1974-79 FUEL SYSTEMS
Bosch Diesel Fuel Injection – Mercedes-Benz

240D, 300D, 300SD

1977-79 FUEL SYSTEM SPECIFICATIONS

Application	Specifications
Idle Speed	650-850 RPM
Fuel Pump Delivery Pressure	
At Idle Speed	8.5-11.4 psi (0.6-0.8 kg/cm²)
At 3000 RPM	11.4 psi (0.8 kg/cm²)
Fuel Pump Final Delivery Pressure	
At Idle Speed	15.6 psi (1.1 kg/cm²)
At 3000 RPM	18.5 psi (1.3 kg/cm²)
Start of Delivery	24 Degrees BTDC
Nozzle Opening Pressure	
240D & 300D	1635-1750 psi (115-123 kg/cm²)
300SD Turbo	1958-2074 psi (135-143 kg/cm²)

DESCRIPTION

The Bosch Diesel Fuel injection system consists of pre-filter, main fuel filter, fuel injection pump, centrifugal governor, automatic altitude compensating device, vacuum control unit, injection nozzles, and glow plugs.

Fuel is pumped from fuel tank, through a pre-filter and main fuel filter into suction chamber of injection pump. Pump's camshaft operates injection pump plungers, which force fuel through delivery valves, reverse-flow dampening valves, and pressure lines to fuel injection nozzles. When pressure stroke is completed, spring-loaded valves close pressure lines. Plungers return to original position.

FUEL INJECTION PUMP

Fuel delivery pump, attached to fuel injection pump, is driven by injection pump camshaft and features a hand primer pump. *See Fig. 1.* Some injection pumps feature control levers, full load stop screws, and idle adjusting screws. *See Fig. 2.* On 240D, control pressure rod for automatic transmission is connected to end of control lever.

Some pumps include a built-in mechanical centrifugal governor, which eliminates the need for previously-used throttle valve in intake manifold. Engine shut-off is achieved by vacuum control unit. Pumps are lubricated by engine lubrication system. An automatic altitude compensating device in governor housing may be used to meet exhaust emission standards at varying altitudes.

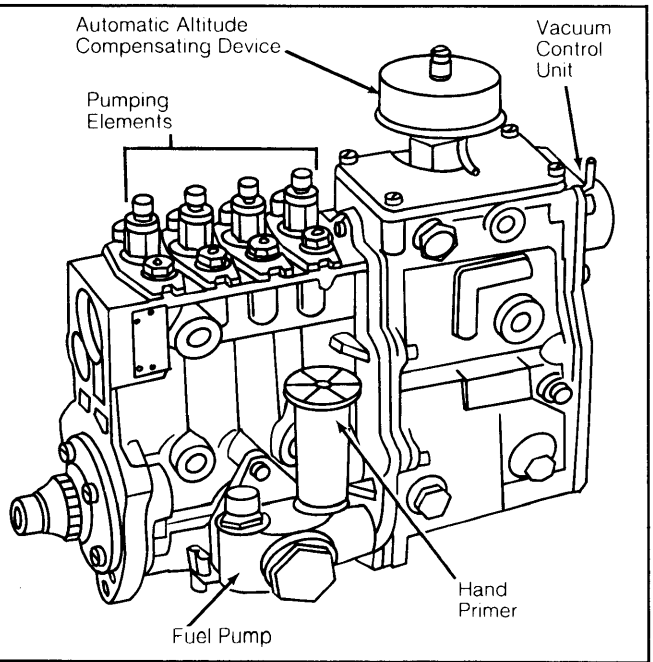

Fig. 1: Fuel Injection Pump Components

GOVERNOR

Governor is an idle-maximum RPM control. Springs are designed and adjusted so no regulating takes place in intermediate range except for compensation. Between idle and maximum RPM cutout, main rack is operated only by accelerator pedal. Pedal is connected, through linkage, with fulcrum lever of governor.

When engine RPM increases, flyweights move outward as soon as centrifugal force exceeds spring pressure. Movement of flyweights is transmitted through the angle lever, adjusting screws and control lever to main rack.

When reaching maximum RPM, main rack is moved toward the cutout position, reducing the amount of fuel and limiting engine RPM. As engine RPM decreases, the function is reversed.

Through governor action, engine RPM is held constant at idle speed, regardless of engine operating conditions. At 5000-5100 RPM, governor limits RPM by pulling main rack back, until balance exists between engine RPM and fuel delivery.

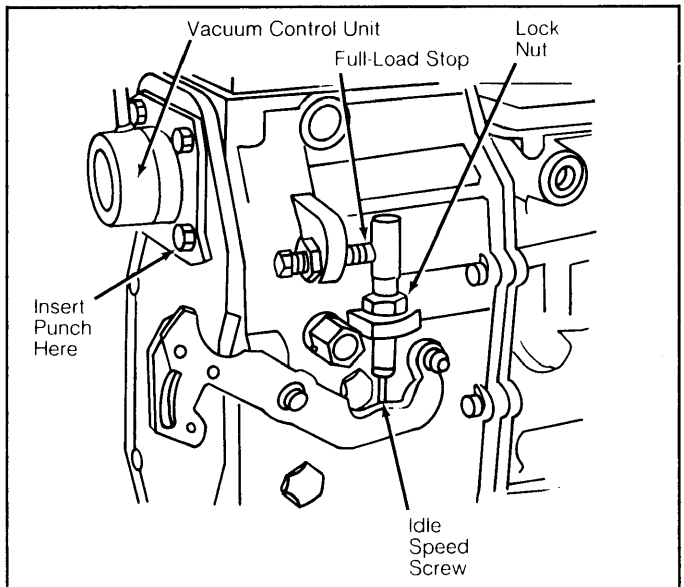

Fig. 2: Control Lever & Adjusting Screws

AUTOMATIC ALTITUDE COMPENSATING DEVICE

1977-79 Models – Governor is equipped with an automatic altitude compensating device to control exhaust emissions at varying altitudes. On 1979 300SD Turbo, this aneroid valve is equipped with an inlet from the intake manifold to sense increased (boosted) manifold pressure.

With increasing altitude, atmospheric pressure is decreased. This causes two aneroid (non-fluid) compensators to expand. At specified atmospheric pressure, internal force of compensators becomes greater than pretension of aneroid compression spring.

Pushrod moves downward, moving linkage. This causes main rack to move in direction "d", allowing less fuel to be injected. *See Fig. 3.* During increased manifold pressures on 300SD Turbo, the pressure in the aneroid cavity is increased causing the compensator and main rack to move in opposite direction, allowing more fuel to be injected while turbocharger boosts engine compression.

As adjusting lever moves closer to idle stop, compensating adjustment in partial load range is gradually reduced. At idle it is almost completely eliminated. At low altitudes, governor settings are not affected by compensators.

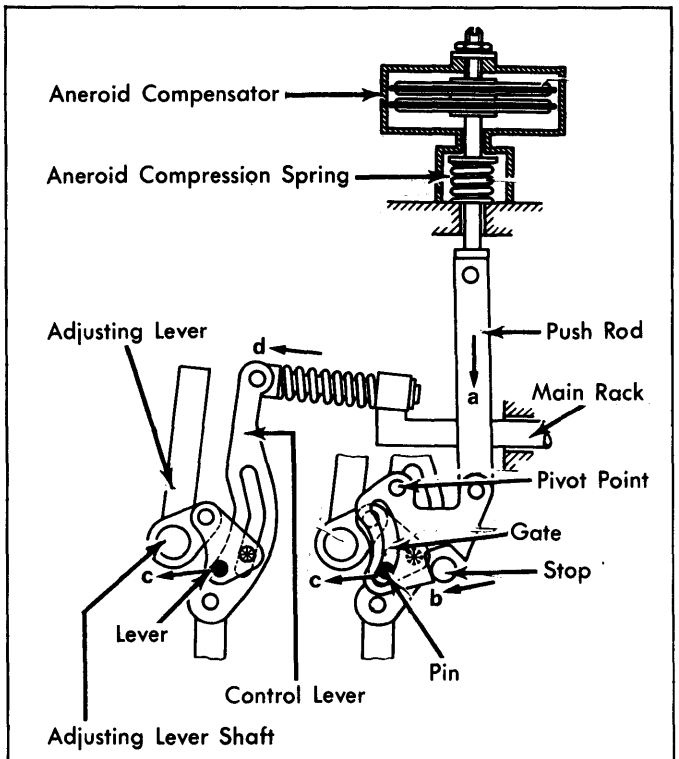

Fig. 3: Automatic Altitude Compensating Device Linkage

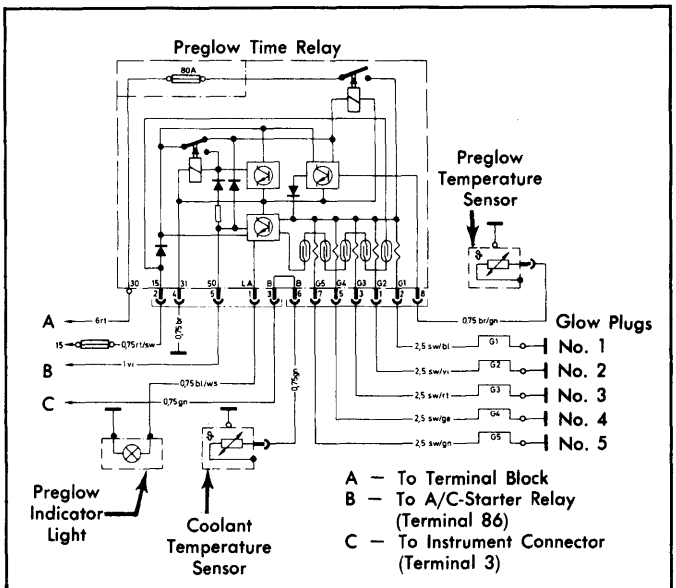

Fig. 5: 300SD Turbo Pre-Glow System Wiring Schematic

INJECTION TIMER DRIVE

1977-79 Models – The 240D and 300D have an injection timer drive installed in the end of the intermediate gear shaft. Injection timer drive is pressure lubricated. Use care when servicing engines, as bores in bearing bushing have been eliminated in newer design.

Never use a new injection timer and bearing bushing with earlier version intermediate gear shafts, since no oil would reach bearing bushing. However, the new intermediate gear shaft may be used along with previous injection timer and bearing bushing. Never install only a bearing bushing separately.

PRE-GLOW SYSTEM

1977-79 240D & 300D – With key in position "2", current flows over terminal No. 15 of starter switch to control relay and coil of pre-glow relay. Pre-glow relay closes, permitting current to flow to glow plugs over terminal No. 30. System is equipped with a temperature sensor, which turns off dash-mounted indicator light when most favorable pre-glow temperature is sensed. System is protected by a 50 ampere fuse in engine compartment.

With ignition switch in "START" position, current is supplied to solenoid switch of starter and to pre-glow time relay over terminal No.

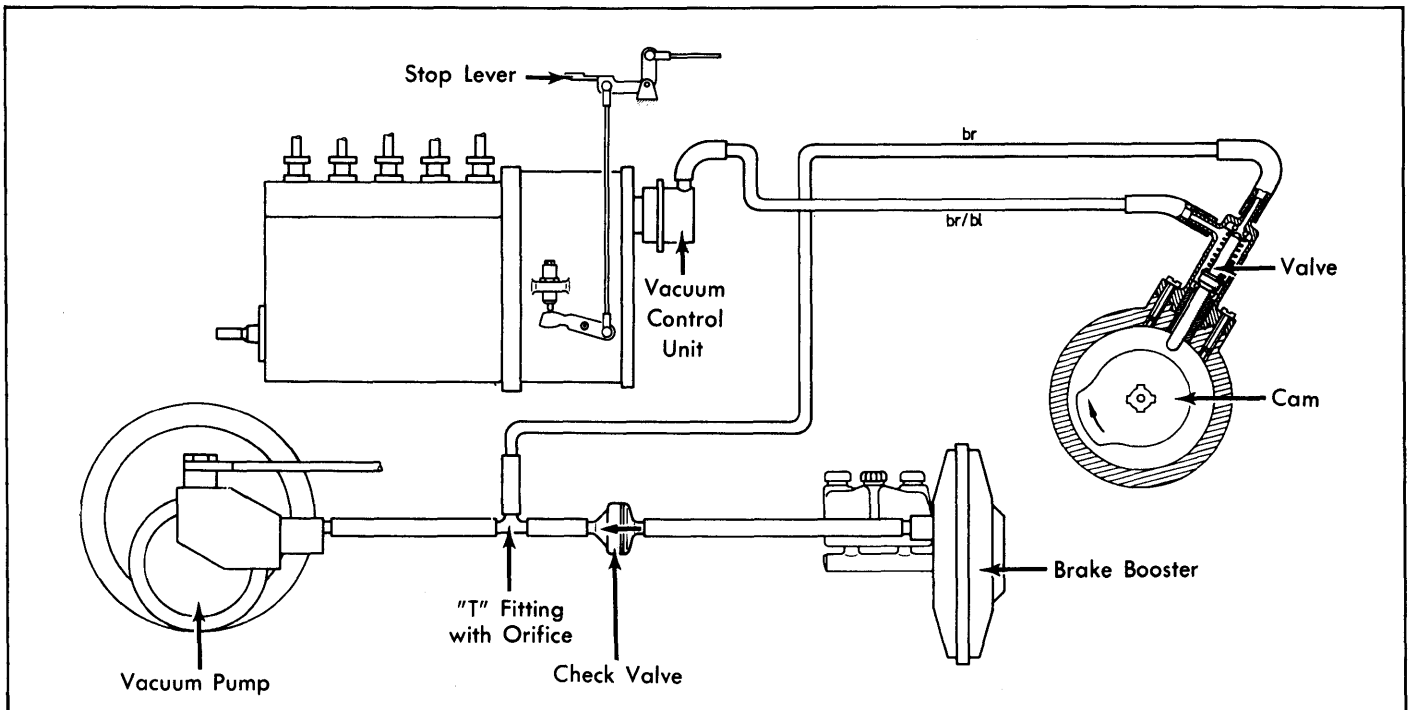

Fig. 4: Vacuum Diagram Showing Vacuum Pump, Valve, & Vacuum Control Unit On Injection Pump (Typical)

50. Two circuits are then energized. The coil of control relay is energized and relay is held closed by current supplied over terminal No. 15. During cranking, glow plugs remain energized through direct connection from terminal No. 50 to coil of pre-glow relay. Pre-glow relay contact remains closed.

When engine starts, release key will return to position "2". Current is then interrupted to terminal No. 50 and to coil of pre-glow relay. Coil of control relay remains energized, however, over terminal No. 15. Current to glow plugs is turned off.

1979 300SD Turbo – The turbocharged 5-cylinder engine is equipped with pin-type glow plugs which are connected in parallel. *See Fig. 5.* The parallel connection allows glow plugs to operate independently of each other and provides 11 volts to each plug during pre-glow process.

These glow plugs are grounded directly to the cylinder head through plug body. Each receives separate power directly from pre-glow time relay (total initial current draw is approximately 200 amperes).

The pre-glow time relay is located on left inner fender panel of engine compartment. This relay is protected by an 80 ampere fusible link mounted on its cover. It is equipped with a safety cutout circuit to turn off pre-glow current if after 90 seconds no attempt to start vehicle has been made.

REVERSE FLOW DAMPENING VALVE

1977-79 Models – The disc-type reverse flow dampening valve is crimped into place above each delivery valve compression spring. Valves permit free fuel flow toward injection nozzles, opening in direction of nozzles.

Closing needle valve in nozzle causes a pressure wave to return toward injection pump. Since delivery valve is already closed, pressure wave would normally return to injection nozzle and open it briefly again. This would cause higher HC content of exhaust gases. Pressure wave is eliminated, however, by orifice in dampening valve disc, preventing secondary injection.

ADJUSTMENTS

IDLE SPEED & IDLE SPEED REGULATOR

1974-76 Models – 1) Run engine until oil temperature reaches 176°F (80°C). Turn idle control knob on dashboard to extreme right position. this should create slack between angle lever and idle adjustment cable.
2) Remove oil plug screw from engine and install tachometer drive. Disconnect rod connecting angle lever to throttle duct. Adjust idle speed to 800-900 RPM by turning idle speed screw located on throttle duct.
1977-79 Models – 1) Check throttle linkage for free movement and wear. Run engine until oil temperature reaches 140-176°F (60-80°C). Turn idle speed regulator knob on dashboard as far as it will go. Distance between collar and spring should be .040" (1.0 mm). Adjust as necessary, making sure spring is properly adjusted.
2) Depress stop lever. Cruise control cable should rest tension-free against bellcrank. If necessary, adjust cable with adjusting nut. Release stop lever. Cable should have play.
3) Disconnect control rod at bellcrank. Check idle speed with tachometer. Loosen lock nut. *See Fig. 2.* Using adjusting screw, adjust idle speed to 650-850 RPM. Reconnect control rod free of tension. Adjust throttle linkage if necessary.
4) Place automatic transmission selector lever in a Drive position. Turn on air conditioner and turn power steering to full lock position. Engine must run smoothly. If necessary, readjust idle speed.
5) Depress accelerator pedal slightly. Simultaneously, turn idle speed regulator knob counterclockwise to "STOP". Release accelerator pedal. Engine speed should be 1000-1100 RPM. If necessary, readjust idle speed by turning adjusting screw.
6) Let engine run for a short period. If engine speed increases by itself, reduce engine speed with adjusting screw.

NOTE: If engine speed is adjusted higher, it will be above controlled idle speed range of governor. Engine speed could automatically increase up to maximum RPM (without load).

GOVERNOR CONTROL

1974-76 Models – 1) Remove oil pump drive and install tachometer drive. Run engine until oil temperature reaches 176°F (80°C). Run engine at maximum no-load speed. If speed is more than 5000 RPM, adjust full-load stop screw on injection pump governor.
2) With tachometer installed, operate vehicle under full-load conditions (35 MPH in 2nd gear or 57 MPH in 3rd gear) until maximum speed is obtained. If speed is more than 4350 RPM, adjust speed by turning full-load stop screw on throttle control duct.

START OF FUEL DELIVERY

1974-76 Models – 1) Set piston of No. 1 cylinder in TDC position of compression stroke. Turn crankshaft in normal direction of rotation 1 3/4 turns.
2) Unscrew pipe fitting of cylinder No. 1 injector. From pipe fitting, remove rubber "O" ring, coil spring, and pressure valve. Install pipe fitting and screw on overflow pipe.
3) Detach start/stop cable from timing lever and move timing lever to full power position. Connect Auxiliary Fuel Container (000 589 05 23 00) to intake side of fuel pump.
4) Turn engine over slowly in normal direction of rotation until fuel stream from overflow pipe stops dripping. *See Fig. 6.* At this point piston has covered intake bore in pump cylinder. If pointer on timing cover coincides with mark on crankshaft damper, start of fuel delivery is correct.
5) Turn crankshaft in normal direction of rotation 2 turns to verify start of fuel delivery. Near end of second turn, turn crankshaft slowly until fuel ceases to drip out of overflow pipe.
6) If adjustment is incorrect, loosen pump flange bolts and rotate pump on its own axis to align start of fuel delivery mark on crankshaft damper. Moving pump TOWARD engine advances start of delivery and AWAY FROM engine to retards start of delivery.
7) When adjustment is correct, tighten pump flange and install components to pipe fitting. Bleed fuel system and connect start/stop cable. See BLEEDING FUEL SYSTEM in this article.

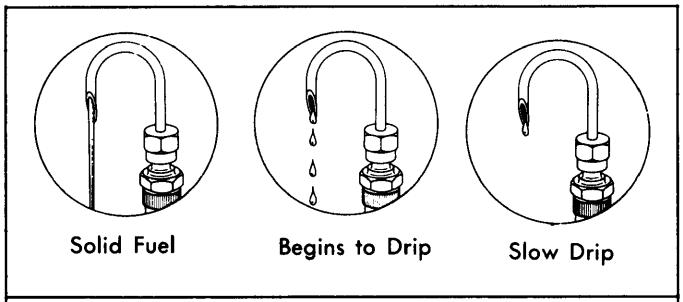

Fig. 6: Start Of Fuel Delivery Adjustment

1977-79 Models – 1) Remove plug and fill injection pump with 1/2 pint of engine oil. Turn crankshaft in normal direction of rotation until 45 degree BTDC mark aligns with pointer.
2) With piston of No. 1 cylinder in compression stroke, slide coupling sleeve onto drive collar of injection pump. Now, slide coupling forward onto drive shaft in crankcase.
3) Turn crankshaft in normal direction of rotation, until 24 degree BTDC mark aligns with pointer. Piston of No. 1 cylinder must again be in compression stroke position.
4) Screw out pipe connection fitting of first pumping element and remove valve parts. Reinstall fitting and attach overflow pipe. Set control lever on injection pump to full throttle (full-load) position.
5) Connect Auxiliary Fuel Container (000 589 05 23 00) to intake side of fuel pump. Turn engine over slowly in normal direction of rotation until fuel stream from overflow pipe stops dripping. *See Fig. 6.* Another drop may follow 10-15 seconds later, but this is normal.

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Bosch Diesel Fuel Injection – Mercedes-Benz (Cont.)

6) Start of delivery should occur when pipe stops dripping. Crankshaft pointer should then be on 24 degree BTDC mark. Turn crankshaft 2 more full turns. Fuel should stop dripping again at end of second full turn. If so, tighten injection pump in this position.
7) If crankshaft position is incorrect, loosen injection pump mounting nuts and turn pump TOWARD engine to advance start of delivery and AWAY FROM engine to retard start of delivery. When adjustment is correct, tighten mounting nuts of pump and recheck position.
8) Remove overflow pipe and connection fitting. Reinstall valve parts using new gasket. Tighten fitting to 29-36 ft. lbs. (39-49 N.m). Remove auxiliary fuel container. Connect all fuel, vacuum, and oil lines.
9) Install all control rods, cables, and other parts removed. Install battery and bleed fuel system. See BLEEDING FUEL SYSTEM in this article. Bring engine to operating temperature. Check all connections for leaks. Check idle speed and adjust as necessary.

BLEEDING FUEL SYSTEM

1974-76 Models – 1) Back off bleed screw on top of main fuel filter. Unlock operating cap on hand operated plunger, by turning it counterclockwise. Depress pump plunger until bubble free fuel flows from bleeder screw.
2) Tighten bleed screw and continue depressing pump plunger until injection pump overflow valve opens. When overflow valve opens, a buzzing sound will be heard.
3) Push operating cap of hand operated plunger down and lock by turning it clockwise. Ensure that pump plunger is locked down. If cap is not locked down properly, pump will leak during operation and allow air to enter system.
1977-79 Models – 1) To bleed fuel filter, loosen hollow bolt (smaller bolt of top of fuel filter). Pump hand primer pump until fuel emerges free of bubbles. Retighten hollow bolt.
2) To bleed injection pump, depress hand primer until by-pass valve on injection pump opens. You will hear a buzzing sound when this occurs. Run engine and check for leaks.

NOTE: Trapped air in fuel system can cause knocking, loss of power, and in some cases starting problems. Bleeding is required any time fuel tank runs dry, lines of fittings are loosened or removed.

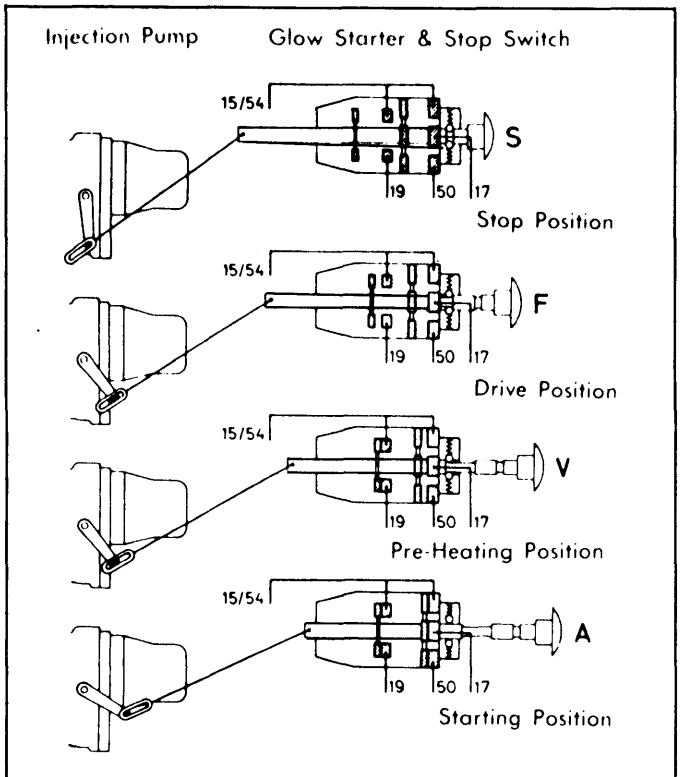

Fig. 7: 1974-76 Start/Stop Cable Adjustment

START/STOP CABLE

1974-76 Models – 1) With negative battery cable disconnected, depress button of start/stop switch (set to stop position). Check position of adjusting lever to make sure it is completely forward.
2) Pull button outward through slight resistance to starting position. *See Fig. 7.* Check that pin of adjusting lever is in contact with far end of slotted cable end.
3) Release start/stop button and check that cable slotted end is about midway position of adjusting lever pin. Pin should be at least .080" (2.0) from end of slot. If necessary, adjust cable by moving coil spring of angle bracket.
4) Reconnect negative battery cable and start engine. Move start/stop cable to off position and make sure engine stops. If necessary, readjust cable. If difficulty in obtaining correct adjustment is experienced, start of fuel delivery may be reduced in favor of stop position.

TESTING

NOTE: Manufacturer recommends that all test be conducted on an injection pump test stand, using test sheets furnished by the manufacturer. Only those procedures provided by manufacturer are included in this article.

FUEL PUMP

1974-76 Models – 1) Disconnect return line from fuel tank and place hose in container to trap discharged fuel. Start engine and check that fuel is discharged from fuel return line. If fuel is not discharged, check return line for damage. If return line is okay, reconnect line and go to next step.
2) Disconnect pressure line between fuel pump and main fuel filter. Install Tester (000 589 49 21 00) on pressure line. Bleed tester and fuel system. See BLEEDING FUEL SYSTEM in this article. Check pressure at tester with engine running at idle speed. Pressure should be 14.7-22.0 psi (1.0-1.5 kg/cm²).
3) Raise engine speed to 3000 RPM. Pressure should read 32 (2.2 kg/cm²). If pressure is much higher or lower, check that by-pass valve is opening properly. Next, check final delivery pressure. Using fingers, squeeze hose between tester and main fuel filter. If pump is working properly, pressure should be at least 29 psi (2.0 kg/cm²).
1977-79 Models – 1) Install Tester (000 589 49 21 00) between main fuel filter and fuel injection pump. Bleed tester and fuel system. See BLEEDING FUEL SYSTEM in this article.
2) Check for proper fuel delivery pressure, and opening pressure of by-pass valve. Using tester's glass tube, check for air bubbles in fuel at same time pressure is read. Check pressure at tester with engine running at idle speed. Pressure should be 8.5-11.4 psi (0.6-0.8 kg/cm²).

NOTE: When making pressure tests, observe glass tube for air bubbles. If bubbles appear, check system thoroughly for leaks. Check hose porosity, hairline cracks in fuel lines or hoses, deteriorated or scuffed hoses, or slack hose clips.

3) Raise engine speed to 3000 RPM. Pressure should read 11.4 psi (0.8 kg/cm²). If pressure is much higher or lower, check that by-pass valve is opening properly. If excessively high, check for crushed or restricted fuel lines.
4) Next, check final delivery pressure. Using fingers, squeeze hose between tester and injection pump. If pump is working properly, pressure should be at least 15.6 psi (1.1 kg/cm²) at idle and at least 18.5 psi (1.3 kg/cm²) at 3000 RPM.
5) If pressure is lower than specified, either the valve requires replacing, or pump requires repair or replacement. If pressure is higher than specified, and opening pressure of by-pass valve is greater than 11.4 psi (0.8 kg/cm²), remove, clean and check by-pass valve for leaks. Replace valve if necessary.

INJECTION NOZZLES

If exhaust gives off intermittent clouds of black smoke, this usually means one or more nozzles are operating unevenly. If exhaust offers

a rumbling noise, it usually indicates one cylinder is partly or completely out of action. To determine problem, check injection nozzles as follows:

1) At idle, loosen each injection pipe cap nut (in turn) 1/2 turn. If sound of engine does not change, part of problem is a defective nozzle or inadequate sealing between pipe union and nozzle holder.
2) Raise engine RPM above idle speed and repeat test procedure. If engine still does not run erratically with nut loosened, repair or replace that particular nozzle. If engine runs erratically when nut is loosened, nozzle is operating properly. Tighten 1/2 turn and check next nozzle.

NOTE: On 240D and 300D, nozzle opening pressure should be 1635-1750 psi (115-123 kg/cm²) for new nozzles. A minimum of 1422 psi (100 kg/cm²) for used nozzles. On 300SD, nozzle opening pressure should be 1958-2074 psi (135-143 kg/cm²). Difference in opening pressures in one engine should not exceed 71 psi (5 kg/cm²).

GOVERNOR

1974-76 Models – 1) With injection pump installed on vehicle, remove protective cap from end of control rod (injection pump end). Remove vacuum connection from top of governor housing.
2) While holding adjusting lever in full stop position, place finger over vacuum fitting on top of governor housing and release adjusting lever. Observe reaction of control rod.

NOTE: Testing governor assembly may be necessary if engine shows too low and output, heavy smoking, irregular running, faltering or lope during idle, or surpassing full-load RPM on a level stretch of road under no-load conditions.

3) If diaphragm and housing are properly sealed, control rod will only extend a short distance out of injection pump. If control rod is either fully extended or slowly extends (while still holding finger over vacuum connection), then a vacuum leak exists either in diaphragm or governor housing.
4) If a leak exist, it will be necessary to disassemble governor housing. Remove 4 screws securing diaphragm housing to injection pump. Remove bolt securing diaphragm to control rod and remove diaphragm. If diaphragm seems stiff or brittle, it must be replaced.

DIESEL KNOCK

1) Diesel knock can be traced to mechanical causes, diesel fuel properties, or a combination of both. Knock is a pinging noise caused by excessive combustion pressure.
2) To eliminate or reduce knock, use recommended fuel. If knock continues, check and/or correct fuel delivery to assure optimum compression temperature and air charge.
3) Check valve clearance. Correct nozzle spray pattern and opening pressure. Check reverse flow dampening valve for proper operation. Check compression pressure and perform cylinder leak test.

GLOW PLUGS

1974-76 240D & 300D – 1) Red glow plug indicator on dashboard has the same voltage applied to it as the glow plugs. In pre-heat position, glow plug indicator should glow lightly.
2) If indicator does not glow, an open circuit is indicated. With switch in pre-heat position, connect a screwdriver between the power leads of 2 successive glow plugs. When faulty glow plug is located, glow plug indicator will glow. Replace defective glow plug.
3) If indicator glows bright Red in step **1)**, a short circuit is indicated. Disconnect ground lead at end of system. *See Fig. 8.* If glow plug indicator continues to glow bright Red, one of the glow plugs is shorted to ground.
4) To locate faulty glow plug, start at ground end of system and successively disconnect each glow plug power lead until indicator light goes out. Replace faulty glow plug making sure new glow plug is of proper rated voltage. Reinstall system ground lead.

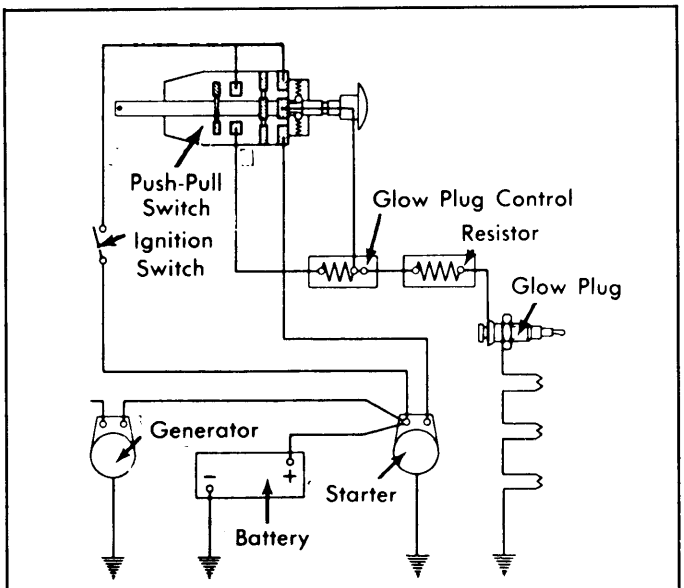

Fig. 8: 1974-76 Glow Plug Wiring Schematic

1977-79 240D & 300D – 1) Glow plugs provide ignition during starting. Use dash-mounted indicator light to locate faulty glow plugs. *See Fig. 9.* To do so, hold starting switch key in pre-glow position "2".
2) Using a screwdriver, have assistant short plugs to ground, one at a time. Each plug should spark if working properly. When grounded in this manner indicator light on dash should come on.
3) If light stays on, when ground is disconnected, a short to ground exists in system. Check for leads touching cylinder head and then for carbon-fouled plug electrodes. Also check grounding of glow plug bus bar. Be sure control rods do not rest against bus bar or glow plugs.
4) If leads appear correct, turn key to pre-glow position "2". Disconnect one glow plug power lead at a time, starting from ground end. Indicator light will go out when faulty plug is disconnected.
5) Remove glow plugs with Glow Plug Remover (617 589 00 03 00). Ream bores with Reamer (636 589 03 53 00). Prevent dust from entering pre-chamber by greasing reamer prior to use. Remove all dirt or deposits from threaded bore.
6) Visually check glow plugs for burning, cracks, or foreign metallic particles. If glow plug is burned out, also check next plug in circuit, since a short between threaded glow plug body and outer electrode or between outer electrode and cylinder head may result from metallic particles.

PRE-GLOW SYSTEM

1979 300SD Turbo – Certain malfunction of pre-glow system are indicated through pre-glow indicator light on instrument panel as follows:
1) If pre-glow light blinks for approximately 30 seconds with ignition switch in position "2", main power circuit is interrupted. Blown 80 ampere fusible link or defective power relay in pre-glow time relay.
2) If pre-glow light fails to light but engine can be started, inspect pre-glow indicator light circuit and check for open in circuit between temperature sensor and pre-glow time relay.
3) If pre-glow light blinks for approximately 30 seconds after engine is started, disconnect 8-pin connector from pre-glow time relay. Measure resistance between engine ground and harness terminals leading to glow plugs. High or infinite ohm reading indicates open in glow plug, cable to glow plug, or terminal connections.

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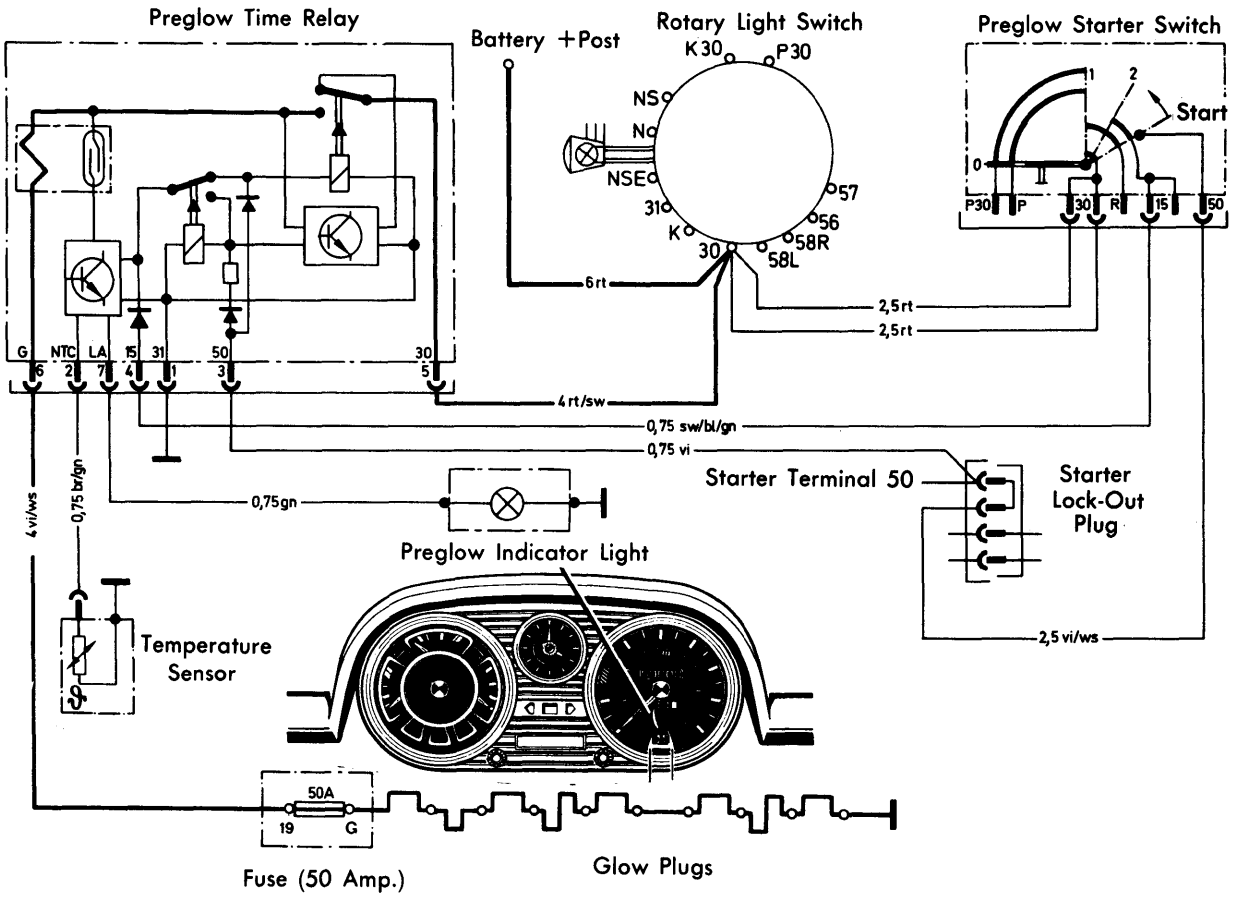

Fig. 9: 1977-79 240D & 300D Glow Plug Wiring Schematic

VACUUM CONTROL UNIT

NOTE: On 300 series 5-cylinder engine, engine oil can enter vacuum system through a defective diaphragm in the vacuum control unit. Sometimes vacuum pump has been mistakenly blamed. If complaints are received that engine does not shut off or shuts off with difficulty, check vacuum control unit.

1977-79 Models – **1)** Remove Brown and Blue line from vacuum control unit. Check for traces of oil. If present, replace unit and oil-filled vacuum lines. Also repair vacuum pump and replace brake booster if oil is found at connecting fitting for vacuum line.
2) If no traces of oil are found at control unit or in vacuum lines, start and run engine at idle. Pull off Brown vacuum line from "T" fitting, between vacuum pump and brake booster. *See Fig. 5.* Check for vacuum. If none present, remove and check "T" fitting and clean with compressed air.
3) If vacuum is present, by-pass valve by connecting vacuum control unit directly to "T" fitting. Pump is now free to act directly upon diaphragm of control unit.
4) If engine does not shut off immediately, replace vacuum control unit. If engine shuts off immediately, vacuum control unit is not to blame. Problem could be a jammed vacuum valve in steering lock.
5) Be sure all vacuum lines are connected properly. *See Fig. 5.* Start engine, check vacuum control unit, valve in steering lock and injection pump for leaks.

NOTE: When installing new unit, be sure control linkage in pump governor is properly engaged and is not holding main rack in full-load position.

REMOVAL & INSTALLATION

FUEL LINE FITTINGS

Removal & Installation – **1)** If external fuel leakage occurs between pipe connection fitting (union) and adjusting plate of injection pump, install new "grooved" fittings.
2) If pump is equipped with non-grooved fittings, replace all fittings with new "grooved" fittings. If equipped with "grooved" fittings, replace only leaking fittings.

NOTE: Do not loosen adjusting plate, as this would require recalibration of injection pump on a test stand.

3) Whenever new fittings are installed or fittings are removed for any purpose, install new copper gaskets under delivery valve carriers. Grooved end of valve carrier should be installed downward. Reinstall other valve components previously removed.
4) Oil fitting threads and tighten to 29-36 ft. lbs. (4-5 N.m), using one continuous motion. Install injection lines and operate hand primer until by-pass valve opens (audible sound). Run engine and check for further leaks.

FUEL INJECTION PUMP

NOTE: Engine should NOT be turned against normal direction of rotation. If drive collar is to be replaced, observe markings on flange, collar, and pump shaft for installation reference. After aligning injection pump, there must be a clearance of 3.15" (80 mm) between crankcase and center of injection line fitting to permit glow plug removal.

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Removal (1974-76 Models) – **1)** Clean pump and fuel lines to prevent entrance of dirt into system. Disconnect all injection, vacuum, fuel and oil lines at injection pump. Plug injection lines and fuel hose unions at pump.
2) Detach connecting rods and all cables from pump, as well as start/stop cable. Remove hex nut at bell shaped support and nuts at front flange. Remove injection pump from crankcase.
Installation – **1)** Turn crankshaft in normal direction of rotation until 45 degree BTDC mark aligns with pointer. With piston of No. 1 cylinder in TDC of compression stroke, slide coupling sleeve onto drive shaft in crankcase.
2) Remove plug from oil overflow pipe as rear of injection pump. Set injection pump to "START OF FUEL DELIVERY" position by turning pump shaft until drive collar tooth gap and injection pump marks align. *See Fig. 11*. See ADJUSTMENTS in this article.
3) When applying light counterclockwise pressure (opposite direction of rotation) to drive collar, cam pressure action causes drive collar to jump back 2 teeth to cam base circle. Second tooth must then coincide with marking on injection pump housing.

NOTE: Before installing pump, be sure piston of No. 1 cylinder is in compression stroke and crankshaft is 45 degrees BTDC.

4) Apply grease to either side of new paper gaskets and place gaskets on crankcase. Install injection pump in coupling sleeve. Be sure stud bolts are centrally positioned within slotted holes to permit alignment in either direction.
5) Place washers in position and slightly tighten injection pump nuts. Adjust injection pump to start of fuel delivery position. Reverse removal procedure to complete installation. Adjust start/stop cable if required.

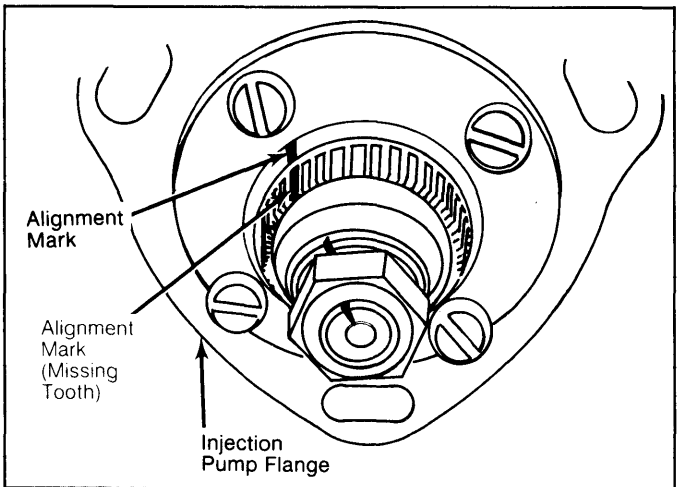

Fig. 11: Aligning Marks On Injection Pump Shaft Drive Collar & Flange

Removal (1977-79 Models) – **1)** Remove battery and battery frame. Clean pump and fuel lines to prevent entrance of dirt into system. Disconnect all injection, vacuum, fuel and oil lines at injection pump. Plug injection lines and fuel hose unions at pump.
2) Detach connecting rods and all cables from pump. Remove mounting nuts at rear support and front flange, using a 13 mm box wrench (bent at 45 degrees). Lift injection pump rearward from crankcase.
Installation – **1)** Remove plug and fill injection pump with 1/2 pint of engine oil. Turn crankshaft in normal direction of rotation until 45 degree BTDC mark aligns with pointer.
2) With piston of No. 1 cylinder in compression stroke, slide coupling sleeve onto drive collar of injection pump. Now, slide coupling forward onto drive shaft in crankcase.
3) Set injection pump to "START OF FUEL DELIVERY" position by turning pump shaft until drive collar tooth gap aligns with pump shaft and pump flange marks. *See Fig. 11*. See ADJUSTMENTS in this article.
4) When applying light counterclockwise pressure (opposite direction of rotation) to drive collar, cam pressure action causes drive collar to jump back 2 teeth to cam base circle. Second tooth must then coincide with marking on injection pump housing.

NOTE: Before installing pump, be sure piston of No. 1 cylinder is in compression stroke and crankshaft is 45 degrees BTDC.

5) Apply grease to either side of new paper gaskets and place gaskets on crankcase. Install injection pump in coupling sleeve. Be sure stud bolts are centrally positioned within slotted holes to permit alignment in either direction.
6) Place washers in position and slightly tighten injection pump nuts. Use Spacers (116 990 14 40) and M8 x 16 hex head screw to fasten rear support bracket. Reverse removal procedure to complete installation.

FUEL FILTER

Removal & Installation (1977-79 Models) – Loosen mounting bolt. Pull downward on one-piece element and lower housing. Install new lower housing and element. After installation, bleed fuel filter and injection pump. See BLEEDING FUEL SYSTEM in this article.

NOTE: The main fuel filter and lower housing should be replaced every 37,500 miles.

VACUUM CONTROL UNIT

Removal (1977-79 Models) – Unscrew lower right-hand mounting screw from vacuum control unit. *See Fig. 2*. Depress stop lever on cylinder head cover. Measure position of main rack by inserting punch into screw bore until it touches main rack. Mark this position on punch. Unscrew 3 remaining screws and remove control unit.

Installation – **1)** Install new gasket and steel ring. Make sure tang on vacuum control unit engages in main rack. Install last three mounting screws removed. Insert punch in lower right-hand screw bore. Check main rack position with mark on punch.
2) When punch touches main rack, press lightly on punch and move control lever on injection pump from stop position to full-load stop. Punch must follow the main rack smoothly. If correct, install remaining screw.

AUTOMATIC ALTITUDE COMPENSATING DEVICE

NOTE: Do not attempt to remove upper cover of governor housing. Governor linkage is assembled to altitude compensating device.

Removal (1977-79 Models) – Hold altitude compensating device by small nut, while loosening larger nut (both nuts are on underside of device). Unscrew altitude compensating device and remove shims.

Installation – Using shims removed, install compensating device into place. Be sure vent tube is positioned at lowest point to drain off any possible condensation. Hold small nut and tighten large nut.

TIGHTENING SPECIFICATION

Application	Ft. Lbs. (N.m)
Rocker Arm Cover	4 (5.4)
Glow Plugs	36 (49)
Pre-Combustion Chamber	119 (161)
Nozzle-to-Holder	54 (73)
Nozzle Holder-to-Head	54 (73)
Nozzle Holder Connector	54 (73)
Injection Pump Shaft Nut	51 (69)
Connecting Fitting (Union)	29-36 (39-49)
Injection Pipe Cap Nuts	18 (24)