MERCEDES-BENZ DIESEL TURBOCHARGING SYSTEM

Mercedes-Benz
300 SD

DESCRIPTION

The Diesel turbocharged engine (617.950) is basically the same design as the naturally aspirated engine (617.912). See *Fig. 1*. Installation of the Garret turbocharger produced an increase to 110 SAE net brake horsepower at 4200 RPM.

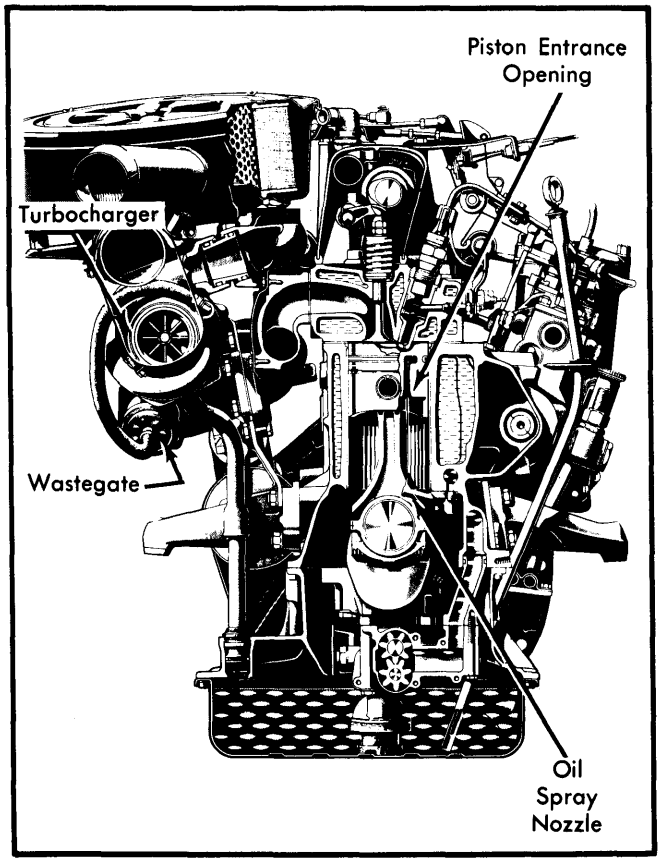

Fig. 1 Cutaway View of Mercedes 300 SD Turbocharged Engine

This increased power output required modifications of engine and vehicle components, including redesign of the crankcase, pistons, valve train, lubrication system, cooling system and fuel injection system.

The turbocharger delivers pre-compressed air to the engine, providing a higher air charge in the cylinders and creating higher pressures and temperatures in the combustion chambers.

The system includes a turbocharger which consists of a turbine, compressor and a wastegate that prevents excessive boost pressures from damaging the engine. See *Fig. 2*.

The turbocharger's turbine wheel and compressor wheel are mounted on a common shaft and turn at the same speed. The turbocharger is mounted between the exhaust manifold and the exhaust pipe and is connected directly to the engine for lubrication and cooling. The wastegate is attached to the turbine housing. Should its boost pressure control valve malfunction, an engine overload protection system will prevent engine damage.

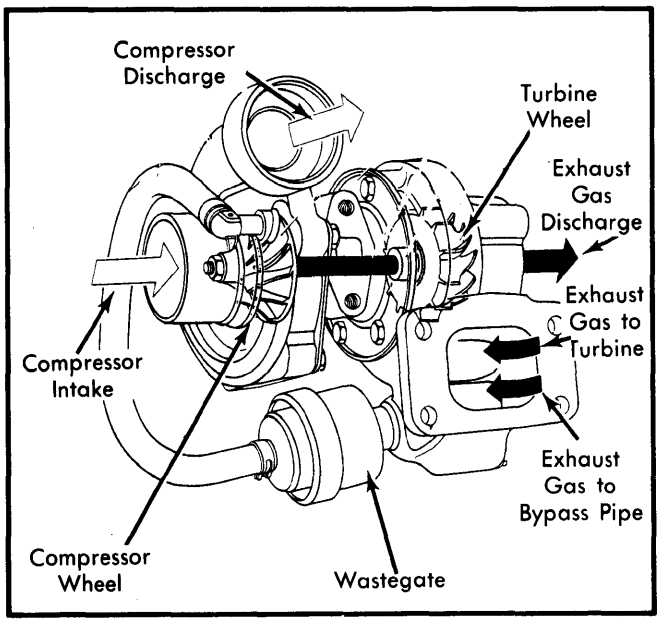

Fig. 2 Cutaway View of Garret Turbocharger Used in Mercedes 300 SD

OPERATION

Exhaust gases leaving the cylinders flow through the exhaust manifold directly into the turbocharger's turbine housing. The force of the gases turns the turbine wheel, which in turn spins the compressor wheel at the same speed. Turbine and compressor wheel speeds can reach up to 100,000 RPM. See *Figs. 2 and 3*.

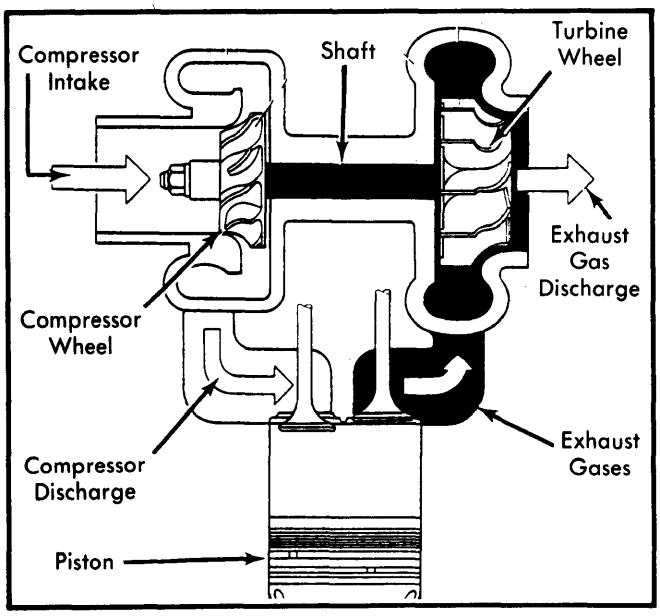

Fig. 3 Airflow Pattern with Garret Turbocharger

The fresh air drawn in by the compressor wheel is compressed and delivered to the combustion chamber above the pistons. At idle speed, the engine operates like any other. However, with

MERCEDES-BENZ DIESEL TURBOCHARGING SYSTEM (Cont.)

increasing load and engine speed, exhaust gases are expelled with increasing velocity. This causes the turbine wheel to turn faster, increasing boost pressure at the compressor wheel. Boost pressure is routed to the intake manifold and to individual cylinders, completing the cycle.

Exhaust gases passing through the turbine housing are routed to the exhaust pipe. As the cycle is continuous, the wastegate limits boost pressure, preventing engine damage. *See Fig. 4.* Installed on the turbine housing, the wastegate valve opens, permitting the exhaust gases to bypass the turbine and flow directly into the exhaust pipe. Boost pressure is therefore maintained at a constant level.

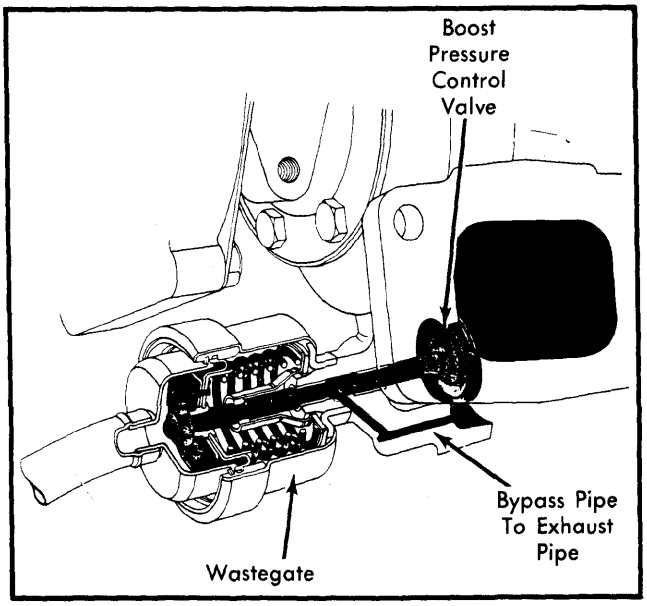

Fig. 4 Cutaway View of Wastegate Valve

The aneroid compensator on top of the fuel injection pump automatically adjusts the fuel quantity injected into the cylinders depending on existing boost pressure or atmospheric pressure in the intake manifold. Therefore, the correct air-fuel relationship is maintained at all times.

Should boost pressure control valve (wastegate) fail, a pressure switch installed in the intake manifold closes an electrical circuit, energizing a switch-over valve. This valve closes the pressure line to the intake manifold and simultaneously opens the aneroid compensator to atmosphere. This reduces the fuel quantity being injected. The pressure switch only functions when intake manifold boost pressure reaches 16 psi (1.125 kg/cm²). When pressure drops below this figure, the pressure switch opens the electric circuit and venting of the pressure line is stopped.

LUBRICATION

The exhaust gas turbocharger and piston cooling systems increased the total capacity of the lubrication system to 9.0 quarts (7.9 quarts for an oil and filter change).

Oil is supplied to the turbocharger for lubrication and cooling from the rear cover of the oil filter. The oil return line runs from the turbocharger back to the upper oil pan housing. Oil spray nozzles for cooling the pistons are connected internally to the engine lubrication system's main oil gallery. *See Fig. 1.* Check valves in the oil spray nozzles open at engine oil pressure of 21.8 psi (1.53 kg/cm²). An oil stream is sprayed directly into the piston entrance openings for the ring passages and travels around the piston crown and returns to the oil pan. The spray nozzles close at 14.5 psi (1 kg/cm²) oil pressure.

NOTE – *The direction of oil nozzle spray should be checked during assembly operations on the engine, as spray must be directed exactly at the entrance opening of the piston.*

CAUTION – *When removing and installing pistons, always remove oil spray nozzles first. They should be reinstalled only after pistons and connecting rods have been installed. Nozzles must not be interchanged from cylinder to cylinder and should be carefully checked for damage before installation. Nozzle bores should only be cleaned with air pressure applied in the direction of oil travel.*

The engine is equipped with an oil cooler with a .75 quart capacity. Oil flow through the cooler is controlled by a thermostat in the oil filter housing. The thermostat opens at 203°F (95°C).

TESTING

1) To check turbocharger boost pressure, connect pressure gauge (617 589 02 21 00) to intake manifold after removing plug.

2) Using a dynamometer, drive vehicle in driving range "S" at full load and 4000 RPM. Boost pressure should be 10.1-11.6 psi (.71-.82 kg/cm²).

3) If boost pressure is too low, check air filter and air intake shroud duct for obstructions. Check turbocharger for leaks between manifold and turbine housing, compressor housing discharge and intake manifold, and between intake or exhaust manifold and cylinder head.

4) Check pressure line between intake manifold and aneroid compensator and overload switch-over valve. To check valve, turn ignition switch to position "2". Disconnect plug on valve and check for battery voltage at black/red wire. If not present, check fuse number 4 or wiring. Check for ground condition of brown/black wire. There should be no ground connection below boost pressure of 16 psi (1.13 kg/cm²). If ground exists, check pressure switch in intake manifold or its wiring.

5) Other possible causes of low boost pressure would be a defective wastegate, requiring turbocharger replacement, or problems with the fuel injection pump, requiring removal, testing, and repair.

6) If boost pressure control valve (wastegate) does not open, causing boost pressure at full load operation to exceed 16 psi (1.13 kg/cm²), check hose between compressor housing and wastegate. If hose is leaking or is kinked, replace the hose. If not, replace turbocharger.

MERCEDES-BENZ DIESEL TURBOCHARGING SYSTEM (Cont.)

NOTE – *When dynamometer test is complete, road test vehicle with tester inside the vehicle. Drive vehicle in driving range "L" or "S" at 4000 RPM. Fully depress accelerator pedal and hold engine speed at 4000 RPM with brakes (short test duration only). Boost pressure should be 10.1-11.6 psi (.71-.82 kg/cm²). If not, repeat steps* **3)** *through* **6).**

REMOVAL & INSTALLATION

Removal – **1)** Remove air filter and disconnect electrical cable from coolant temperature switch.

2) Loosen hose clamp at air intake duct. Remove vacuum line, crankcase breather pipe, air filter housing and air intake duct. Disconnect engine oil supply line to turbocharger. Remove air filter mounting bracket and disconnect exhaust flange.

3) Disconnect and remove exhaust bracket on automatic transmission. Press exhaust pipe to the rear. Remove mounting bracket for intermediate flange and four mounting nuts on the turbocharger.

4) Lift off turbocharger and remove intermediate flange and disconnect oil return pipe at turbocharger.

Installation – **1)** Install all parts in reverse order of removal. Before mounting the turbocharger, install intermediate flange and oil return pipe. Install flange gasket between turbocharger and exhaust manifold with reinforcing bead towards the exhaust manifold.

2) Use only heatproof nuts and bolts when installing turbocharger. Fill center turbocharger housing with approximately ¼ pint of engine oil through the engine oil supply bore, before operating turbocharger. Be sure "O" rings are mounted correctly when installing air intake duct.