressor. This is accomplished when desired by motion transfer through a master-slave piston arrangement which opens the cylinder exhaust valves near the top of the normal compression stroke, releasing the compressed cylinder charge to exhaust.

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

Exhaust blowdown of the braking cylinder is accomplished by utilizing injector push tube motion. 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 creating a high-pressure oil flow 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 flow moves down, momentarily opening the exhaust valve, while the engine piston is near its top dead center position, releasing compressed cylinder air to the exhaust manifold.
5. Compressed air escapes to atmosphere completing a compression braking cycle.

ENGINE BRAKE APPLICATION INFORMATION.

BRAKE MODEL	ENGINE	MAX ENGINE LUBE OIL PRESSURE	NO. OF BRAKE HOUSINGS TO BE INSTALLED	COMMENTS
59	Small Cam	87 PSI	1 per Cyl.	See Notes 1 & 2
59A	Small Cam	110 PSI	1 per Cyl.	See Note 2
59B	Small Cam & Big Cam	110 PSI 110 PSI	1 per Cyl. 6 Max on V6 or V8	Caution See Note 3

NOTE 1. Model 59 housings can be converted to Model 59A assemblies for higher engine lube oil pressure operation. Use the Parts Manual to identify the proper parts and part numbers.

NOTE 2. Model 59 and 59A cannot be converted to Model 59B because of differences in the machined housing.

NOTE 3. Engine and engine brake damage will result if (8) eight engine brake housings are installed on Big Cam V8 Engines.



VT-504 BIG CAM



V-504 SMALL CAM

SPECIAL TOOL

To complete the installation of the Models 59, 59A & 59B Engine Brake, A Jacobs slave piston adjusting tool is required.



Additional reference should be made to Cummins Service Manual, 3379069-03 for specific engine adjustment information.

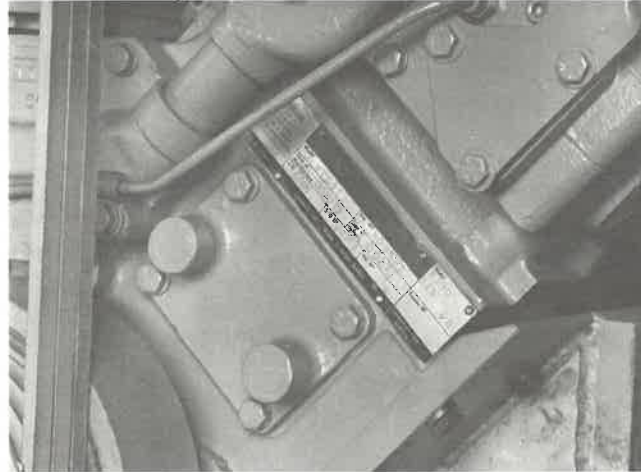
MODEL 59 TO 59A CONVERSION

Model 59 housings can be converted to Model 59A assemblies for higher engine lube oil pressure operation. Use the Parts Manual to identify the proper part numbers.

Replace the outer control valve spring with the part listed for the Model 59A. Add to the slave piston assembly the inner slave piston spring and the spring guide.

Model 59 and 59A cannot be converted to Model 59B because of differences in the machined housing.

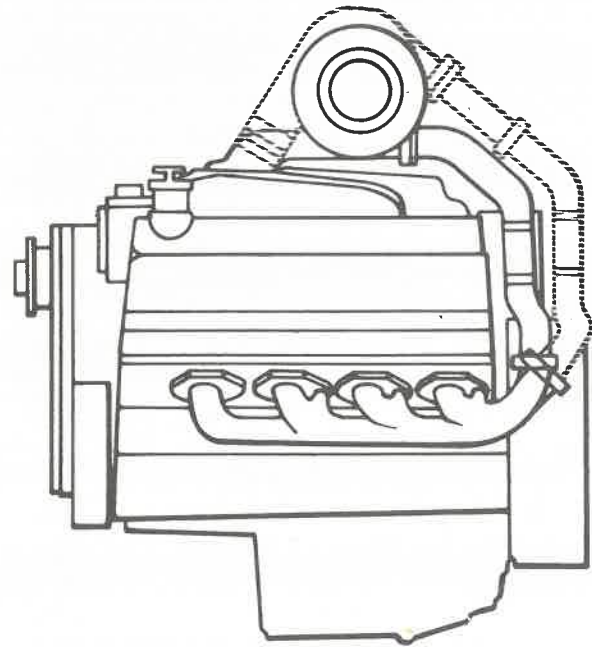
Before installing the Engine Brake, the engine model identification must be established. This will help insure that the correct model Engine Brake is installed.



The engine model identification is on the data plate. The engine data plate can be found on the left bank front casting face of the cylinder block or on the valve cover.

BIG CAM/SMALL CAM IDENTIFICATION

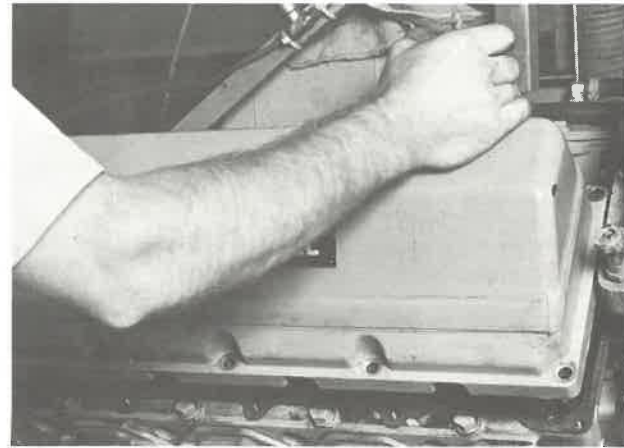
1. All naturally aspirated small vee engines are SMALL CAM.
2. All turbocharged VT-378 and VT-504 small vee engines are BIG CAM.
3. All VT-555 engines with HC3 turbochargers are BIG CAM.
4. VT-555 with T-50 turbochargers may be either small cam or big cam. Use the C.P.L. Number found on the data plate to determine if the engine is small cam or big cam. Big cam C.P.L.'s are: 5039, 5047, and 5048. All other VT-555 engines with a T-50 turbocharger are small cam.



T50 TURBORCHARGER -----

HC3 TURBORCHARGER _____

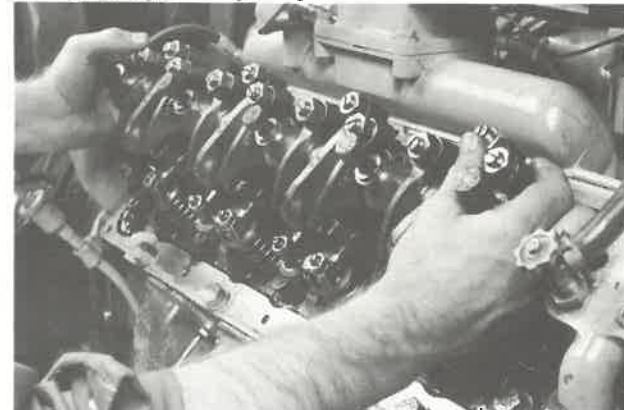
ENGINE PREPARATION



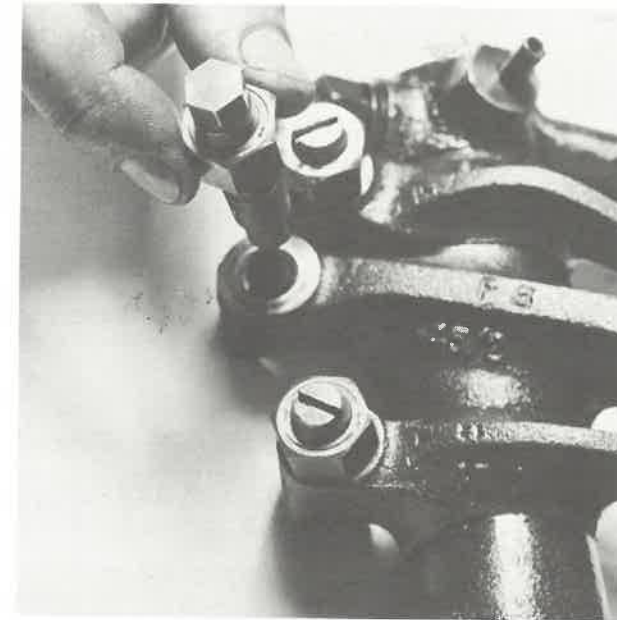
Clean engine thoroughly and remove valve covers from both banks.



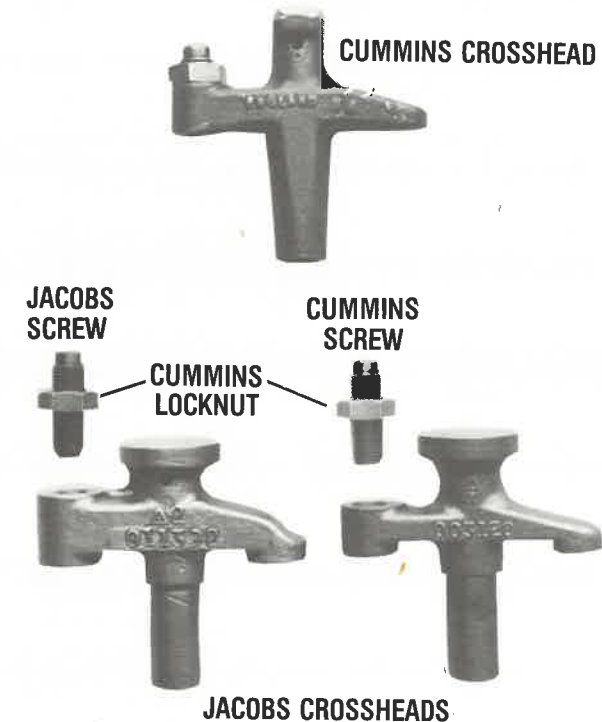
Loosen all injector adjusting screw locknuts.



Loosen all rocker pedestal head bolts on both banks. Leave them in the rocker shaft assemblies and remove the assemblies from the engine.

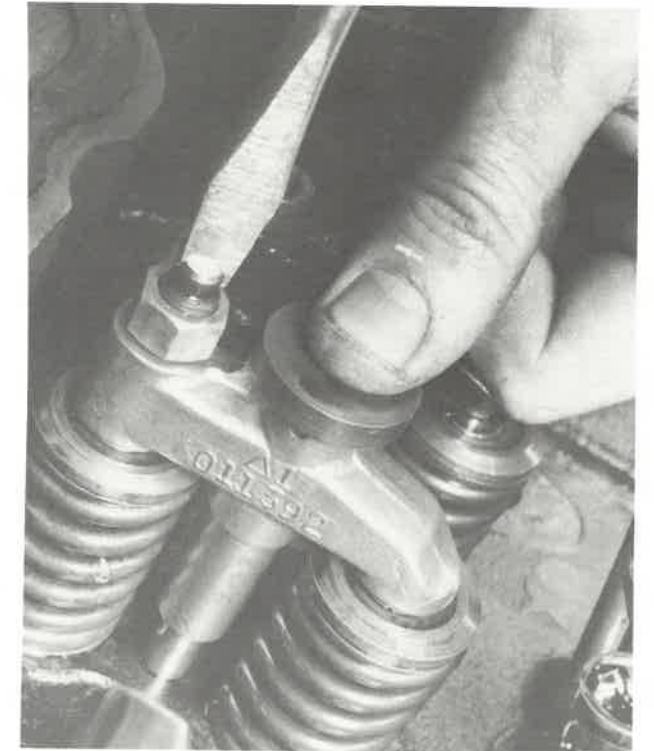


Remove the Cummins injector adjusting screws and replace them with the Jacobs injector adjusting screws using the Cummins locknuts.



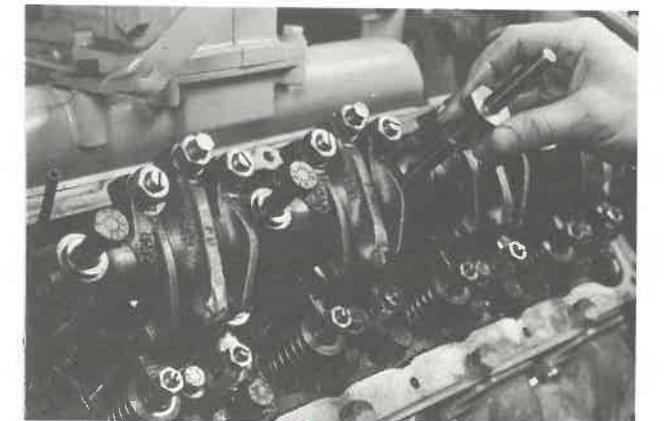
Remove Cummins exhaust valve crossheads and replace with Jacobs exhaust valve crossheads. Depending on the Jacobs crossheads used, either Jacobs adjusting screws will be included in the kit or the Cummins adjusting screw will be used. Always reuse the Cummins locknuts.

NOTE: Crosshead retainers, if installed on engine are not used with the Jacobs crossheads.



Put some clean engine lube oil into the crosshead bore. Install the Jacobs exhaust valve crosshead on the engine and adjust the screw.

- a. Hold the crosshead firmly down on the mating valve stem. Run the crosshead adjusting screw down until it touches the valve stem.
- b. Hold the adjusting screws in position and lock the nut.
- c. Tighten the adjusting screw locknut 26 lb. ft. (36 N•m). When ST-669 Torque Wrench Adapter is used tighten the nuts to 24 lb. ft. (33 N•m).



⚠ WARNING

BEFORE INSTALLING ROCKER SHAFT ASSEMBLIES BACK ON ENGINE, USE A SUITABLE LENGTH OF TUBING ATTACHED TO A BLOW GUN NOZZLE. BLOW THE OIL OUT OF THE HOLDDOWN BOLT HOLES TO PREVENT THE ENGINE BLOCK FROM CRACKING DURING THE TORQUING OF THE JACOBS HOLDDOWN STUDS. WHILE BLOWING THE OIL OUT, COVER THE BOLT HOLES WITH A CLEAN RAG TO PREVENT OIL FROM SPREADING. EYE PROTECTION SHOULD BE WORN.

Replace the Cummins holddown bolts and washers with the Jacobs holddown studs and washers. Do not use the Cummins washers. An exception to this is on Big Cam engines as noted below.

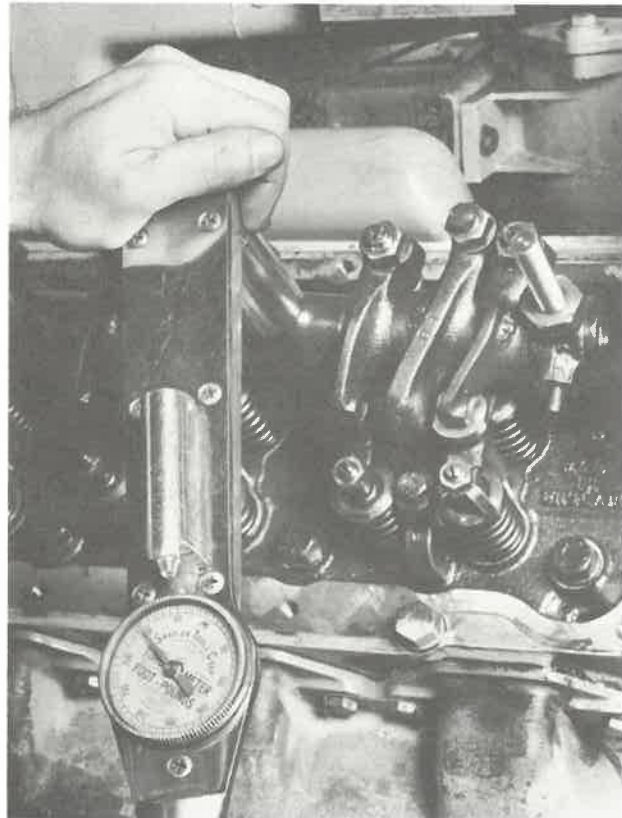
Apply clean engine oil to the threads and at underside of head of all Jacobs stud assemblies. Place the rocker shaft assemblies back on the engine. Fit the push tubes to the rocker adjusting screws.

CAUTION

BIG CAM V8 ENGINES USE SIX ENGINE BRAKE HOUSINGS, THREE PER CYLINDER HEAD. ENGINE BRAKE HOUSINGS WILL BE INSTALLED ON CYLINDERS NO. 2, 3, 4, 6, 7, 8 ONLY.

STUD LOCATIONS ARE NOTED WITH AN "X" ON FIG. 2.

INSTALL FOUR JACOBS STUDS PER CYLINDER HEAD. RE-USE THE CUMMINS BOLT AND WASHER IN THE REMAINING LOCATION.



On engines with 1/2" (12.7mm) holddown studs torque to 85 lb. ft. (115 N•m) per sequence.

Retorque holddown studs to 112 lb. ft. (152 N•m).

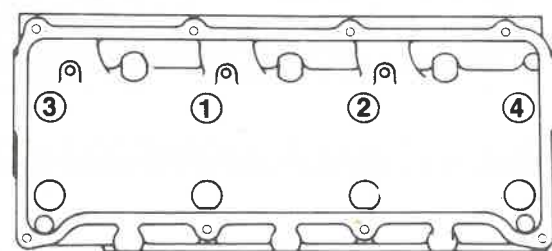


Fig. 1 Cylinder head tightening sequence—V6.

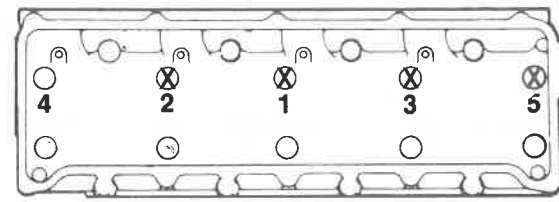


Fig. 2 Cylinder head tightening sequence—V8.

On engines with 9/16 (14.3mm) holddown studs torque to 30 lb. ft. (41 N•m).

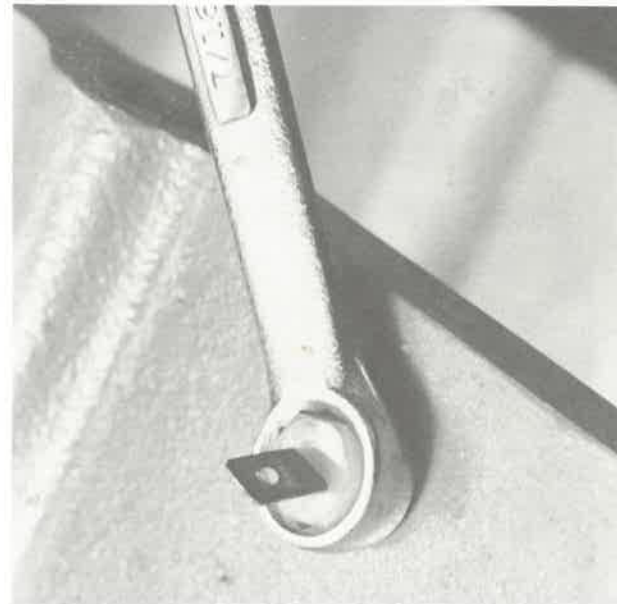
Retorque to 90 lb. ft. (122 N•m).

Torque all studs to a final torque of 138 lb. ft. (187 N•m).

Adjust all injectors and valves as instructed in the Cummins service manual. Be sure that proper procedures are followed for the engine you are working on.

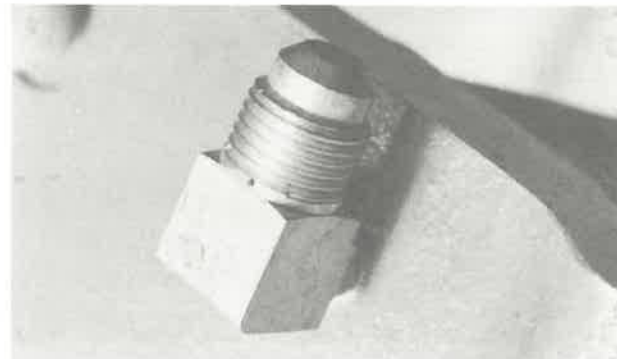
Engine identification is found on the data plate.

VALVE COVER SPACER INSTALLATION

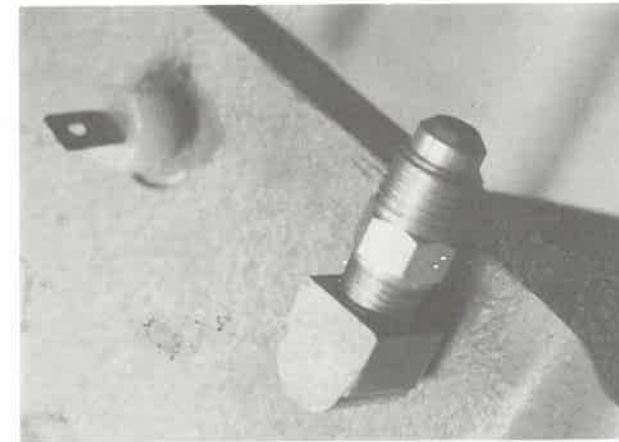


Tighten the terminal leadout assembly in the cover spacers. Use a hex box wrench and tighten until the lead out assembly is fully seated.

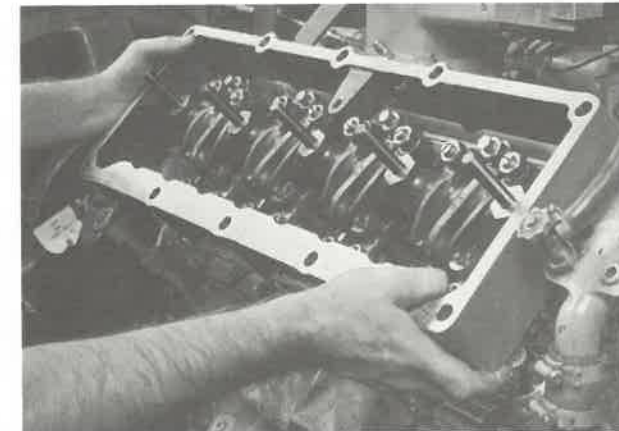
Note: The tabs may be bent to make wire connection easier, but be sure that the tab does not touch the spacer.



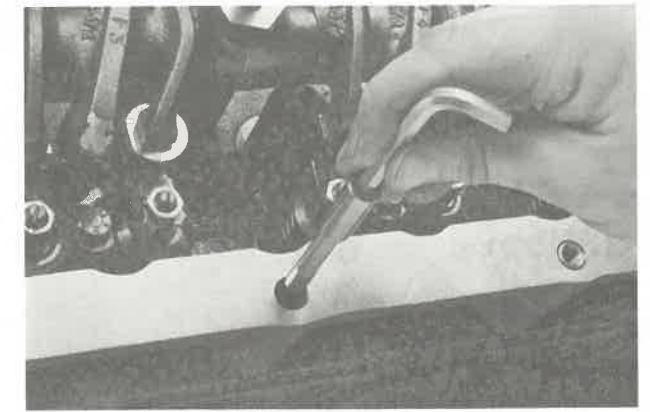
Install the 90 degree oil supply elbows into the cover spacers to position shown.



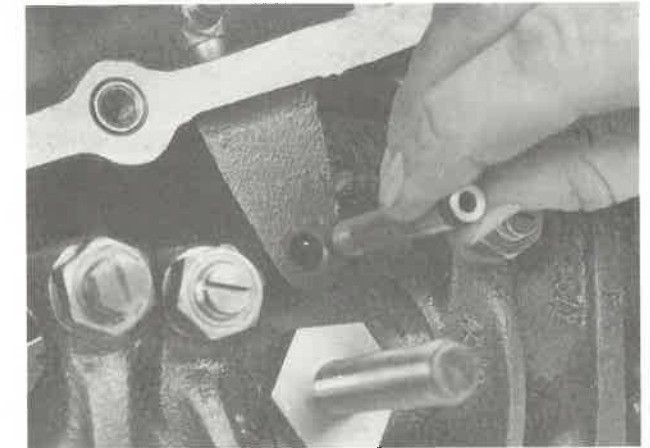
On some model engines, an interference occurs between the Jacobs spacer and the intake manifold, making it impossible to attach the oil supply hose to the 90° elbow. To eliminate this problem, a special adapter must be used as shown.



Install new cover gaskets and cover spacers on the engine.



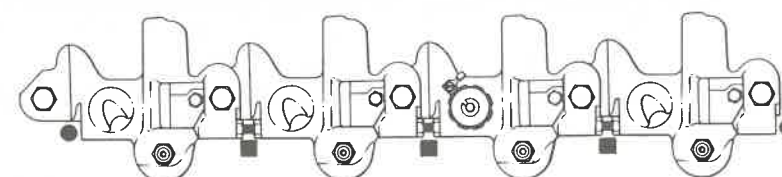
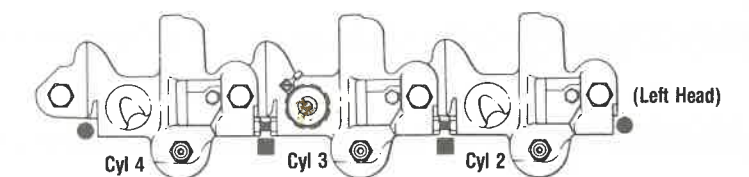
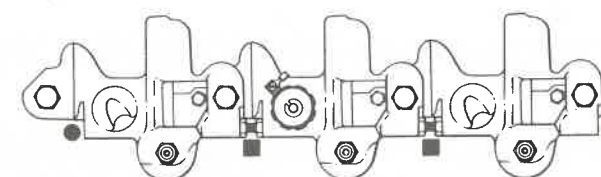
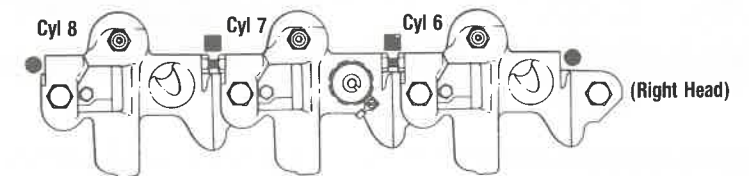
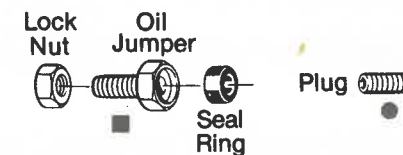
Insert the Jacobs rocker cover studs into the cover spacers using a hex wrench. Insure that the hex wrench is fully seated into the stud and tighten to 30 lb. ft. (40 N•m).

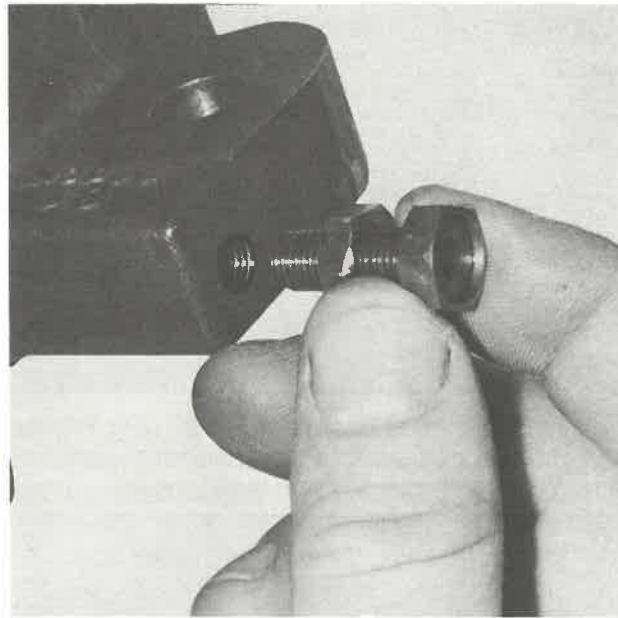


Apply a small amount of grease to the rubber seal rings on the oil connector tube and push one end of the tube into the oil supply hole in the cover spacer.

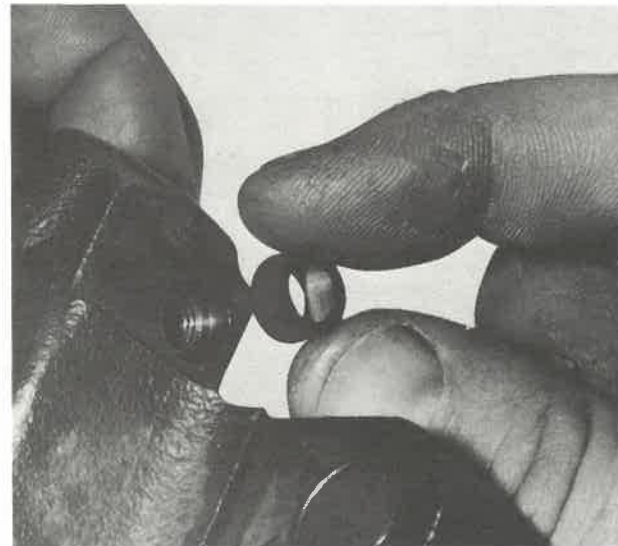
INSTALLATION OF BRAKE UNITS ON ENGINE

Prior to installing the Jacobs Engine Brake units, arrange them on a workbench in the order in which they're to be installed on the engine. Oil jumper screws, plugs and seal rings must be inserted into the housings as follows:

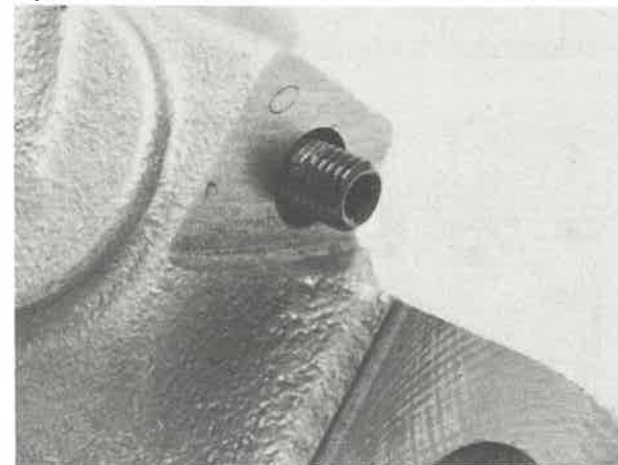




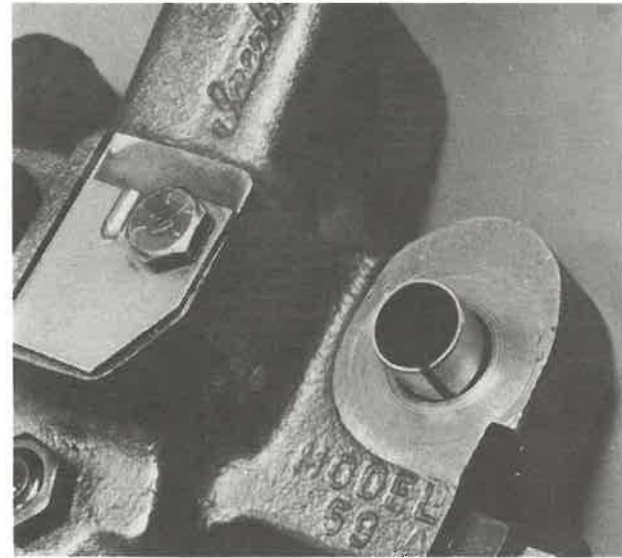
Install the oil connectors with the lock nut attached. Screw it in about a half inch to avoid damage when you assemble the housing to the engine. See the brake arrangement diagram for oil connector locations.



In the appropriate housing counter bores insert the lube oil seal ring.



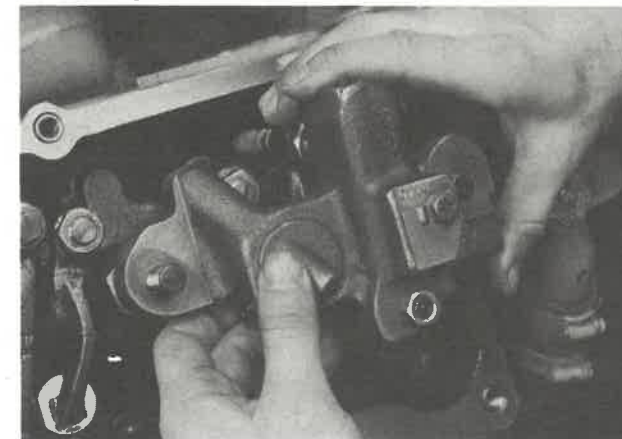
Install plugs in all end drone housings. Tighten until flush with the housing.



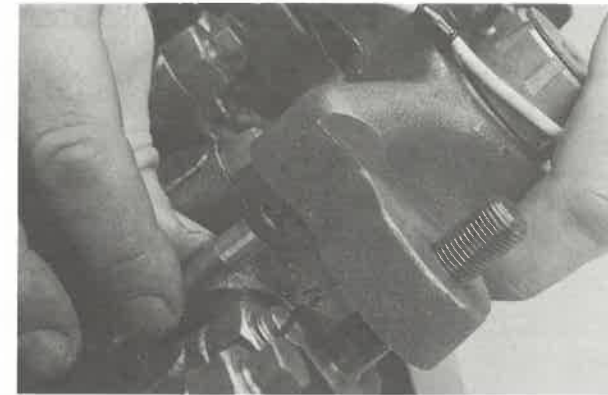
Press the stud guide sleeves, found in the housing attaching parts group, into housings being installed over 1/2" (12.7mm) holddown studs.



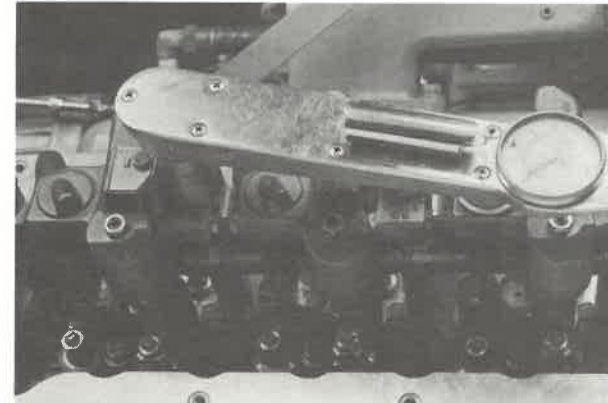
Install an end unit spacer on the holddown stud (right side of both cylinder heads) to provide a level mounting surface for the first Engine Brake Unit.



Install the Engine Brake Units on the engine in the same order in which they were arranged on the workbench, starting from the right side.



While fitting the supply unit (Second from Right) onto the hold-down studs, guide the oil supply connector into the oil supply hole in bottom of supply housing. Install remaining Brake Units.



Install the holddown nuts. Starting from right to left on both banks, torque the nuts initially to 25 lb. ft. (34 N•m). Repeat the procedure and torque the nuts to 100 lb. ft. (136 N•m).



Re-position the seal ring in the head of the oil connector to make sure it fits into the recessed hex head of the connector screw.

Screw out the oil connector until metal-to-metal contact is made with the adjacent housing.

Then, back off one third of a turn, or two flats of the hex. Backing off is necessary to provide for movement of rocker and brake assemblies.

Hold the oil connector in this position and carefully lock the lock nut. Use two short open end wrenches. Remember, too much muscle on these connectors will cause them to crack.

SLAVE PISTON ADJUSTMENT

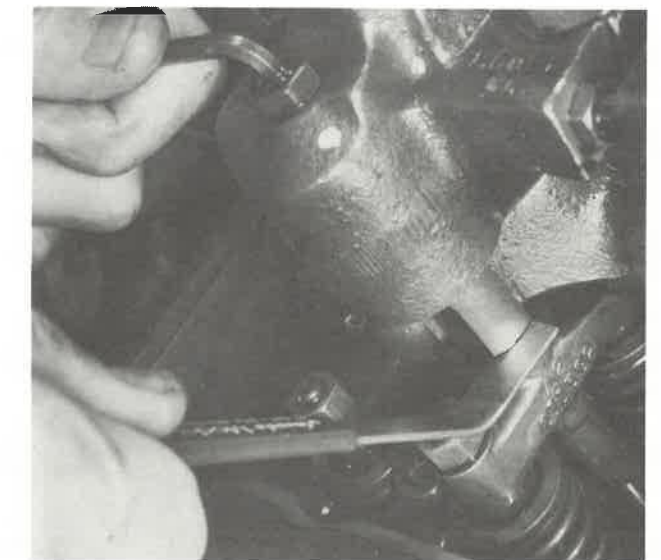
CAUTION

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

SMALL CAM ENGINES

With any given crankshaft position you can probably adjust two or three engine brake units.

Using a hex wrench loosen the slave piston adjusting screw until slave piston is seated in its bore. Slave piston adjustment must be made with a cold, shut down engine. Exhaust valves must be closed and crosshead loose. Insert the .038" (.96mm) end of the Jacobs feeler gage between the slave piston and the crosshead. Turn the adjusting screw until a slight drag is felt on the feeler gage. Torque the lock nut to 18 lb. ft. (24 N•m). Rotate the engine and complete the slave piston adjustment on remaining cylinders.

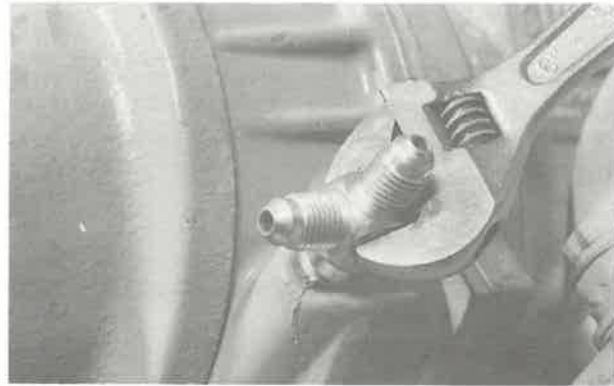


BIG CAM ENGINES

With any given crankshaft position you can probably adjust two or three engine brake units.

Using a hex wrench loosen the slave piston adjusting screw until slave piston is seated in its bore. Slave piston adjustment must be made with a cold, shut down engine. Exhaust valves must be closed and crosshead loose. Insert the .028" (.71mm) end of the Jacobs feeler gage between the slave piston and the crosshead. Turn the adjusting screw until a slight drag is felt on the feeler gage. Torque the lock nut to 18 lb. ft. (24 N•m). Rotate the engine and complete the slave piston adjustment on remaining cylinders.

INSTALLATION OF OIL SUPPLY



Install the tee fitting into the oil supply hole in the accessory gear drive as shown.



Connect the oil supply hoses to the tee fitting.

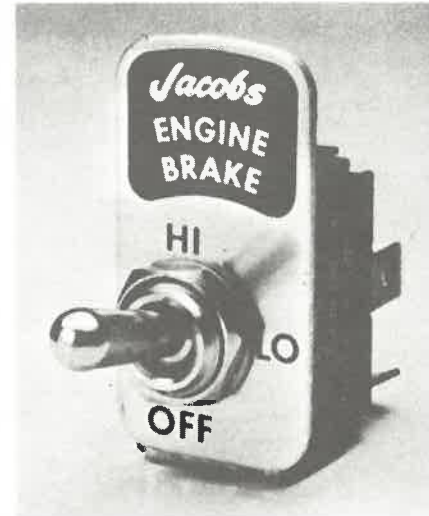


Connect the oil supply hoses to the 90° elbow fittings in the cover spacers. Adjust position of 90° elbow in the cover spacer if necessary. Attach the hose clamps in suitable positions to prevent hose vibration.

⚠ WARNING

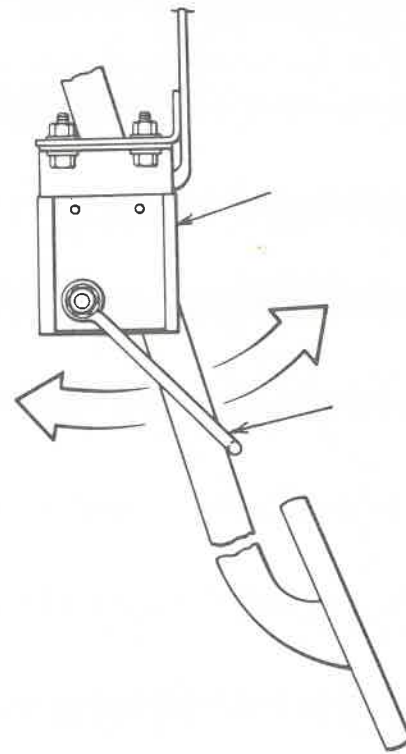
KEEP HOSE CLEAR OF ALL HOT ENGINE COMPONENTS AND FREE FROM RUBBING ON ENGINE OR CHASSIS. A RUPTURED HOSE WILL SPRAY HOT OIL AND COULD CAUSE HEAVY SMOKE OR FIRE UPON HITTING HOT ENGINE COMPONENTS.

ELECTRICAL SYSTEM INSTALLATION DASH SWITCH



Install the dash switch in a convenient location in the cab. Carefully measure and cut all harnesses to proper length and install receptacles at the locations shown in the wiring diagram.

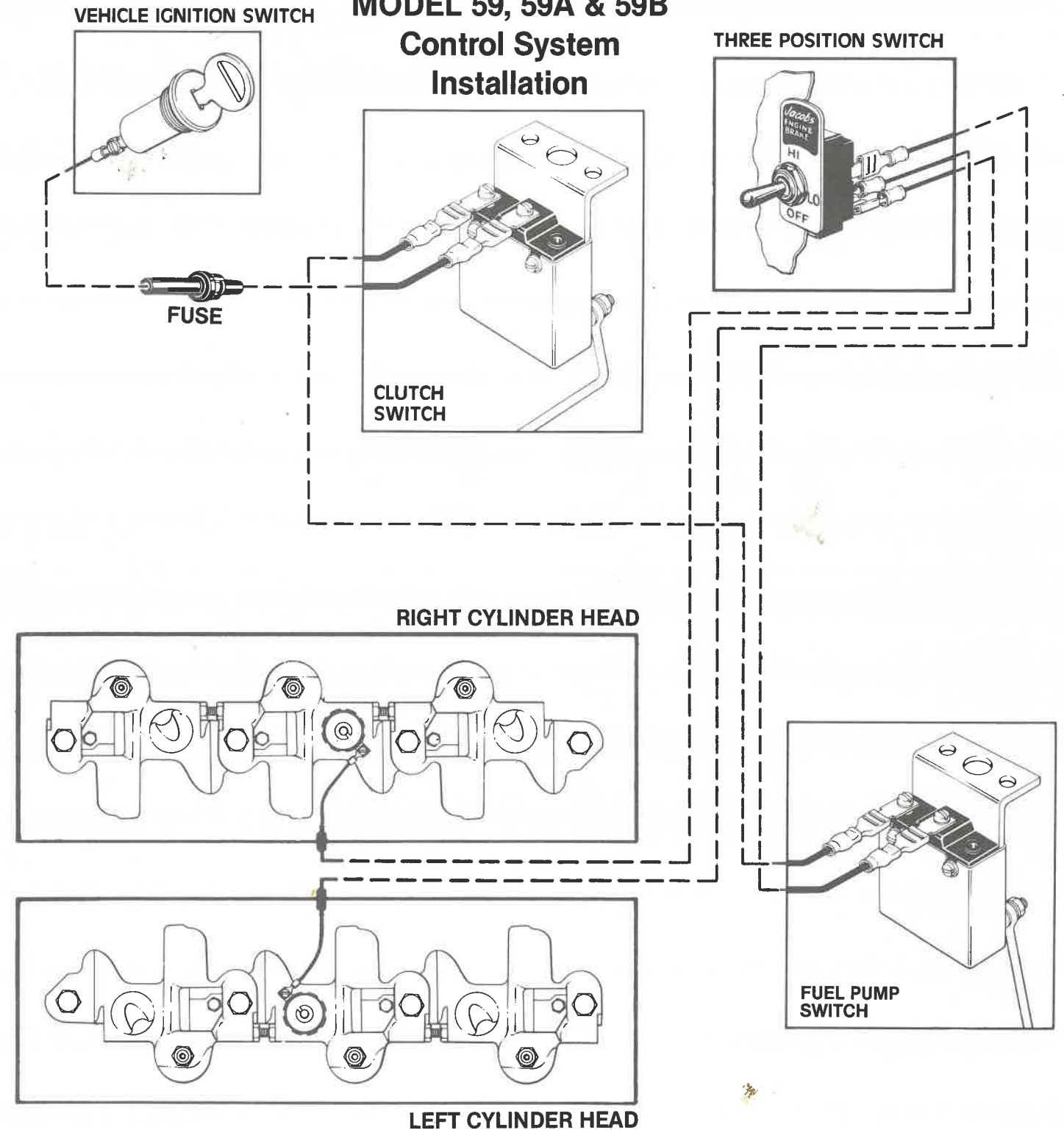
CLUTCH SWITCH



Mount the clutch switch in the most convenient or accessible location as possible. The actuating arm of switch can be bent so as to obtain the proper contact with the clutch pedal arm.

To adjust the switch, have the clutch pedal in a relaxed position. Loosen the outer nut on the switch assembly. Bend the actuating arm so that it contacts the clutch pedal arm and you hear a click. Tighten the outer nut. This adjustment should allow the switch to work on the "backlash" of the clutch pedal before you disengage the clutch.

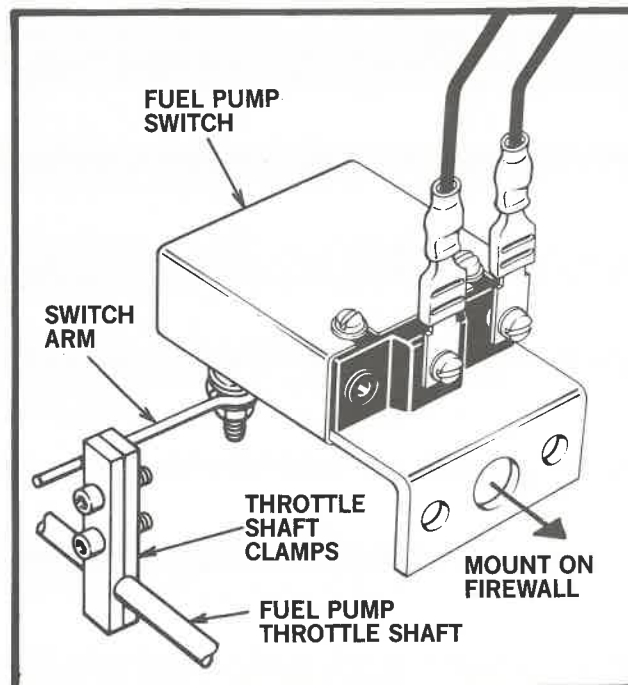
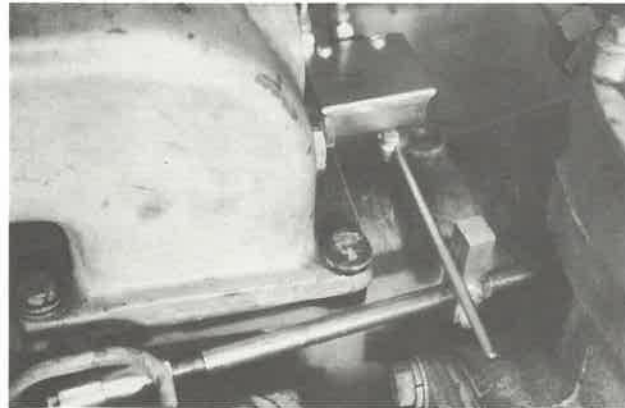
MODEL 59, 59A & 59B Control System Installation



FUEL PUMP SWITCH

Specifically, there is no one location for the fuel pump switch to be mounted due to engine configuration and truck type. On cab-over type trucks the switch is generally mounted somewhere along the frame rail or structure in the immediate vicinity of the fuel pump throttle shaft. It is also possible to attach the switch to a designed-in-shop bracket which in turn could be mounted at the rear of the engine.

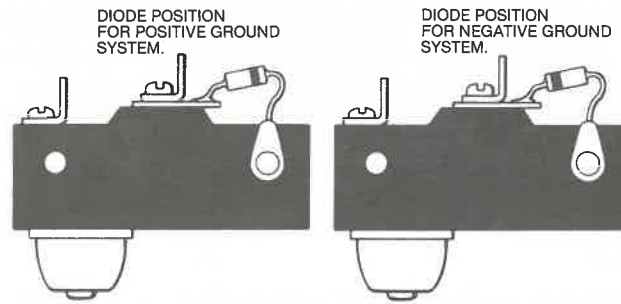
To mount the switch on conventional type cabs the firewall is usually the most convenient. The illustrations show how the control rod clamps must engage the fuel pump switch arm to activate or deactivate the engine brake.



Proper adjustment of the fuel pump switch is obtained by positioning the switch arm so that when the throttle shaft is returned to idle fuel position you hear a click.

CAUTION

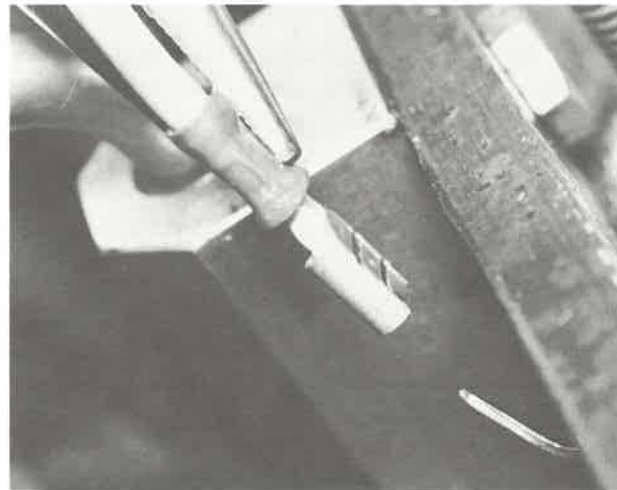
CHECK TO BE SURE THAT THE GOVERNOR OPERATING LEVER MOVES FREELY FROM LOW IDLE TO HIGH IDLE POSITION AND RELEASES WITHOUT BINDING.



The fuel pump switch is equipped with a diode to minimize electrical arcing of the switch contact, and prolonging the life of all switches in the control system.

The Engine Brake must be connected to the load side terminal. If the vehicle has a positive ground electrical system, reverse the position of the diode as shown.

FINAL ENGINE PREPARATION



Install the solenoid valve harness and its clamp. The eyelet end of the harness attaches to the solenoid. The other end attaches to the inside terminal of the leadout assembly in the spacer.

Complete the wiring. Refer to the wiring diagram.

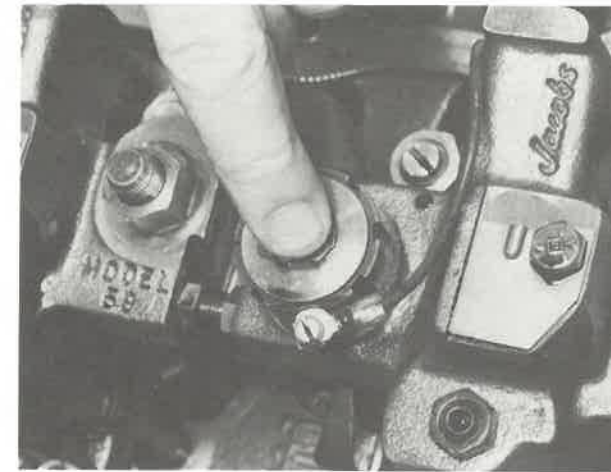
Be sure that all the wiring is neatly installed and properly tied off. Avoid routing wires where chafing, mechanical interference, etc. will take place.

Check electrical system by turning on ignition switch and moving Jacobs dash switch from OFF to LO to HI. In LO only the right brake housing solenoid valve should activate. In HI, both right and left solenoids should activate.

Note! For automatic transmissions, a pressure switch, which senses transmission lock up pressure, is used in the engine brake control system in place of a clutch switch.

Now take the time to re-check the housing installation. Be certain no foreign objects have been left behind and that all proper clearance requirements have been met.

The engine may now be started and idled so that the brake housings can be bled manually.



WARNING

WHENEVER ENGINE IS RUNNING AND THE VALVE COVERS ARE REMOVED, THERE IS SIGNIFICANT OIL SPLASH IN THE ENGINE BRAKE AREA. WE RECOMMEND THAT YOU WEAR EYE PROTECTION AND THAT YOU DO NOT EXPOSE YOUR FACE OVER THE ENGINE AREA. TAKE PRECAUTIONS TO PREVENT OIL LEAKAGE DOWN ON THE ENGINE.

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

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

Accelerate the engine to governed speed, turn the dash switch on and remove foot from throttle. Observe the solenoid operation, the solenoid and Engine Brakes should actuate. Shut the engine down and make one last check to see that the wiring, oil hoses, etc. are properly installed.

ENGINE BRAKE MAINTENANCE

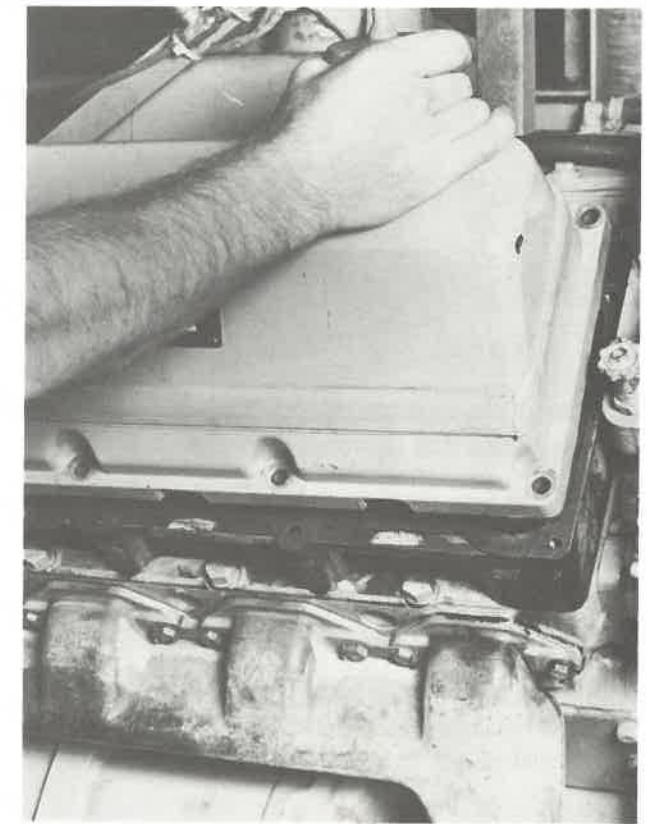
WARNING

NEVER REMOVE ANY ENGINE BRAKE COMPONENTS WITH ENGINE RUNNING.

The Jacobs Engine Brake is a relatively trouble free and maintenance free device. It does require periodic inspections and part replacement. Use the following procedures to keep your engine brake in top condition.

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

REMOVAL AND INSTALLATION OF CONTROL VALVES



Replace the valve covers using new Cummins gaskets and tighten the bolts evenly to prevent any oil leakage.

NOTE: On some rocker covers, the nameplate bosses inside the cover may interfere with the top face of the Engine Brake Units. If so, remove the covers and grind the bosses until a proper clearance is obtained. Other modifications may have to be made depending on engine accessories.

Finally, attach the **OPERATING INSTRUCTION** decal in a convenient location on the dash.

Then complete and mail the Engine Brake Warranty card.

WARNING

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



Remove capscrew slowly from cover plate.



Carefully remove both control valve springs.

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

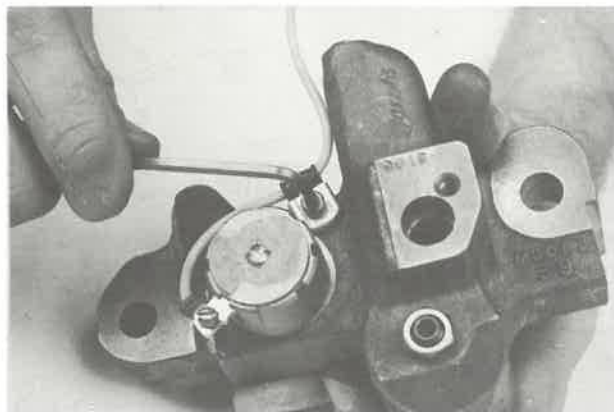
Wash out the control valves with approved cleaning solvent. Push a wire through the hole in the base of the valve to the distance required to insure that the ball check is free. The ball should lift with light pressure on the wire. Dry the valve with compressed air and wipe clean with a paper towel.

Thoroughly clean the control valve bore in the housing, using clean paper towels.

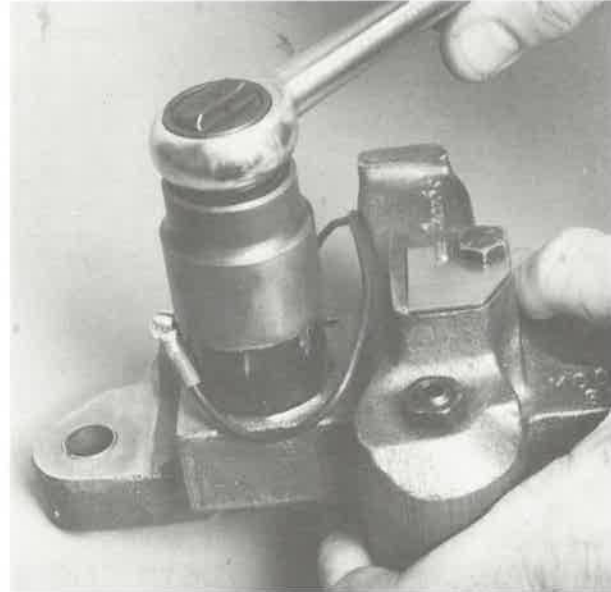
Drop the control valve into clean lube oil. Holding the valve by the stem, let the valve drop into its bore. If binding occurs or if the ball is stuck in the valve, the control valve should be replaced.

Insert the small diameter spring over the stem of the control valve. Insert the large diameter spring over the smaller spring. Reinstall the cover and capscrew.

REMOVAL AND INSTALLATION OF SOLENOID VALVE



Remove the solenoid lead wire clamp from the housing. Loosen tab screw on solenoid valve and remove wire.



Using a Jacobs solenoid valve wrench, unscrew the solenoid valve assembly and remove it. Remove the two seal rings from the solenoid valve body. Be sure to remove the third seal ring from the base of the bore. Use a hooked wire if required.



Wash out the solenoid valve with approved cleaning solvent. Use a brush to clean the oil screen. When clean, dry the valve with compressed air.

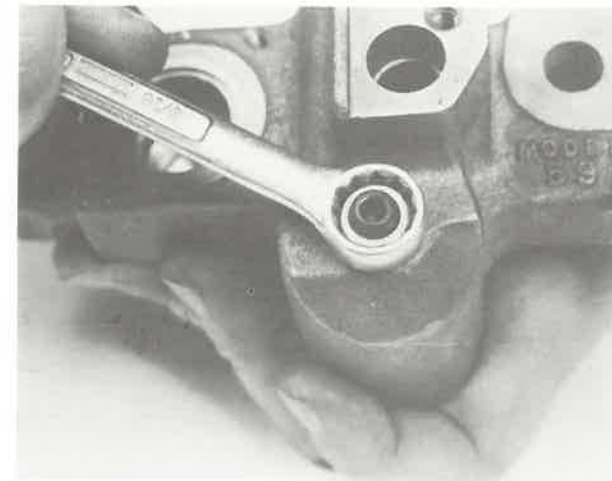
Clean out the solenoid valve bore in the housing. Use clean paper towels. Never use rags, as they may leave lint and residue which can plug the oil passageways.

Install a new seal ring in the base of the solenoid valve bore. Wipe clean lube oil into and around the bore. Install the upper and center seal rings onto the solenoid valve body. Now insert and screw down the solenoid valve assembly. Torque the valve to 60 lb. in. (7 N•m). Be careful not to twist the seals while installing.

REMOVAL AND INSTALLATION OF SLAVE PISTON

⚠ WARNING

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.

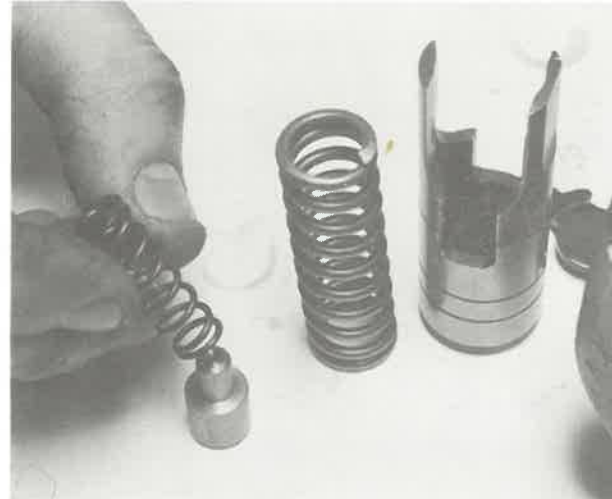


Loosen locknut and remove it and the slave piston adjusting screw from housing.

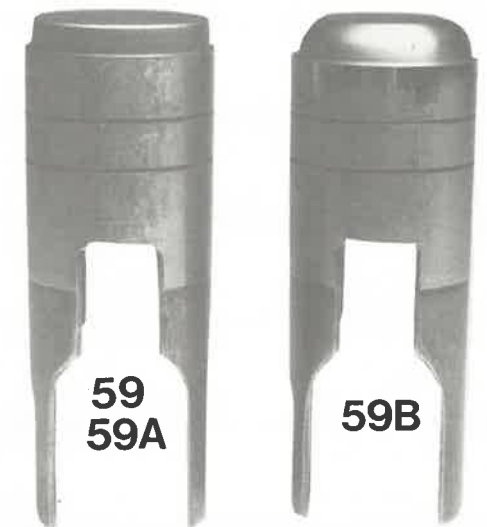


Using an arbor press, or a suitable clamp, slowly apply pressure to the retainer and remove the snap ring. Relieve the clamping pressure gradually until the springs are free.

Remove the retainer, springs and slave piston. Check for binding or burrs. Clean or replace as necessary.



The Model 59A and 59B use inner and outer slave piston springs and guide. Use the same procedure for assembly and disassembly.



The Model 59 and 59A use a flat top slave piston. The Model 59B uses a domed top slave piston. The domed top piston can be used in Model 59 and 59A housings. Flat top pistons must not be used in Model 59B housings.

REMOVAL AND INSTALLATION OF MASTER PISTON



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



Remove master piston from its bore—needle nose pliers are usually needed to initially pull the piston up. If binding occurs, check for burrs or contaminants in lube oil. Clean in an approved cleaning solvent. Replace the piston if it binds in its bore or if the hard face surface is cracked or chipped.

Reassemble in same order, being careful that when tightening the capscrew, the two tabs of the spring do not interfere with the sides of the center raised portion of the master piston.