

## GENERAL MOTORS DIESEL MECHANICAL FUEL INJECTION – V6 & V8

### DESCRIPTION

Diesel mechanical fuel injection systems differ greatly from electronic fuel injection systems. In this diesel system, a mechanical high pressure rotary pump, gear driven by the camshaft at camshaft speed, injects a precisely metered amount of fuel to each cylinder at the proper time. The pump is mounted on top of the engine and provides necessary timing advance under all operating conditions.

High pressure fuel pipes (6 or 8) carry fuel from pump to an injection nozzle in each cylinder. All pipes are exactly the same length to ensure that there is no variance in timing. Engine RPM is controlled by a rotary fuel metering valve. As the accelerator pedal is pushed down, a throttle cable opens the metering valve and allows increased fuel delivery. A built-in low pressure transfer pump delivers fuel to the main injection pump. A built-in low pressure transfer pump delivers fuel to the main injection pump.

A fuel filter is located between the electric (V6) or mechanical (V8) fuel supply pump (mounted on the side of the engine block) and the diesel injection pump. Any excess fuel is returned to the tank by a fuel return system.

### OPERATION

#### AIR INDUCTION SYSTEM

An air crossover housing is located on top of the engine over the injection pump. It is bolted to the intake manifold with 4 bolts and serves as the only air inlet in the system. No fuel passes through the crossover. It is an open-chambered housing with a single inlet drawing air through an air filter assembly mounted above. The crossover unit has two branches, one leading to each side of the intake manifold. Gaskets are installed between crossover and manifold to prevent vacuum leaks. Starter fluid should NEVER be used or sprayed into crossover. If crossover is removed, air screens must be installed.

#### FUEL TANK-TO-PUMP SYSTEM

Diesel fuel, NOT gasoline, is drawn from the fuel tank by an engine mounted electric (V6) or mechanical (V8) fuel supply pump. The electric pump receives battery current when the ignition switch is in the "RUN" or "START" positions and puts out about 5 $\frac{3}{4}$ -8 $\frac{3}{4}$ " psi to the main injection pump. Maximum operating current is 3 amps. The mechanical pump is driven by an eccentric cam mounted on the crankshaft and puts out

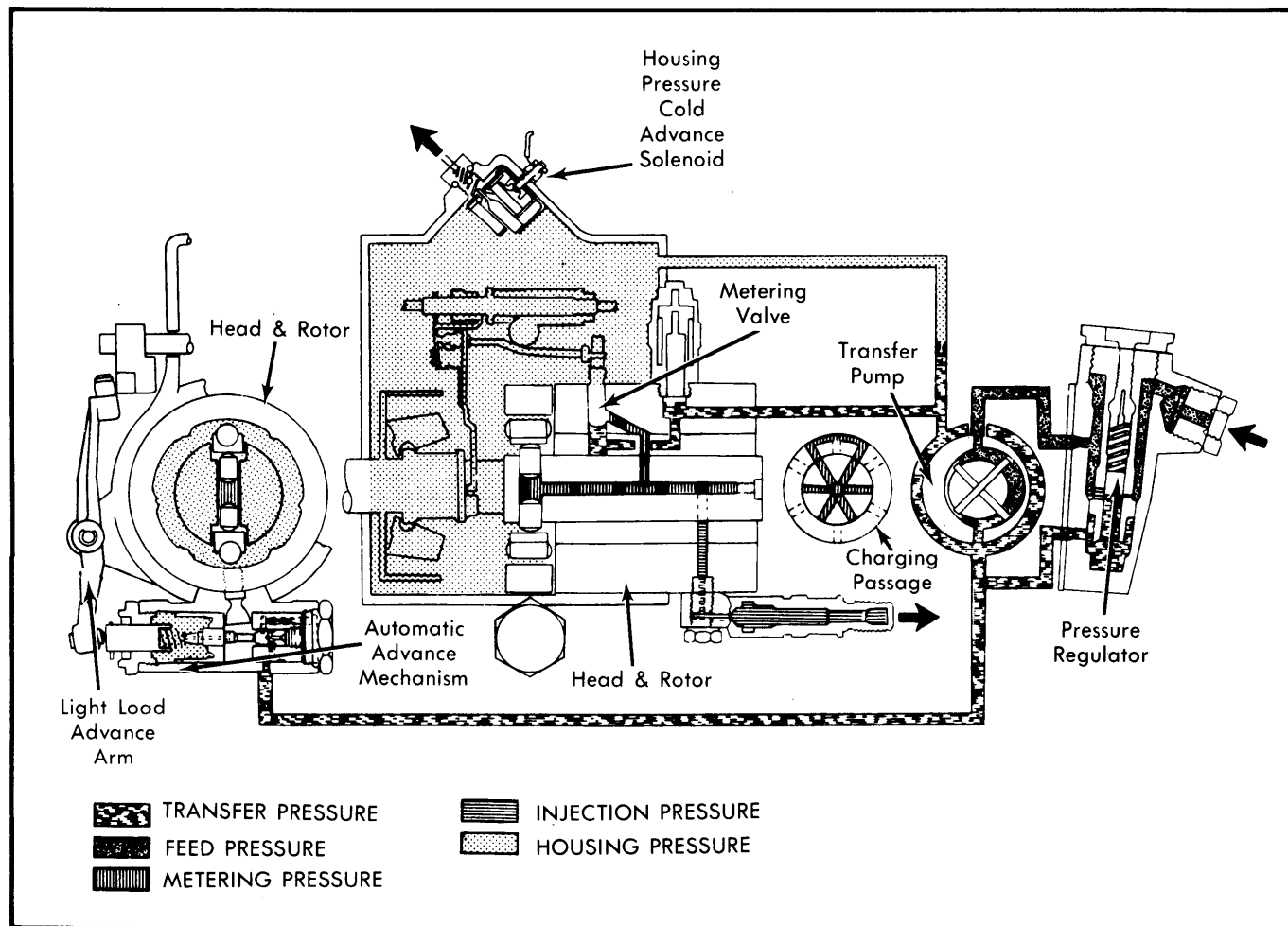


Fig. 1 CAV Type Diesel Injection Pump Fuel Circuit Diagram

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about 5½-6½ psi to the diesel injection pump. A small screen type filter is located in the fuel tank at the pickup. A larger sealed 11-12 micron fuel filter is located on the rear of the engine between the fuel supply pump and the diesel injection pump. Diesel fuel arrives at the center inlet fitting on the injection pump after leaving the filter. A fuel return line is provided to return any excess fuel to the tank.

### DIESEL INJECTION PUMP

The high pressure diesel injection pump is mounted to the top of the engine below the air crossover. The pump is cam driven at speed equal to the camshaft. Because of this, the pump can precisely govern time and amount of fuel injection.

A built-in fuel pressure regulator and transfer pump picks up fuel at the pump inlet, and pushes it through a passage to the pump head. The pump head distributes fuel, still at transfer pump pressure (8-12 psi), to metering valve, governor and

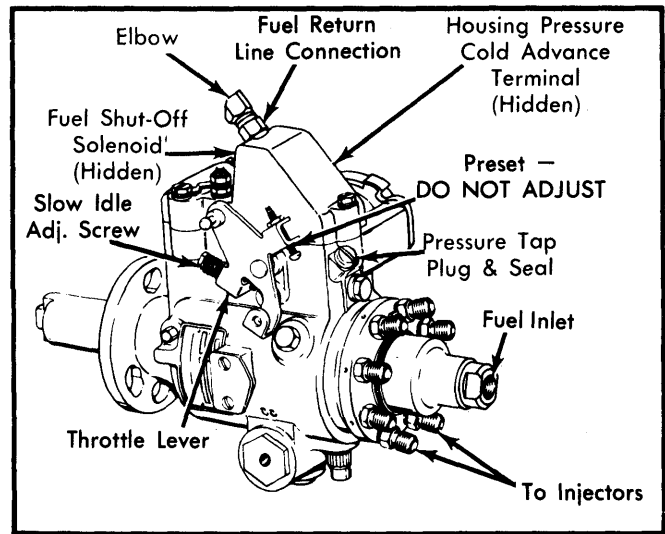


Fig. 2 Diesel Injection Pump (Roosa-Master Type Shown - CAV Type Similar)

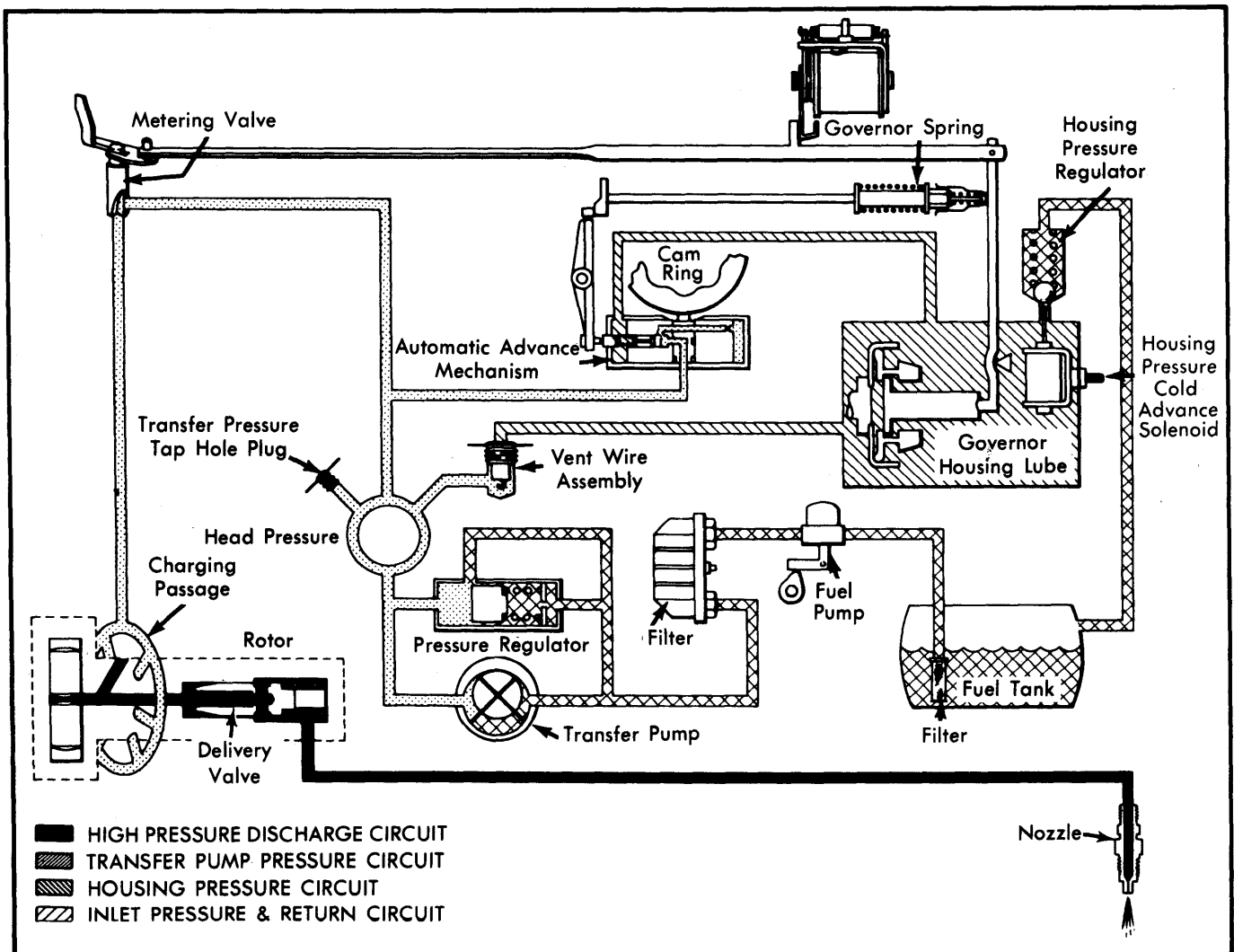


Fig. 3 Roosa-Master Type Diesel Injection Pump Fuel Circuit Diagram

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automatic advance mechanisms. Fuel then passes to the rotary fuel metering valve and into a charging passage. As the pump shaft rotates, fuel is fired, under high pressure, through each delivery pipe to an injector. The pump is not serviceable and must be exchanged in case of a malfunction.

### FUEL DELIVERY PIPES

High pressure pipes (6 or 8) are routed from injection pump to an injector in each cylinder. The pipes are of equal length but are bent differently to achieve this equal length. Pipes are not interchangeable and are pre-bent by the manufacturer.

### GLOW PLUGS

Glow plugs are small heaters provided to assist in cold starting. The glow plug controller and relay cycle 12 volts to these 6 volt heaters, which causes them to heat rapidly. After the engine starts, the glow plugs remain on for about a minute, then shut off. If the ignition is turned on and the engine is not started, the glow plugs will continue to cycle until the batteries are discharged.

**CAUTION** – Do not manually by-pass glow plug relay; glow plugs will be ruined instantly.

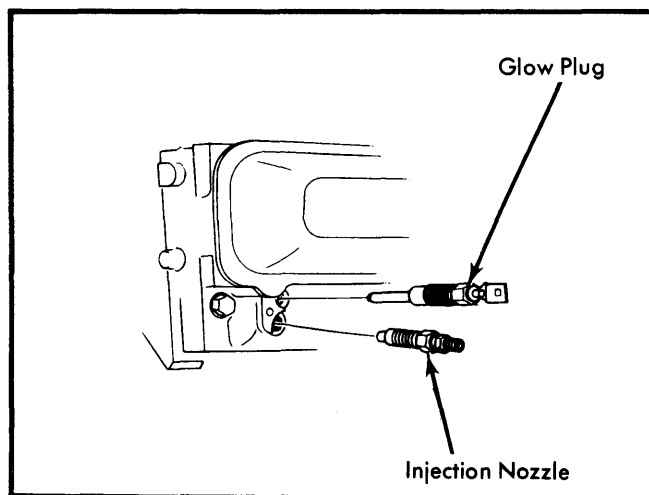


Fig. 4 Diesel Glow Plug & Injection Nozzle Location

### INJECTION NOZZLES

One injection nozzle is located in each combustion chamber. It has a single fuel inlet fitting and is threaded into the cylinder head as are glow plugs. Injection nozzles are spring loaded and calibrated to open at specified fuel line pressure. The combustion chamber end of the nozzle has a replaceable copper compression seal. The inlet fitting in the body of the injector must be tightened to the correct torque when installed or checked. See Fig. 5.

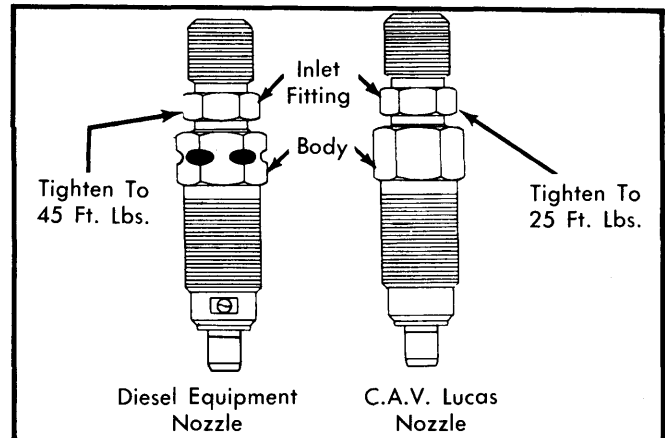


Fig. 5 Diesel Injection Nozzle Identification

### VACUUM PUMP

Vacuum to operate accessory systems on diesel vehicles is provided by a vacuum pump. On most models, the pump is located at the rear of the block and driven by the cam; others use a belt driven vacuum pump. Engines with block-mounted pump should never be operated without the pump in place as it is also the oil pump drive.

### HOUSING PRESSURE COLD ADVANCE (HPCA)

The HPCA is used to improve cold starting and emission control. The solenoid is controlled by the engine temperature switch and advances injection timing by 3° when the engine is cold. It does this by decreasing the housing pressure from 10 psi to zero. At the same time, the fast idle solenoid is activated. When the temperature switch opens (125° F), the HPCA solenoid is de-energized and housing pressure rises, retarding pump timing.

### WATER IN FUEL INDICATOR

Diesel vehicles are equipped with an indicator to warn of water contamination in fuel tank. When water in tank nears fuel pick-up lever, warning lamp will light.

### STARTING INDICATOR

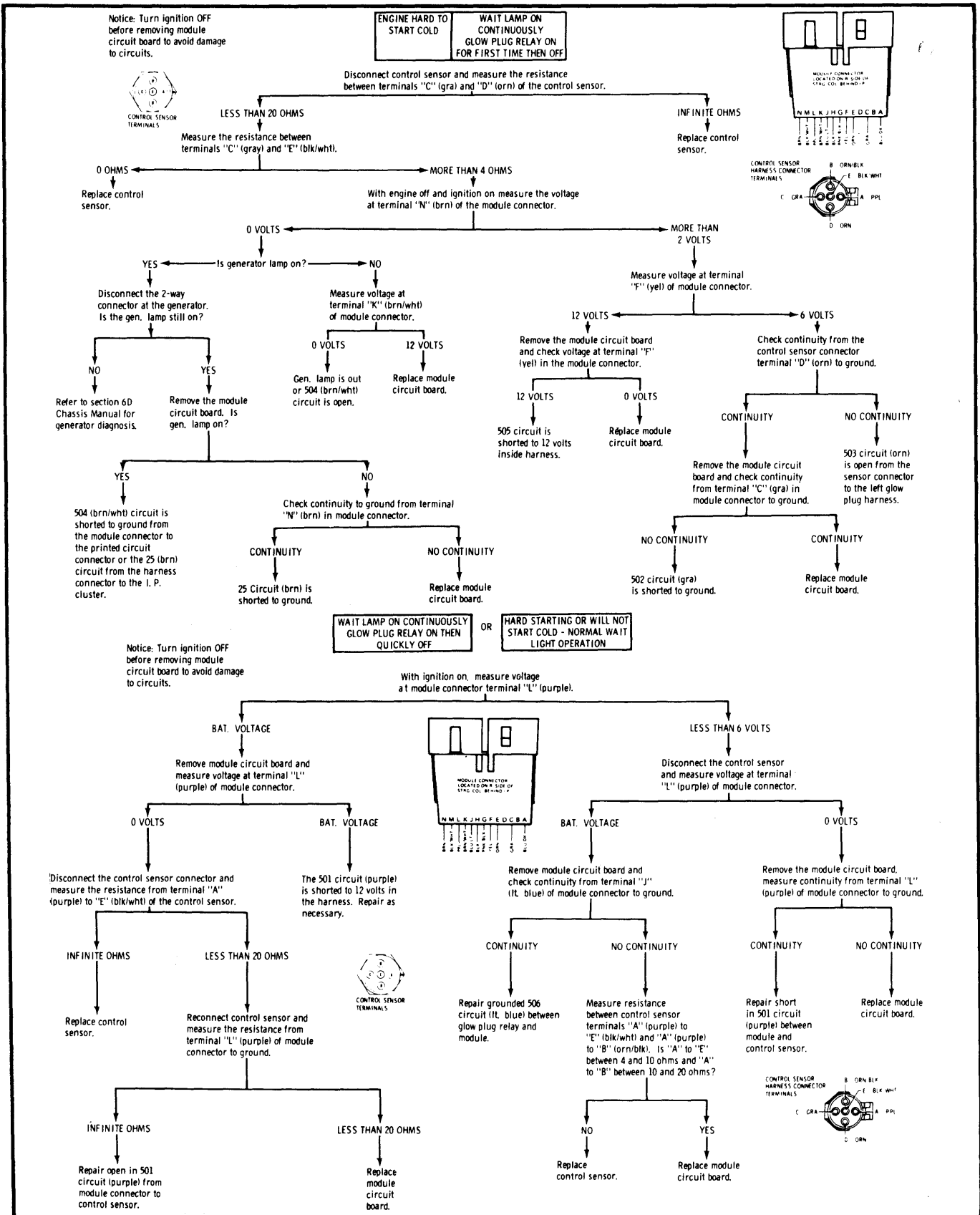
Lights are used to indicate when the vehicle is ready to be started. A wait lamp is lit when glow plugs are heating. As the combustion chambers reach starting temperature, the wait lamp goes off, indicating that the engine can be cranked to start.

### DIESEL FUEL HEATER (OPTIONAL)

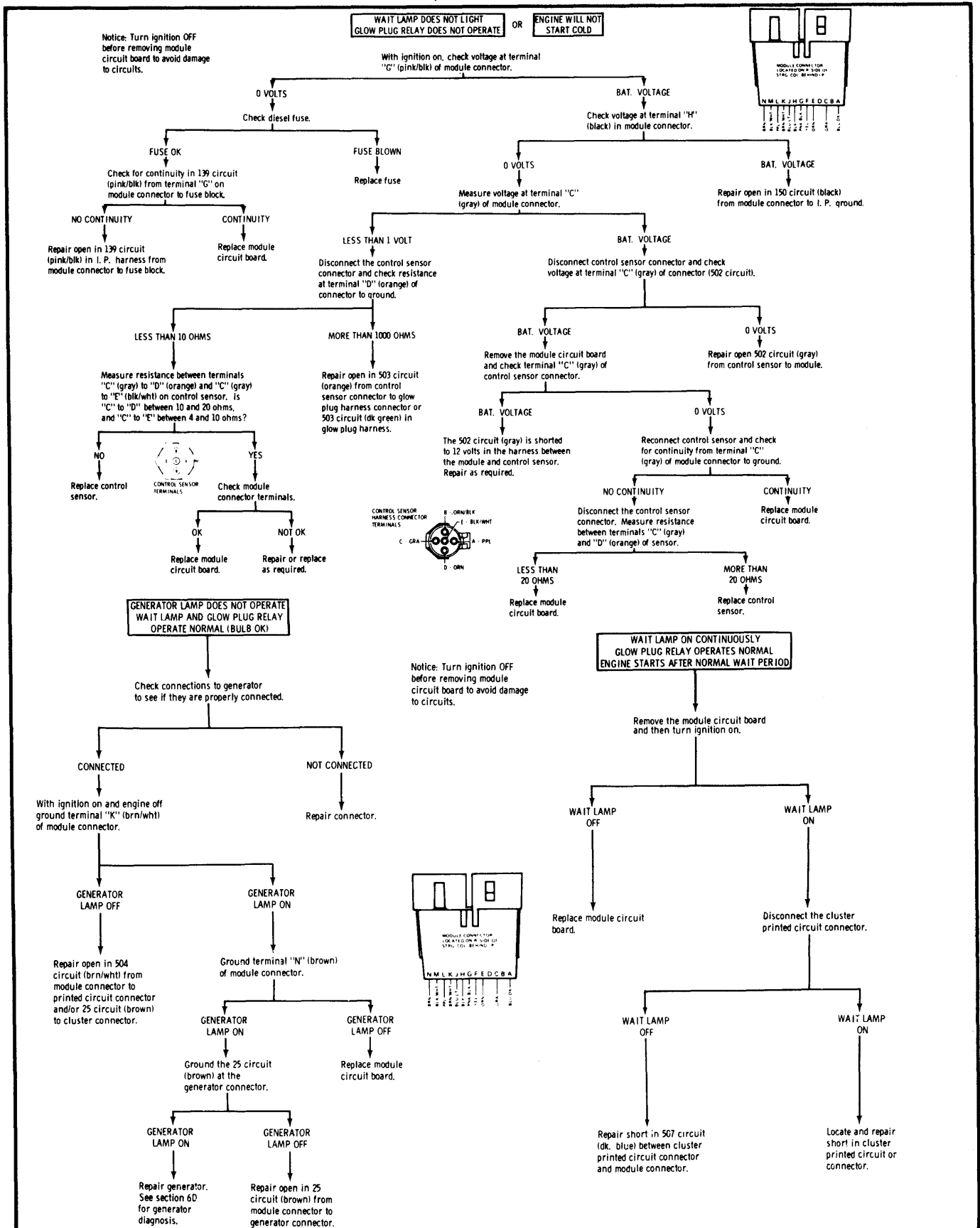
This option is used to heat the fuel during low temperature (below 20° F) operation. This prevents wax crystals from building up and blocking the fuel filters. The filter is located along the right side of the intake manifold and uses a resistance wire spiralled around the fuel line.

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## GENERAL MOTORS DIESEL MECHANICAL FUEL INJECTION V6 & V8 (Cont.) TROUBLE SHOOTING ELECTRONIC GLOW PLUG SYSTEM DIAGNOSIS (ALL MODELS)



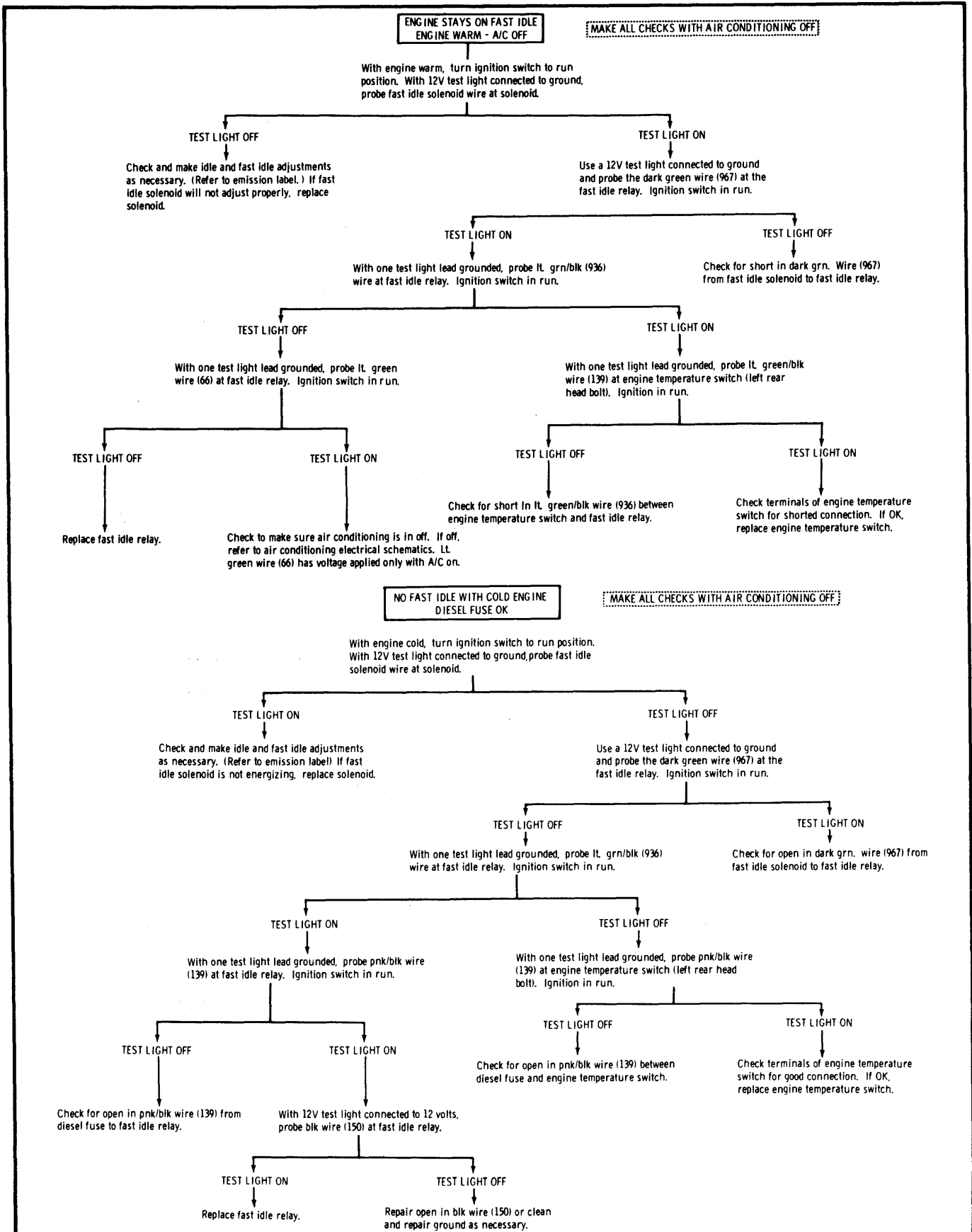
## GENERAL MOTORS DIESEL MECHANICAL FUEL INJECTION V6 & V8 (Cont.) ELECTRONIC GLOW PLUG SYSTEM DIAGNOSIS (Cont.) (ALL MODELS)





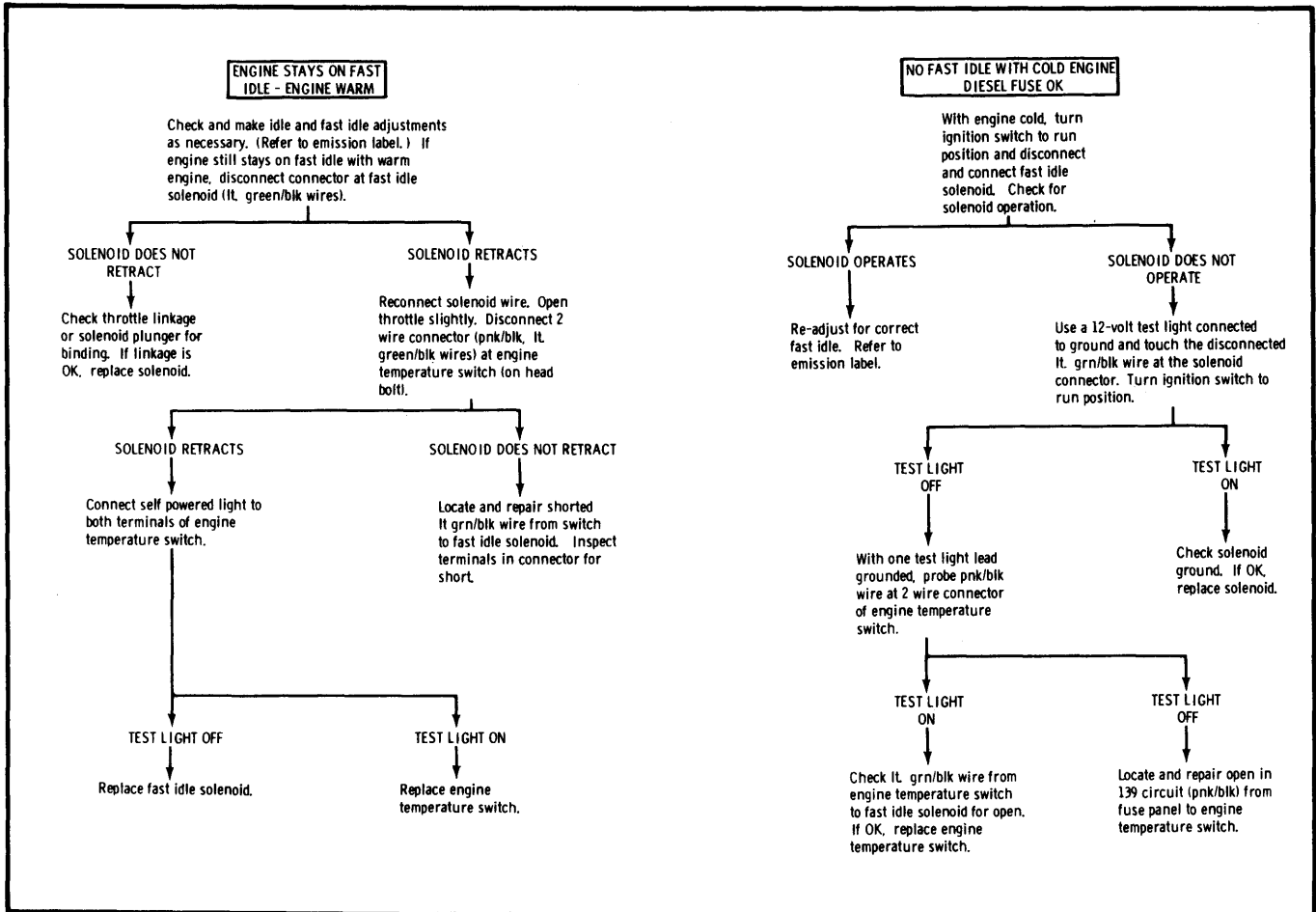
# 1982 Fuel Injection

## GENERAL MOTORS DIESEL MECHANICAL FUEL INJECTION V6 & V8 (Cont.) ELECTRONIC GLOW PLUG SYSTEM DIAGNOSIS (Cont.) (V6 MODELS ONLY)



# 1982 Fuel Injection

## GENERAL MOTORS DIESEL MECHANICAL FUEL INJECTION V6 & V8 (Cont.) ELECTRONIC GLOW PLUG SYSTEM DIAGNOSIS (Cont.) (V8 MODELS ONLY)



### THERMAL GLOW PLUG SYSTEM DIAGNOSIS

**NOTE** — If a problem occurs when engine is cold, then engine must be cold when trouble shooting.

**No Wait Lamp (Cold Engine) — 1)** With engine off and ignition switch in "RUN" position, check if charge light is on. If not, check gauges fuse. Check for click at glow plug relay. If relay operates, check for break in Pink/Black wire between fuse block and splice S287 (S221). If relay does not operate, check Pink wires between ignition switch and fuse block.

**2)** Disconnect connector of wait lamp control relay near wiper motor. Using a jumper wire, connect Blue wire at connector to ground. If wait lamp does not go on, check for burned out bulb. Check for break in Blue wire between wait lamp control relay connector and wait lamp and in Pink/Black wire between wait lamp and splice S287 (S221).

**3)** Check connection at ground G178 near wiper motor. Connect 1 end of test lamp to Red wire terminal of glow plug relay and other end to ground. Then touch lead to Black wire at wait lamp control relay connector. If light comes on, replace wait lamp control relay.

**Wait Lamp Pulses Slowly On and Off — 1)** With wait lamp pulsing, connect test lamp between White and Yellow wires at wait lamp control relay. If test lamp is on when wait lamp is off and off when wait lamp is on, replace wait lamp control relay.

**2)** If test lamp does not come on, connect test lamp between ground and Orange wire at thermal controller. With wait lamp pulsing, check if test lamp pulses on and off with wait lamp. If test lamp still does not come on, touch to front Red wire and rear Blue and Black wire posts of glow plug relay.

**3)** Check for break in Red wire between batteries and glow plug relay, in Black, Green or Orange wires between relay and thermal controller or for fault in relay.

**4)** If test lamp pulses with wait lamp when connected to Orange wire at thermal controller, connect test lamp between Black wire at controller and ground. If test lamp again pulses, repair Black wire between controller and ground. If not, replace controller.

**Wait Lamp Stays On More Than 10 Seconds — 1)** Disconnect connector at diode module. Connect 1 end of test lamp to

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ground and other end to Red (front) post of glow plug relay. Touch test lamp lead to rear post (Blue and Black wires) of glow plug relay. Test lamp should come on if relay operates.

2) If relay operates, disconnect connector at wait lamp control relay. Wait lamp should go out. Connect test lamp between White and Yellow wires at connector. If test lamp comes on, replace wait lamp control relay. If test lamp does not come on, turn off power and check for 30 ohms resistance at pins 4 and 5 of thermal controller. Replace controller if resistance is high. Check continuity of Black, Dark Green, Orange, White, Yellow and Black wires.

3) If relay does not operate, check diesel or ECM fuse and ground G178. Disconnect connector at thermal controller. Connect test lamp between pins 3 and 6 at harness connector. If test lamp comes on with ignition on, check continuity between pins 3 and 6. Replace controller if no continuity. If test lamp does not come on, check glow plug relay coil resistance. Replace if resistance is high. Check continuity of Pink, Pink/Black, Yellow and Black wires.

**Engine Does Not Start When Cold (Wait Lamp OK) – 1)** Check that cranking speed is 100 RPM or more. If less, check battery voltage with voltmeter (12.4 volts with ignition off). Using test lamp, check for voltage at Pink wire lead at fuel solenoid of fuel injection pump with ignition switch in "RUN" position. Repair Pink wire if no voltage.

2) If test lamp comes on, turn off ignition. Using self-powered test lamp, check for continuity through fuel solenoid to ground. If no continuity, replace fuel solenoid. With ignition switch in "RUN" position and engine off, listen for glow plug relay operation. It should click on and off.

3) If relay operates, turn ignition switch to "OFF" position. Disconnect all glow plug harness connectors at glow plugs. Connect self-powered test lamp between rear post (Blue and Black wires) of glow plug relay and ground. At each glow plug, touch harness connector to glow plug spade terminal.

4) If test lamp comes on, glow plug and harness lead are good. Disconnect harness connector after testing each glow plug. After testing all glow plugs, reconnect all connectors to glow plugs.

5) If test lamp does not come on, touch harness connector to ground. If lamp comes on, replace glow plug. If lamp does not come on, replace wire to glow plug. If all glow plugs are open-circuited, also replace thermal controller.

6) If relay does not operate and wait lamp went on, then off, disconnect connector at thermal controller. With ignition switch in "RUN" position, connect 1 end of test lamp to ground. Check for voltage on Brown wire. If test lamp comes on, check if coolant temperature switch is closed. If so and engine is cold, replace switch.

7) Check for voltage on Orange wire. If lamp comes on, check for shorted contacts in glow plug relay. If contacts are shorted, replace relay, all glow plugs and thermal controller. Connect 1 end of test lamp to positive battery cable and touch Yellow wire between controller and glow plug relay. If lamp comes on, replace thermal controller. If lamp does not come on, repair Yellow wire.

**Engine Runs Rough When Cold – 1)** With engine off, turn ignition switch to "RUN" position. Disconnect at engine temperature switch. Touch jumper wire to 2 terminals on connector. Check that fast idle solenoid extends. If not, check throttle linkage or solenoid plunger for binding. If no binds, replace solenoid.

2) If fast idle solenoid extends, attach tachometer and start engine. With jumper wire still connected, remove connector at cold advance solenoid of fuel injection pump. Engine speed should change 30 RPM when connector is removed. Check solenoid and fuel pump if no change.

3) Turn engine off. Using self-powered test lamp, check that engine temperature switch has continuity below 120° F and no continuity above 120° F. Replace switch if bad. Connect 1 end of test lamp to ground. With engine off and ignition switch in "RUN" position, touch other end of test lamp to Green wire pin at diode module. If lamp comes on and engine is cold, replace coolant temperature switch.

4) Turn ignition switch to "OFF" position. Disconnect all glow plug harness connectors at glow plugs. Connect self-powered test lamp between rear post (Blue and Black wires) of glow plug relay and ground. At each glow plug, touch harness connector to glow plug spade terminal.

5) If test lamp comes on, glow plug and harness lead are good. Disconnect harness connector after testing each glow plug. After testing all glow plugs, reconnect all connectors to glow plugs.

6) If test lamp does not come on, touch harness connector to ground. If lamp comes on, replace glow plug. If lamp does not come on, replace wire to glow plug. Check fuel system for proper fuel delivery.

**No Fast Idle When Cold – 1)** With engine off, turn ignition switch to "OFF" position. Connect jumper wire to both terminals on harness connector. Disconnect connector at fast idle solenoid and then reconnect it, checking solenoid operation. If solenoid operates, readjust for current fast idle operation. Refer to emission control label for specifications and adjustment procedures.

2) If solenoid does not operate, connect 1 end of test lamp to ground and other end to Light Green/Black lead at solenoid. If lamp comes on, disconnect connector at solenoid. Using self-powered test lamp, check continuity.

3) If lamp does not come on, touch test lamp lead to Pink/Black terminal of engine temperature switch. If lamp

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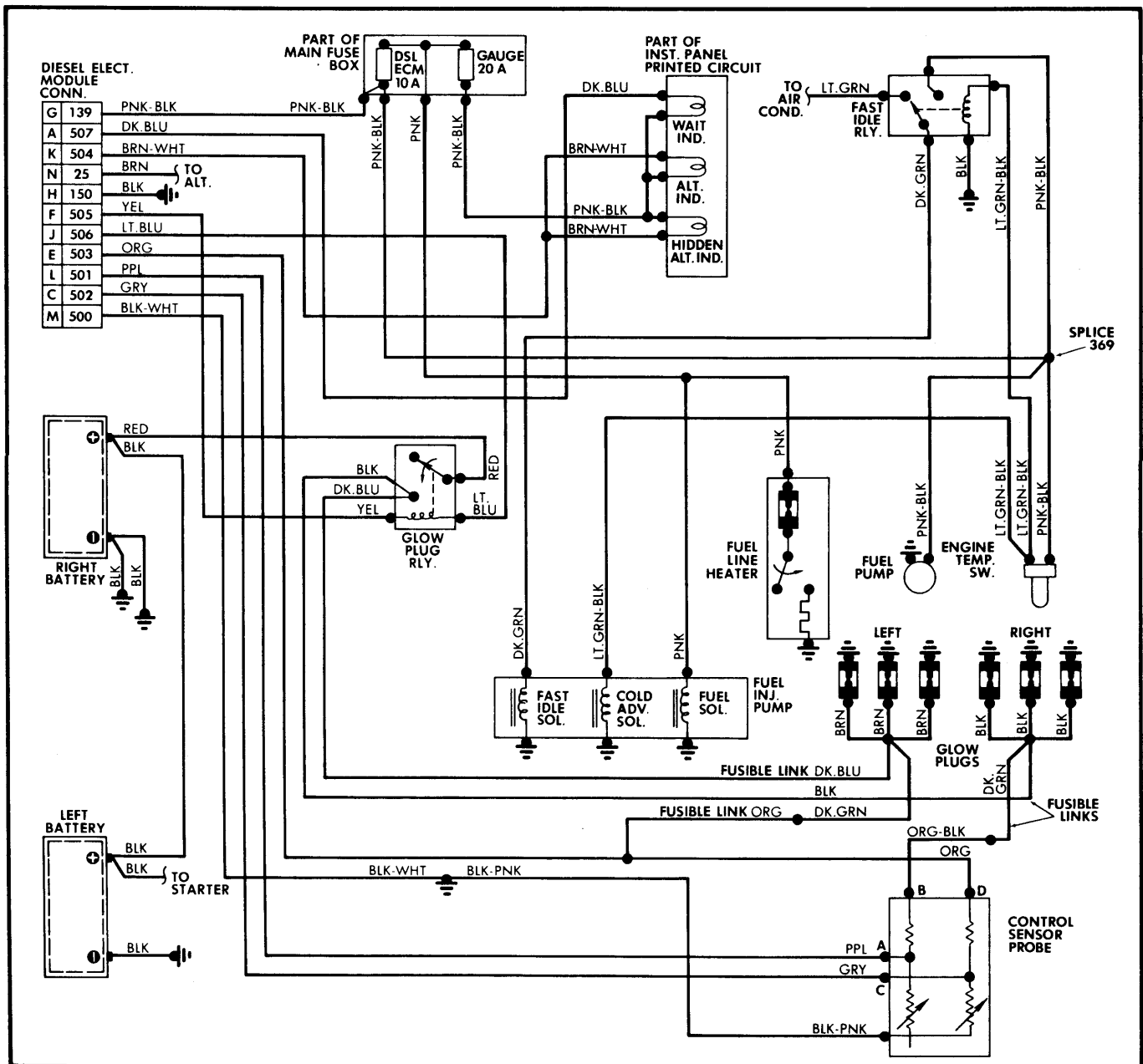
comes on, remove connector from switch and test for continuity. Switch should be closed below 120° F and open above 125° F. If not, replace switch.

2) Using self-powered test lamp, check continuity of engine temperature switch. Switch should have continuity below 120° F and no continuity above 120° F. Replace switch if bad.

**Engine Stays on Fast Idle – 1)** With engine off, turn ignition switch to "RUN" position. Disconnect connector at engine temperature switch. Touch jumper wire to 2 terminals on connector. Check that fast idle solenoid extends. If not, check throttle linkage or solenoid plunger for binding. If no binds, replace solenoid.

**Engine Continues To Run With Ignition Off – 1)** With ignition switch off and engine still running, disconnect connector at diode unit. If engine stops, replace diode unit.

2) If engine continues to run, disconnect Pink wire connector at fuel solenoid in fuel injection pump. If engine still continues to run, stop engine by crimping flexible fuel return line near fuel supply pump. Repair or replace fuel solenoid.



**Fig. 6 Glow Plug System Wiring Diagram (Electronic Type – V6)**

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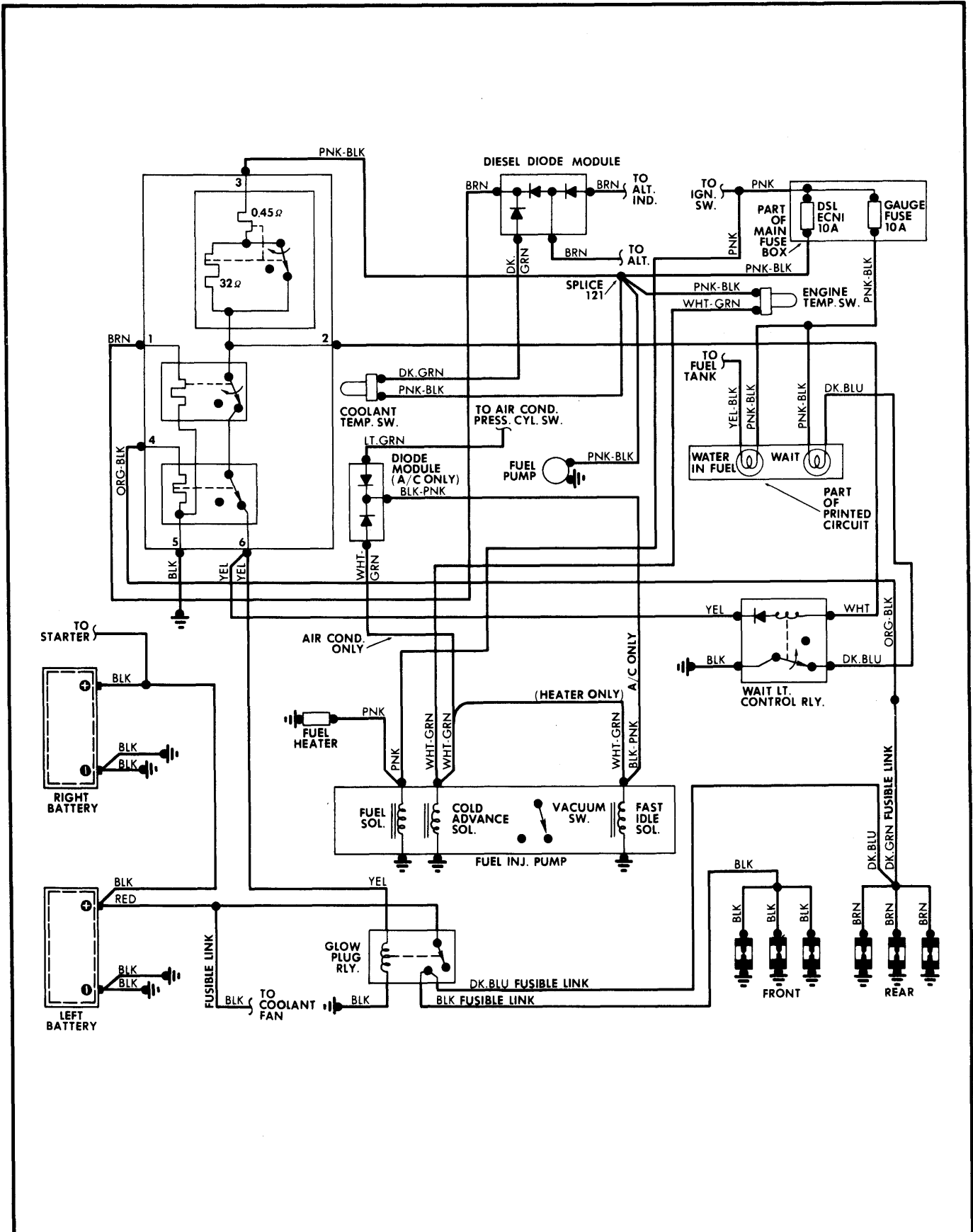


Fig. 7 Glow Plug System Wiring Diagram  
(Thermal Type - V6)

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## GENERAL MOTORS DIESEL MECHANICAL FUEL INJECTION - V6 & V8 (Cont.)

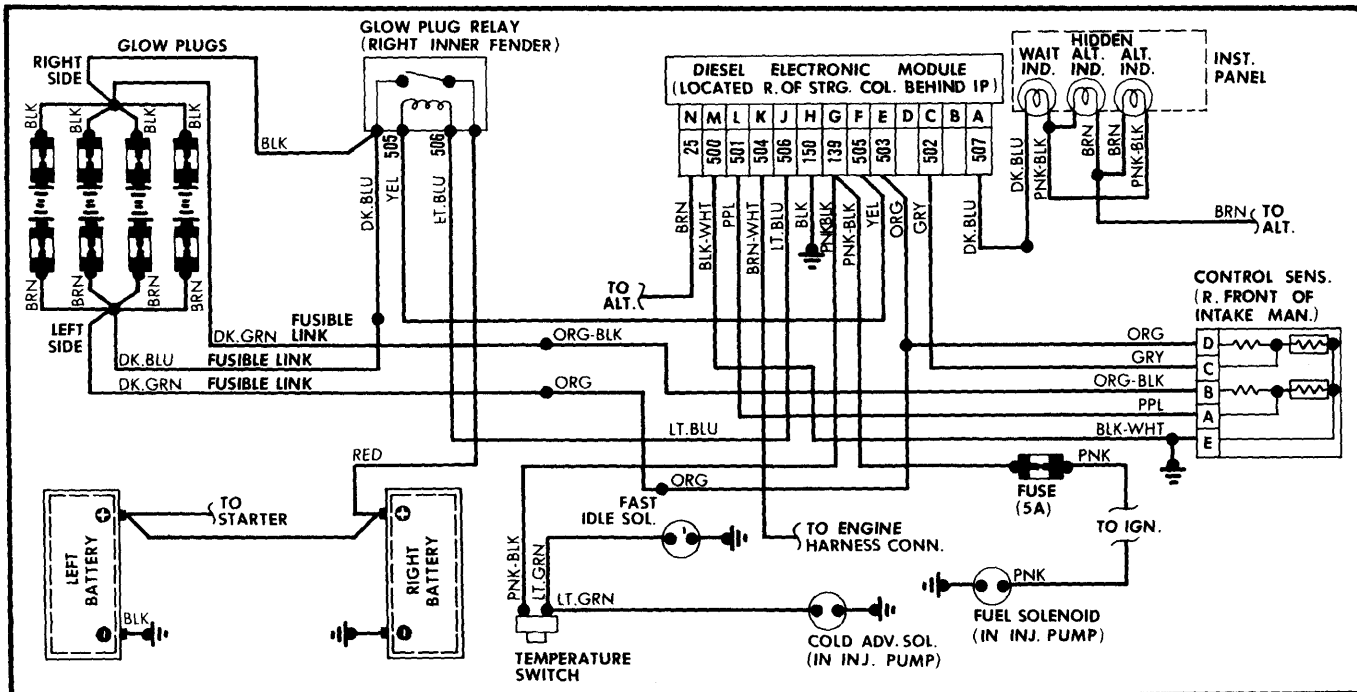


Fig. 8 Glow Plug System Wiring Diagram (Electronic Type - V8)

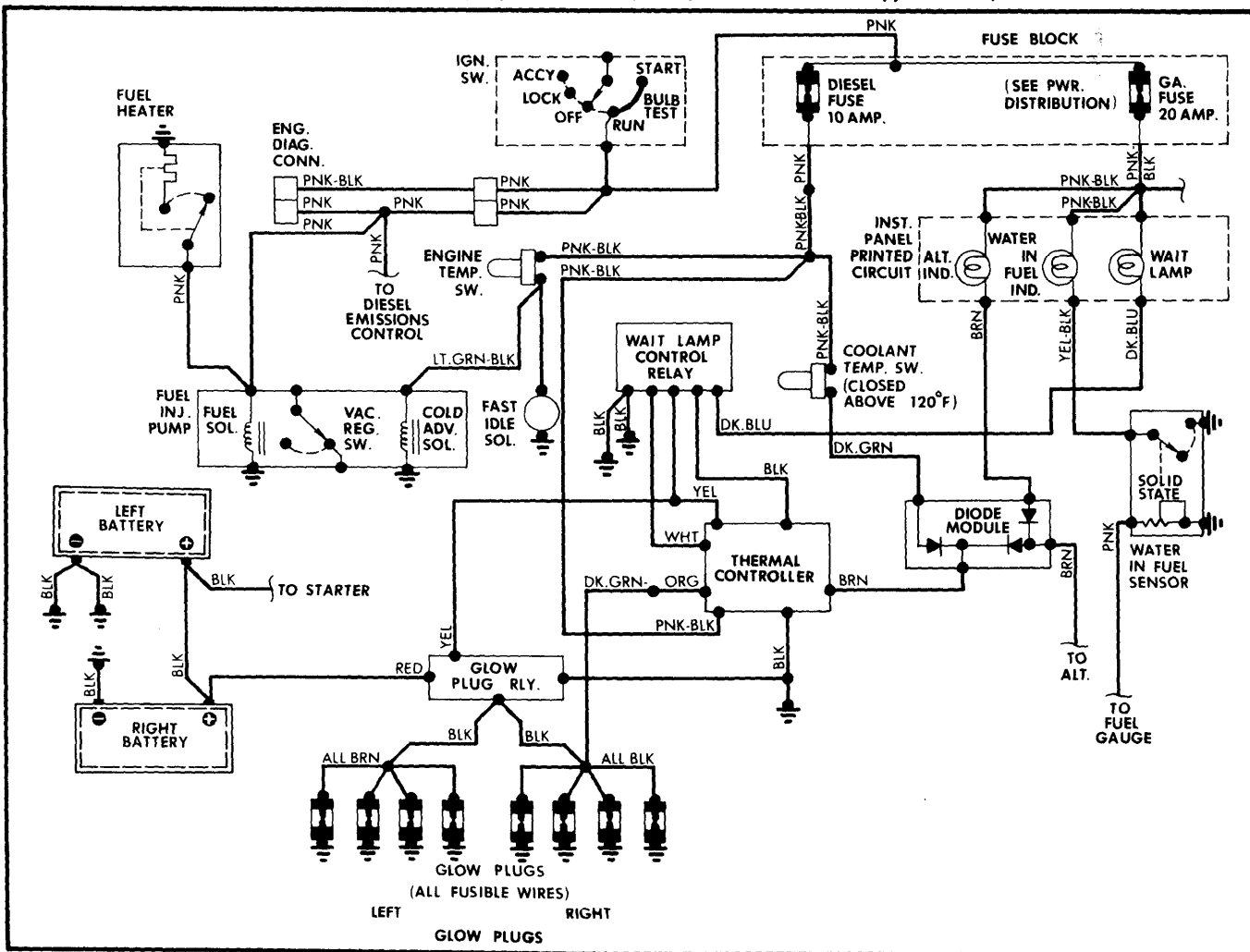


Fig. 9 Glow Plug System Wiring Diagram (Thermal Type - V8)

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### TESTING

#### GLOW PLUG RESISTANCE TEST

1) Start engine and allow to warm up. Remove all glow plug wires. Using idle speed screw on side of injection pump, adjust idle to roughest speed not exceeding 900 RPM. Allow engine to run for 1 minute.

2) Attach jumper wire between voltmeter ground lead and engine lift point on left side of intake manifold. DO NOT use any other point for ground connection. Check resistance by touching positive lead of voltmeter to glow plug terminals (with engine running). Write down values obtained in firing order sequence (V6 – 1-6-5-4-3-2 or V8 – 1-8-4-3-6-5-7-2).

3) If ohm reading on any cylinder is about 1.2-1.3 ohms, make a compression check on that cylinder before continuing fuel injection diagnosis. Most cylinders should measure between 1.8-3.4 ohms. If more than .3 ohms difference is observed between 2 consecutive cylinders in firing order, remove injectors and check opening pressure.

4) To improve rough idle, switch nozzles as necessary. Install nozzles with a higher opening pressure to lower ohm reading, and a lower opening pressure to raise ohm reading. A change of about 30 psi will vary ohm reading by .1 ohm.

5) Repeat procedure to confirm idle improvement. Be sure to check glow plug resistance at the same idle speed both times. If no improvement is observed, injection line replacement or injection pump calibration may be necessary.

#### INJECTION PUMP HOUSING FUEL PRESSURE

1) Engine must be at normal operating temperature. Remove air crossover assembly and install screen covers over openings in intake manifold.

2) Remove pressure tap plug from injector pump.

3) Place seal from pressure tap plug onto pressure tap adapter J-28382 and screw adapter into pump housing in place of plug. Screw pressure tap adapter J-28526 into pressure tap adapter J-28382.

4) Connect a low pressure gauge to adapter. Install magnetic pickup tachometer. Start engine and run with transmission selector in "P". Pressure should be 8-12 psi, with no more than 2 psi fluctuation.

5) If pressure is zero, remove connector from housing pressure cold advance terminal. If pressure is still zero, remove injection pump cover and inspect solenoid operation. Free up solenoid if binding.

6) If pressure rose when solenoid lead was disconnected, check operation of temperature switch on rear head bolt. Switch should open above 125° F, then close when temperature drops to 95° F.

7) If pressure is still incorrect, replace or clean fuel return line connector assembly and return line.

8) Recheck pressure. If pressure is still not correct, remove injection pump for repair. Pump is not serviceable and must be exchanged for another unit. See *Injection Pump Removal*.

9) Remove tachometer, pressure gauge and adapter. Install a NEW pressure tap plug seal on plug. Install tap plug into pump.

10) Remove screened covers from manifold. Install air crossover assembly.

#### INJECTION NOZZLE

1) Remove injection nozzles. Refer to removal procedure under *REMOVAL & INSTALLATION*. Clean carbon from tip of nozzle with a soft brass brush. Check torque of inlet fitting to nozzle body and correct as necessary.

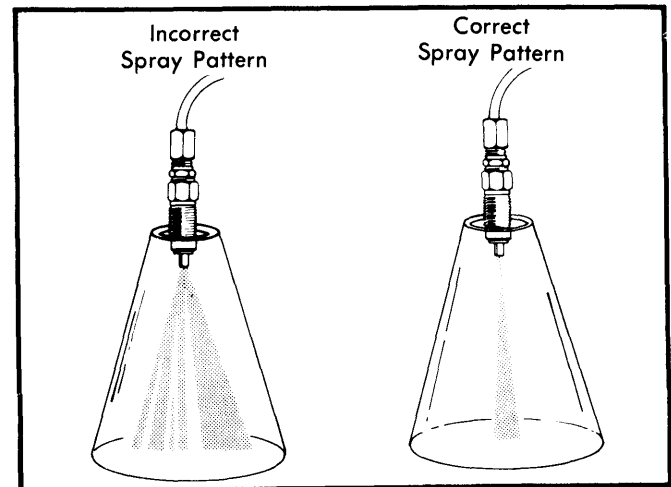


Fig. 10 Injector Nozzle Spray Patterns

2) Assemble nozzle to a suitable diesel injection nozzle tester using a connecting line (high pressure) 12" long by 1/4" O.D by 1/16" I.D. between nozzle and tester. Refer to test equipment manufacturers' instructions for exact tester operating instructions.

**CAUTION** – When testing nozzles, keep spray contained to avoid serious injury. DO NOT allow injector to release line pressure on hands, arms or any part of body. Pressure of atomized test spray has sufficient penetrating power to puncture flesh.

3) Build nozzle pressure slow enough to determine exact minimum opening pressure of nozzle. Minimum opening pressure is 1000 psi on V6 models or 1225 psi on V8 models for new nozzles and about 200 psi less for used nozzles. When nozzle releases pressure, note spray pattern and compare with examples shown in Fig. 10. If incorrect, or if a liquid stream, replace nozzle.

4) To test nozzle seat for leakage, decrease pressure to at least 290 psi BELOW actual opening pressure. Dry nozzle tip with compressed air, then increase pressure to 150 psi BELOW actual opening pressure. Maintain pressure for 5 seconds and compare fuel leakage to examples shown in Fig. 11.

5) Replace defective nozzles, then reinstall all nozzles. Install carefully and tighten to recommended torque.

#### REMOVAL & INSTALLATION

**NOTE** – Manufacturer does not recommend disassembly of pump. However, pump cover, guide stud, and throttle shaft seals may be replaced to eliminate leaks. For all other problems, pump must be removed and taken to an authorized repair station.

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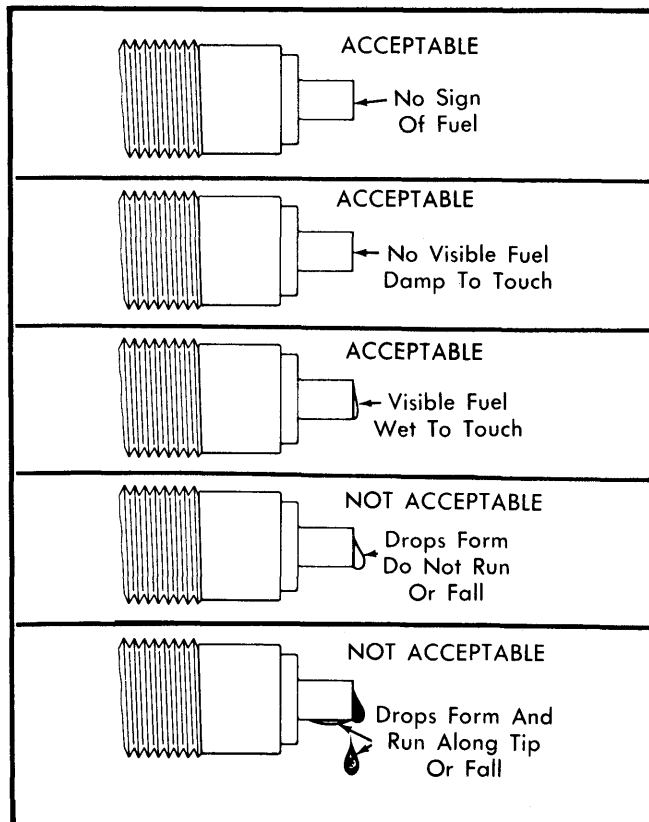


Fig. 11 Injection Nozzle Seat Tightness Check

## INJECTION PUMP SEAL REPLACEMENT

**CAV Type** - 1) Remove air cleaner and crossover. Install screens over air intakes. Clean injection pump cover and upper pump area. Place rags in engine valley to catch fuel. Remove fuel return pipe and control cover screws discarding washers and gasket.

2) Remove fast idle solenoid and vacuum regulator valve. Disconnect throttle cable, T.V./detent cable and throttle return springs. Install tool (J-29601) over throttle shaft with slots of tool engaging vacuum return valve drive lock pin.

3) Put spring clip of tool over throttle shaft advance cam and tighten wing nut. Without loosening wing nut, pull tool off shaft. This provides a reference for proper alignment during reassembly.

4) Drive pin from throttle shaft and from pump housing. Remove governor support rod discarding "O" ring. Tilt governor carrier assembly by lifting end nearest drive end of pump and ease carrier clear of pump housing.

**CAUTION** - Do not allow any dirt or foreign objects to drop into injection pump. Engine damage will result.

5) Remove clamping screw from light load cam and remove cam. Remove any burrs on end of shaft. Remove "E" circlip from throttle shaft. Pull throttle shaft out of pump. See Fig. 12.

6) Remove "O" rings and thrust washers from throttle shaft noting position for reassembly. Discard "O" rings. Examine throttle shaft for wear or damage and replace if necessary. In-

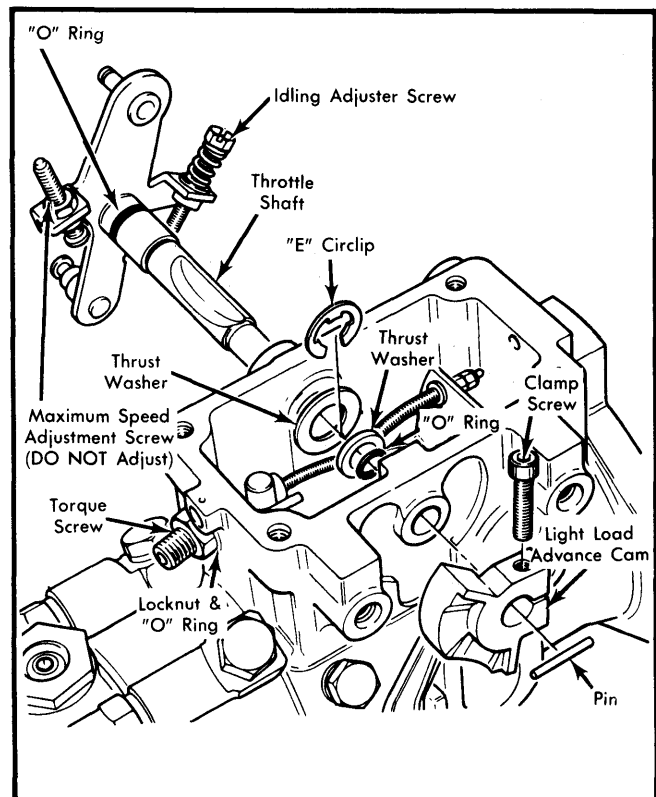


Fig. 12 CAV Injection Pump Throttle Shaft and Seals

spect shaft bushings. If replacement is necessary, pump must be sent to authorized repair dealer.

7) Lubricate shaft and new "O" ring. Install larger "O" ring using protector (J-33097). Slide shaft through until thrust washers can be installed on shaft in their original positions. Using protector (J-33098), install smaller "O" ring and fully install shaft into pump. See Fig. 12.

8) Place light load advance cam on shaft and insert clamping screw, but do not tighten. Install new "E" circlip into shaft recess. If new throttle shaft assembly has been installed, check shaft end play and adjust with selective thrust washers, if necessary. End play should be .006-.012".

9) Install new pin on end of shaft. Realign advance cam in original position with tool (J-29601), place pin in slots and spring clip over advance cam. Tighten cam screw and remove tool.

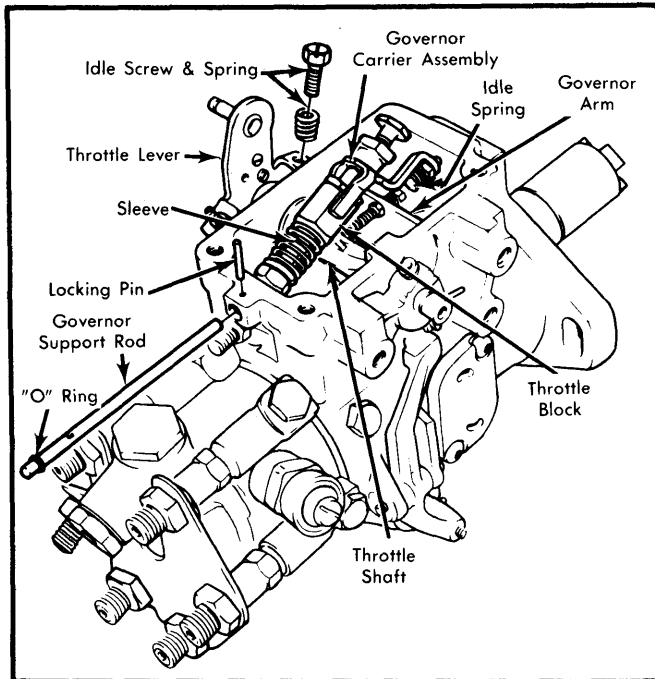
10) Rotate throttle lever forward toward drive (idling) end of pump. See Fig. 13. Lower governor carrier assembly into housing and engage lug on underside of throttle block with notch in throttle shaft. Lubricate governor support rod and new "O" ring and install "O" ring on rod using tool (J-33096).

11) Insert plain end of governor support rod through rear of governor housing and into carrier assembly sleeve. Fully install rod into housing and install new locking pin. Install new gasket and governor control cover. Torque cover screws to 25 INCH lbs.

12) Install fuel return pipe and throttle return springs. Connect throttle and T.V./detent cables. Install and adjust vacuum regulator valve. Install fast idle solenoid. Start engine and

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check for leaks. Remove intake manifold screened covers. Install air crossover and air cleaner.



**Fig. 13 CAV Injection Pump Governor Carrier Assembly**

**Roosa-Master Type** – 1) Disconnect ground cables from both batteries, then remove air cleaner and crossover. Install screens over air intakes. Disconnect fuel return line and wiring from injection pump.

2) Clean injection pump cover and area around throttle rod and guide stud. Place rags in engine valley to catch fuel. Remove vacuum regulator valve, throttle and T.V./detent cable (V6), throttle rod (V8) and return springs. Remove throttle cable bracket (V8).

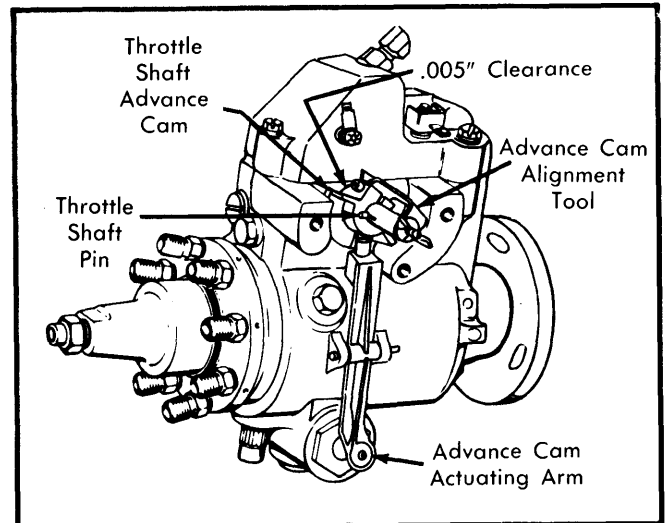
3) Install tool (J-29601) over throttle shaft with slots of tool engaging pin. Put spring clip of tool over throttle shaft advance cam and tighten wing nut. Without loosening wing nut, pull tool off shaft. This provides a reference for proper alignment during reassembly.

4) Drive pin from throttle shaft and remove advance cam and fiber washer. Remove any burrs that may have been caused by pin removal. Remove injection pump cover and remove screws from cover.

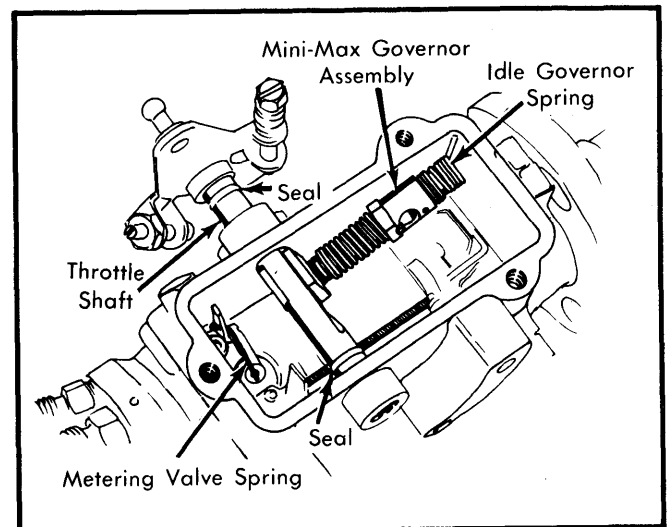
**CAUTION** – Do not allow any dirt or foreign objects to drop into injection pump. Engine damage will result.

5) Note position of metering valve spring over top of guide stud. This position must be exactly duplicated during reassembly. Remove guide stud and washer, then rotate mini-max governor assembly up and remove from throttle shaft.

6) Remove throttle shaft and inspect. If damaged or worn, replace. It may be necessary to loosen and rotate pump slightly to remove throttle shaft. Inspect shaft bushings. If replacement is necessary, pump must be sent to authorized repair dealer.



**Fig. 14 Roosa-Master Injection Pump With Advance Cam Tool Installed**



**Fig. 15 Roosa-Master Injection Pump With Cover Removed**

7) Remove throttle shaft seals. Do not cut off, as a nick on shaft will cause leakage. Coat new seals lightly with grease and install on shaft.

8) Slide shaft into pump until mini-max governor will slip onto throttle shaft. Rotate governor downward, hold in position, and slide shaft and governor cam into place.

9) Install new fiber washer, throttle shaft advance cam (do not tighten screw) and throttle shaft drive pin. Realign advance cam in original position with tool (J-29601), place a .005" feeler gauge between fiber washer and cam, and tighten cam screw.

10) Reinstall guide stud with new washer. Ensure that metering valve spring extension rides on top of guide stud. Tighten guide stud to 85 INCH Lbs.

11) Hold throttle in idle position and install new pump cover seal. Do not insert screws in cover; position cover slightly forward and above pump. Carefully move cover rearward and downward into position, taking care not to damage seal.

**GENERAL MOTORS DIESEL MECHANICAL FUEL INJECTION – V6 & V8 (Cont.)**

12) Insert screws, using flat and lock washers with flat washers against pump cover. Tighten to 33 INCH Lbs., then install vacuum regulator valve.

13) Connect battery ground cables, turn ignition on, and touch pink solenoid wire to solenoid terminal. A clicking sound should be heard as solenoid operates. If not, remove cover and check for solenoid operation.

**CAUTION** — *If clicking sound is not heard as solenoid wire is connected, DO NOT start engine. Throttle may be stuck in wide-open position.*

14) If solenoid clicks, connect all wires to pump housing. Reconnect throttle cable and T.V./detent cable (V6), throttle cable bracket and throttle rod (V8) and throttle return springs.

15) Adjust pump timing and throttle linkage. Install fuel return line and check that all fuel lines are tight. Start engine and check for leaks. Allow engine to idle for several minutes to purge air bubbles and smooth out idle. It may be necessary to stop engine for several minutes to allow air to rise and be purged.

16) Adjust vacuum regulator valve. Remove intake manifold screens. Reinstall air crossover and air cleaner.

**AIR CROSSOVER**

**Removal** — Remove air cleaner, then remove filters and pipes from air crossover. Remove bolts and washers and lift crossover from manifold. Place screened covers over intake manifold openings.

**Installation** — Reverse removal procedure. Torque air crossover bolts to 24 ft. lbs. on V6 models or 22 ft. lbs. on V8 models. Be sure to install new gaskets between crossover and intake manifold.

**INJECTION PUMP FUEL LINES**

**Removal** — 1) Remove air cleaner and crossover, then install screened covers over openings in intake manifold.

2) Remove injection pump line clamps. It is not necessary to use a back-up wrench when removing lines from pump.

3) Remove injection pump lines and cap open lines.

4) Using a back-up wrench on upper injector nozzle hex, disconnect injection pump lines at nozzle inlet fittings.

5) It is not necessary to remove pump to replace a line(s).

**Installation** — 1) Install new injection pump line(s) loosely. Position line properly.

2) Torque all high pressure fuel lines to 25 ft. lbs.

**NOTE** — *Use a back-up wrench when tightening fuel lines to fuel inlet fittings on injector nozzles.*

3) Install line clamps. Start engine and check for fuel leaks.

**NOTE** — *If several lines are to be replaced, start by connecting lower lines first.*

4) Remove screened covers from intake manifold and install air crossover and air filter assembly.

**DIESEL INJECTION PUMP**

**Removal** — 1) Remove air cleaner and crossover, then install screened covers over openings in intake manifold.

2) On V6 models, remove fuel lines and fuel pump. Disconnect throttle cable and T.V./detent cable. On V8 models, disconnect throttle rod and bellcrank. On all models, remove throttle return spring.

3) Remove throttle and T.V. cables from intake manifold brackets. Position cables away from engine.

4) Remove lines to fuel filter and remove filter.

5) Disconnect fuel line at fuel pump. On models equipped with A/C, remove rear compressor brace.

6) Remove fuel line to injection pump.

7) Disconnect fuel return line at injection pump. Remove fuel return line bracket and fuel return line from engine.

8) Remove injector fuel lines at pump, using 2 wrenches.

9) Using special wrench (J-26987 or equivalent), remove 2 bolts (V6) or 3 nuts (V8) securing injection pump. Remove pump and cap all open lines and nozzles.

**Installation** — 1) Position cylinder No. 1 at TDC by lining up crankshaft pulley mark with indicator. Remove caps placed over fittings.

2) Line up offset tang on pump driveshaft with pump driven gear and install pump.

3) If new adapter is installed, set injection pump at center of slots in pump mounting flange. If original adapter is retained align pump timing with mark on adapter. See Fig. 17.

4) Install 2 bolts (V6) or 3 nuts (V8) and lockwashers securing pump and torque to 35 ft. lbs. (V6) or 18 ft. lbs. (V8).

5) Connect pump lines at nozzles and tighten to 25 ft. lbs. with TWO wrenches. Connect fuel return line to injection pump. Reconnect fuel line at fuel pump (V8). On A/C models, install rear compressor brace.

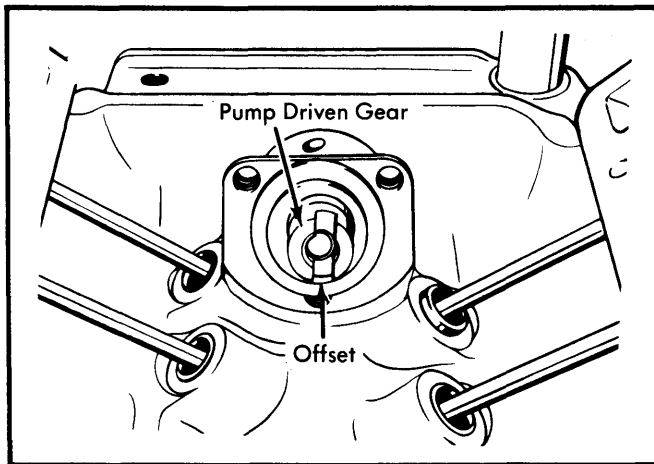
6) On all models, install fuel filter and line to injection pump. Install throttle and T.V./detent cables into intake manifold brackets.

7) On V6 models, connect throttle and T.V./detent cables to pump throttle lever. Connect throttle return spring and adjust T.V./detent cable.

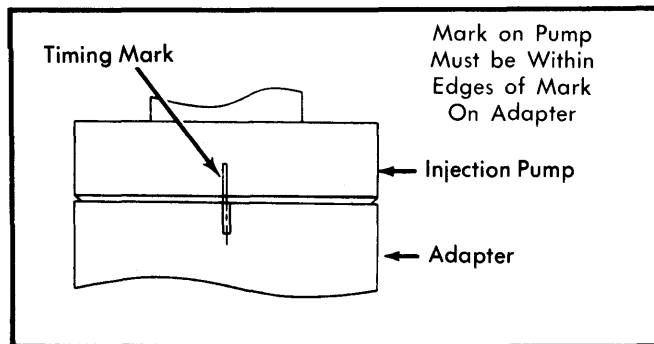
8) On V8 models, connect throttle rod and return spring. Adjust throttle rod. See *Linkage Adjustment* in this article.

9) On all models, install remaining fuel lines and fuel. Start engine and check for leaks. Check and, if necessary, adjust pump. See *Injection Timing* in this article.

## GENERAL MOTORS DIESEL MECHANICAL FUEL INJECTION – V6 & V8 (Cont.)



**Fig. 16 Pump Driven Gear Offset at TDC (Shown with Intake Manifold Removed)**



**Fig. 17 Aligning Timing Marks on Pump & Adapter**

**10)** Adjust vacuum regulator valve. See *Vacuum Regulator Valve* in this article. Adjust idle speed. See *Idle Speed Adjustment* in this article. Remove screened covers from intake manifolds. Install air crossover.

**11)** Install tubes and hoses in air crossover and ventilation filters in valve covers. Install air cleaner. Reconnect EGR valve hose.

### INJECTION PUMP ADAPTER, SEAL & NEW ADAPTER TIMING MARK

**Removal – 1)** Remove air cleaner, air crossover, injection pump and lines.

**2)** Remove injection pump adapter. Remove seal from pump adapter.

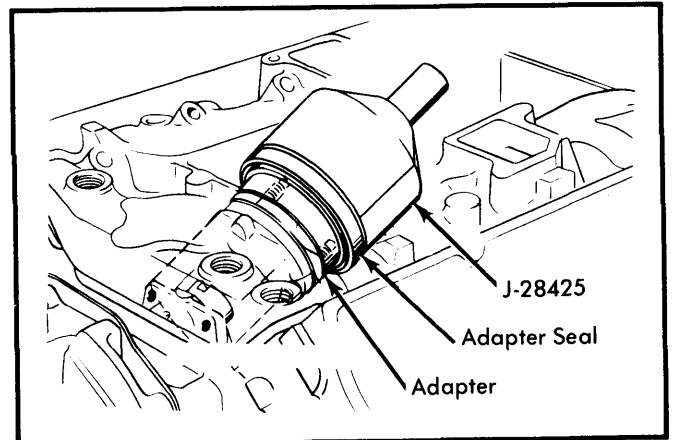
**Installation – 1)** Rotate engine to place No. 1 piston at Top Dead Center (TDC). Align mark on balancer with ZERO mark on indicator.

**NOTE** – Index is offset to the right with No. 1 at TDC.

**2)** Apply chassis lube to seal area on adapter, taper edge and seal area on intake manifold. Install adapter and leave loose.

**3)** Thoroughly lube seal, inside and out, with chassis lube. Install seal on seal installation tool (J-28425). Push seal onto pump adapter using installation tool.

**4)** Remove tool. Observe seal for proper positioning. Torque adapter bolts to 35 ft. lbs. (V6) or 25 ft. lbs. (V8).



**Fig. 18 Installation of New Adapter Seal**

### INJECTION NOZZLES

**Removal – 1)** Remove fuel lines from injection pump-to-nozzle on bank of engine where nozzle is to be serviced. DO NOT bend lines out of way to remove nozzle.

**2)** Cap open fittings and nozzles. Remove nozzle, using wrench on largest hex of injector nozzle. Make sure copper compression seal is removed with nozzle.

**NOTE** – Tip of nozzle must be protected from any damage or dirt.

**Installation – 1)** Use new copper compression seal and install nozzle. Tighten to 25 ft. lbs.

**2)** Install fuel lines to fuel inlet fittings and using a back-up wrench on the upper hex of injector, tighten lines to 25 ft. lbs. Start engine and check for leaks.

### GLOW PLUGS

**Removal – 1)** Glow plugs are mounted near each injector nozzle in the cylinder heads. They are threaded and have an electrical wire plugged into the top end.

**2)** Remove electrical wire from glow plug and remove plug with deep socket. Be sure to engage socket on largest diameter hex surfaces.

**Installation –** Install glow plug. Torque to 15 ft. lbs. (V6) or 12 ft. lbs. (V8). Connect electrical wire.

## ADJUSTMENT

### INJECTION TIMING

**NOTE** – 1982 Diesel model timing adjustment must be made with a timing meter (J-33075 or equivalent). This meter picks up engine speed and crankshaft position from the crankshaft balancer using a luminosity signal through a glow plug probe to determine combustion timing. Engine malfunctions should be corrected before a timing adjustment is made. Timing mark alignment may be used in emergency situations, but for op-

## GENERAL MOTORS DIESEL MECHANICAL FUEL INJECTION V6 &amp; V8 (Cont.)

imum engine operation the timing meter should be used as soon as possible.

**Checking** — 1) Place transmission selector in "P", apply parking brake and block drive wheels. Start engine and run at idle until fully warmed up. Shut off engine.

**NOTE** — Failure to have engine fully warmed up will result in incorrect timing reading and adjustments.

2) Remove air cleaner assembly and plug air crossover using cover (J-26996-1 or equivalent). Disconnect EGR valve hose. Clean engine probe holder (RPM counter) and crankshaft balancer rim.

3) Clean lens on both ends of glow plug probe and lens in photo-electric pick-up. Using a dulled toothpick, scrape carbon from combustion chamber side of glow plug probe. Retarded readings will result if probe is not clean.

4) Install RPM probe into crankshaft RPM counter (probe holder). Remove glow plug from cylinder No. 1 on V6 models or No. 3 on V8 models. Install glow plug probe into plug opening.

5) Set timing meter offset selector to A (20) on V6 models or B (99.5) on V8 models. Connect battery leads (Red to positive, Black to negative). Start engine and adjust RPM to speed specified on "Vehicle Emission Control Information Label".

6) Observe timing readings at 2 minute intervals. When readings stabilize, compare to specification. Timing reading, when set to specification, will be negative (ATDC).

7) Disconnect timing meter and install removed glow plug, tightening to 15 ft. lbs. (V6) or 12 ft. lbs. (V8). Install air cleaner. Reconnect EGR valve hose.

**Adjusting** — 1) Shut off engine. Note position of marks on pump flange and pump intermediate adapter (V6) or pump adapter (V8). Loosen bolts or nuts holding pump to adapter until pump can be rotated.

2) Using an offset open end wrench (1" on V6, 3/4" on V8) on boss at front of injection pump, rotate pump to left to advance or to right to retard timing as necessary.

3) On V6 models, the width of mark on intermediate adapter is about  $2/3^\circ$ . On V8 models, the width of mark on adapter is about  $1^\circ$ . Move pump the amount that is needed and tighten pump retaining nuts to 35 ft. lbs. (V6) or 18 ft. lbs. (V8).

4) Start engine and recheck timing reading as outlined previously. Reset and recheck timing if necessary. On V8 models, adjust pump rod. On all models, reset fast and curb idle speeds. See *General Motors V6 Diesel or V8 Diesel Tune-Up* article in TUNE-UP Section.

**NOTE** — Sooty or dirty probes will result in retarded readings. The luminosity probe will soot up very fast when used in cold engine. Wild needle fluctuations on timing meter indicate a cylinder not firing properly. Correct this condition prior to timing adjustment.

## LINKAGE ADJUSTMENT

**NOTE** — V6 linkage is cable operated and no adjustment is necessary.

**Throttle Rod Adjustment (V8 Only)** — 1) With engine off, check pump timing. If equipped with cruise control, remove clip from cruise control throttle rod and disconnect rod from throttle lever.

2) Disconnect transmission T.V. or detent cable from throttle assembly. Loosen lock nut on pump rod and shorten by several turns. Rotate lever to full throttle position and hold.

3) Lengthen rod until injection pump lever just contacts full throttle stop. Release lever and tighten lock nut. Remove pump rod from lever assembly.

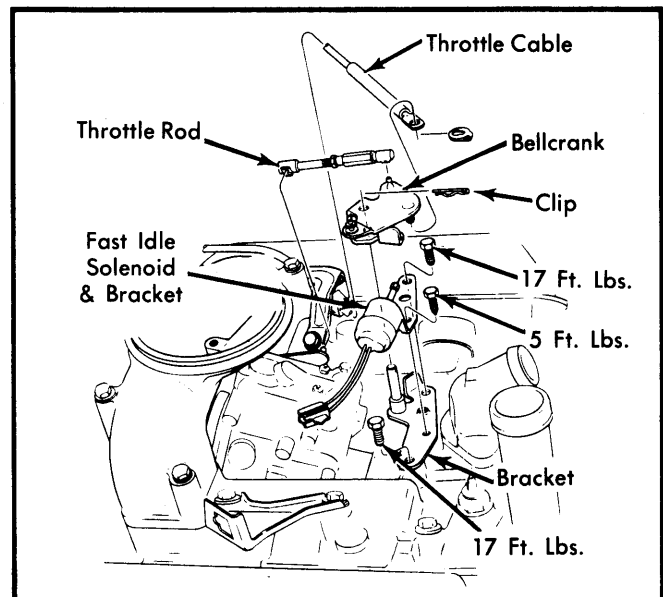


Fig. 19 Disassembled View of V8 Throttle Linkage

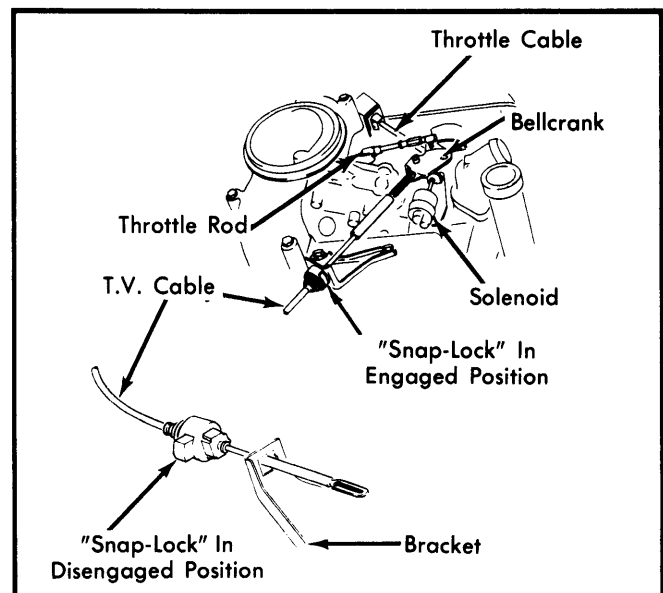


Fig. 20 Transmission T.V. or Detent Cable Adjustment

## GENERAL MOTORS DIESEL MECHANICAL FUEL INJECTION V6 & V8 (Cont.)

- 4) Reconnect transmission T.V. or detent cable. Depress and hold metal lock tab on upper end of cable, then move slider away from lever assembly until it stops against metal fitting.
- 5) Release metal tab, rotate lever assembly to full throttle stop and release lever assembly. Reconnect pump rod and cruise control rod.
- 6) Adjust vacuum regulator valve. See *Vacuum Regulator Valve* in this article. Adjust idle speed. See *General Motors V6 Diesel* or *V8 Diesel* article in TUNE-UP Section.

### VACUUM REGULATOR VALVE

- 1) Remove air crossover and install screen covers over openings. On V6 models, disconnect throttle and T.V./detent cables from pump throttle lever. On V8 models, disconnect throttle rod from pump.

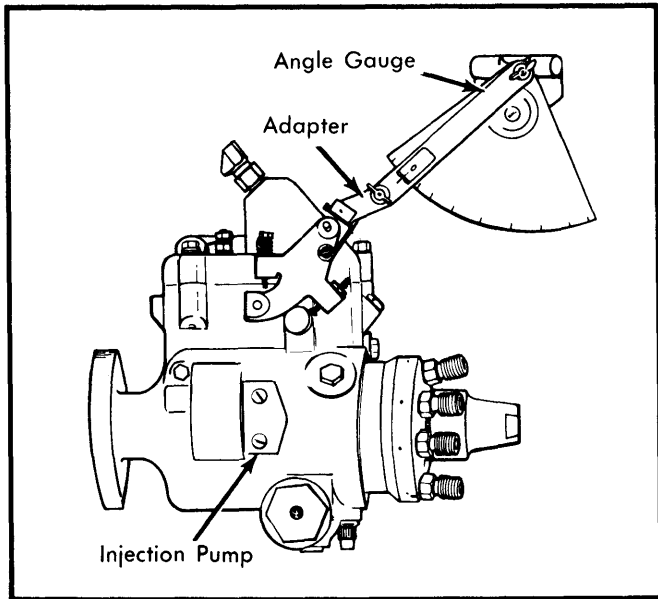


Fig. 21 Vacuum Regulator Valve Adjustment

- 2) On all models, loosen vacuum regulator valve-to-pump bolts. Install carburetor angle gauge to injection pump throttle lever. Rotate throttle lever to wide-open throttle position and set angle gauge to zero degrees, then center bubble.

- 3) Set angle gauge to 49° (V6) or 58° (V8). Rotate throttle lever until bubble is centered. Attach vacuum pump to port "A" of vacuum regulator valve and vacuum gauge to port "B". See Fig. 22.

- 4) Apply 18-24 in. Hg vacuum to port "A", then rotate vacuum valve clockwise to obtain 10.6 in. Hg. Tighten bolts and remove vacuum gauge, pump and angle gauge.

- 5) Connect throttle and T.V./detent cables (V6) or throttle rod to pump lever (V8). Remove screen covers on intake manifold. Install air crossover.

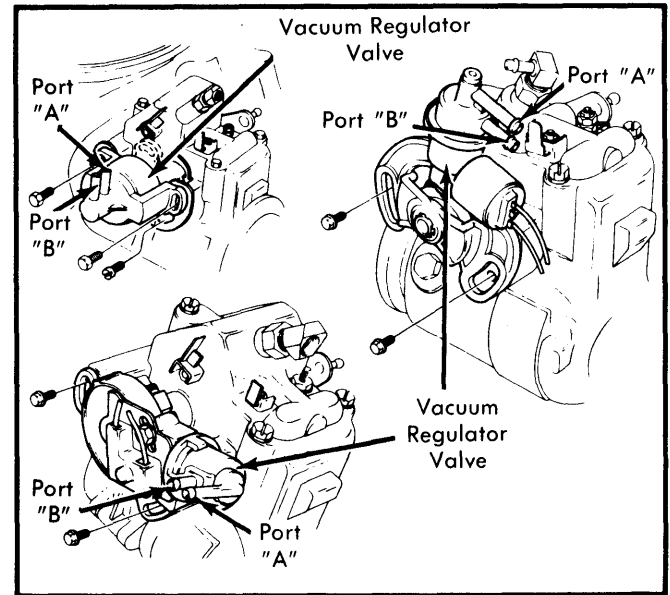


Fig. 22 Vacuum Regulator Valve Port Locations