A. Exhaust Gas Turbocharger

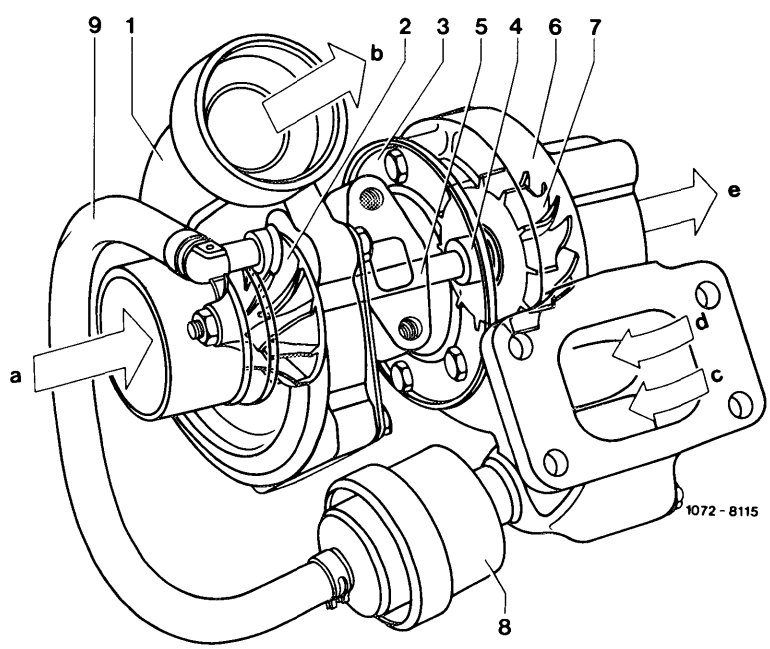
Exhaust gas turbocharger designation

Garret	TA 0301
Kühnle Kopp and Kausch	KKK 532 679 60 31

General

The exhaust gas turbocharger is a machine using the aerodynamic energy of the exhaust gases to drive a turbine which in turn propels a compressor via a shaft. The turbocharger is located between the exhaust manifold and exhaust pipe, being connected to the engine oil cycle for lubrication and cooling.

A boost pressure control valve on the turbine housing prevents a given boost pressure from being exceeded. In the event of a defective boost pressure control valve, an engine or an engine-transmission overload protection prevents breakdown of engine or transmission.



Layout of exhaust gas turbocharger with boost pressure control valve

1 Compressor housing
2 Compressor wheel
3 Center housing
4 Bearings
5 Shaft
6 Turbine housing
7 Turbine wheel
8 Boost pressure control valve
9 Connecting hose
a Compressor intake (fresh air)
b Compressor discharge (compressed air)
c Exhaust gases to bypass duct
d Exhaust gases to turbine wheel
e Exhaust gas discharge

Functional Description

The engine exhaust gases are routed via the exhaust manifold straight to the turbine housing (6) and the turbine wheel (7). The aerodynamic energy of the exhaust gases makes the turbine wheel (7) rotate, driving the compressor wheel (2) which is joined to the turbine wheel (7) via the shaft (5). Maximum speed amounts to about 100,000/min. The fresh air induced by the compressor wheel (2) is compressed and delivered to the engine.

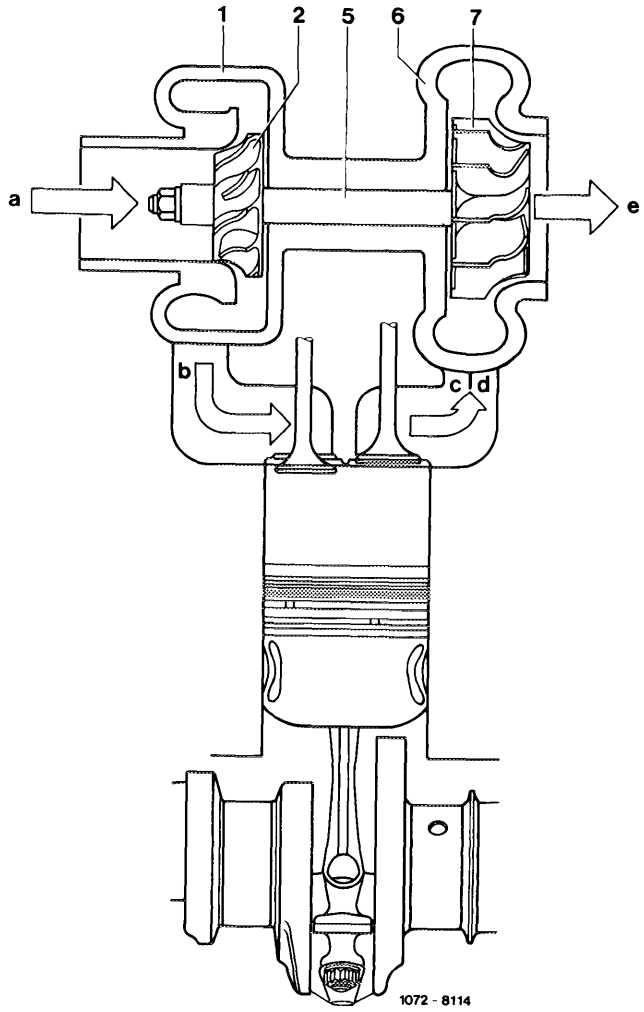
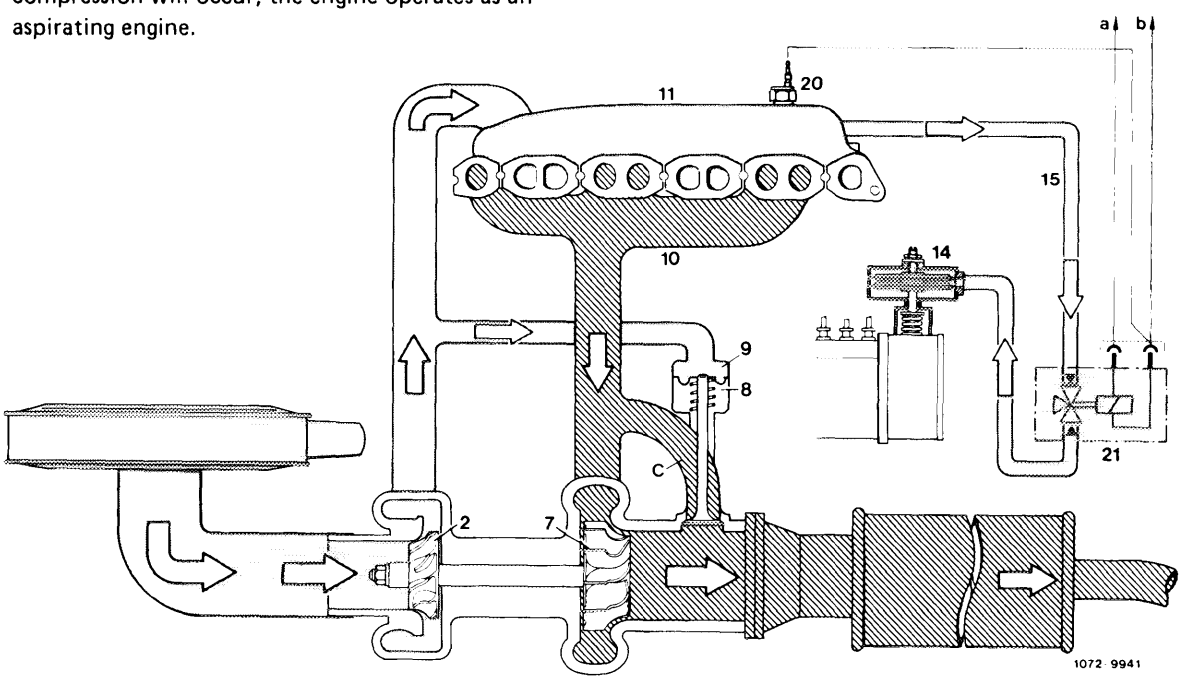


Diagram of fresh air and exhaust gas flow

1 Compressor housing
2 Compressor wheel
5 Shaft
6 Turbine housing
7 Turbine wheel
a Compressor intake (fresh air)
b Compressor discharge (compressed air)
c Exhaust gases from exhaust manifold
d Exhaust gases from exhaust manifold
e Exhaust gas discharge (to exhaust pipe)

Idle speed and lower partial load

At idle and lower partial load no worthwhile pre-compression will occur, the engine operates as an aspirating engine.



Compressor inlet (fresh air)

Exhaust gas outlet

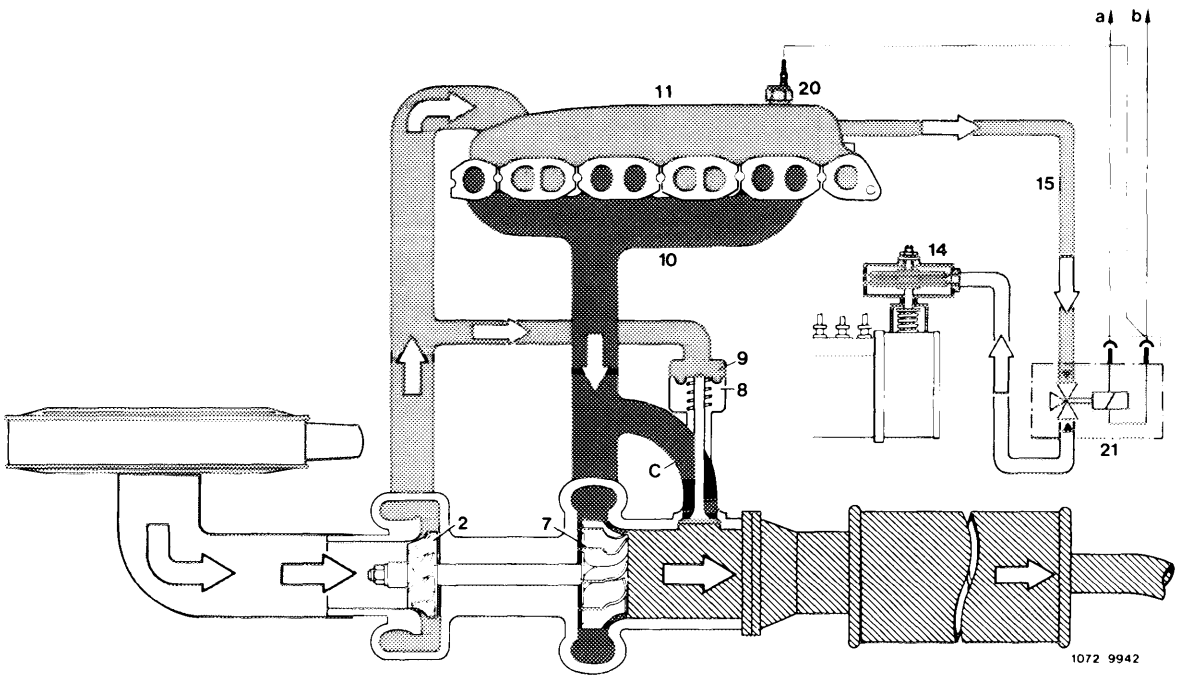
2 Compressor wheel
7 Turbine wheel
8 Boost pressure control valve
9 Connecting hose
10 Exhaust manifold
11 Boost air pipe
14 ALDA capsule
15 Pressure line
20 Pressure switch boost air pipe
21 Changeover valve

a Fuse terminal 15
b Switching unit overload protection
c Exhaust gas to bypass duct

Upper partial load and full load

With increasing load and speed, that is, with increasing exhaust gas flow, the turbine wheel (7) is accelerated and the compressor wheel (2) will then generate a boost pressure up to a given value. The compressed charge-air is fed to the indiviual cylinders by way of the boost air (charge-air) pipe. The boost pressure adds increased fuel quantities by way of the ALDA unit on injection pump.

During deceleration, boost pressure is available but fuel injection is stopped due to position of control rod.



Compressor inlet (fresh air)

Compressor outlet (pre-compressed air)

Exhaust gases to turbine wheel

Exhaust gas outlet

2 Compressor wheel
7 Turbine wheel
8 Boost pressure control valve
9 Connecting hose
10 Exhaust manifold
11 Boost air pipe
14 ALDA capsule
15 Pressure line
20 Pressure switch boost air pipe
21 Changeover valve overload protection

a Fuse terminal 15
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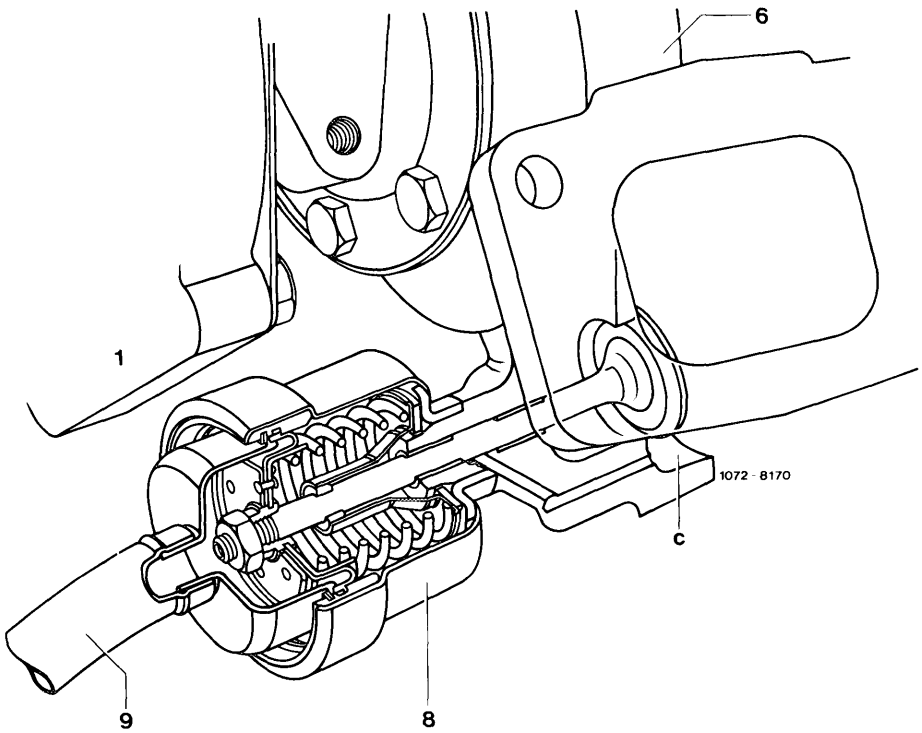
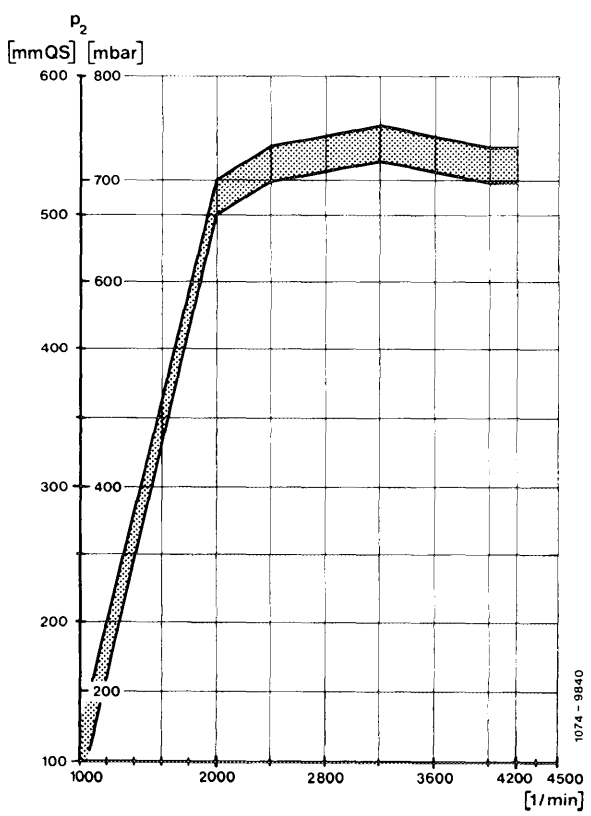
c Exhaust gas to bypass duct

Boost Pressure Control Valve

The turbine housing (6) bears a boost pressure control valve (8) designed to prevent the boost pressure from exceeding a given value. The boost pressure is tapped at the compressor housing (1) and passed to the boost pressure control valve (8) via the connecting hose (9). Once a given boost pressure is reached, the boost pressure control valve (8) begins to open the bypass duct (c). Some of the exhaust gases are now able to flow directly into exhaust pipe, keeping the boost pressure at a constant level.



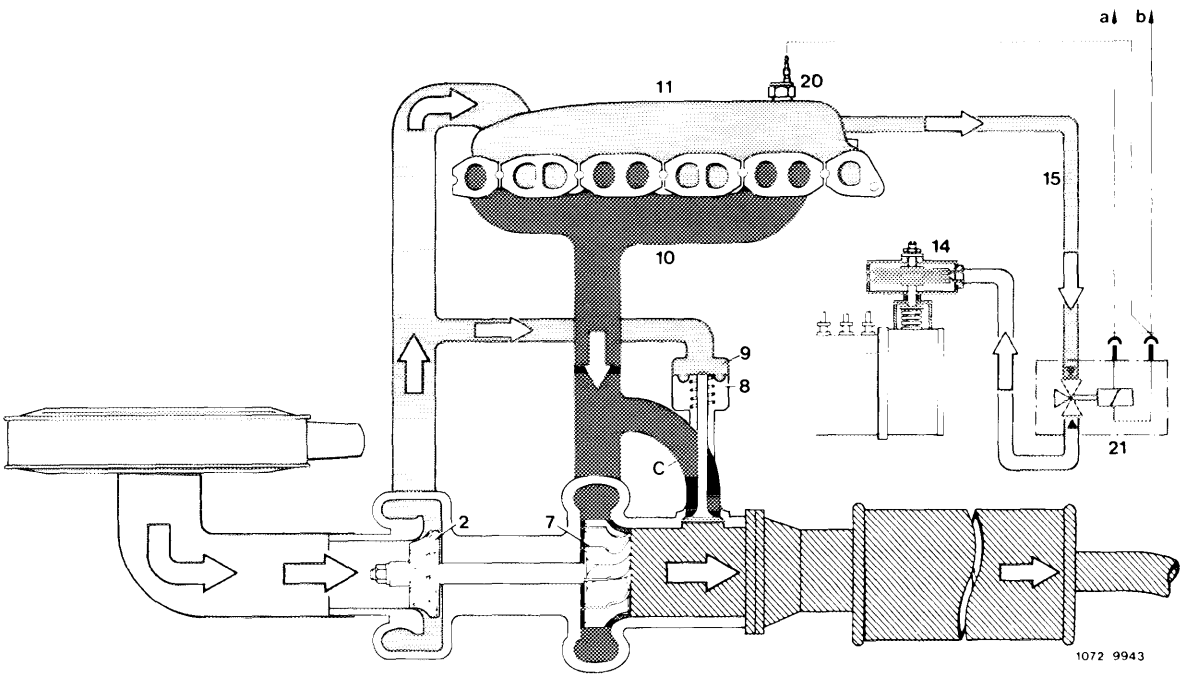
1 Compressor housing
6 Turbine housing
8 Boost pressure control valve
9 Connecting hose
c Bypass duct



Boost pressure diagram at full load.

Engine overload protection

For overload protection of mechanical engine components a pressure switch is mounted in boost air pipe. If the boost pressure increases above 1.1 ± 0.15 bar gauge pressure, the ALDA diaphragm capsule is positively vented via changeover valve and the fuel quantity is restricted to that of an aspirating engine.



Exhaust gases to turbine wheel

Compressor outlet (pre-compressed air)

Compressor inlet (fresh air)

Exhaust gas outlet

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7 Turbine wheel
8 Boost pressure control valve
9 Connecting hose
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11 Boost air pipe
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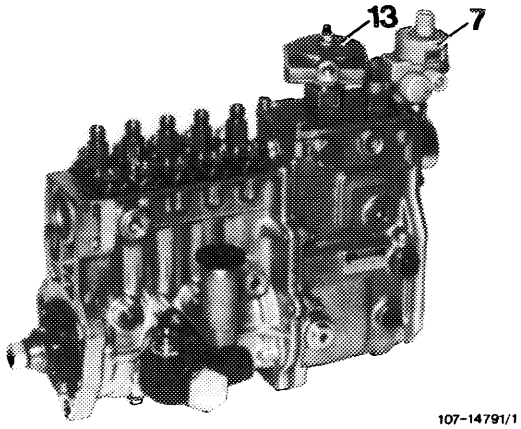
B. Absolute-measuring boost pressure stop (ALDA)

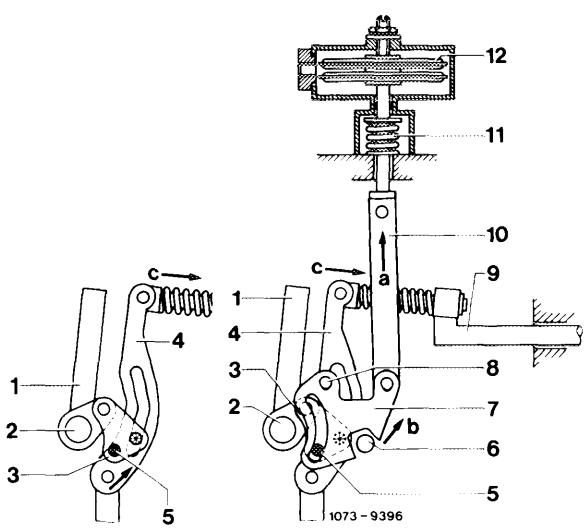
The MW injection pump is provided with an absolute-measuring boost pressure stop (ALDA) and a vacuum control valve (7) for the modulating pressure of the automatic transmission.

The ALDA equipment adapts the injected fuel quantity to the prevailing boost pressure and the respective altitude. As a result, the combustion chambers will always be provided with the correct injected fuel quantity of the respective cylinder charge to provide the best possible efficiency during the various operating modes. The ALDA capsule (13) is connected to the boost pressure pipe by means of a pressure line.



Enrichment by means of boost pressure

The ALDA unit comprises 2 aneroid capsules (12), a compression spring (11), a connecting rod (10) and the slotted lever (7). Connecting rod (10) is connected to control rod (9) by way of the slotted lever (7), lever (3) and control lever (4). When the boost pressure increases, the aneroid capsules (12) are compressed and, assisted by compression spring (11), will move the connecting rod (10) in direction "a". This in turn will move the slotted lever (7) within its adjusting range in direction "b" and will push the control rod (9) in direction "c" via coupling lever (3) and control lever (4). The injected fuel quantity is increased.



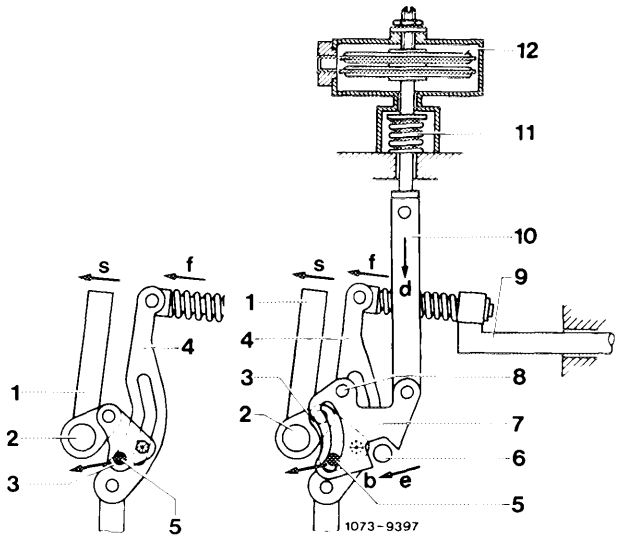
ALDA with control linkage

1	Adjusting lever	7	Slotted lever
2	Adjusting lever shaft	8	Pivot (slotted lever)
3	Coupling lever	9	Control rod
4	Control lever	10	Connecting rod
5	Bolt	11	Compression spring
6	Stop	12	Aneroid capsules

Correction at high altitudes

During operation at high altitudes the aneroid capsules (12) begin to expand due to the increasing atmospheric pressure and force the connecting rod (10) in direction "d" against the compression spring (11).

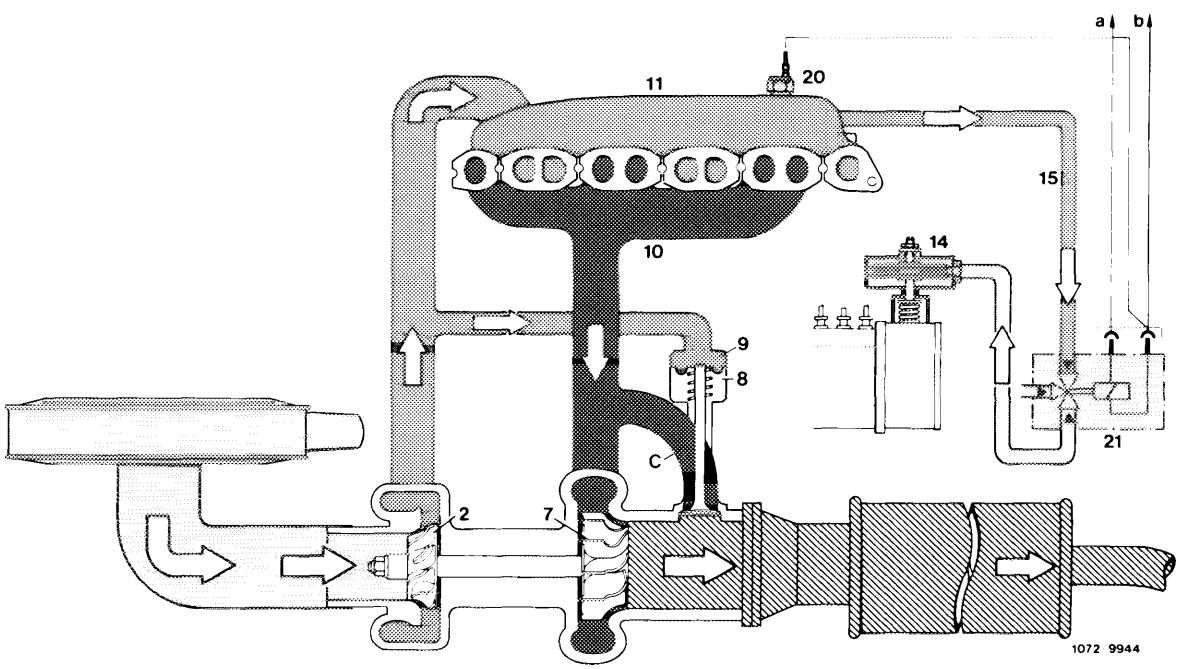
The slotted lever (7) then moves in direction "e" and hence pushes the control rod (9) in direction "f" via the coupling lever (3) and the control lever (4). The amount of fuel injected begins to drop.



Transmission overload protection

For overload protection of automatic transmission in extreme cases, e.g., moving-off uphill with a trailer, two values are decisive in influencing pressure conditions in ALDA aneroid capsule.

Below a modulating pressure of 0.3 bar gauge pressure and at engine speeds > 2000/min, the changeover valve will positively vent the ALDA aneroid capsule and will thereby limit the fuel quantity.



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Compressor outlet (pre-compressed air)

Exhaust gases to turbine wheel

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