SEAT

Post-Venta

# Gasoline engines
# 1.6, 1.8, 2 L and 1.8 L 16 v



## No. 4 Autodidactic exercise book

FORMACION ASISTENCIAL

# Contents



You will find detailed instructions for checking and repairing in the Repair Manual.

# Engines - Introduction

These engines feature an excellent performance because of their elasticity as a result of the high torque developed, which assures top performance with reduced fuel consupmtion and a considerable decrease in the emission of pollutants.
The new engine range consists of the
following seven engines:

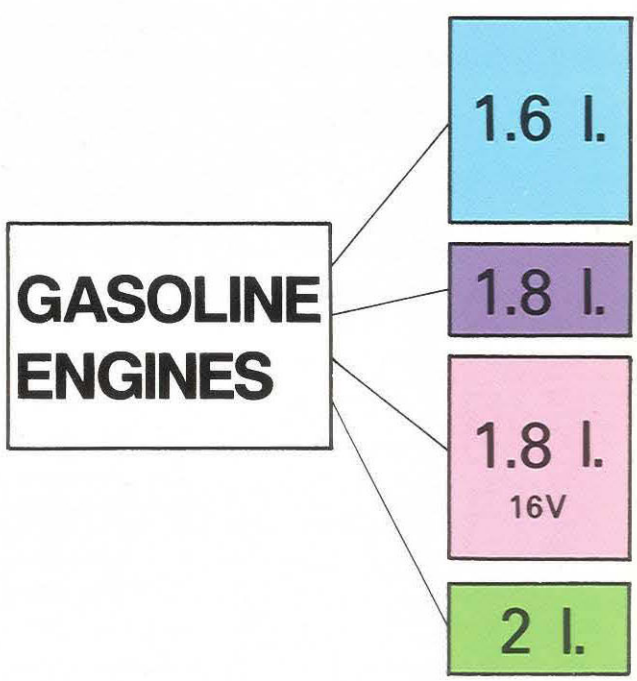


— 1.6 L engine with double body carburettor and without purification of the exhaust gases. It can also run on unleaded gasoline.

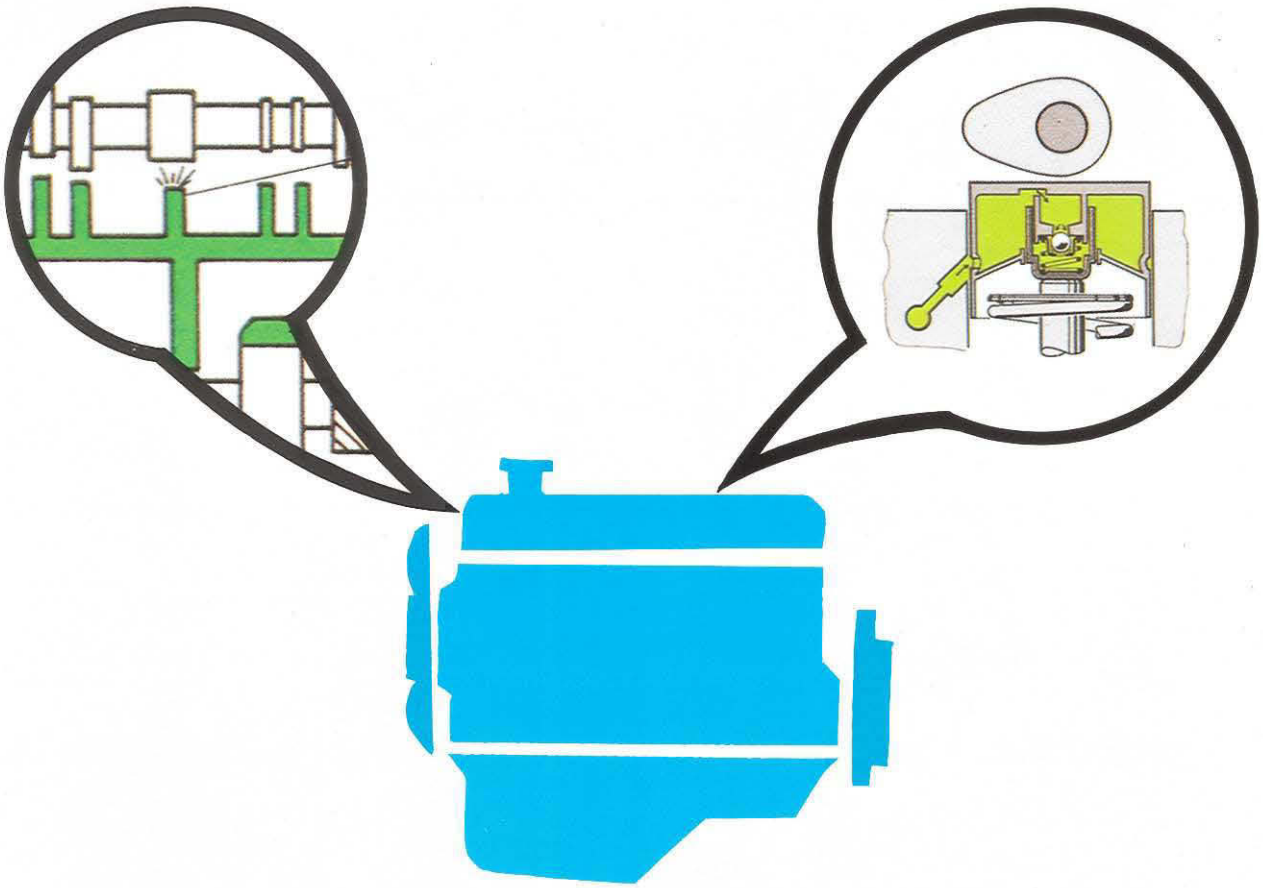
— 1.6 and 1.8 L injection engines with Monojetronic regulator.

— 1.6 L-16 valve engines with mechanical K-Jetronic injection and with adjusted KE-Jetronic injection.

— 2 l injection engines with Digifant



# Engines - Introduction



Carburettor 2E3

Mono-Jetronic — Catalizador

Mono-Jetronic — Catalizador

K-Jetronic

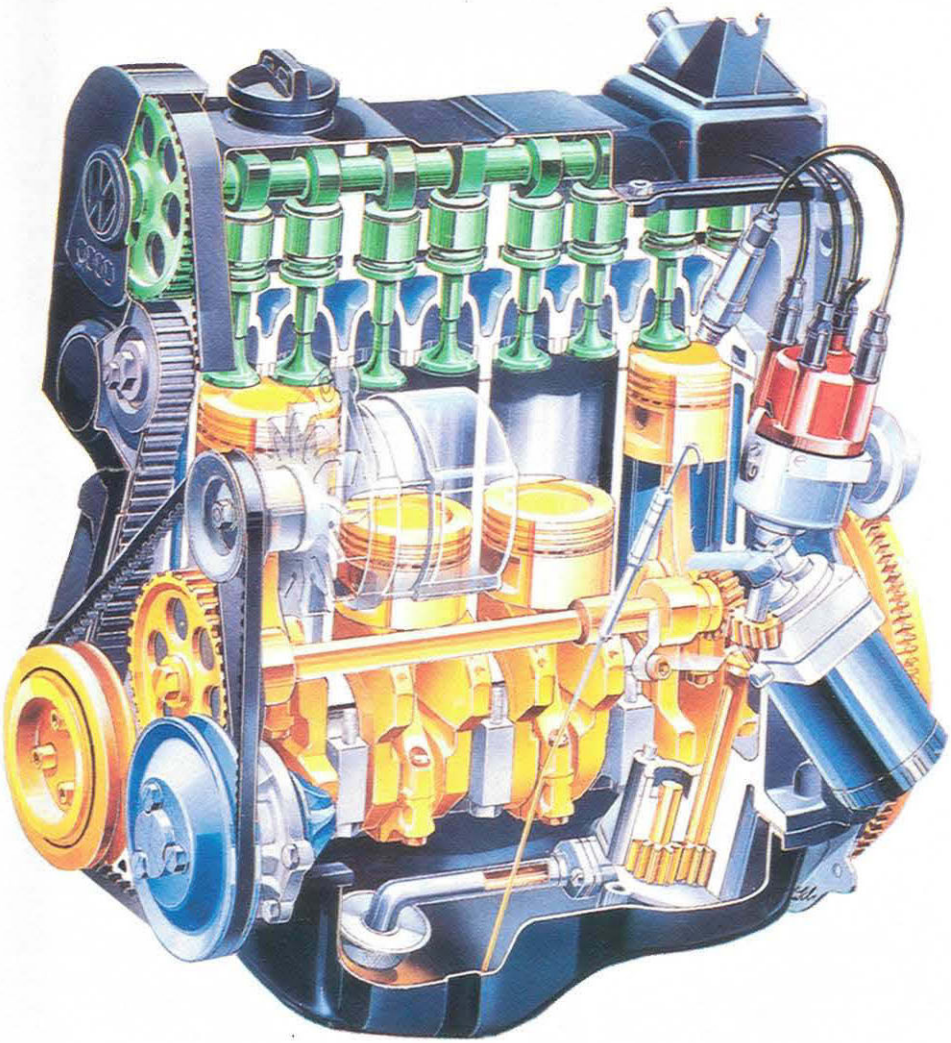
KE-Jetronic — Catalizador

Digifant — Catalizador

All SEAT engines included in the new generation are fitted with hydraulic tappets and with dynamic control for the oil pressure.

# 1.6, 1.8 and 2.0 L engines



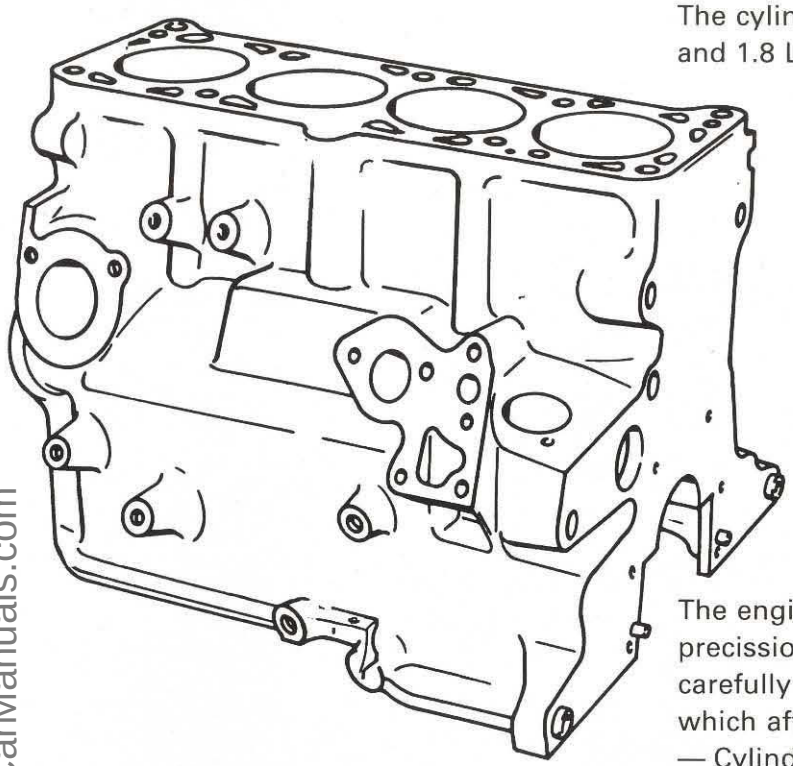




| Engine | Carburettor 1.6 L | Injection 1.6 L | Injection 1.8 L | Injection 2.0 L |
|---|---|---|---|---|
| ENGINE INITIALS | EZ | 1F | RP | 2E |
| Swept volume, $cm^3$ | 1.595 | 1.595 | 1.781 | 1.984 |
| Diameter/stroke, mm | 81,0/77,4 | 81,0/77,4 | 81,0/86,4 | 82,5/92,8 |
| Compression ratio | 9,0 | 9,0 | 9,0 | 10,4 |
| Mixture preparation | 2E3 carburettor | Mono-Jetronic | Mono-Jetronic | Digifant |
| Ignition system | Transistorised | Transistorised | Transistorised | Digifant |
| Catalyst | unregulated | — | — | — |
| DIN brake horsepower, kW (HP)/r.p.m. | 55(75)/5.200 | 53(72)/5.200 | 66(90)/5.250 | 85(115)/5.400 |
| Torque, Nm/r.p.m. | 125/2.600 | 125/2.750 | 142/3.000 | 166/3.200 |

# Cylinder block and crankshaft

The cylinder block is made of gray cast iron with dry fixed sleeves. Its unique design includes the water pump coupling and the oil drain circuit from the cylinder head to the oil sump.
The cylinder block is the same for the 1.6 and 1.8 L engines.

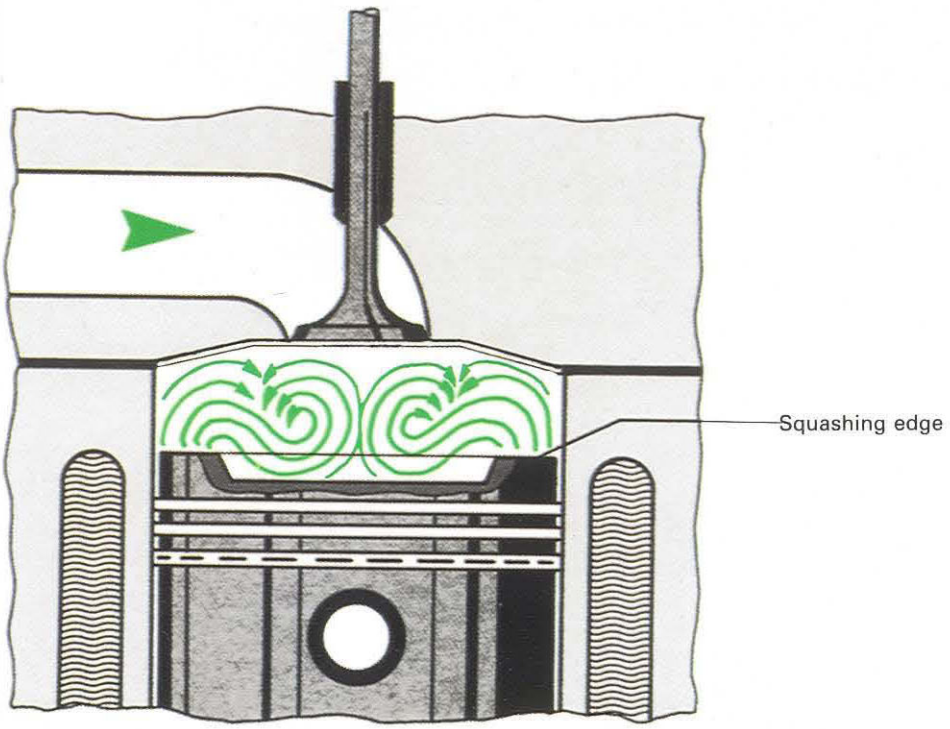


The engines are built with very high precission and it becomes mandatory to carefully control the compression tolerances which affect the following parts:

— Cylinder block (cylinder block height).
— Crankshaft (crankshaft radius).
— Connecting rods (length).
— Pistons (volume and height of the chamber).
— Cylinder head (housing volume).

The crankshaft is made of nodular iron with tempered and rolled necks, and it has five bearing points and two counterweights per pin.
With this configuration and balancing the failures due to fatigue as well as the vibrations are minimized.

# Pistons and valves

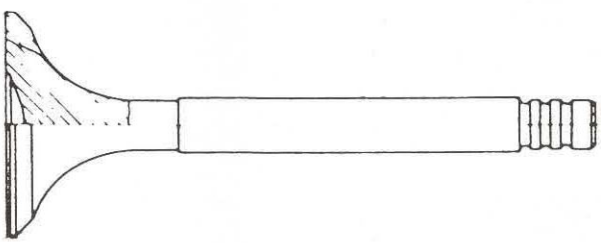



The HCS principle (High Compression and Squash) is based on the "Heron" piston. The piston includes the combustion chamber and the cylinder head is flat. With this kind of construction it is possible to achieve a high compression ratio.

During the compression process, the mixture is carried like chips through the squashing edge to the piston hollow. Inside the piston hollow the mixture is subject toi a turbulent motion.

This turbulent motion is enhanced because of the high temperature of the piston head.

The squashing edge is the upper annular surface of the piston.
The accuracy of the mixture and the ignition sparks precisely controlled are also necessary conditions for a full fuel combustion.



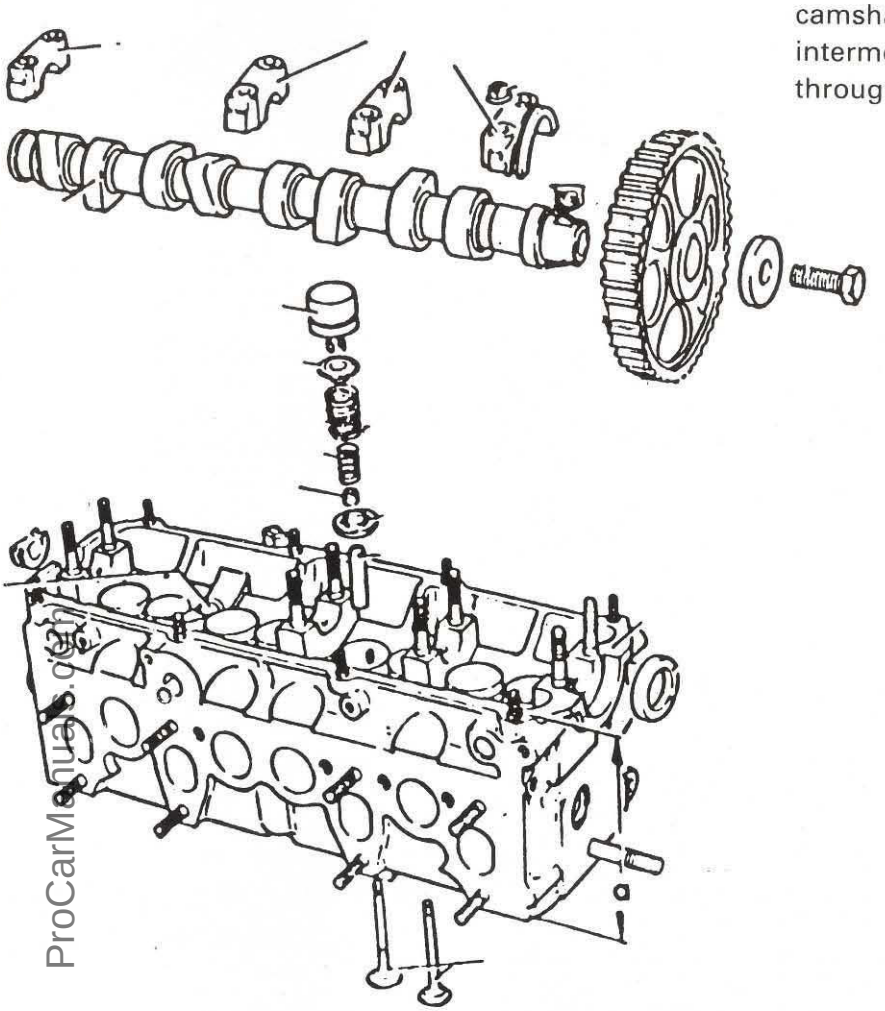
NOTE
The exhaust valves must not be grinded on a leather; only grinding with emery paste is allowed.

The valves are positioned longitudinally and parallel to the cylinder axis. As the valves are shorter, the cooling is improved and the inertia is reduced.

The valve seats are made of sintered material with high specific gravity incorporating lead* and with Stellite applied on the sealing area. The Stellite considerably improves the air tightness and the valve life.

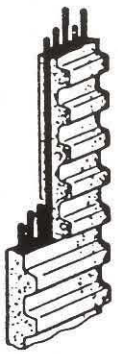
* It allows using unleaded gasoline.

# Cylinder head



**Toothed belt drive.** The crankshaft drives the camshaft and the intermediate shaft through a toothed belt.

Steel reinforcement



Warning!:

After replacing the toothed belt the timing must be adjusted.



Construction details:

| |
|---|
| Toothed belt drive |
| Crankshaft → Camshaft → Intermediate shaft |

Toothed belt drive benefits:

| | |
|---|---|
| Low noise. | Low stretching: and thus maintenance free. Because of the steel reinforcement, it is virtually impossible that the toothed belt becomes stretched. |
| Long life, when the contact with oil or grease is avoided. | |

# Hydraulic cup tappets

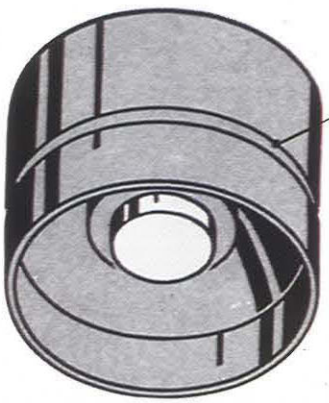
All the engines are fitted with hydraulic cup tappets. This results in a noise reduction and simplified maintenance.

— Lesser engine wear.

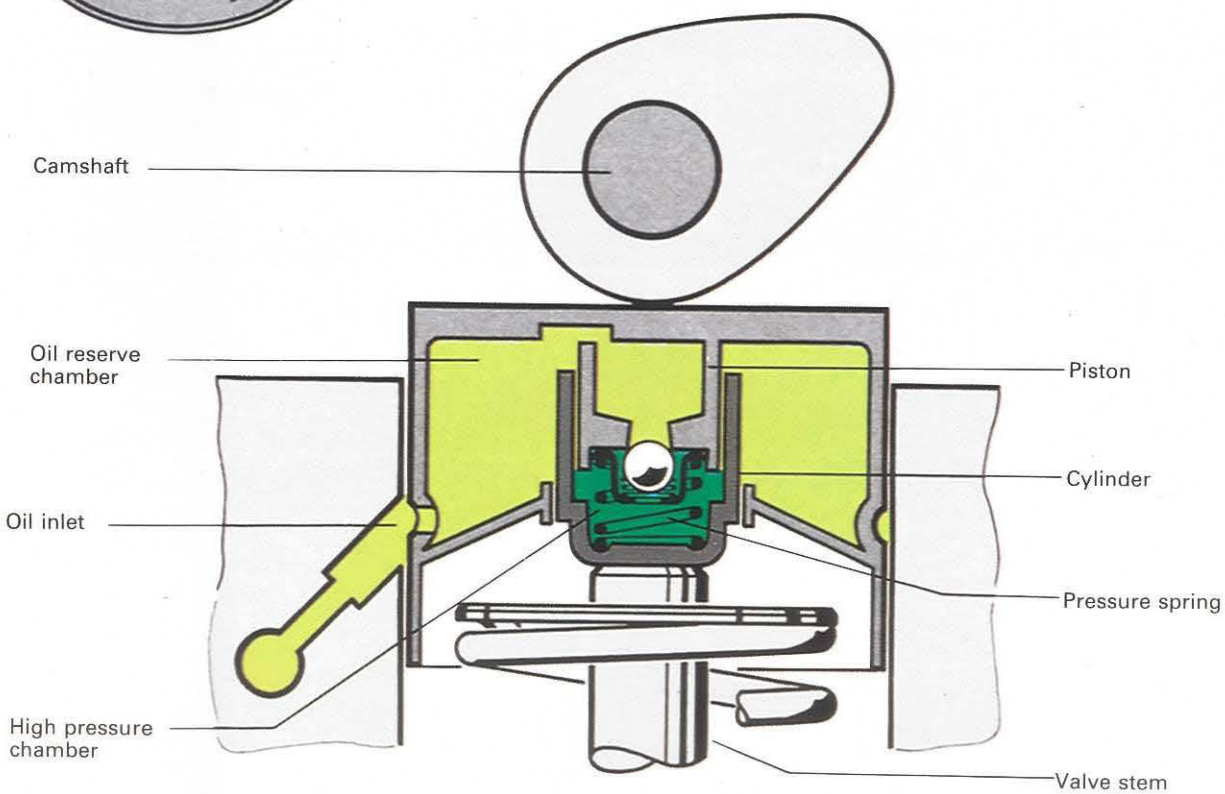
— The checking and adjustment of the valve play is eliminated.

— The valve distribution times are kept more accurattely longer.

— The exhaust gases are cleaner.



The external mark on the hydraulic cup tappet is an oil filling groove along the whole perimeter.



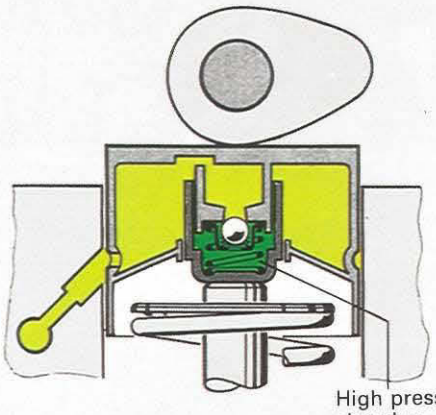

The hydraulic cup tappet consists basically of two moving parts:

— The cup tappet with the piston and the cylinder.

The two parts are kept apart from each other by the spring until the play between the camshaft and the valve stem disappears. The non return valve is used to fill and keep the high pressure chamber oil tight.

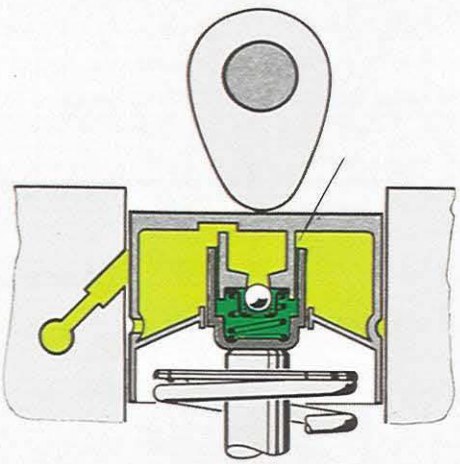
## The operation is as follows:
## Valve run start

When the cam gets in contact with the cup tappet, the non return valve closes and pressure builds up in the high pressure chamber.
The volume of the oil inside the high pressure chamber cannot be reduced.
The cup tappet acts as a rigid body.




## Valve run

The cam applies a force on the tappet, increasing thuus the pressure in the high pressure chamber.
Some oil comes out of the high pressure chamber through a leak groove. This allows the tappet to be compressed a maximum of 1 mm along the valve run.
This is necessary from the manufacturing point of view, so that the tappet may adapt itself to a diminishing dimension between the camshaft and the valve.



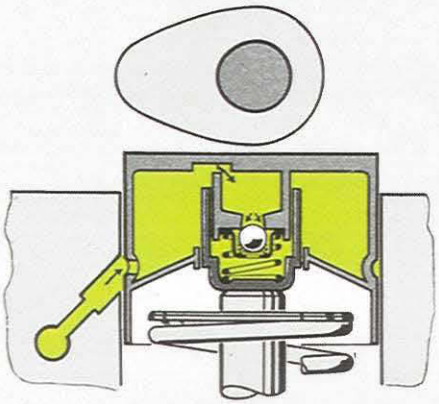
## Valve play balancing

After the valve is closed, the valve play balancing starts.

The cam has stopped pressing on the tappet and the pressure inside the high pressure chamber is lowered.

The pressure spring detaches the cylinder from the tappet until there is no play between the camshaft and the cup tappet. The non return valve opens so that the oil can flow from the reserve chamber to the high pressure chamber.

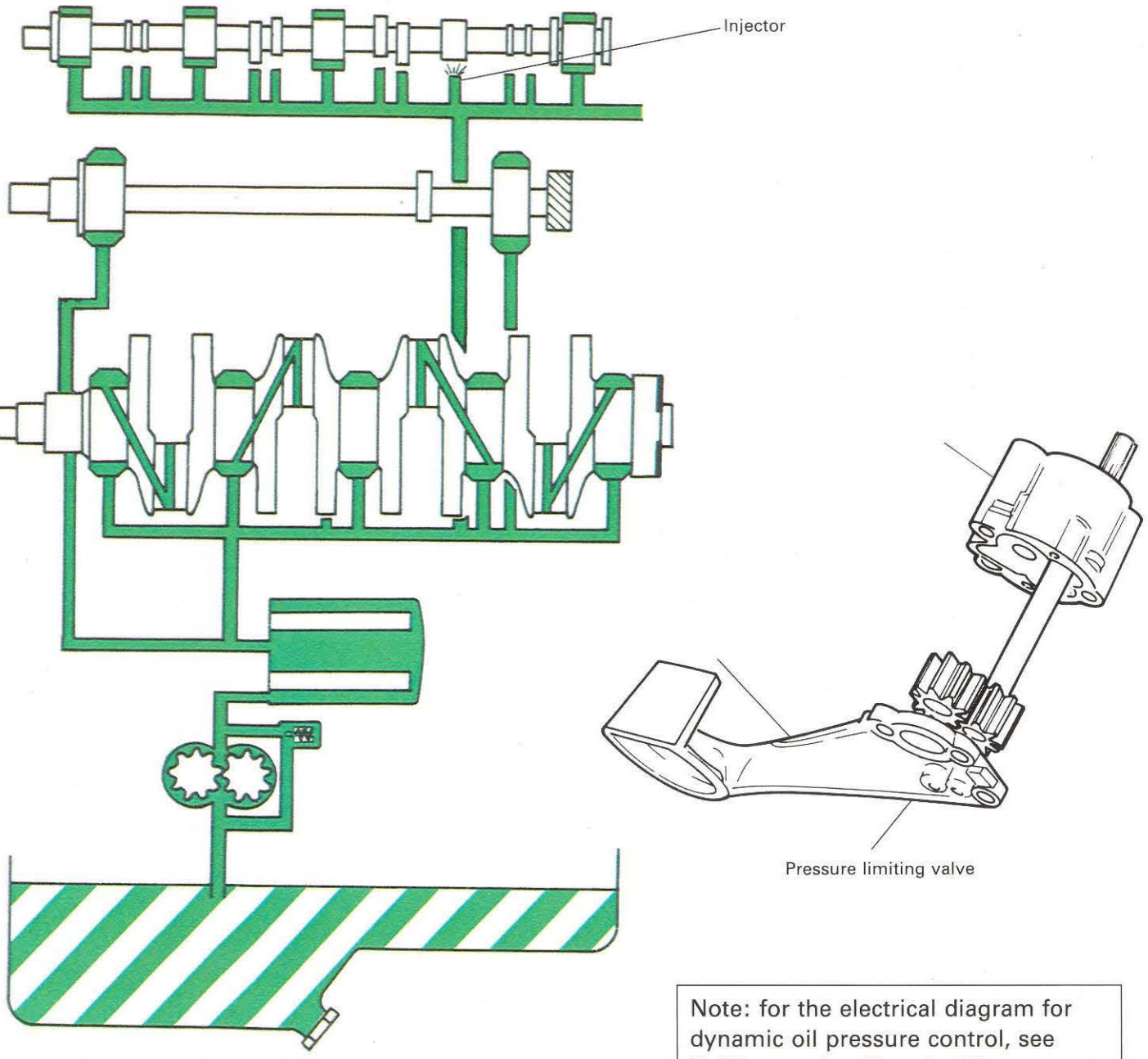
The oil flow depends on the valve play. If the valve play is reduced, for excample when the engine reaches the operating temperature, this will be reflected on the valve run.



**Please note:**

It is a normal condition to hear noise coming from the valve operation when the engine is started. The reason is that when the engine is at rest, the oil comes out of the tappet. Depending on the cam position, this may happen to a greater or leser extent. When the engine is started again, the high pressure chamber is refilled with oil and the noise disappears. This process may last until the engine reaches its operating temperature.

# Lubrication





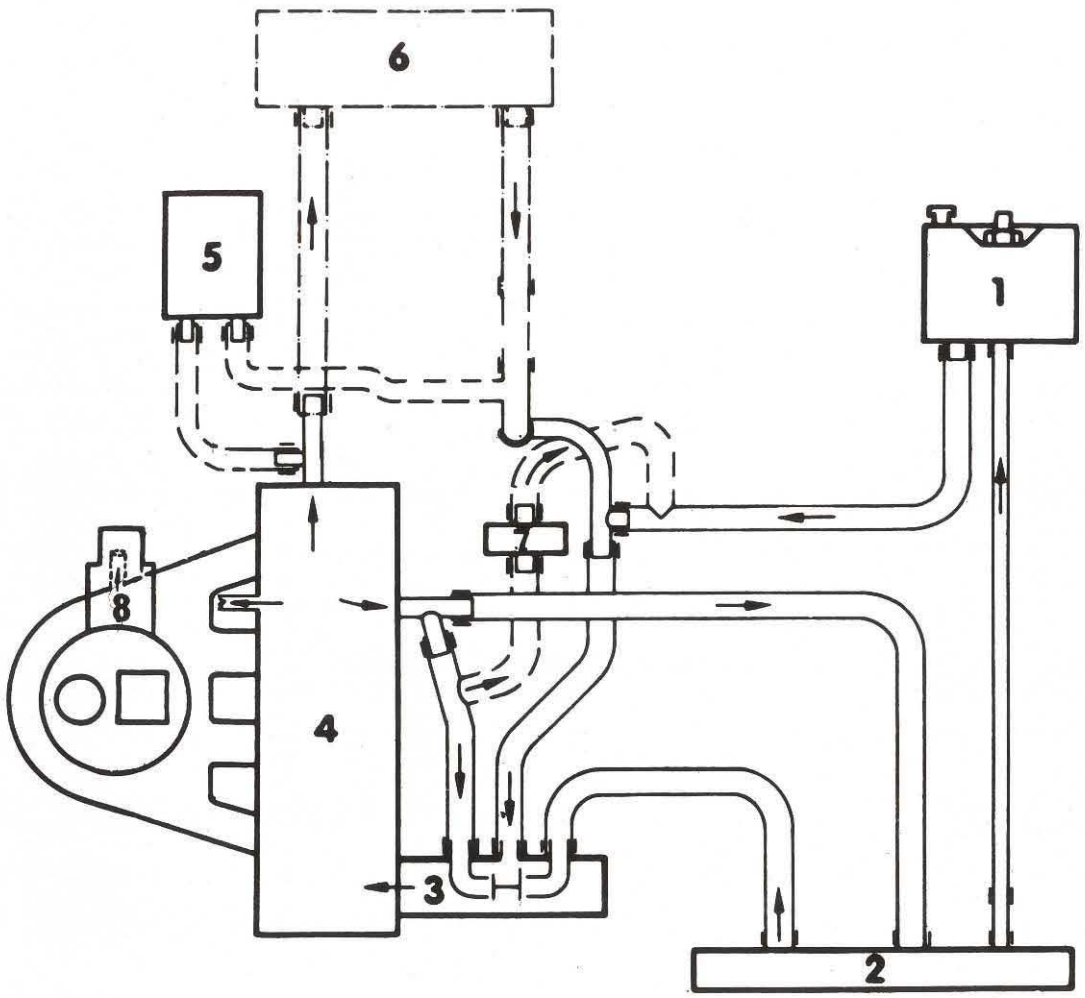

Note: for the electrical diagram for dynamic oil pressure control, see Self-Instruction Electrical System

## The operation is as follows:

The gear pump, fitted in the cylinder block, is driven through the intermediate shaft and its function is to generate the required flow and pressure for the system. The pump body has a built-in relief valve to adjust the system pressure.

The filter has a built-in safety valve, which in case the filter becomes clogged with impurities, overides the operation of the filter by establishing a by-pass, thus assuring that there is always oil pressure in the system.

The system is pressurized and with forced feed circulation by means of a pump with built-in thermostat.



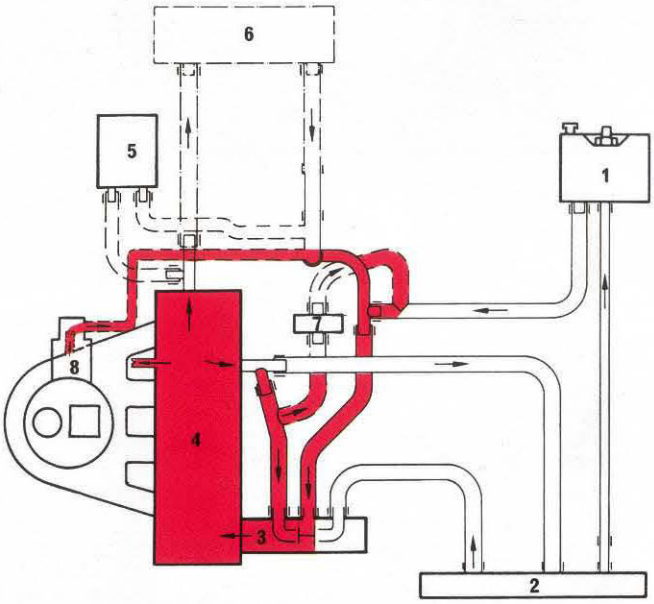

1. Expansion bowl
2. Radiator (1)
3. Water pump with thermostat (2)
4. Cylinder head and Engine Block (7)
5. Automatic gearbox oil radiator
6. Heating (5)
7. Oil filter (6)
8. Carburettor (4).(10)

The water pump (2) forces the cooling liquid into the cylinder block and from this the liquid is directed through several outlets to the cylinder head (7), intake manifold, carburettor (4), heating radiator (5) and oil filter (6), returning from the cylinder head to the main radiator (1) in order to dissipate the absorbed heat. (3) is the liquid inlet to the automatic starter capsule and (10) is the thermoswitch for the automatic starter.

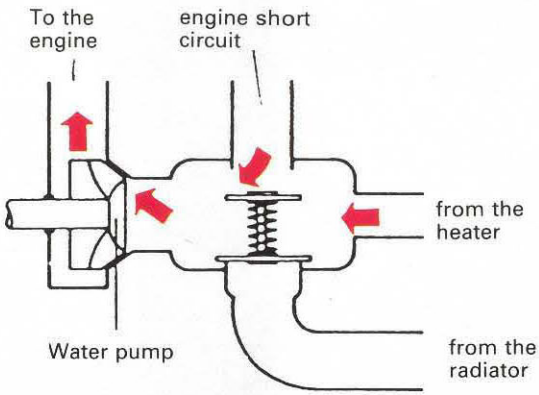
# Cooling system

**Cold engine: Short circuit.**

**The water heats up quicly.**
**The operating temperature is quicly reached.**




**Thermostat closed:**




**What are the benefits of this?**

**The risk of a reduction in the viscosity of the oil is reduced.**

**Corrosion inside the engine is prevented.**

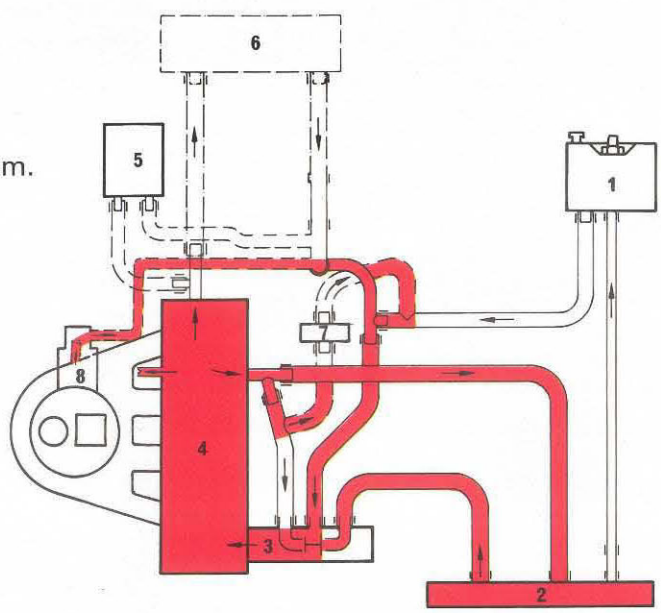
**Piston rings and cylinder wear is reduced.**

**The heating starts operating quickly.**

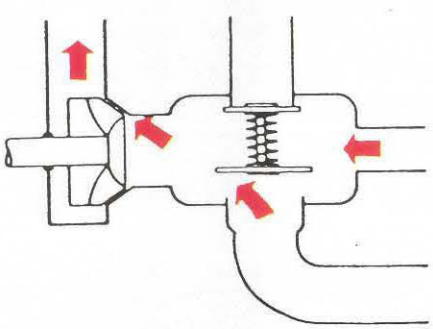
**Engine hot: main circuit.**

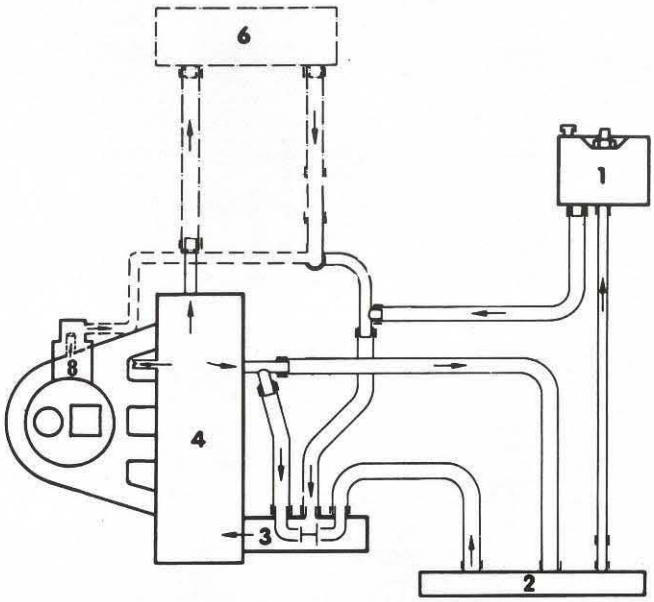
The operating temperature has been reached.

The radiator is incorporated into the cooling system.

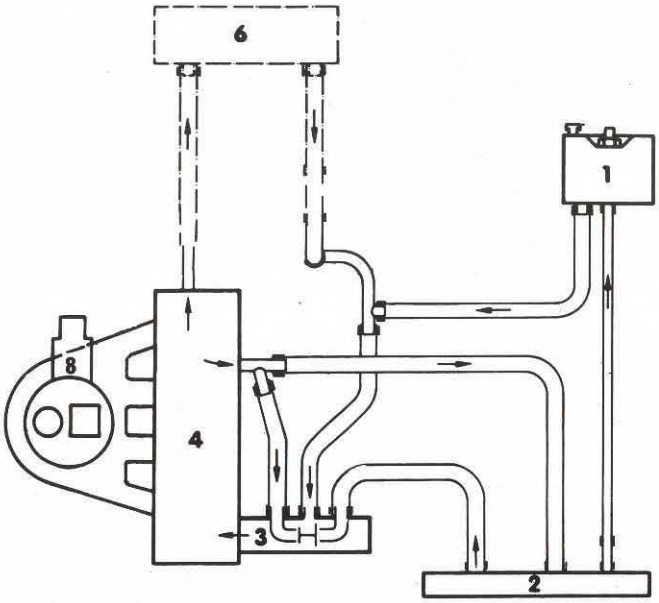



**Thermostat open:**

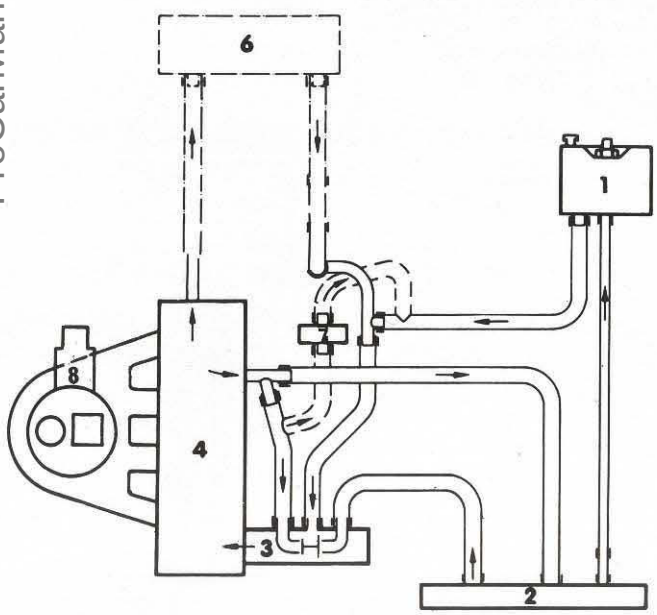




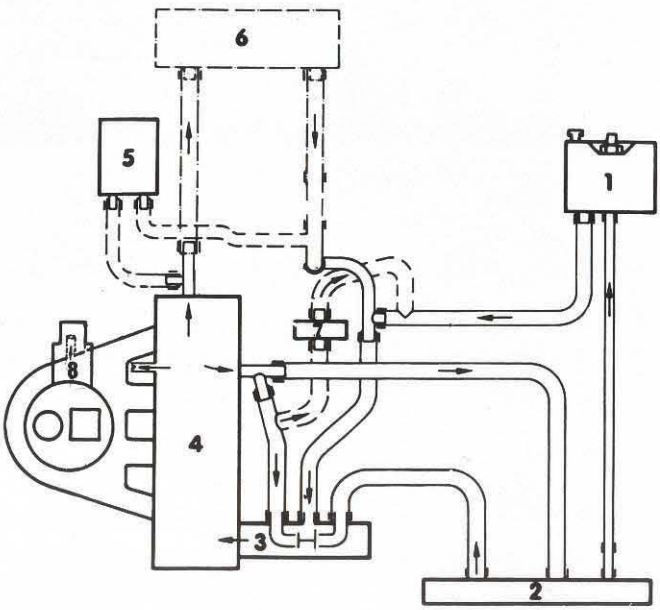

1.6 l with carburattor




1.6 l injection




1.8 l injection

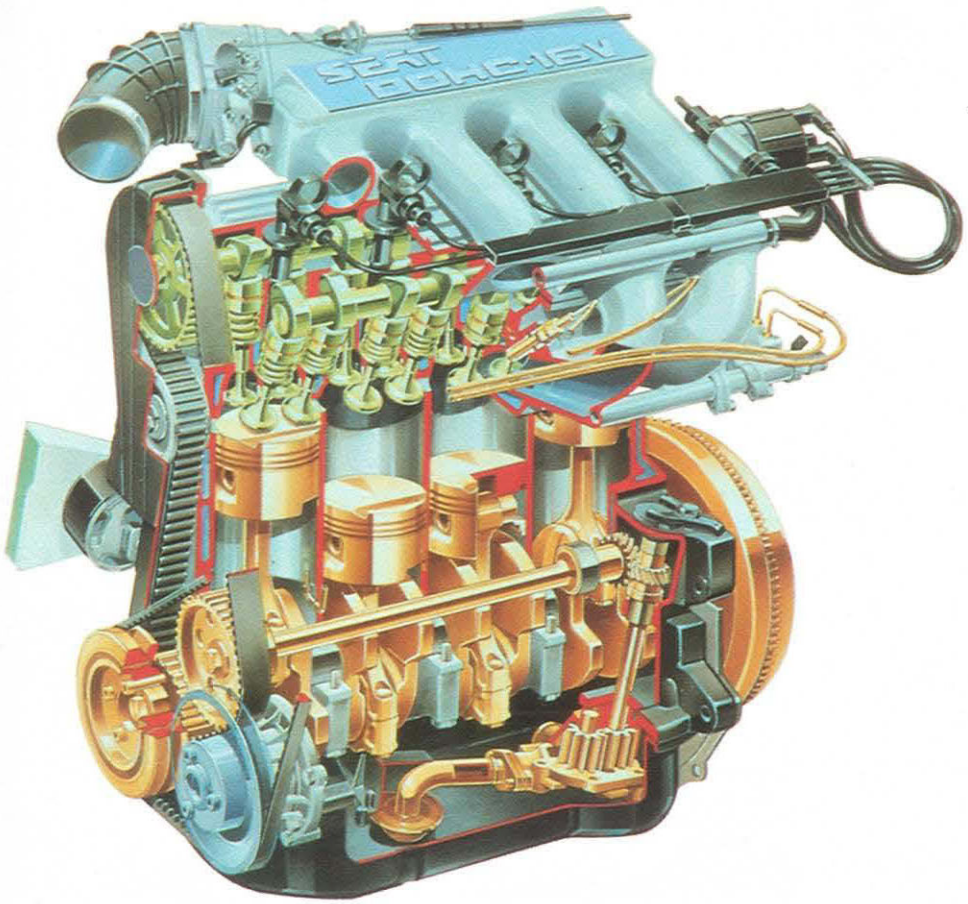



2 l injection Automatic GB

Note: for the electrical diagram for engine temperature control and coolant level, see Self-Instruction Electrical System

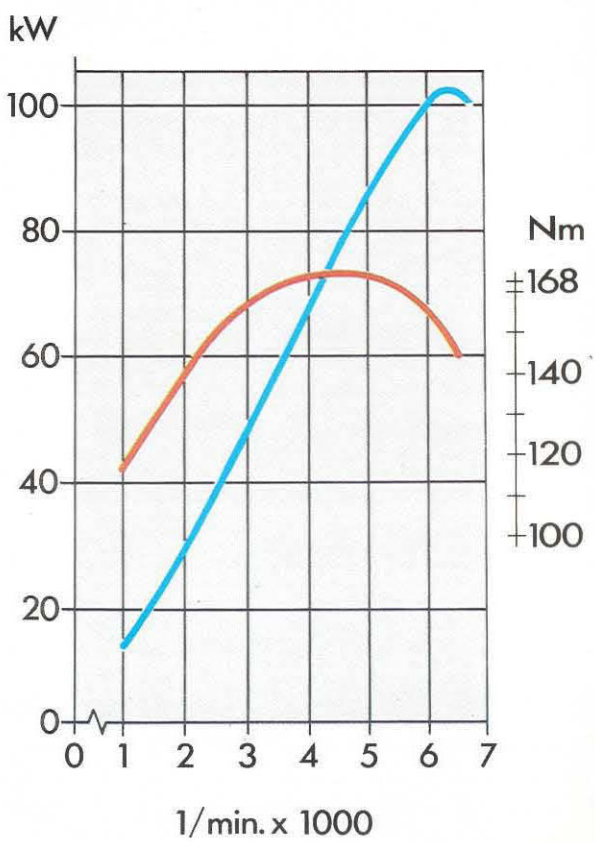
# 1.8 L-16 Valve engine







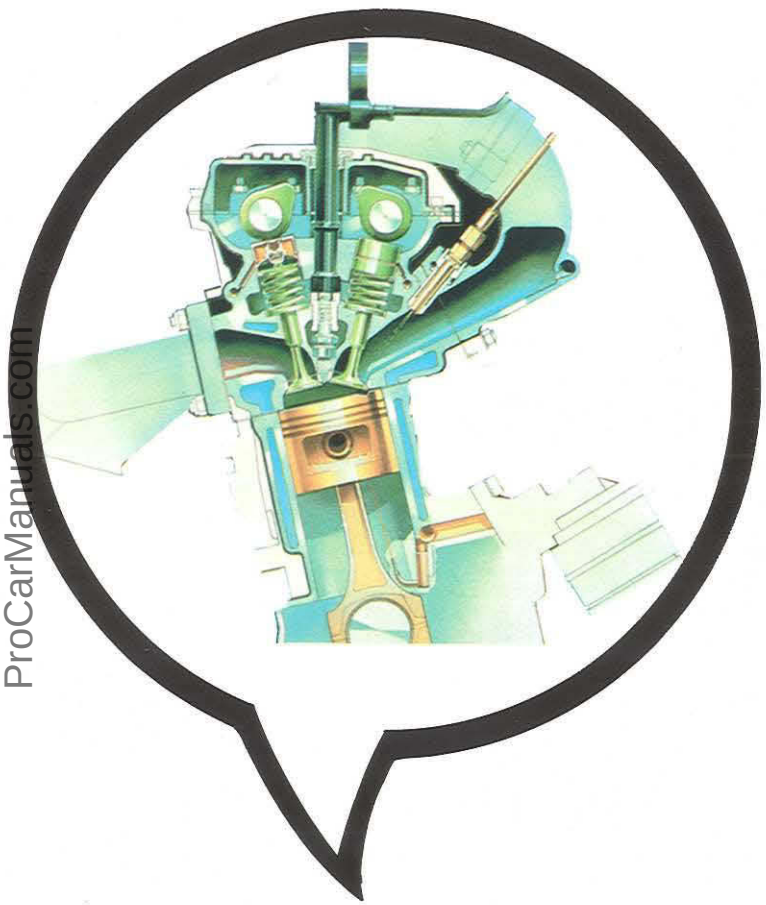

| Engine | 1.8 L, 16 valve, injection engine |
|---|---|
| ENGINE INITIALS | KR |
| Swept volume, $cm^3$ | 1.781 |
| Diameter/stroke, mm | 81,0/86,4 |
| Compression ratio | 10,0 |
| Mixture preparation | K-Jetronic |
| Ignition system | Characteristic field |
| Catalyst | — |
| DIN brake horsepower, kW (HP)/r.p.m. | 102 (139)/6.300 |
| Torque, Nm/r.p.m. | 163/4.600 |

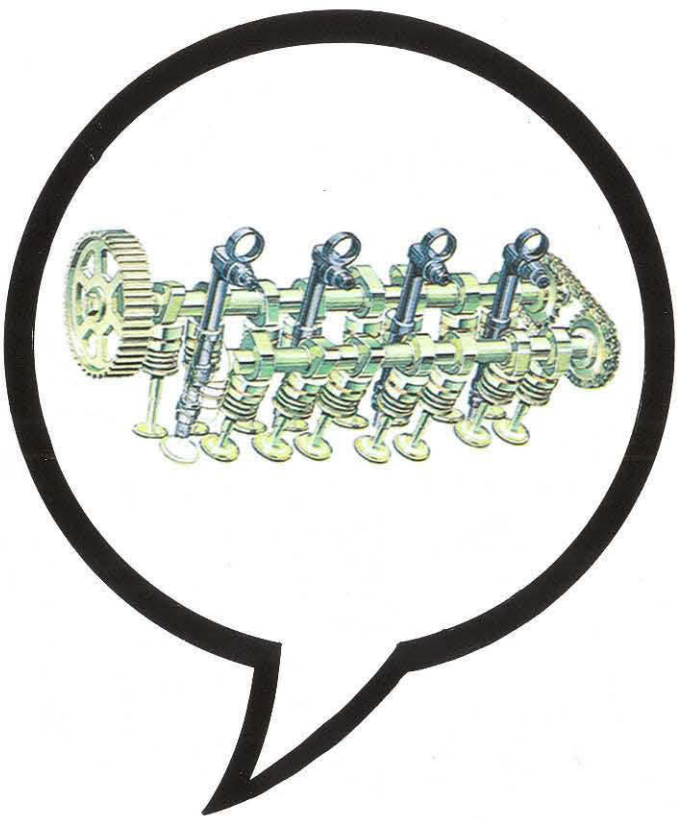


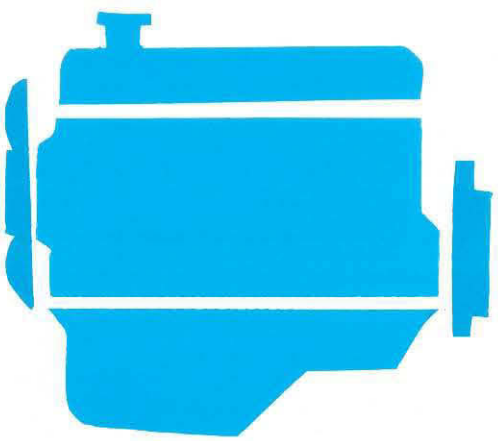
# Engine

The manufacturing improvements in the 16 valve engine have been introduced basically in the cylinder head and in the intake conduits.

The increase in brake horsepower is the result of an improvement in the filling of the cylinders.



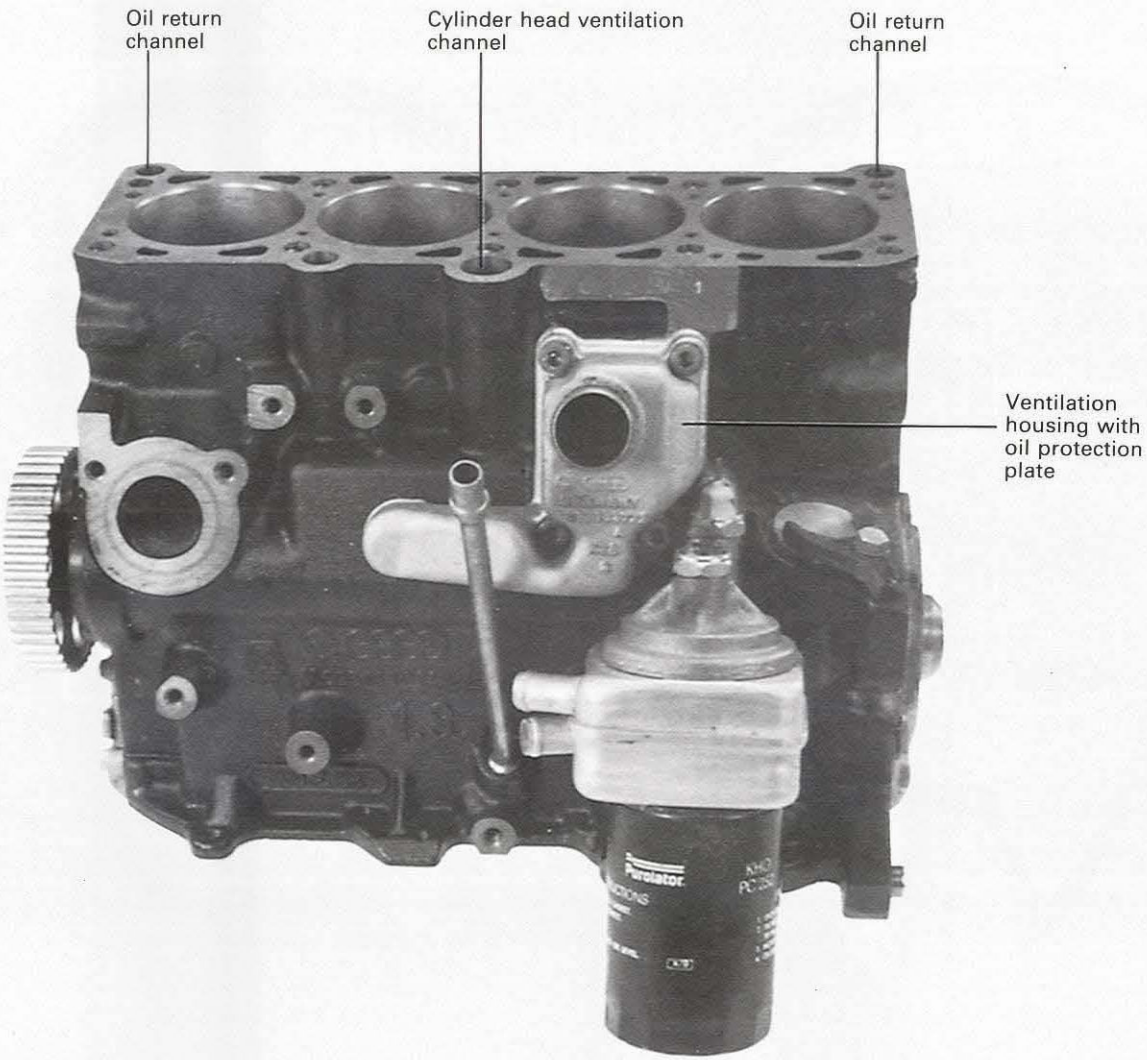




# Cylinder block

The oil return channels have been extended downwards inside the cylinder block in order to improve the oil return.

Through an oil channel, oil is supplied to the oil injectors to cool the cylinder.



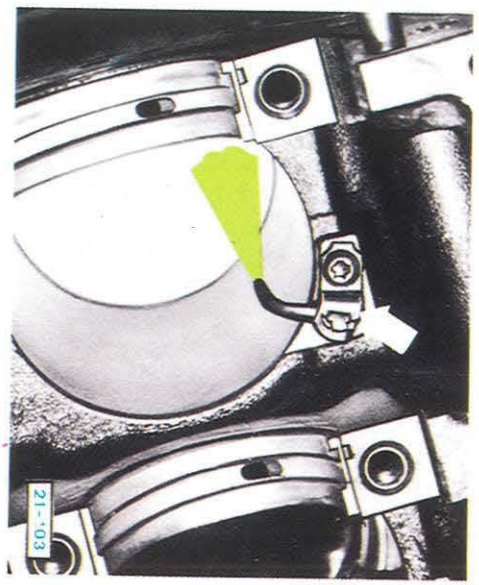

## Ventilation housing

In this engine, the ventilation of the cylinder block is achieved through a special ventilation housing, screwed to the cylinder block with an oil protection plate. The channel for the ventilation of the cylinder head has also been increased.

The gas flow reaches first the cylinder block and is carried from the ventilation housing to the air filter housing through a flexible pipe.

# Pistons

The oil injectors shown in the picture are intended for the cooling of the pistons. The valves open when the oil pressure is about 3.5 bar. When a valve opens, an oil jet from below reaches the piston bottom, eliminating in this way part of the heat. When making repairs, the oil flow through the injectors must be checked.



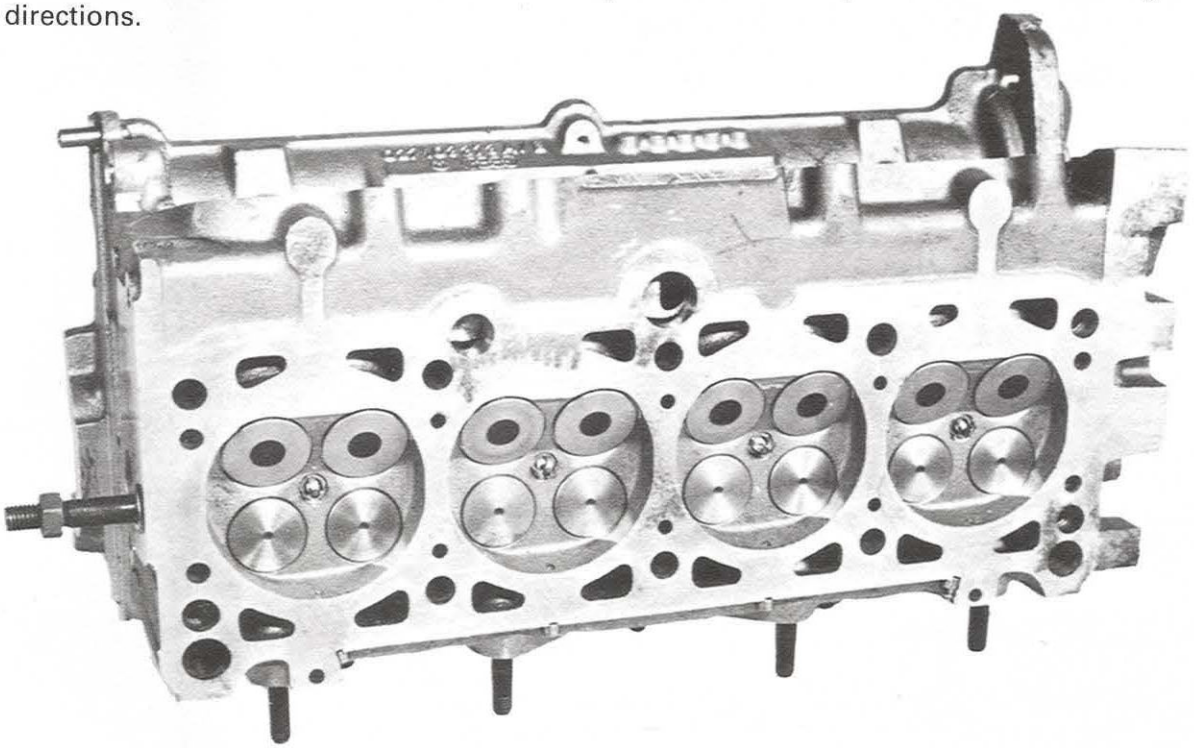


## Pistons and piston rods

As the four valves together with the combustion chamber have been moved to the cylinder head, this engine is fitted with flat pistons. However, the piston bottom has a hollow to assure that the intake valves will have sufficient play. Due to the valve arrangement, there is a squash area next to the intake valves. At the end of the compression stroke, the fresh gases squashed inside the combustion chamber, are subject to a high turbulence and are burnt in good conditions, the combustion being initiated through the spark plug located in the centre.

# Cylinder head

The cylinder head design is new and is made of a cast aluminum alloy. Each combustion chamber is fitted with two exhaust valves vertically mounted and two tilted intake valves. The spark plugs are located in the centre. In this way the combustion path has the same length in all directions.



## Intake valves

The intake valve diameter is 32 mm and allow a good filling of the cylinder, being tilted with regard to the cylinder head. The intake valves carry a shielded ring in the disc.

## Exhaust valves

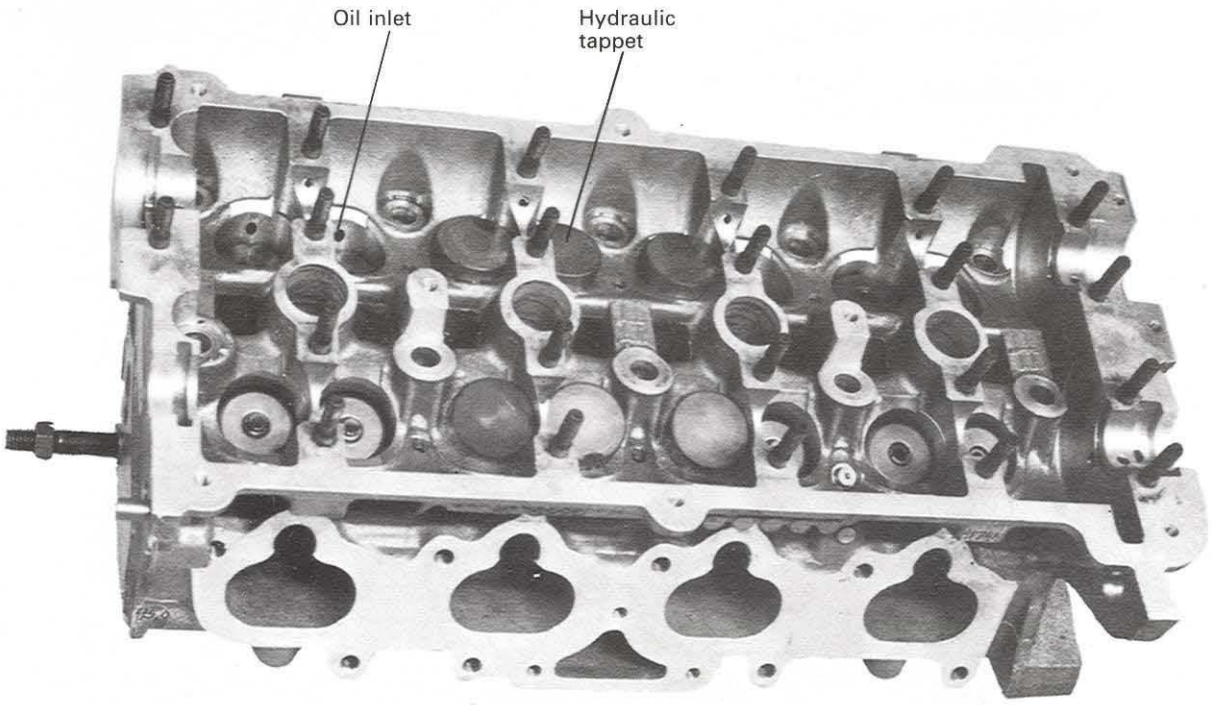
The exhaust valve diameter is 28 mm. The valves are made of heat resisting material. The valve stems are hollow and filled with sodium to improve the heat dissipation.

When in service, the sodium fill is vigorously shaken; i.e. in the valve disc area the sodium is heated and thereafter it passes to the valve stem.
From the valve stem the heat is transmitted to the cylinder head through the valve guide. The valve stems have the keyways for the valve keys, with only a keyway for the valve keys which have been modified accordingly.

## Warning

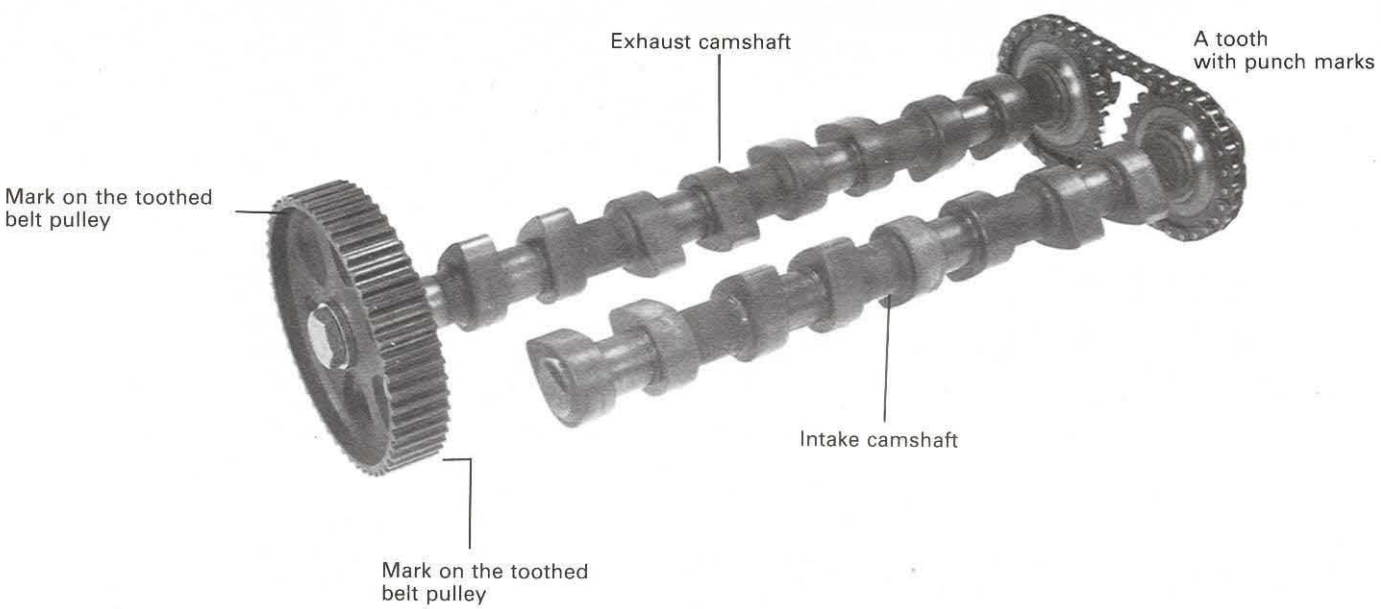
The sodium filled valves must never be heated on a fire to grind them. The valves can explode and produce severe burns if the incandescent sodium is projected. The exhaust valves removed must be treated according to the Volkswagenwerk's instructions before disposing of them.

# Cylinder head



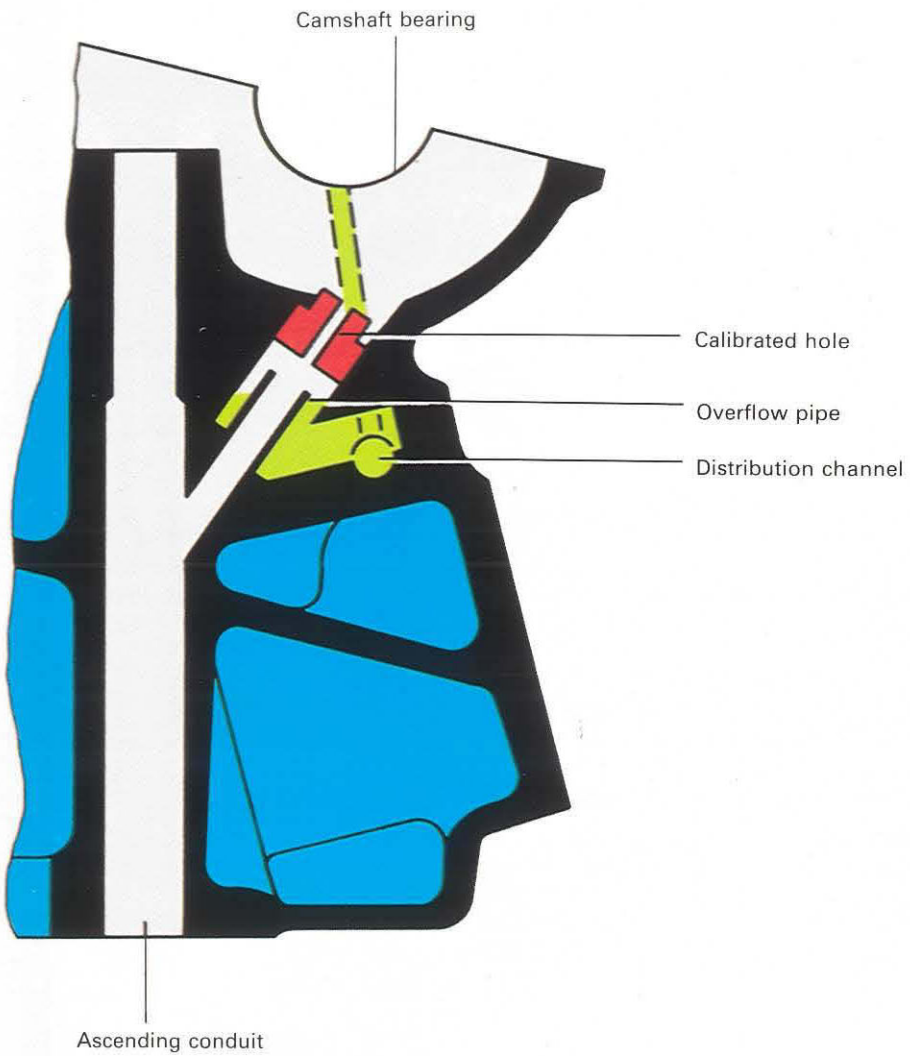

Both camshafts are supported on the cylinder head top. The exhaust camshaft is driven through a toothed belt. The exhaust camshaft in turn drives the intake camshaft through a chain. The chain sprockets cannot be replaced. The camshafts must be positioned so that when the chain is fitted, the marks on the chain sprockets match. The toothed belt pulley has a mark which when the engine is assembled must mutch with the sealing surface and a second mark which must match a reference point on the cylinder head cover.

Below the camshafts, the hydraulic tappats drive the intake and exhaust valves. The cylinder head incorporates oil conduits to feed oil to the bearings and to the tappets.



## Camshaft lubrication

There is an oil channel running along each side of the cylinder head. In the area below the ignition distributor, both longitudinal channels are joined together.



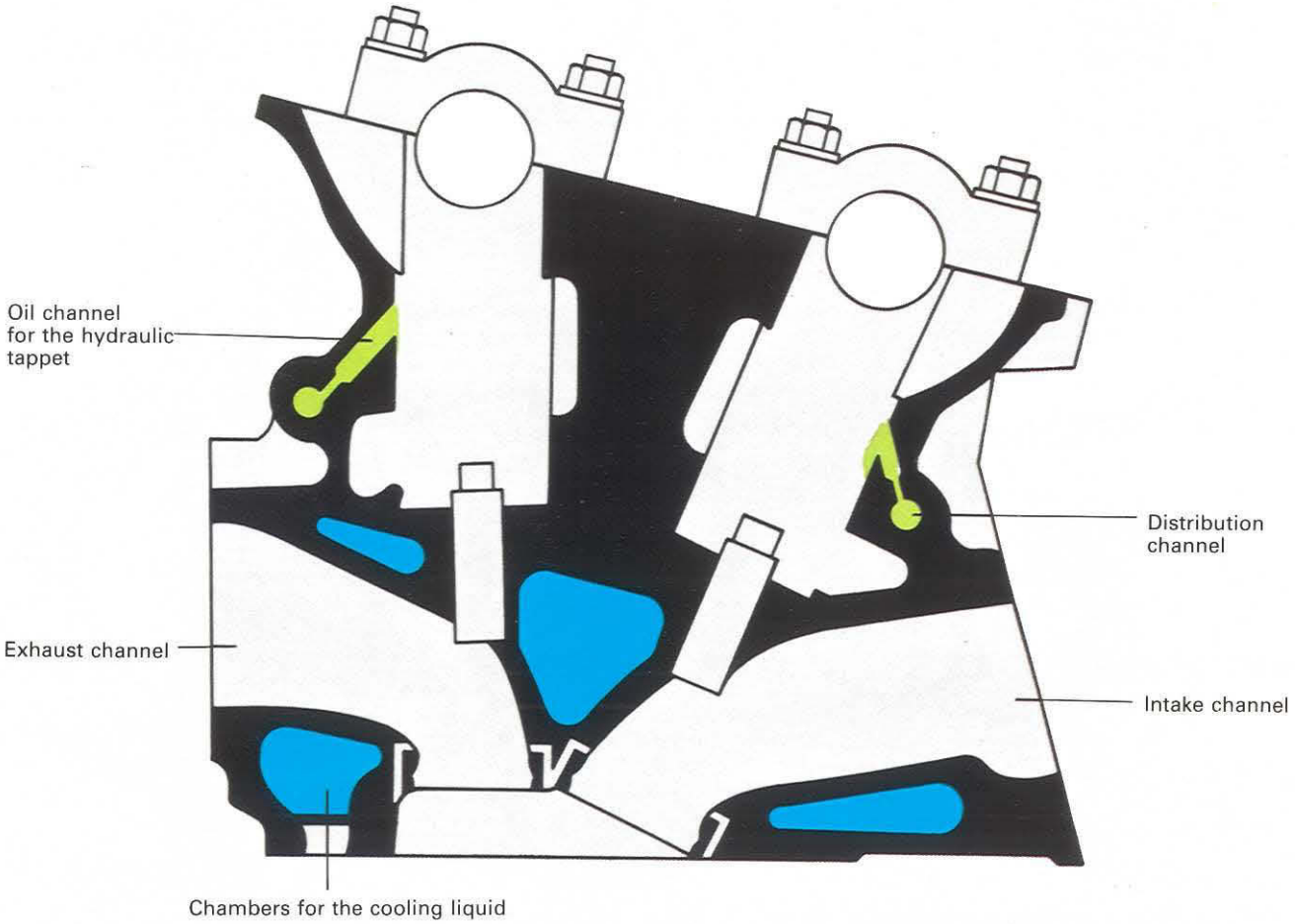

## It works this way

The oil arrives to the cylinder head through the ascending conduit. The ascending conduit is an enlarged hole of the fixing bolt. The oil arrives to the distribution channel through the overflow pipe and from the distribution channel the oils flows to each of the bearings.

When the engine is stopped, the oil flow is also stopped. Only a small amount can return as the overflow pipe in the main enlarged channel does not allow more oil to return. When the engine is started, all that is required is to fill the ascending conduit. Thereafter, the oil pressure is sufficient to lubricate all the parts and to feed oil to the hydraulic tappets.

# Cylinder head

## Oil feed to the hydraulic tappets

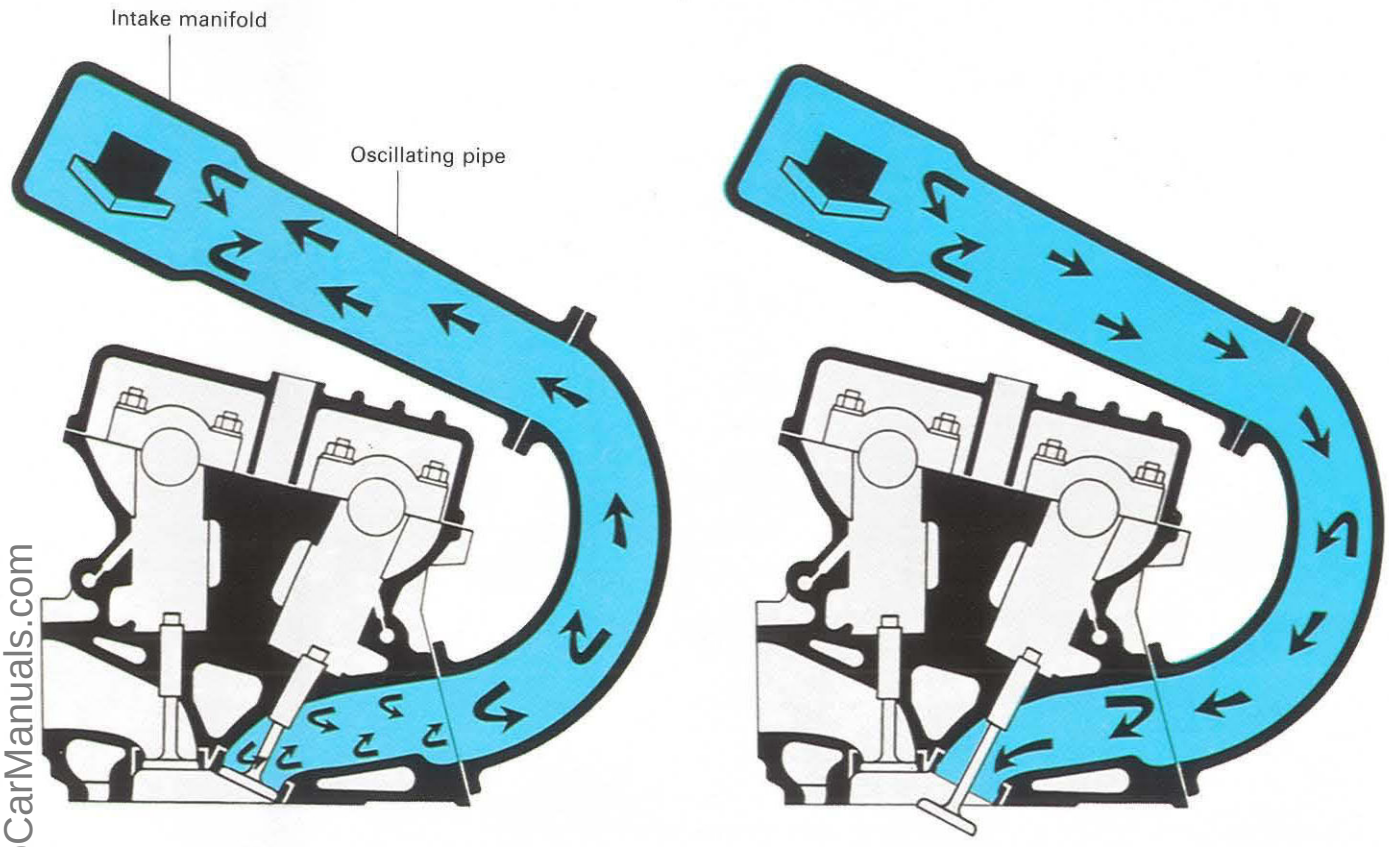



The above figure is a cross section through a different plane. In this cross section it is possible to see the oil conduits for feeding the hydraulic tappets. The right and left distribution channels are drilled in the cylinder head as an annular channel. Through the relevant channels, the hydraulic tappet sliding surfaces are lubricated and the tappets are fed with sufficient amount of oil to compensate for the play.

## Cylinder head bolt

This is a new bolt for the 16 valve engine. The manufacturing corresponds to the so called "expandable bolt". The spiral groove above the thread makes a contribution to this function by giving to the bolt increased elasticity.

After extended testing, these pipes were adopted for the engine as they allow a good filling of the cylinder by using the oscillating pipe technique.






## Oscillating pipe technique

When conducting research on the gas movements inside a pipe, it has been discovered that **the gases are moved according to certain laws**. The gases oscillate, that is, they move back and forth **under certain conditions**. This behaviour can be used to achieve a better filling of the cylinder.

## It works this way

When the intake valves close after the intake stroke, the gas masses keep moving towards the intake valve due to their momentum, then hit the intake valves, undergo a slight compression and oscillate backwards in the direction to the intake pipe. At the area where the cross section increases, the gases are reflected and oscillate again towards the intake valves. If the intake valves are opened again at this time, the gas masses are already moving and subject to a certain pressure. It becomes unnecessary the suction action of the engine.

By matching the cross sections, pipe lengths, distribution times, etc.,and with the help of the oscillating pipe technique, it is possible to fill better the cylinder within a given range of engine r.p.m. By improving the filling, the brake horsepower increases.

## Intermediate shaft

In this engine, the intermediate shaft drives the oil pump only, as the ignition distributor has been moved to the cylinder head. Because of this, the reduction ratio 2:1 has become unnecessary.

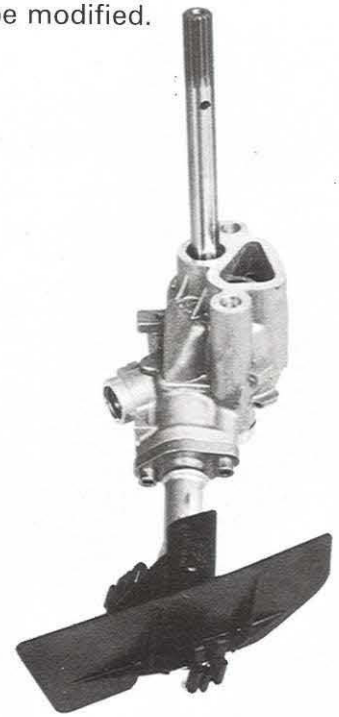
The driving gear of the intermediate shaft has been reduced, increasing thus the pump speed by 20 %.

Increasing the speed of the oil pump has meant an increase in the oil flow. Because of the reduction in diameter of the intermediate shaft toothed belt gear, the number of teeth of all the toothed belt gears and the toothed belt itself has had to be modified.

## Oil pump

To increase the oil flow, a new pump has been fitted. In this pump, the gear teeth are longer and, therefore, each revolution of the pump increases further the amount of oil pumped.

All the above changes assure a higher oil flow which is required, for example, for cooling the pistons and the hydraulic tappets and also for the general oil supply.



## Cooling system with oil radiator

In this engine, an oil radiator has been fitted into the oil system. Cooling liquid flows through the oil radiator and keeps the oil temperature within the specified limits.

The oil radiator is fitted on the oil filter flange.