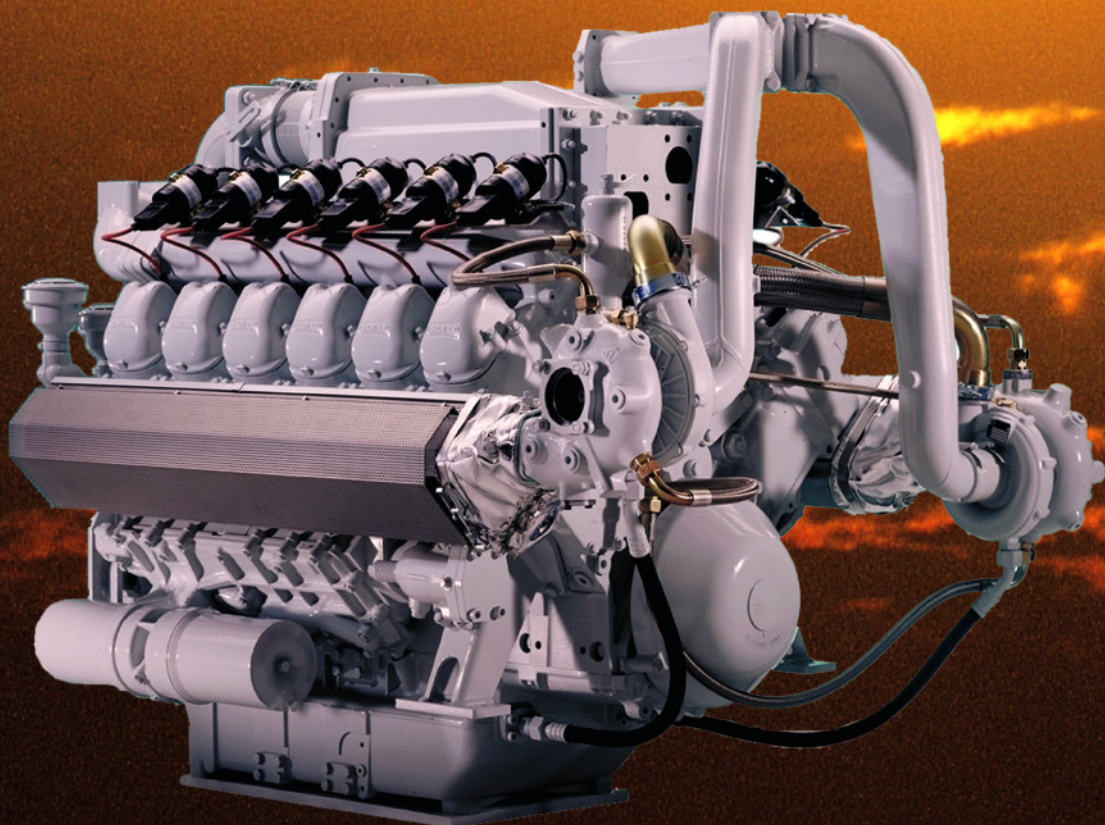




Repair Manual

MAN Industrial Gas Engines

E 2842 LE 302



Important instructions which concern technical safety and protection of persons are emphasised as shown below.

**Danger:**

This refers to working and operating procedures which must be complied with in order to rule out the risk to persons.

**Caution:**

This refers to working and operating procedures which must be complied with in order to prevent damage to or destruction of material.

**Note:**

Explanatory descriptions which help in understanding the relevant work or operating procedure to be carried out.

Assembly of pipes

**Danger:**

No pipes may be bent.
Risk of breakage!

Fitting flat seals / gaskets

Flat seals / gaskets are often inserted with sealing agents or adhesives to make fitting them easier or to achieve better sealing. Flat seals may slip in operation due to the “sewing -machine” effect, in particular if they are used between parts with different rates of linear expansion under heat (e.g. aluminium and cast iron), and leaks may then occur.

Example:

The cap of the front crankshaft seal. If a sealing agent or an adhesive is used here the flat seal will move inwards in the course of time as a result of the different expansion rates of the materials. Oil will be lost, for which the shaft seal may be thought to be responsible.

Flat seals / gaskets can be fitted properly only if the following points are observed:

- Use only genuine MAN seals / gaskets
- The sealing faces must be undamaged and clean
- Do not use any sealing agent or adhesive – as an aid to fitting the seals a little grease can be used if necessary so that the seal will stick to the part to be fitted
- Tighten bolts evenly to the specified torque

Fitting round sealing rings

- Use only genuine MAN round sealing rings
- The sealing faces must be undamaged and clean
- Always wet round sealing rings with engine oil before fitting them



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The type designation, consisting of a sequence of letters and numbers, indicates some characteristics of each engine, provided you are familiar with the basic terminology.

The system is explained here using the type E 2842 LE 302 / E 2842 LE 312 as an example:

- | | |
|-----|--|
| E | The "E" at the start of the type designation stands for natural gas (German: Erdgas) |
| 28 | The numbers "28" indicate that this is a power unit with 128 mm bore |
| 4 | The "4" means 142 mm stroke |
| 2 | The "2" indicates the number of cylinders 12 |
| L | This letter stands for " charge-air cooling " (German: Ladeluftkühlung) |
| E | The "E" stands for " fitted engine " (German: Einbaumotor) and is intended to distinguish MAN vehicle engines |
| 302 | This is a factory-internal development number. |

General

Important safety regulations are summarized in this quick-reference overview and arranged by topic to effectively convey the knowledge necessary to avoid accidents causing injury, damage or environmental hazard. Additional information can be found in the operating instructions of the engine.

Important:

Should an accident occur despite all precautionary measures, particularly one involving contact with corrosive acid, penetration of fuel under the skin, scalding by hot oil, antifreeze splashing into the eyes etc. ***you must seek medical assistance immediately.***

1. Regulations for the prevention of accidents with personal injury

Inspection, adjustment and repair work may only be performed by authorised and skilled personnel.

- The engine may only be started and operated by authorised personnel.
- When the engine is running, do not get too close to the rotating parts.
Wear close-fitting clothing.
- Do not touch hot engine with bare hands: Risk of burns.
- Keep area surrounding engine, ladders and stairways free of oil and grease. Accidents caused by slipping can have serious consequences.
- Only work with tools which are in good condition. Worn spanners/wrenches slip: Danger of injury.
- Persons must not stand under an engine suspended on a crane hook. Keep lifting gear in order.
- Open the coolant circuit only when the engine has cooled down. If it is unavoidable that the circuit be opened with the engine at operating temperature, observe the instructions in the chapter "Maintenance and care" in the operating instructions.
- Do not tighten or undo pipes and hoses under pressure (lubricating oil circuit, coolant circuit and any downstream hydraulic oil circuits). The fluids which flow out can cause injury.





- When working on the electrical system, first disconnect the earth cable of the battery and reconnect this last to prevent short circuits.



- Follow the manufacturer's instructions for handling batteries.
Caution:
Accumulator acid is toxic and caustic. Battery gases are explosive.



- When performing welding work, observe the "Notes for welders".

2. Regulations for the prevention of engine damage and premature wear

- ***The engine must be cleaned thoroughly prior to repair. Ensure that during repair work no dirt, sand or foreign bodies enter the engine.***
- If engine operation is disrupted, immediately determine the cause and have it remedied to prevent additional damage.
- In every case, use only original MAN spare parts. The installation of parts that are “just as good” but do not originate from MAN can under certain circumstances cause severe damage – for which the workshop performing the repair must bear responsibility.
- Never allow the engine to run dry, i.e. without lubricant or coolant.
Appropriate notices must be attached to engines that are not ready for operation.
- Only use lubricants, fluids and fuel approved by MAN (gas, engine oil, antifreeze and corrosion protection agents). Pay attention to cleanliness.
- ***Do not fill engine oil beyond the max. notch on the dipstick. Do not exceed the maximum permissible tilt of the engine.***
Serious damage to the engine may result if these instructions are not adhered to.
- Control and monitoring devices (charge control, oil pressure, coolant temperature) must be in perfect working order.

3. Safety instructions for handling the ignition system

- When the engine is in operation, the following parts of the ignition system must not be touched or disconnected under any circumstances:
 - Ignition coils and caps
 - Cables of the high-voltage circuit
 - Cables of the low-voltage circuit
 - Plugs of the output and input wiring harness
- For all work related to set-up, operation, conversion, customisation, maintenance and repairs, the power must be disconnected from the ignition system and secured against inadvertent reactivation.





4. Regulations for the prevention of environmental damage

Engine oil and filter cartridges

- Old oil must be passed on for recycling.
- Take extreme care that no oil enters the waste water system or seeps into the ground.
Caution: The drinking water supply could be contaminated.
- Filter elements are classed as dangerous waste and must be treated as such.

Coolant

- Treat undiluted corrosion protection agents and / or antifreeze as hazardous waste.
- When disposing of used coolant, the regulations issued by the relevant local authorities must be observed.

5. Instructions for handling used engine oil *

Prolonged or repeated contact between the skin and any kind of engine oil decreases the skin. Drying, irritation or inflammation of the skin may therefore occur. Used engine oil also contains hazardous substances that have caused skin cancer in tests on animals. If the basic principles of work safety and hygiene are observed, handling used engine oil does not represent a health hazard.

Precautionary measures to protect your health:

- Avoid prolonged or repeated skin contact with used engine oil.
- Protect your skin by means of suitable agents (creams etc.) or wear protective gloves.
- Clean skin which has been in contact with engine oil.
 - Wash thoroughly with soap and water. A nail brush provides effective assistance here.
 - Special hand cleaning agents make it easier to clean dirty hands.
 - Do not use petrol (gasoline), diesel fuel, gas oil or solvents as washing agents.
- After washing apply a fatty skin cream to the skin.
- Change clothing and shoes that are soaked in oil.
- Do not put oily cloths in your pockets.

Ensure that used engine oil is disposed of in the appropriate manner.
– Engine oil is a substance that endangers the water supply –

For this reason do not let engine oil get into the ground, waterways, the drains or the sewers. Violations are punishable.

Carefully collect and dispose of used engine oil. Information on collection points can be obtained from sales personnel, the supplier or the local authorities.

* Based on "Information sheet for handling used engine oil".

6. Safety instructions for handling gaseous fuels

Gaseous fuels consist essentially of methane, propane and butane as well as traces of higher hydrocarbons and inert components such as carbon dioxide and nitrogen.

- The regulations applicable to gas installations must be observed.
- Exhaust gases are toxic. Comply with the regulations for the installation of MAN industrial gas engines for operation in enclosed areas. Ensure adequate ventilation.
- Smoking and naked flames are prohibited.
- Leaks in the gas supply system mean danger of explosion and these must be remedied immediately.
- Fire extinguishers and other firefighting equipment must be on hand.
- Do not store combustible material in the engine room.

**Conduct in the case of gas leaks**

- Close the shutoff valve of the gas supply.
- Switch off the main switch of the electric system.
- Cordon off the danger zone. Ask persons who are not involved in the work to leave the danger zone.
- If gas is leaking, inform the relevant authorities immediately and initiate repairs.

Conduct in the event of fire

- Alert the fire brigade.
- Immediately assist any injured persons, call paramedics if necessary.
- In the case of a pure gas fire, do not extinguish the gas flame; if necessary, cool down the burning object (e.g. by starving the fire of oxygen: close doors and windows).
Burning gas = controlled gas!
- Prevent the flames from spreading.
- If the flames spread to the surroundings, use a fire extinguisher.
- Stay calm!



Operating faults and possible causes

We recommend

A repair is only complete when both the damage that occurred and the possible causes have been eliminated. Finding out the cause of damage is often more difficult than repairing the damage that occurred. We therefore recommend that you obtain a precise description of the operating fault before removing and dismantling components. Then use a process elimination (questions) to pin-point the probable causes and investigate and eliminate these successively on the basis of the table **and your own experience**. This helps to reduce repairs to the required scale and to counteract claims regarding “over-eager” replacement of parts and complaints about expensive work and down time.

Note:

The following list is conceived as an aid to memory for experts so that to causes of damage are overlooked when dealing with faults. It is expected of experts that they are very familiar with the repair instructions for the engine, but also with the engine operating instructions and “Fluids and lubricants for industrial gas engines”.

Fault table

1.	Starter motor does not turn engine or only slowly (solenoid switch energises ("click" is audible)									
2.	Starter motor turns, engine does not turn									
3.	Starter motor turns engine, engine does not start / starts poorly									
4.	Ignition failure									
5.	Irregular engine running									
6.	Engine stalls during operation, no longer starts									
7.	Engine "shakes"									
8.	Engine only runs at idle speed									
9.	Idle speed unstable									
10.	Engine does not reach its nominal speed									
11.	Engine does not reach its nominal power									
12.	Fuel consumption too high									
13.	Oil consumption too high									
14.	Engine too "loud" / mechanical noise									
15.	Heavy blue smoke formation									
16.	Heavy white smoke formation									
17.	Exhaust temperature / exhaust back pressure too high (thermal overload)									
18.	Lubrication oil pressure too low									
19.	Temperature difference engine exit / engine entry too great									
20.	Coolant temperature too high									
										Possible causes
x										Batteries discharged, battery cable connections loose or corroded, power circuit interrupted
x										Starter motor defective (carbon brushes loosened / worn, coil damaged, ground fault)
	x									Engaging lever / bearing bolt of the engaging lever broken
x										Crankshaft drive blocked
x									x	Engine oil viscosity unsuitable, not suited to ambient temperature
	x									Ignition control unit defective
	x									Impulse sensor defective / gap incorrectly set
		x	x	x						Spark plug defective
		x	x	x						Ignition cable defective
		x	x	x						Ignition coil defective
			o	o		x	x	x		Ignition point incorrectly set
				x						Throttle valve does not open / actuating rod jammed / setting unit de-energized or defective
					x	x				Throttle valve not in full-load position / actuating rod jammed / throttle valve incorrectly adjusted
	x		x							Shut-off solenoid valve of gas supply closed / does not open
	x				x					Zero pressure regulator of gas supply not correctly set or defective
					x	x	x			Gas metering valve defective
					x		x	x		Gas / air mixture too rich or too lean
	x					x				Lack of compression, or more than 3 bar pressure difference between the individual cylinders
	x	x		x				x		Valve clearance not correct
							x	x		Valve guides heavily worn
	x	x		x		x				Valve seats leaking
	x	x		x		x	x			Piston rings heavily worn, broken (overpressure in the crankcase)
					x	x	x	x		Air filter heavily soiled
					x	x	x			Charge mixture cooler soiled / leaking
					x	x	x			Charge mixture piping leaking
							x	x		Turbine and compressor wheel in the turbocharger soiled (running off balance)
									x	Coolant entering combustion chamber (cylinder head gasket leaking)
									x	Engine in cold running phase
						x		x		Crankcase breather blocked
						x				Oil level in oil pan too high
									x	Safety valve in the oil circuit defective (does not close, spring fatigued or broken)
									x	Heavy bearing wear
									x	Oil pump heavily worn
									x	Safety valve in the oil circuit defective (does not open), oil lines / oil ducts blocked
									x	Unsuitable exhaust-gas piping, heat exchanger and catalytic converters with excessive resistance
									x	Flow resistance of cooling system too great
									x x	Soiling of cooling system

x = likely to apply
o = might apply



x = likely to apply
o = might apply

The service life of an engine is influenced by very different factors. It is therefore not possible to specify certain fixed numbers of operating hours for general overhauls.

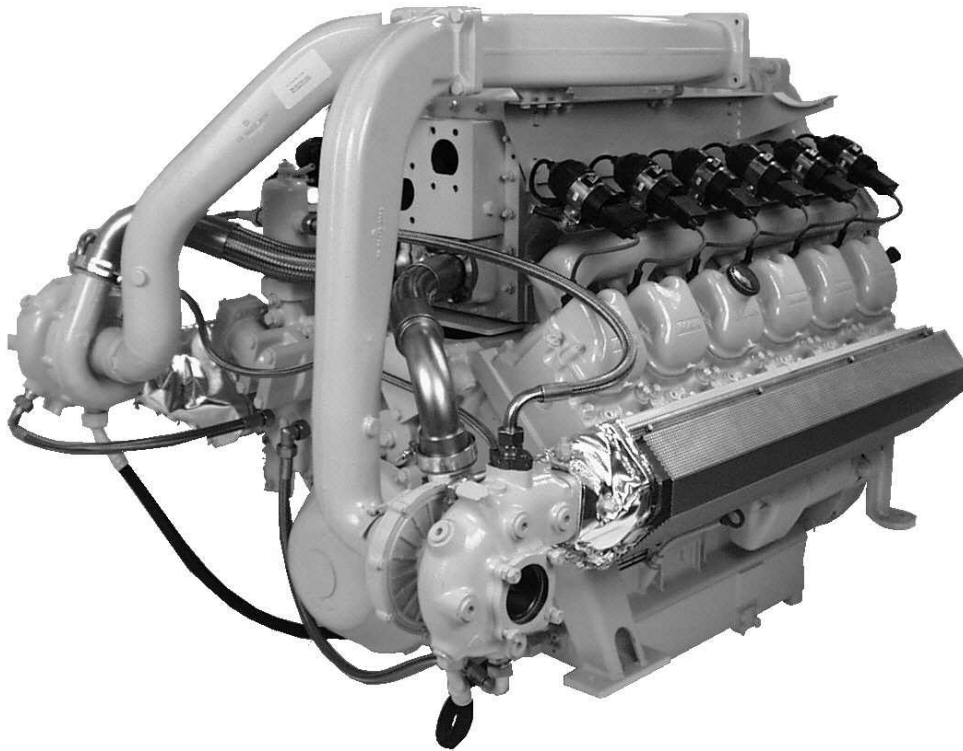
In our view, it is not necessary to open up an engine or perform a general overhaul as long as the engine has good compression values and the following operating values have not changed significantly in relation to the values measured on commissioning the engine:

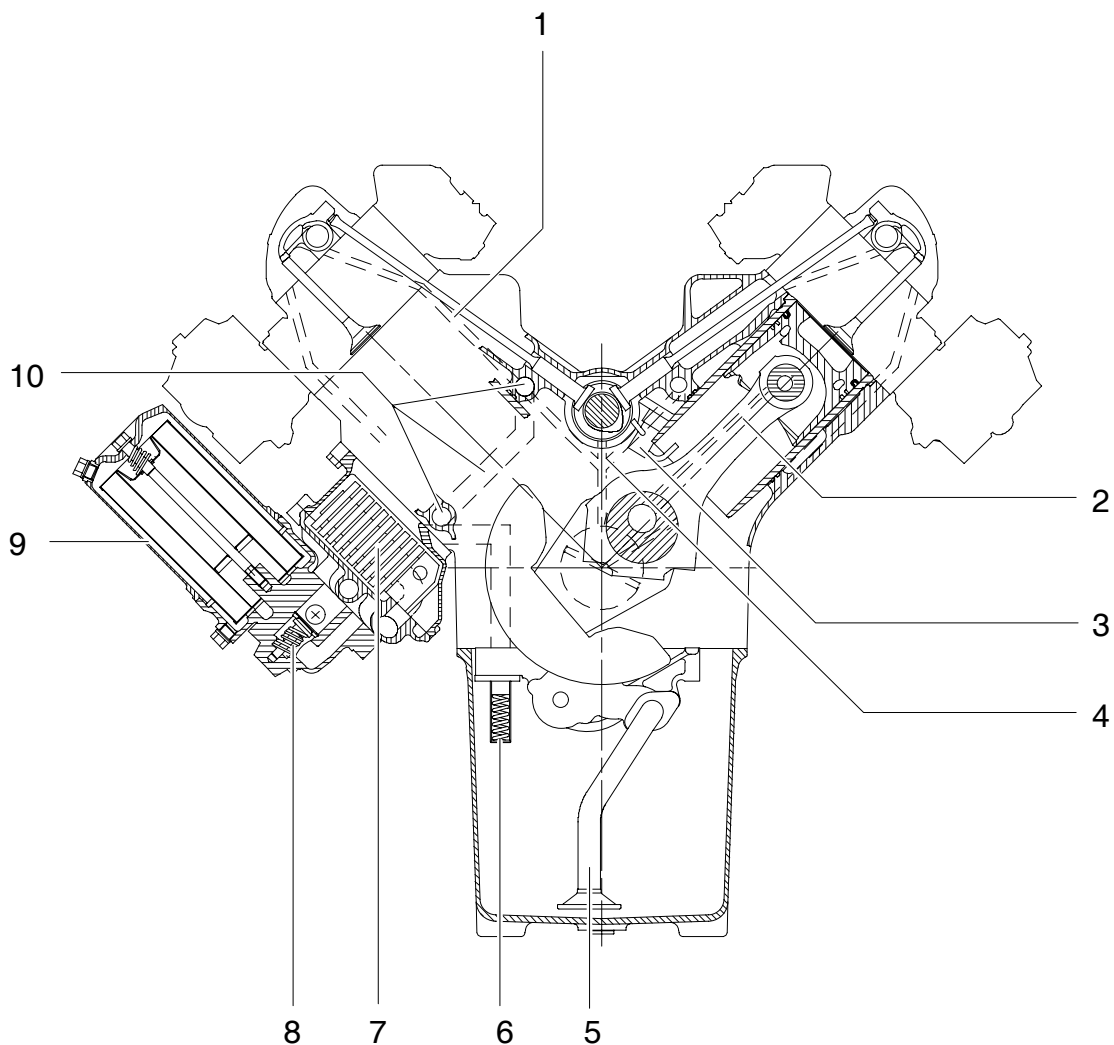
- Charging pressure
- Exhaust temperature
- Coolant and lubricant temperature
- Oil pressure and oil consumption

The following criteria greatly influence the length of the engine service life:

- Correct power setting in accordance with conditions of use
- Technically correct installation
- Inspection of installation by authorised personnel
- Selection and quality of lubricants, fuel and coolant according to publication "Fluids and lubricants for industrial gas engines"

Illustrations of engine E 2842 LE 302 / E 2842 LE 312





1 Rocker arm lubrication

2 Piston bolt lubrication

3 Spray nozzles for piston cooling

4 Camshaft bearing lubrication

5 Oil intake pipe

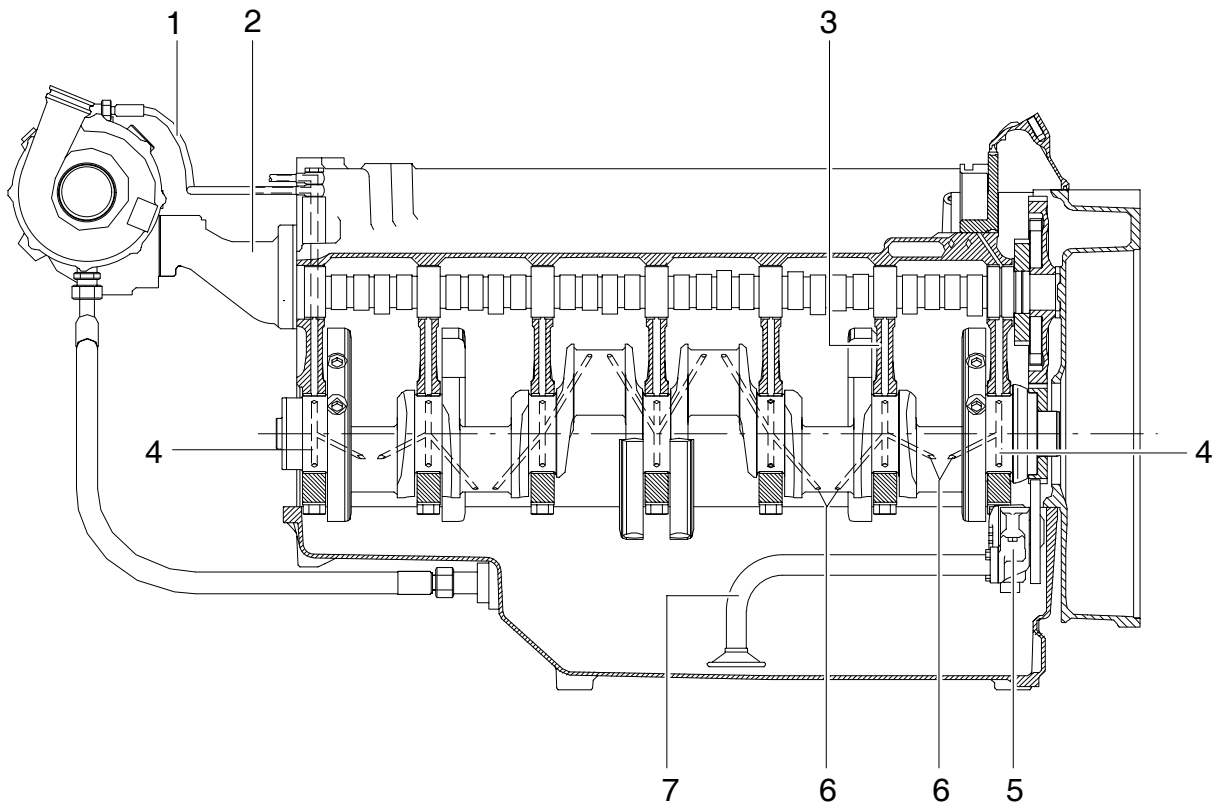
6 Oil overpressure valve

7 Oil cooler

8 Bypass valve

9 Oil filter

10 Main oil channels



1 Lubrication oil lines to the exhaust turbochargers

2 Oil return from exhaust turbochargers

3 Oil line to crankshaft

4 Bore holes to main bearing lubrication

5 Oil pump with oil-pressure relief valve

6 Bore holes for conrod bearing lubrication

7 Oil intake pipe

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