

Bosch Fuel Injection

MERCEDES-BENZ MECHANICAL TYPE

- 250 (1971)
- 280 S (1971)
- 280 SL (1971)
- 280 SE (1971-72)
- 280 SEL (1971)
- 300 SEL (1971)
- 300 SEL 6.3 (1971-72)
- 600 (1971-72)

► **NOTE** - Pressure (pounds per square inch (psi) and Vacuum (inches of Mercury (in. Hg) are listed here in Atmospheres (atm). For conversion; 1 atmosphere of pressure equals 14.70 psi and 1 atmosphere of vacuum equals 29.92 in. Hg.

DESCRIPTION

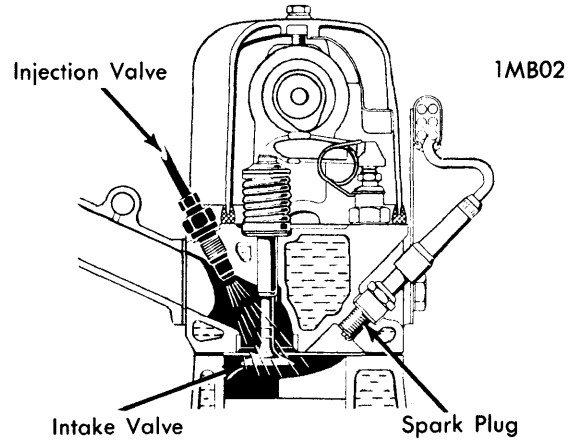
Six or eight plunger pumps are used on the system. The system operates on the principle of intermittent injection. Injection plungers are actuated through pump camshaft via roller tappets. Plungers force fuel to cylinders through six or eight fuel lines, and fuel is discharged into ports by means of injectors located in cylinder heads. The injectors discharge upon intake stroke of the particular cylinder.

OPERATION

INJECTION PUMP

Depending on type of engine in which installed, pump may contain six or eight of the pump units. Each unit consists of a cylinder and a plunger. Each plunger is connected to a tappet which rides on cam lobe. Pump cylinders are fastened to housing and each cylinder is immersed in fuel which can enter cylinder compression chamber through an inlet port. Camshaft exerts a force upon tappet and causes it to move delivery plunger up. As a result, fuel contained in compression chambers is forced out through a check valve into pressure lines connected to injection valves. Maximum lift of delivery plungers is determined by camshaft design and remains constant. Injection quantity

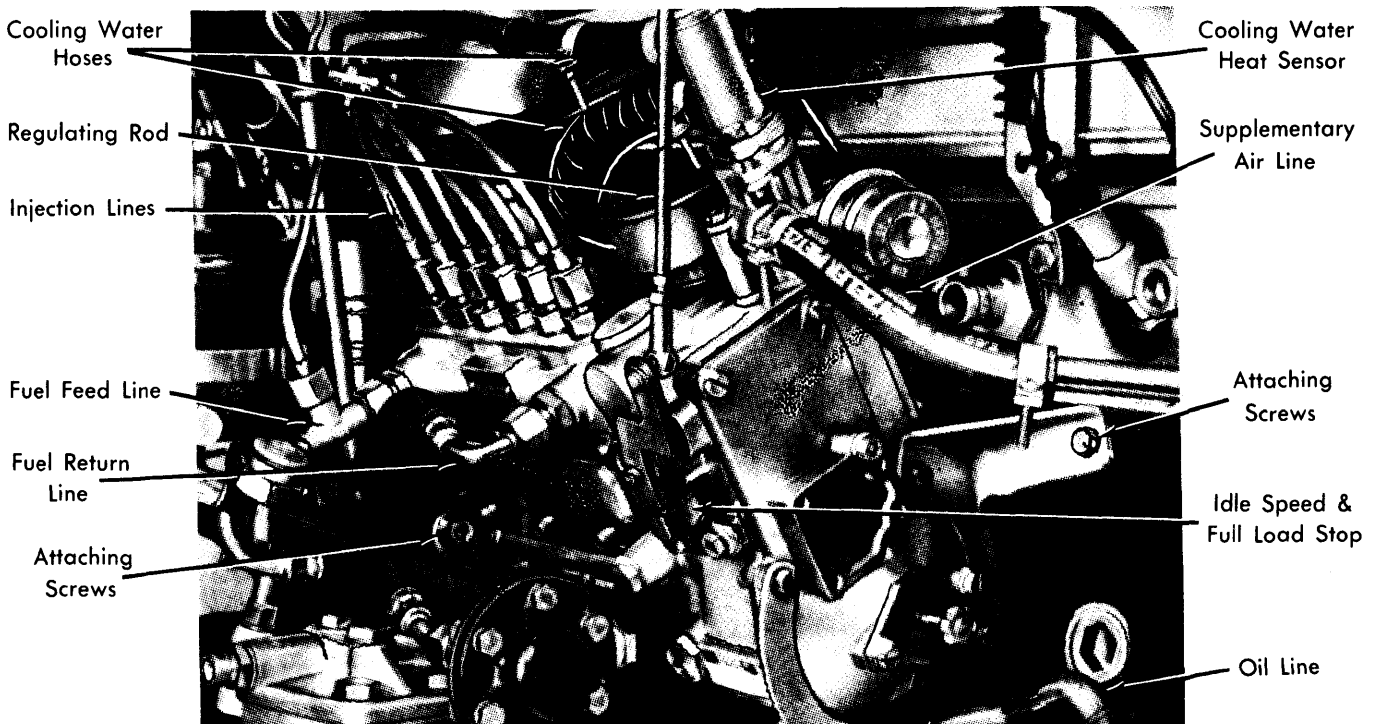
is regulated by turning delivery plungers, thus resetting a metering land in each. A toothed control rack, engaging its toothed counterpart in each delivery plunger, can slide back or forth and to turn delivery plungers as required. As a result, slanted metering land closes fuel inlet port at an earlier or later time, causing greater, or smaller amounts of fuel to be delivered on each stroke, depending on relative position of injection plunger.



INTAKE PORT INJECTION

CONTROL UNIT

To obtain required air/fuel mixture ratio, engine must be supplied with different quantities of fuel under varying engine speed and loads. This is accomplished by a contoured cam which is mounted on camshaft, together with a centrifugal governor. Contoured cam can be moved by centrifugal governor and



INJECTION PUMP (TYPICAL)

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rotated on its axis by accelerator pedal in relation to given engine loads. Riding on contoured cam is a sensor (roller) which transfers appropriate fuel volume requirements to control rack via a guide lever.

INLET AIR THERMOSTAT

With increasing air temperature, fuel quantity injected must be decreased. In order to obtain a constant fuel/air ratio, inlet air thermostat at injection pump transfers action to compensating mechanism moving fuel control rod so that quantity of injected fuel is decreased.

COOLING WATER THERMOSTAT

During warming up period, engine needs more air and fuel. Enrichment is controlled by a cooling water thermostat attached to injection pump and connected to water circulation system. When cold, thermostat opens supplementary air valve and moves control rod to a rich setting. As engine warms up, thermostat gradually releases control until supplementary air valve is closed and fuel control rod has returned to its normal position.

BAROMETRIC CELL

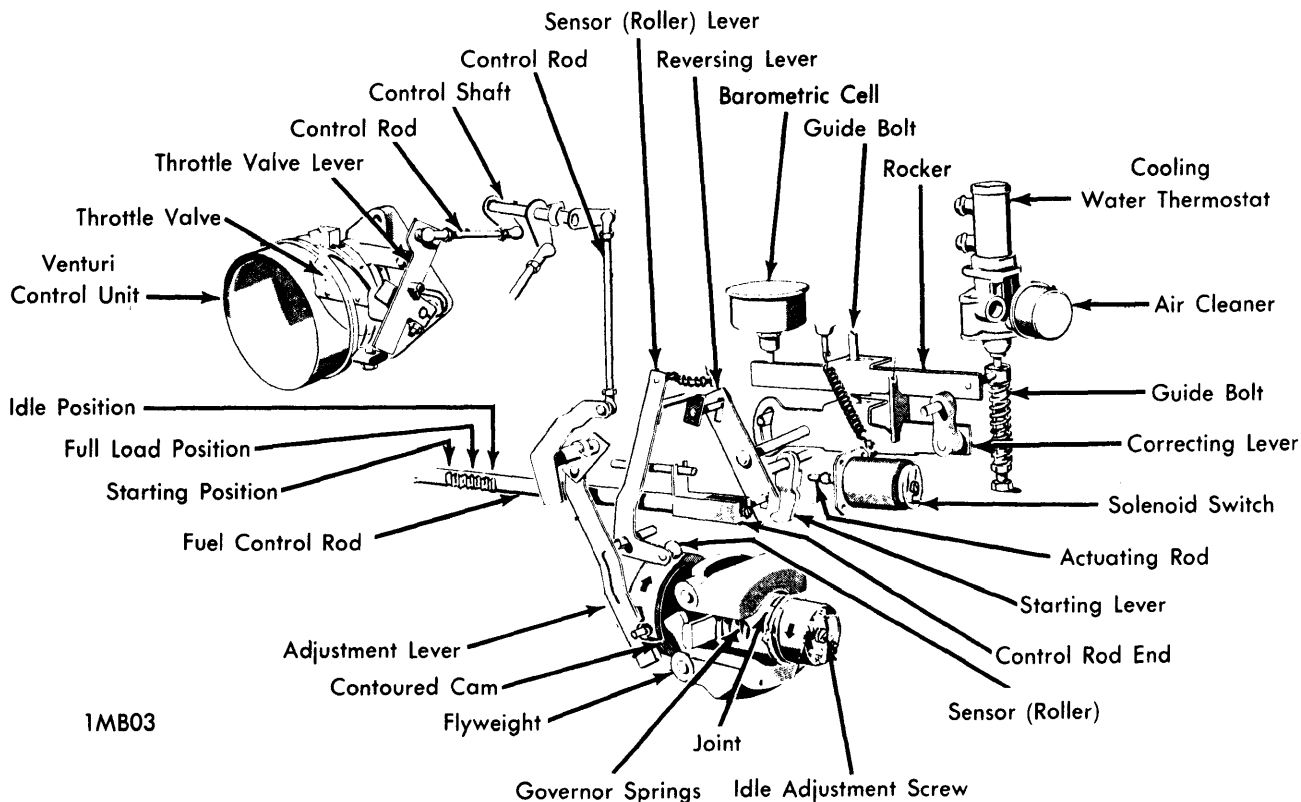
Compensates for changes in air pressure. When aneroid mechanism expands, action is transferred to compensating mechanism which corrects given position of fuel control rod so that quantity of injected fuel is increased at high air pressures, and reduced when pressure drops, such as in changing weather or when driving in mountains.

ENRICHMENT SOLENOID

Enriches combustion mixture in cold and hot starting (controlled by thermo-limit switch and time-limit relay). Enrichment solenoid has been incorporated in pump and acts directly on plunger control rack, moving it beyond "full power" position with plunger aligning for starting-rate fuel delivery. Time-limit relay closes solenoid circuit for two seconds during each starting procedure, without regard to temperature. A thermo-limit switch keeps energizing circuit closed over an appropriately longer period of time during cold starts. An additional thermo-switch also activates a supplemental cold-starting device at lower temperatures.

SHUT OFF SOLENOID

Function of shut-off solenoid is to move plunger control rack to OFF position and interrupt fuel delivery to engine when car is coasting in gear. Shut-off solenoid is controlled by a temperature switch in cooling system, an idling speed switch on venturi control unit, a transmission switch, and an RPM (speed) switch. When engine speed approaches idle RPM, speed-switch interrupts flow of current, causing shut-off solenoid to return to its inactive position and release plunger control rack. As a result, fuel flow to engine is resumed, permitting engine to idle when vehicle is stopped. If engine speed is again increased, speed switch becomes reactivated. However, solenoid circuit will be interrupted by switch on venturi control unit.



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CONTROL UNIT (TYPICAL)

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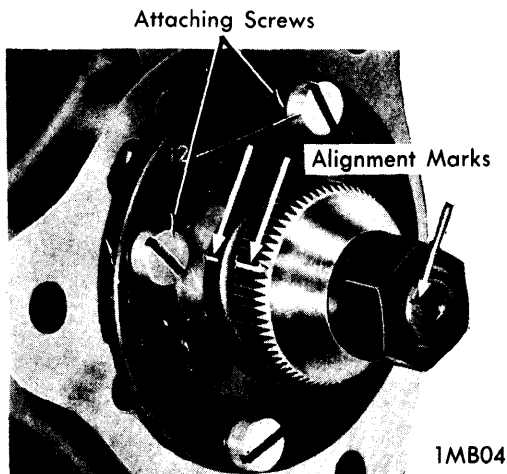
LINKAGE

To obtain a constantly correct air/fuel ratio under all operating conditions, movements of accelerator pedal are transmitted to control lever of injection pump and to throttle valves by means of linkage. Pump control lever regulates quantity of fuel, throttle valve controls quantity of intake air. Movements of pump control lever and that of throttle valve should always be in definite ratio to each other (correlation). Any change of air/fuel ratio results in irregular running of engine during acceleration, while shifting, etc. Correlation is important for proper operation of injection system.

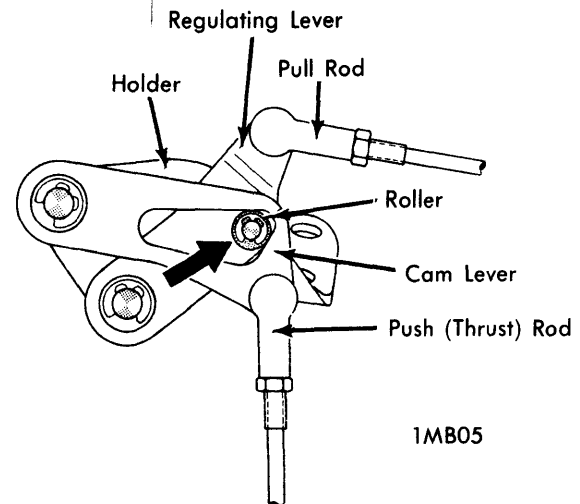
ADJUSTMENT

INJECTION PUMP END OF DELIVERY STROKE

- 1) Bring No. 1 piston to TDC of compression stroke, then set crankshaft pulley to timing mark specified.
- 2) Before installing injection pump, turn camshaft of pump until marking on shaft lines up with mark on pump bearing cover.



INJECTION PUMP TIMING MARKS (TYPICAL)



CONTROL LINKAGE (TYPICAL)

- 3) On engines with progressive linkage check limit stop of roller in quadrant lever and if necessary adjust pull rod in such a way that the roller lightly rests against limit stop in quadrant lever without exerting any force.

Throttle Valve Angle (°)	Governor Angle (°)
0	0
2.5	4-4.5
5	8-8.5
7.5	11.5-12.5
10	15.5-16.5
15	22.5-23.5
20	29-30
30	40.5-42
40	50.5-51.5
50	59-60
60	67-68
70	73.5-75
80-82	79-82

LINKAGE CORRELATION ADJUSTMENT

- 1) Appropriate tools consisting of two protractors with pointers must be used to adjust and correlate linkage. Attach one protractor to throttle valve lever, and other protractor to adjustment lever of injection pump. Attach pointers and bend in such a way that they point to 0° when throttle valve is completely closed and adjustment lever rests against idle stop.
- 2) Actuate control shaft and adjust protractor on venturi control unit to throttle valve angle given in table and read off angle indicated on protractor on injection pump. This angle must be within tolerances given in table. Small differences can be removed by readjusting control rods. In full load position, adjustment lever on injection pump must rest against full load stop, and there must be a clearance of about .004" (1 mm) between throttle valve lever and full load stop.

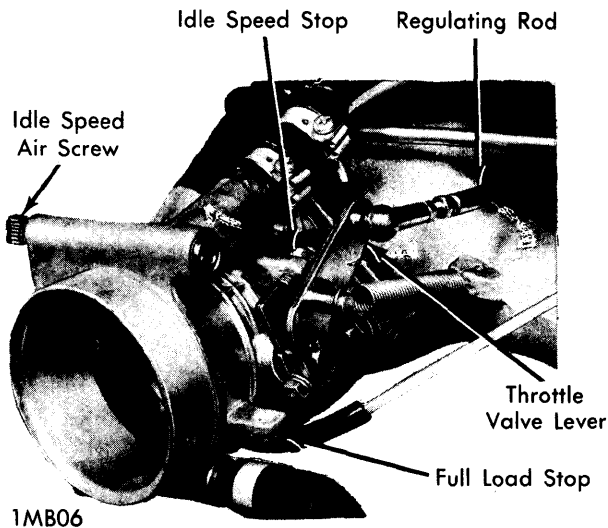
IDLE SPEED ADJUSTMENT

With engine at normal operating temperature, manual transmission in Neutral and automatic transmission in Park, adjust idle speed as follows:

Connect tachometer and adjust idle to specified RPM by means of idle air throttle on Venturi control unit. If engine runs properly, no further correction required. If engine speed fluctuates, fuel/air mixture too rich. If engine vibrates, mixture too lean. If further adjustment is required, idle speed injection quantity may be adjusted with spring-loaded idle control knob on injection pump. Before attempting this adjustment STOP THE ENGINE. This idle control knob must only be operated when engine is stopped since knob rotates as soon as it engages in slot of adjusting screw on centrifugal governor. To adjust, press in on spring-loaded idle control knob and turn it until it engages slot of adjustment screw. Turn knob one notch to left if mixture is too rich and one notch to right if mixture

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too lean. **NOTE** - This adjustment must only be moved from notch to notch and at most, up to three notches to left or right of basic position. Readjust idle to specified RPM by means of idle air throttle. If engine still does not run smoothly, repeat correction until engine has been properly adjusted.



VENTURI CONTROL (TYPICAL)

SPECIFICATIONS

ENGINE IDLE SPEED (RPM)

Application	RPM
All Models (Except 300 SEL 6.3 & 600)	750-850
300 SEL 6.3 & 600	560-600

FUEL PUMP PRESSURE & VOLUME

Delivery Pressure	① 11.8-16.2 (0.8-1.1 atm)
Delivery End Pressure (minimum)	② 19.1 (1.3 atm)
Delivery Volume (15 seconds)	② ③ 2.1 pts. (1.0 ltr)

- ① - Measured in front of starter valve.
- ② - Measured behind overflow valve of injection pump.
- ③ - Fuel tank must be at least half full for test.

NOTE - All tests are made with engine stopped and a minimum of 11 volts at fuel pump.

POSITION OF CRANKSHAFT WHEN INSTALLING INJECTION PUMP

Application	Setting
All Models (Except 300 SEL 6.3 & 600)	20° ATDC
300 SEL 6.3 & 600	60° ATDC

NOTE - Injection pump timing is correct when mark on camshaft lines up with mark on pump bearing cover.

REMOVAL & INSTALLATION PROCEDURES

INJECTION PUMP (ALL EXCEPT 300SEL)

Removal - 1) Disconnect battery ground cable, drain cooling system water, remove water hoses, supplementary air line, and fuel lines. Unscrew oil line (from injection pump) and unscrew oil line from oil filter (on oil cooler).

2) Disconnect regulating rod and loosen cable to starting magnet (if equipped). Unscrew attaching bolts and remove injection pump in rearward direction. Remove coupling sleeve.

3) If driver on camshaft is to be replaced, remove driver with puller. Using suitable tool (spanner), and applying a counterclockwise pressure to spanner, remove nut on camshaft. **NOTE** - After pulling driver, do not forget to replace two attaching screws (see illustration).

Installation - 1) Move crankshaft and injection pump to installation position by setting crankshaft to 20° ATDC of first cylinder. Do this by removing distributor cap and rotating engine crankshaft until TDC is indicated on vibration damper and rotor (of distributor) points to mark on distributor housing. Keep moving engine crankshaft until 20° ATDC is obtained.

2) Rotate camshaft of injection pump until mark on camshaft is aligned with mark on flange. Slide coupling sleeve on driver and install injection pump. Replace coolant, reconnect all lines, and run engine to check for leaks and make all necessary adjustments.

INJECTION PUMP (300 SEL)

Removal - 1) Partially drain cooling system, unscrew bearing bracket, and remove longitudinal regulating shaft (if installed). Unscrew injection lines, using suitable tool (spanner), first from injection pump and then from injection valves. **NOTE** - The lines are identified by their rubber cover or must be identified by means of a tag.

2) Loosen fuel lines, cooling water hoses, and oil lock on injection pump. Unscrew supplementary air lines on pump and on intake pipes. Remove lefthand intake pipe with intermediate piece and cover intake ducts of cylinder head. **NOTE** - Under rear fastening plate (of pump) are compensating washers which should not be lost during removal.

3) Remove coupling sleeve from crankshaft of injection pump. If driver is to be removed, pull off with a puller. Using a suitable tool (spanner) and applying a counterclockwise pressure, remove nut on camshaft of pump.

NOTE - Prior to installation of new injection pump, check regulating rod for proper operation.

Installation - 1) Set piston of first cylinder at 60° ATDC by removing distributor cap and rotating engine until rotor points to mark on distributor housing (for cylinder number one) and indicates TDC on vibration damper. Keep turning engine until vibration damper is at 60° ATDC.

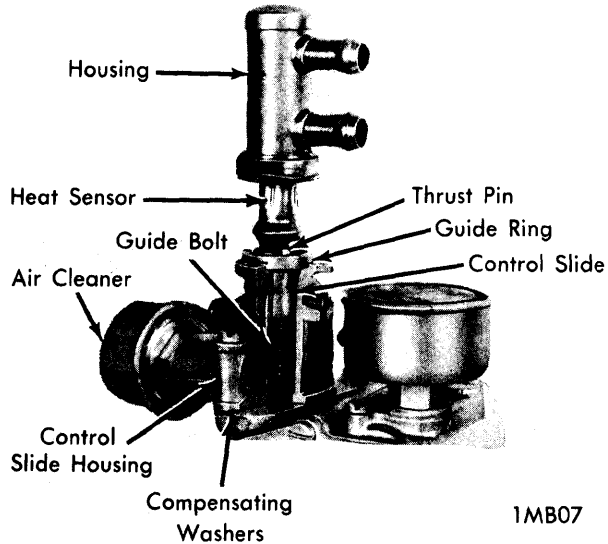
2) Rotate camshaft of pump until mark on camshaft and flange are aligned. Slide coupling sleeve on driver and new seal on flange of engine housing. Install injection pump and measure distance with feeler gauge between engine and fastening plate. Attach proper number of compensating washers and tighten the two bolts.

3) Install intake pipe. Replace seals (if required), connect all fuel lines, vacuum lines, and cooling water hoses. Screw on oil pressure line, injection lines and bearing bracket. Check adjustment of regulating linkage.

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4) Refill cooling system and run engine (until warm) to check for leaks. Adjust idle speed to specifications.



**COOLING WATER THERMOSTAT
(HEAT SENSOR)**

HEAT FEELER (SENSOR)

NOTE — When replacing heat sensor, check that control slide and thrust pin are moving freely. Do not pull thrust pin out of sensor.

When installing, make sure of correct positioning of housing and guide ring. Tighten fastening bolts evenly.

BALL PRESSURE VALVES

Removal — 1) Thoroughly clean injection housing. Unscrew pressure lines and pipe connections. Pull pressure valve using suitable tool (MB 000 589 62 33 00 or Bosch EF8117A).

2) Switch on ignition long enough to flush suction chamber of injection pump. Clean pressure valve, position new seal, and insert new pressure valve.

NOTE — Always install new sealing ring after each removal of pressure valve.

3) Screw in pipe connection. To provide a perfect seal of sealing rings, the following tightening torques must be observed: Tighten pipe connections to 30 ft. lbs. (4.0 mkp), loosen and tighten again to same specification, and loosen and tighten; but this time only tighten to 25.3 ft. lbs. (3.5 mkp).