AUDI TURBOCHARGING SYSTEM

Audi
5000 Turbo

DESCRIPTION

The Audi 5000 Turbo uses a Kuhnle, Kopp, Kausch turbocharger with a small diameter turbine and impeller. It is bolted directly to the front of the exhaust manifold to make best use of exhaust energy. A wastegate, a valve preventing excessive boost pressure, is attached to the back of the manifold. *See Fig. 1.*

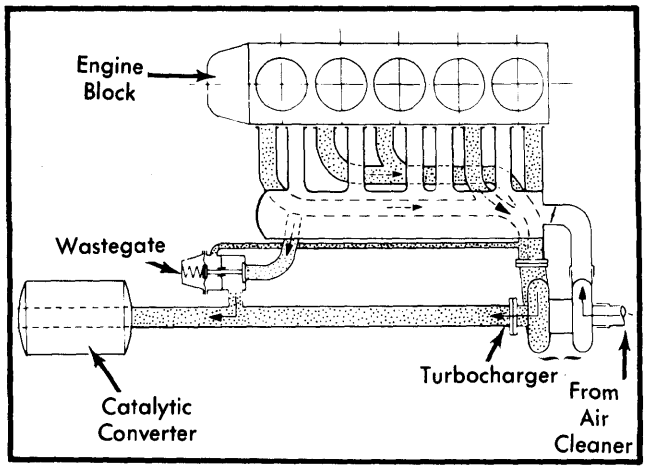

Fig. 1 Components of Audi Turbocharger System

Other components of the turbocharging system include an additional safety switch that prevents excessive boost pressure in the event of wastegate failure; an oil cooler mounted behind the right side of the front spoiler that stabilizes oil temperatures during hard driving an an injector cooling fan.

The Audi 5000 engine has been modified to match the additional power output, as have other vehicle components including the automatic transmission, chassis, tires, front and rear suspension and brakes.

Among the engine changes are the following: The cylinder block has a fitting for the turbo oil return line, a modified oil filter flange to accommodate the oil cooler thermostat, and a piston cooling system. Pistons are cooled by jets which spray engine oil on the inside of the piston anytime oil pressure reaches 36 psi (2.53 kg/cm^2). Pistons have a deep-dished recess in their tops to reduce compression ratio to 7.0:1. The piston skirt is notched on one side to clear the piston cooler spray jets, and larger piston pins are used. Exhaust valves are sodium filled to withstand higher exhaust temperatures.

OPERATION

At idle and light throttle, the Turbo engine operates like any other engine. When more power is required, the usually wasted exhaust gases from the exhaust manifold enter the turbocharger's turbine housing and flow through the turbine blades. *See Fig. 2.*

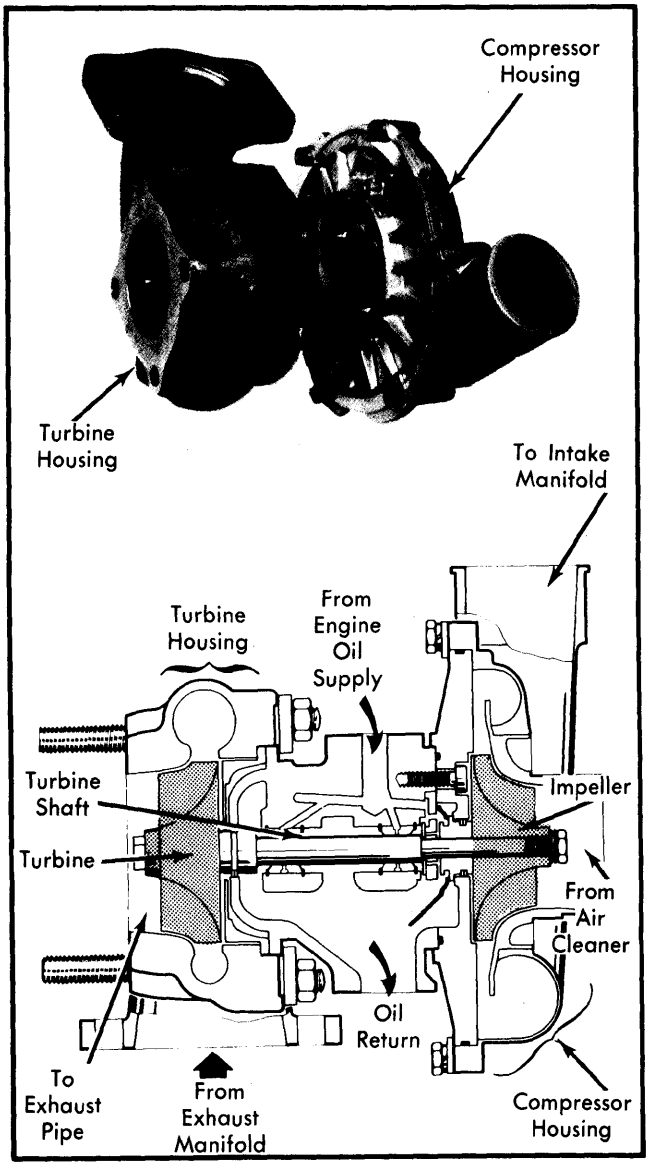

Fig. 2 Cutaway View of Turbocharger

Depending upon the amount of exhaust flow, the turbine will spin at speeds up to 90,000 RPM. The exhaust flow and, in turn, the turbine RPM increases as the throttle is opened and engine speed increases.

The impeller is mounted on the turbine shaft and therefore, it also spins at speeds up to 90,000 RPM. As the impeller turns inside the turbocharger compressor, it draws in air and forces it into the compressor housing. The faster the impeller turns, the more pressurized air (boost pressure) is forced into the intake manifold.

If boost pressures produced in the turbocharger were allowed to go too high, serious engine damage could result. The wastegate, mounted at the rear of the exhaust manifold prevents this from occurring.

When boost pressure created by the turbocharger exceeds a predetermined limit, a valve inside the wastegate begins to

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open. See *Fig. 3*. This permits some of the exhaust gases to bypass the turbocharger and flow directly from the exhaust manifold to the exhaust system through the wastegate.

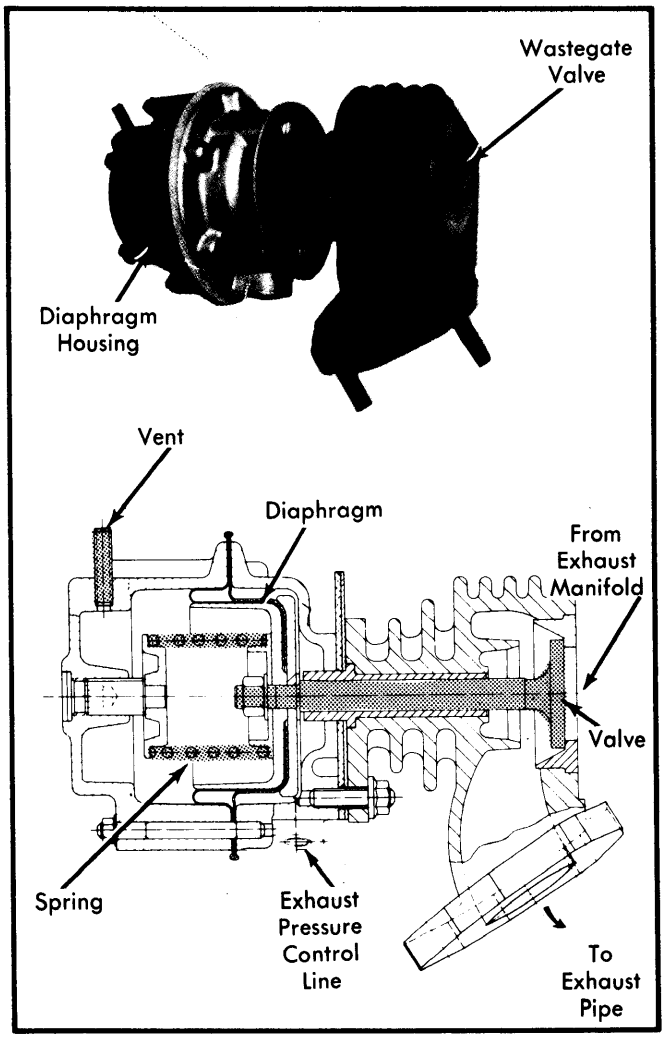

Fig. 3 Cutaway View of Wastegate

The wastegate consists of a valve, attached to a diaphragm. The valve is normally held closed by a spring. A small diameter control line connects the chamber below the diaphragm with the exhaust manifold. When exhaust pressure in this chamber exceeds the tension of the spring, the valve opens.

When the valve in the wastegate is closed, all of the exhaust gases power the turbocharger; when it is open, bypassing the gases limits boost pressure produced in the turbocharger.

Should the wastegate fail, a boost pressure safety switch mounted on a hose leading to the intake manifold, opens and shuts off the fuel pump. The switch is energized whenever boost pressure exceeds 11.6 psi (.82 kg/cm²).

The fuel pump relay is grounded through the safety switch. When boost pressure exceeds the specified limit, the switch opens removing the ground and opening the pump relay.

To prevent vapor lock, a thermo-switch controls an electric blower fan which cools injectors at the cylinder head. The fan comes on (with or without ignition being on) whenever manifold temperatures reach 212°F (100°C).

LUBRICATION

The turbine shaft runs in plain bearings, which must be pressure lubricated. Finely filtered oil from the engine lubrication system enters the top of the turbocharger and is distributed to the bearings. The oil returns to the engine oil pan through a large line attached to the bottom of the turbocharger.

An oil filter and thermostat assembly is attached to the engine block. See *Fig. 4*. Oil from the oil pump flows through the main oil filter and to the thermostat housing. When the engine is cold, the oil bypasses the oil cooler and flows directly to the engine and the turbocharger oil filter. When the engine is hot, a thermostat opens the control piston. Oil from the main filter then flows through the oil cooler before going to the engine and turbocharger oil filter. The oil cooler is located behind the right side of the front spoiler.

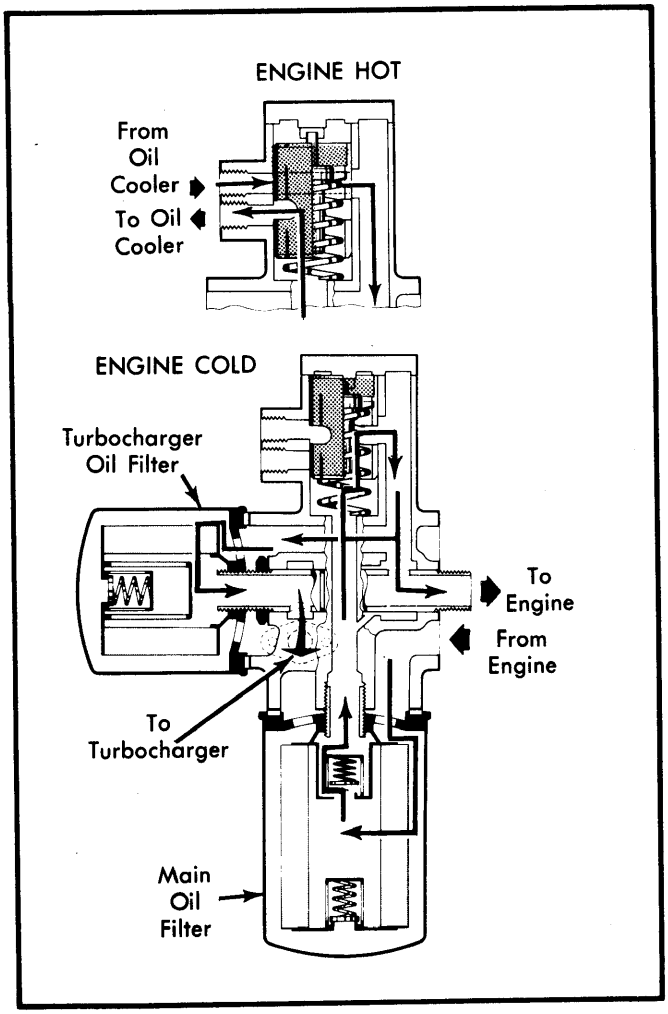

Fig. 4 Cutaway View of Oil Filter Assemblies

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TESTING

1) To test the turbocharging system, use a pressure gauge (VW1397) calibrated in both psi and bar. The gauge is equipped with a valve which locks pressure measurement when closed. See *Fig. 5*.

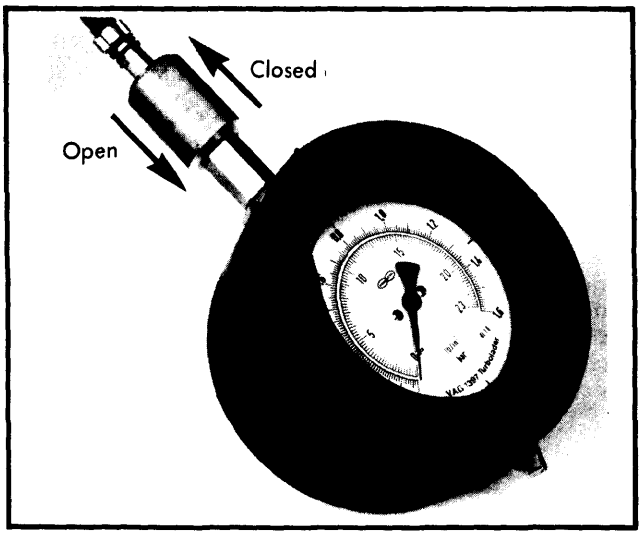

Fig. 5 Turbocharger Boost Pressure Gauge (VW1397)

2) Attach gauge to vacuum advance at distributor, using "T" fitting supplied with gauge. Be sure vacuum advance unit and charcoal canister purge valve are free of leaks. Use hose clamps at all connections to avoid low readings.

3) Boost pressure can only be tested on a chassis dynamometer or through road testing. Carry the gauge inside car by routing the hose out right rear corner of hood and into passenger side vent wing window.

4) Accelerate engine to full throttle in drive position "2". Hold vehicle speed constant with foot brake, when engine speed reaches 4000 RPM. Wait 2 seconds and close gauge valve by pulling sleeve away from dial.

5) Boost pressure will vary according to ambient air temperature. Refer to table.

Boost Pressure Specifications

Ambient Temperature	Psi (kg/cm²)
50°F (10°C)	7.0-7.6 (.49-.53)
68°F (20°C)	6.7-7.4 (.47-.52)
77°F (25°C)	6.6-7.3 (.46-.51)
86°F (30°C)	6.4-7.0 (.45-.49)

6) If boost pressure is too high, wastegate is defective. If boost pressure is too low, replace wastegate and perform tests again. If pressure is still too low, replace defective turbocharger.

NOTE – *The boost pressure gauge in the instrument cluster is calibrated to read absolute pressure. When the engine is not running and gauge reads "1", this is normal atmospheric pressure. A reading of over "1" indicates boost pressure in the intake manifold; a reading less than "1" indicates presence of vacuum.*