Operation Manual

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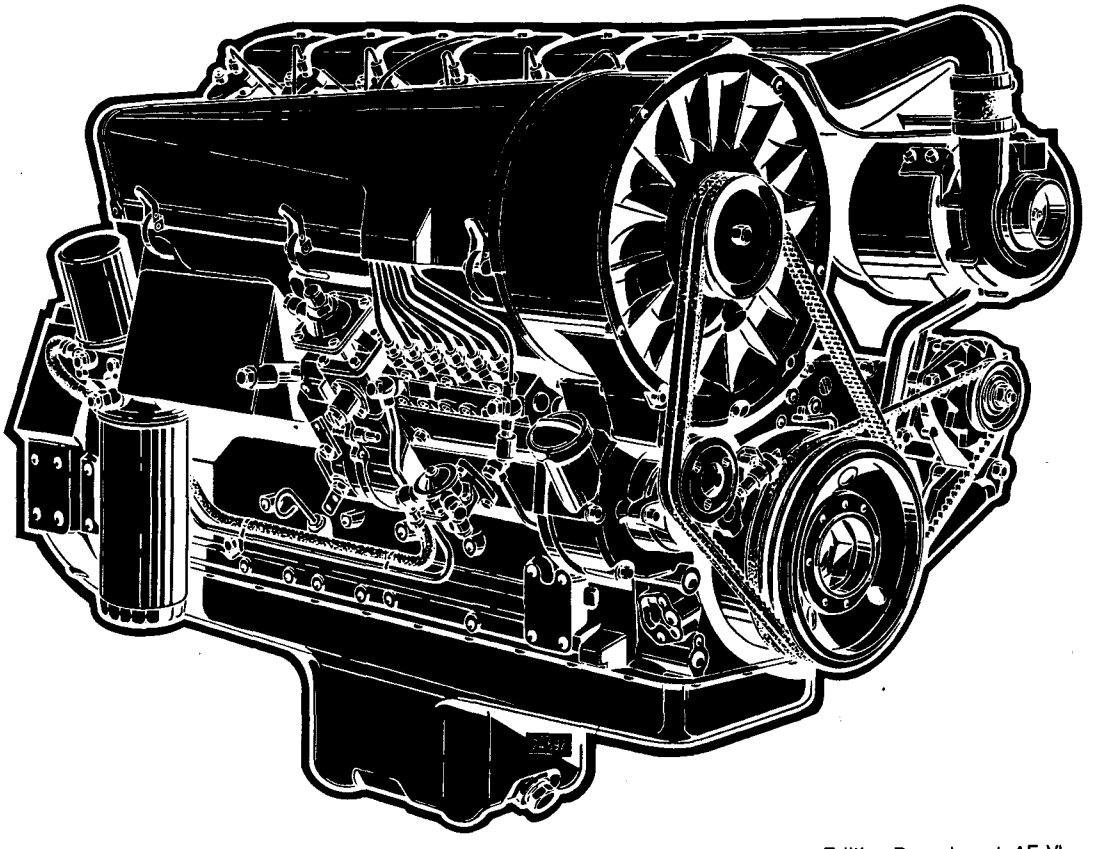
KHD DEUTZ

BF 6L 913/C/T



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Contents

Foreword

Before Commissioning Your New Engine:
Surely you expect top service from your DEUTZ engine ... So please give this manual your top attention!

The necessary safety precautions and regulations have been observed in the design, choice of material and manufacture of your engine, and before the engine left our factory, it stood up satisfactorily to the severest tests and trials.

Maximum engine performance is however not possible without a minimum of upkeep. Remember that even simple household appliances need some care and attention once in a while. So be sure to maintain your engine as scheduled herein and to use the fuels and lube oils recommended. You will get a lot in return: a long lifespan of your DEUTZ engine, high power output and reliability, plus low consumption rates and exhaust emissions.

Should, on the other hand, any trouble arise on engine calling for overhaul or repair, do not tamper with it but entrust the job to a workshop of the worldwide DEUTZ organisation, where you will find a staff of Deutz-trained mechanics, the latest special tools and facilities, and a full stock of

KHD DEUTZ

Genuine Spare Parts

For ordering such spares, please always refer to the relevant Parts Catalogue. Otherwise ask your local DEUTZ distributor.

By the way, you will agree with us that "Safety first" is a good slogan. So please be sure to refit any guards and protective devices that should have been removed for carrying out work on the engine.

To prevent pollution of the environment, please let old fuel and oil run into a special receptacle.

Safety and dependability result from superior technology, correct operation, plus proper care and maintenance

When reading through this manual, you will find the above symbol marking all important safety instructions. Give particular heed to these instructions and proceed with special care. Pass on these safety instructions to your operating personnel.

General Safety Rules

Apart from the safety instructions given in this manual, it is also necessary to observe the official safety rules, which may vary from country to country.

The Right Work Clothing

Work clothing should be closely fitting, so that it cannot be caught by rotating or projecting parts.

Beware of Running Engine

Always stop the engine before refuelling.

Always stop the engine before carrying out maintenance or repair work.

Care and Maintenance

Reliability of the engine largely depends on close observance of the Maintenance Schedule (page 97).

Never attempt to rectify faults or carry out repairs for which you do not have the necessary experience and special tools. Entrust the job to your DEUTZ Service Station, where DEUTZ-trained personnel will give your engine expert attention.

Foreword

Important for your Engine's Power Output

Power output, temperature level and exhaust gas quality of any diesel engine are governed by careful matching of combustion air and fuel injection volumes, and since the density of the combustion air taken in varies with the atmospheric pressure and the ambient temperature, full rated power is obtained only at standard reference conditions in respect of atmospheric pressure (altitude of engine site) and ambient temperature.

Standard reference conditions are as follows:

(a) 101.3 kPa = 1013 mbar (sea level) and 20°C (68°F)
for automotive engines to DIN 70020

(b) 100 kPa = 1000 mbar (100 m above sea level) and 27°C (80.6°F)
for industrial and marine engines to DIN 6271.

Where engines are operated at greater altitudes and/or higher ambient temperatures, they must be de-rated (reduced fuel injection and hence engine loading) in accordance with special Tables available.

Note:

Therefore, never run your DEUTZ diesel in "thin air" under heavy-duty conditions unless your engine has been de-rated accordingly, otherwise the engine's lifespan, reliability and exhaust emissions may be affected, especially at altitudes above 1000 m and/or temperatures above 30°C (86°F). Be sure to contact us or your equipment supplier in good time!

Engine Model and Engine Serial No.

The model designation A and the engine serial No. B are given on the rating plate (Fig. 1).

The rating plate is attached to the crankcase below the starter motor (see Fig. 2).

The serial No. is also stamped into the crankcase near the oil filler neck (see Fig. 3).

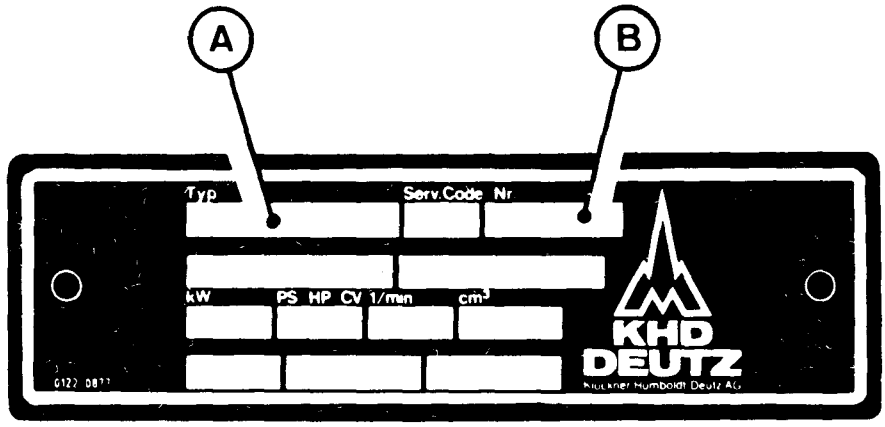

Fig. 1

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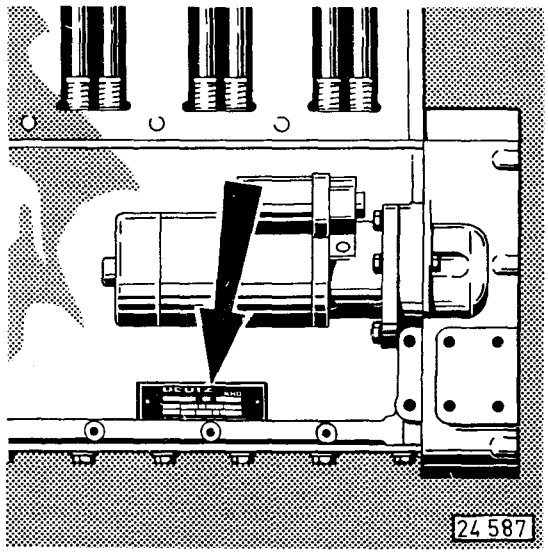


Fig. 2

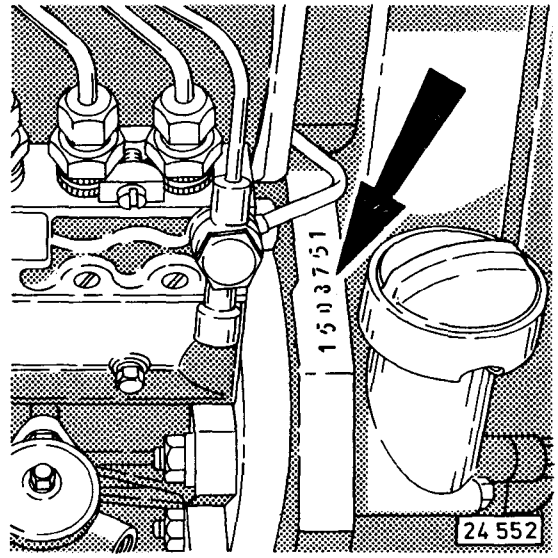


Fig. 3

Description of Engine

Specification Data

Model	BF 6L 913	BF 6L 913T	BF 6L 913C
Number of cylinders	6		
Bore mm	102		
(in)	(4 1/64)		
Stroke mm	125		
(in)	(4 59/64)		
Piston diplacement cm^3	6128		
(in^3)	(373.96)		
Direction of rotation (facing flywheel)	counter-clockwise		
Working principle	four-stroke diesel with direct injection		
Weight (less starter and generator) kg	485	485	510
approx. (lb)	(1069)	(1069)	(1125)
Power output* kW(HP)	see rating plate		
Speed* rev/min	see rating plate		
Lubrication system	full-forced lubrication circuit		
Oil capacity:			
when renewing filter approx. ltr.	18,2**		
(Imp. gall.)	(4)		
w/o renewing filter approx. ltr.	16,0**		
(Imp. gall.)	(3.52)		
Commencement of delivery (crank angle) with advance/retard unit b TDC	24° ±1°	26° ±1°	26° ± 1°
w/o advance/retard unit 1500 - 1999/min	28° ± 1°	–	–
2000 - 2300/min	30° ± 1°	–	–
2301 - 2800/min	32° ± 1°	–	–
1500 - 1800/min	–	26° ± 1°	26° ± 1°
1801 - 2300/min	–	28° ± 1°	28°± 1°
2301 - 2550/min	–	30° ± 1°	30° ± 1°

Valve clearance with engine cold		mm	0.15
Inlet valve opens	at specified valve clearance	bTDC	32°
Inlet valve closes		aBDC	60°
Exhaust valve opens		bBDC	70°
Exhaust valve closes		aTDC	32°

Piston crown clearance (measured with lead wire) ..... 1.0–1.2 mm (0.040 to 0.047 in)

Injection release pressure:

- used engine (check for keeping injector in use)	bar	175 + 8
- new or overhauled engine (original setting)	bar	180 + 8
Firing order		1–5–3–6–2–4

* The power output and speed of the engine are stamped on the nameplate.
** Refers to standard oil sump (observe dipstick marks).

Combustion Method

Direct Injection

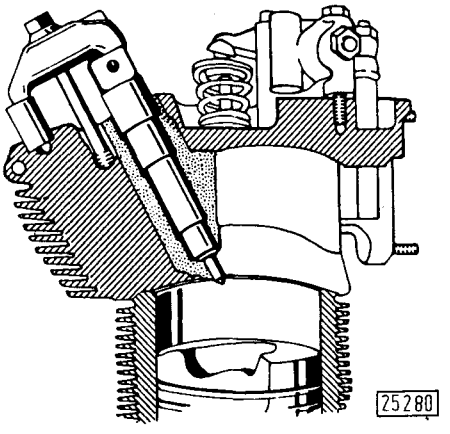


Fig. 4

Numbering of Cylinders

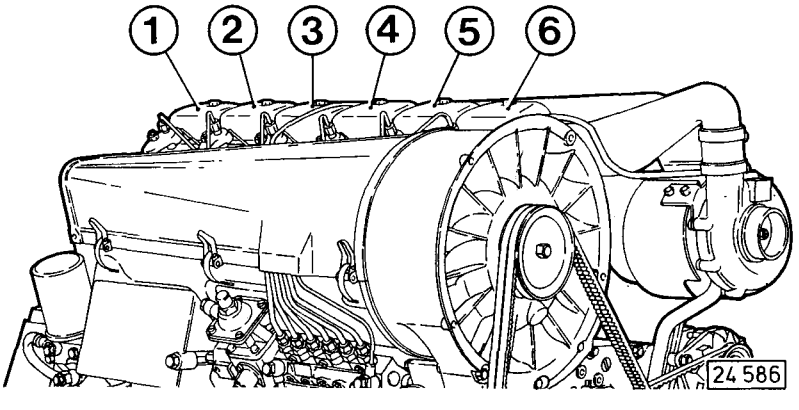


Fig. 5

Description of Engine

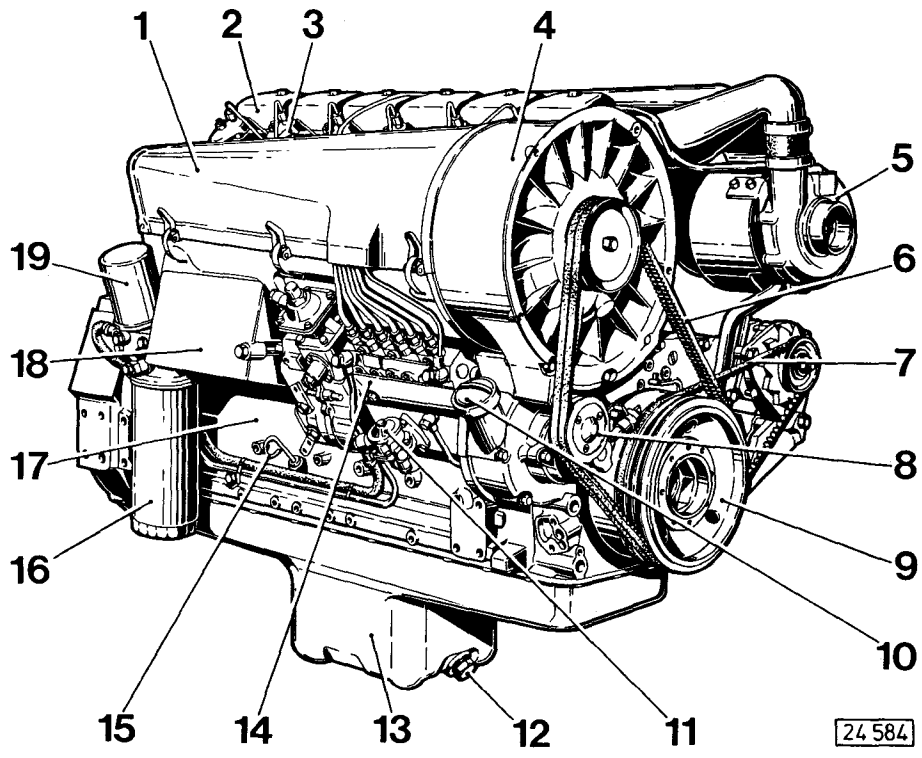


Fig. 6

Description of Engine (service side) BF 6L 913

1 Air cowling
2 Rocker chamber cover
3 Injector
4 Cooling air blower
5 Turbocharger
6 V-belt (cooling air blower)
7 V-belt (alternator)
8 Idler pulley
9 V-belt pulley
10 Oil filler neck
11 Fuel feed pump
12 Oil drain plug
13 Oil sump
14 Injection pump
15 Oil dipstick
16 Oil filter
17 Crankcase
18 Integral oil cooler
19 Fuel filter

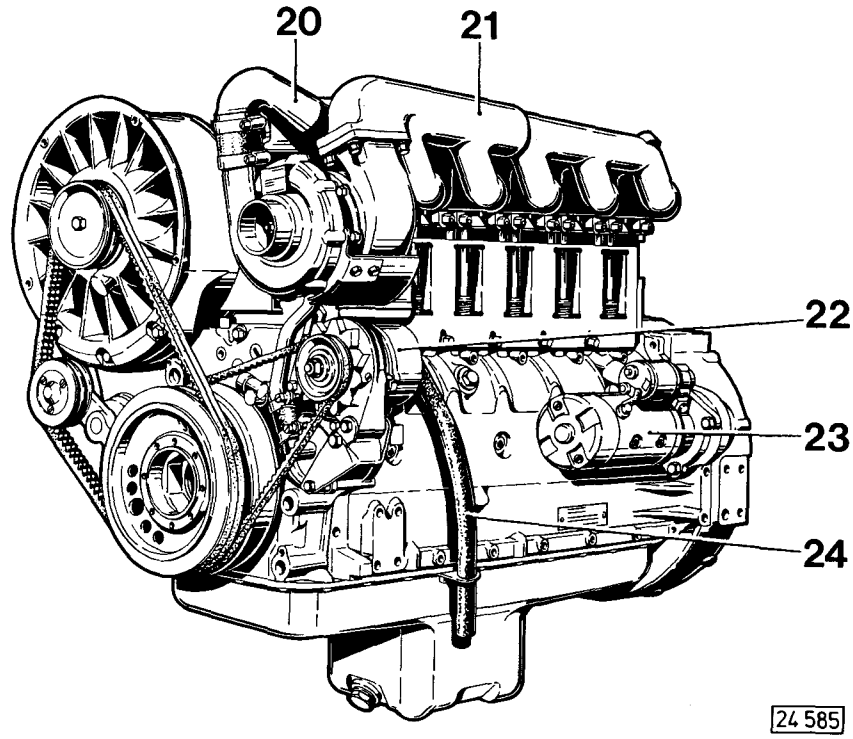


Fig. 7

Description of Engine (exhaust-air side) BF 6L 913

20 Charge air pipe
21 Exhaust manifold
22 Alternator
23 Starter motor
24 Crankcase vent

Description of Engine

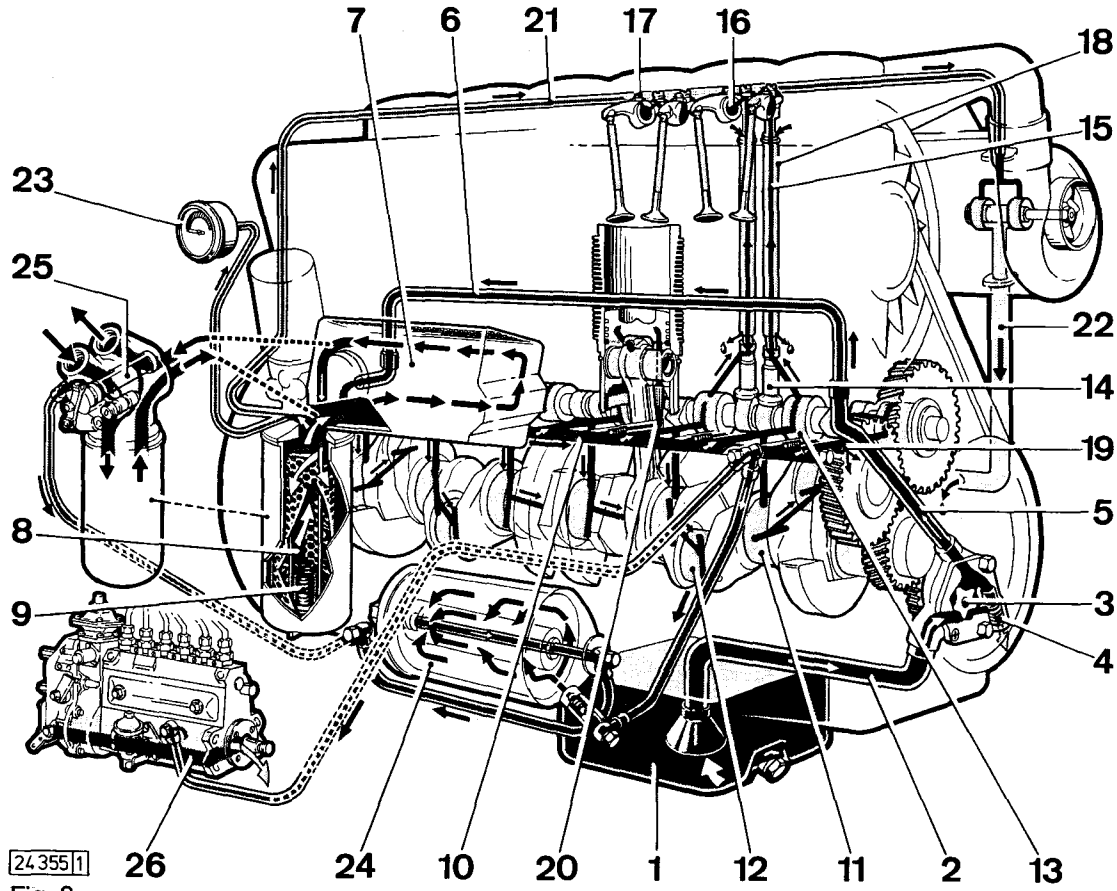


Fig. 8

Lube Oil Circuit

1 Oil sump
2 Suction pipe
3 Oil pump
4 Pressurestat
5 Delivery pipe
6 Pipe to oil cooler
7 Oil cooler, integral type
8 Oil filter
9 Safety valve
10 Oil gallery
11 Main bearing
12 Big-end bearing
13 Camshaft bearing
14 Tappet (with groove for pulse-feed lubrication of rocker arms)
15 Pushrod (hollow for oil flow to rocker arms)
16 Rocker arm bearing
17 Metering plug (for valve lubrication)
18 Pushrod cover tube (for oil return from cylinder head to crankcase)
19 Restrictor hole (for lubrication of gears)
20 Nozzle for piston cooling system
21 Oil pipe to turbocharger
22 Oil return pipe, turbocharger/oil sump
23 Oil pressure gauge
24 Oil microfilter (bypass)
25 Connection for cab heating
26 Injection pump

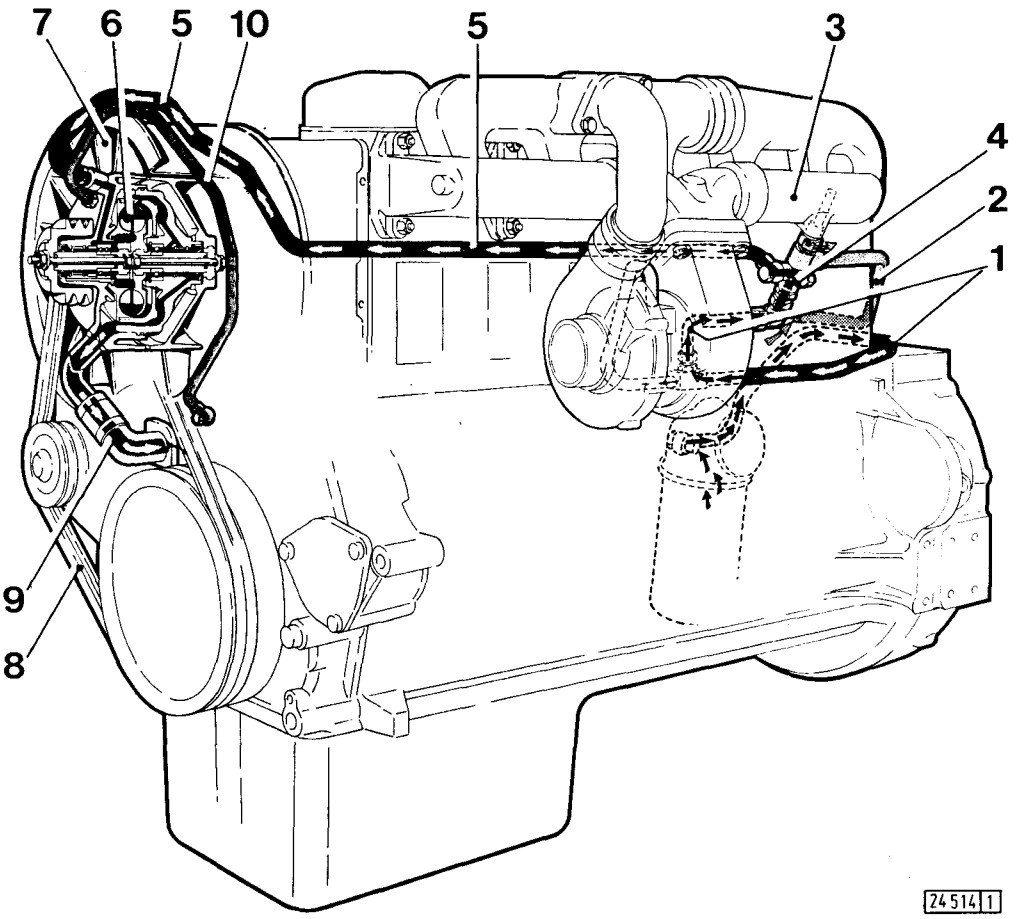
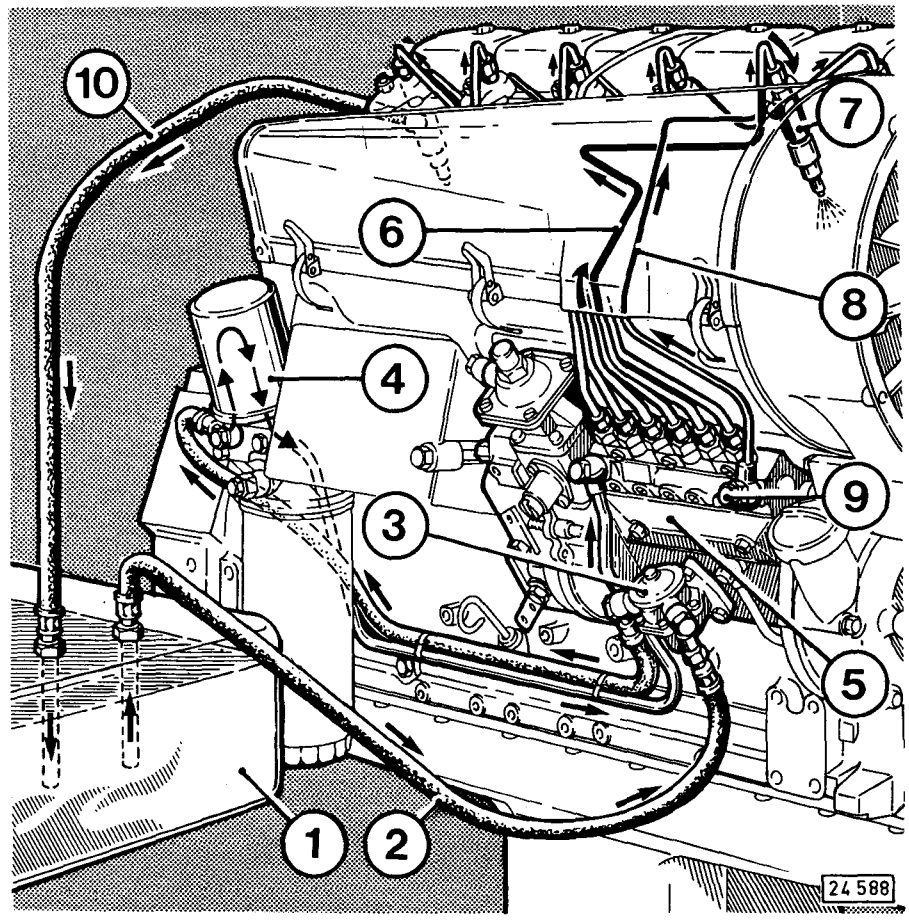


Fig. 9

Control of Cooling Air Flow
by Exhaust Gas Thermostat
(with Oil-Controlled Blower)

1 Pressure oil line from engine to thermostat
2 Air line to exhaust gas thermostat
3 Exhaust manifold
4 Exhaust thermostat
5 Control oil blower coupling
6 Blower coupling
7 Cooling blower
8 Blower drive
9 Oil return line to sump
10 Breather line



g. 10

uel System

1 Fuel tank
2 Fuel supply line
3 Fuel feed pump
4 Fuel filter
5 Injection pump
6 Injection line
7 Injector
8 Overflow line
9 Overflow valve
0 Fuel return line

Engine Operation

Starting up a new engine for the first time involves a number of preparatory jobs, some of which must also be carried out later on in the course of routine maintenance (see Maintenance Schedule on page 97).

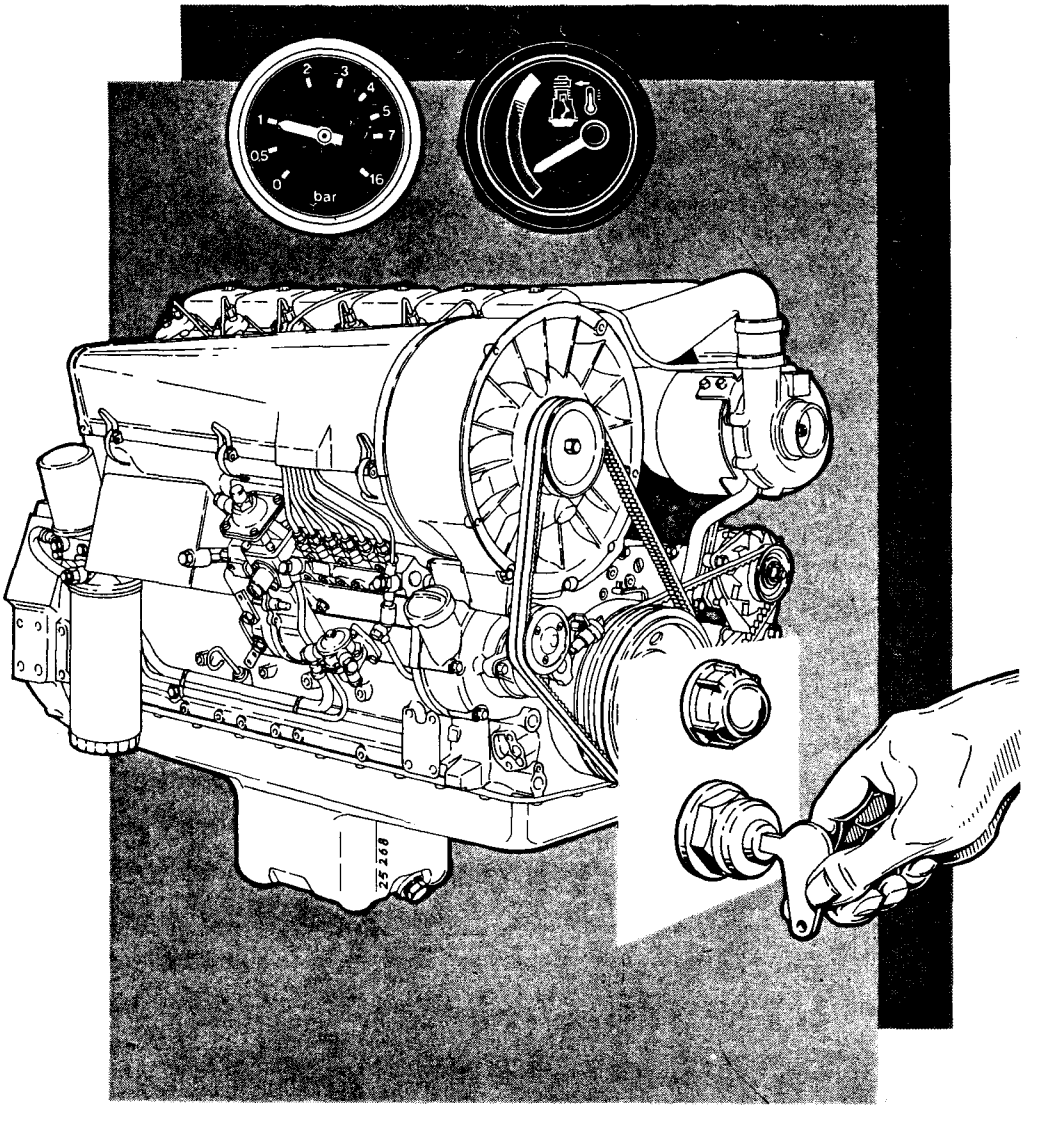


Fig. 11

Engine Operation

1. Fuel

1.1 Grade

Always use a reputable branded grade of gas oil, the sulphur content of which should be below 0.5%, and observe strict cleanliness when filling in. Higher sulphur contents affect the oil-change intervals (page 106). At low ambient temperatures use winter-grade fuel only (see hints on page 92). The fuel must be replenished promptly to prevent the tank from running dry, otherwise fuel filter and injection lines will need air-bleeding.

The following fuel specifications are approved: DIN 51601; NATO Codes F 54, F 75, F 76; BS 2869: A 1 and A 2*; ASTM D 975-78: 1-D and 2-D; V V-F-800 a: DF-A, DF-1 and DF-2.

1.2 Air-bleeding

Never let the tank run dry!

Any air which has found its way into the fuel system can cause irregular running of the engine and decrease its performance, even leading to stopping of the engine and preventing its restarting.

Not only when the fuel tank has been run dry, but also after changing the fuel filter or working on the fuel line system, is it therefore necessary to air-bleed the system by:

Pierburg fuel feed pump:

- undoing the overflow valve 1 (Fig. 12) at the lower (larger) hexagon by 2–3 turns,
- actuating the priming lever 2 by pressing repeatedly downwards against spring force until fuel emerges free of air bubbles at the loosened overflow valve 1,
- and then tightening the overflow valve securely, while still pumping.

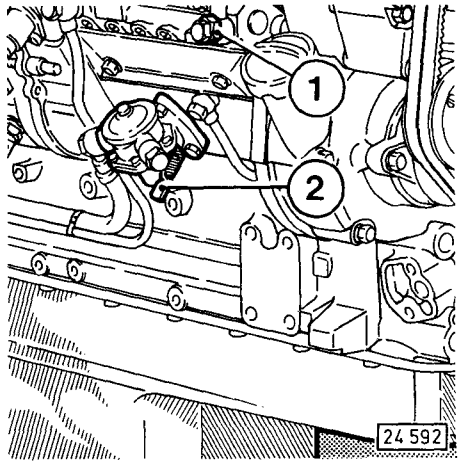


Fig. 12

Bosch fuel feed pump:

- undoing the overflow valve 1 (Fig. 13) at the lower (larger) hexagon by 2–3 turns,
- releasing the knurled knob 3 of hand pump 2 by turning anticlockwise a few times,
- actuating the hand pump until fuel emerges free of air bubbles at the loosened overflow valve 1,
- and then tightening the overflow valve securely, while still pumping.
- Finally, screw in knob 3.

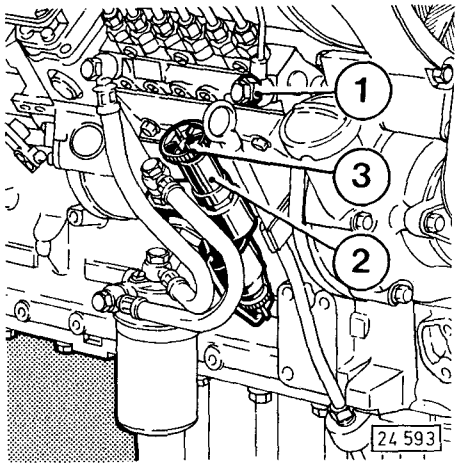


Fig. 13

Note:

Catch leakage fuel in suitable receptacle to prevent pollution of the environment!

Caution:

Stop engine before filling fuel tank!
Observe strict cleanliness.
Do not spill any fuel!

Observe sulphur content!

2. Motor Oil

2.1 Filling in Oil (Fig. 14)

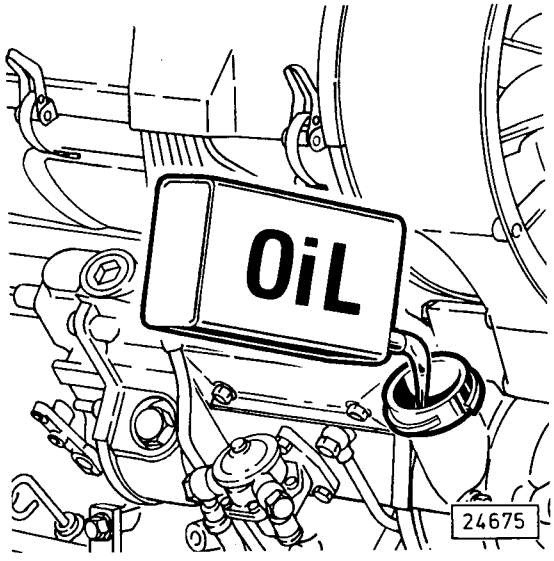


Fig. 14

2.2 Checking Oil Level (Fig. 15) - see page 106 -

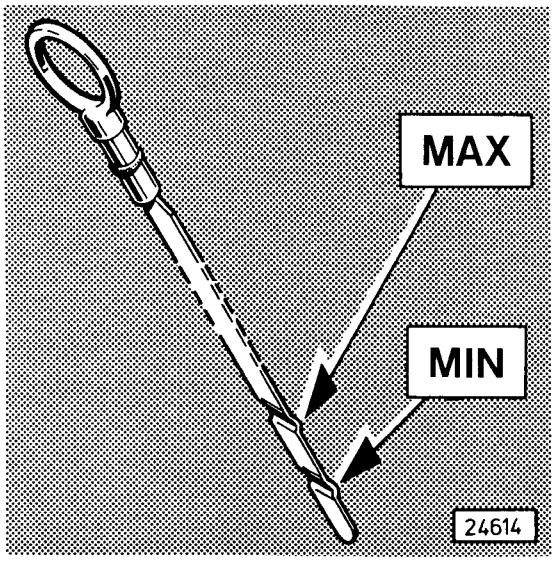


Fig. 15

2.3 Oil Quality

By preference, use oils of the API quality grade **"SHPD"**. You will thus attain the longest possible oil change intervals.

Oils of the API quality grade **CD/SE** and **CD/SF** can be used when halving the length of oil intervals (see page 106).

Note:

During operation of the engine, not only part of the oil lubricating the pistons is burnt but the thermal stress and the combustion residues mixing with the oil also entail a deterioration of the oil and in particular of its chemical additives. Therefore, a complete change of the oil should be carried out at the recommended intervals.

As this deterioration is greatly influenced by the operating conditions as well as by the quality of the fuel and oil used, the oil change intervals differ accordingly. Be sure, therefore, strictly to observe the specifications given on page 106.

2.4 Oil Viscosity

The viscosity of the oil being greatly influenced by the ambient temperature, the choice of the SAE-grade should be governed by the ambient temperature at engine site (see diagram). If temperatures temporarily fall below the limit of the SAE-grade selected, this will merely affect the starting performance but cause no engine damage.

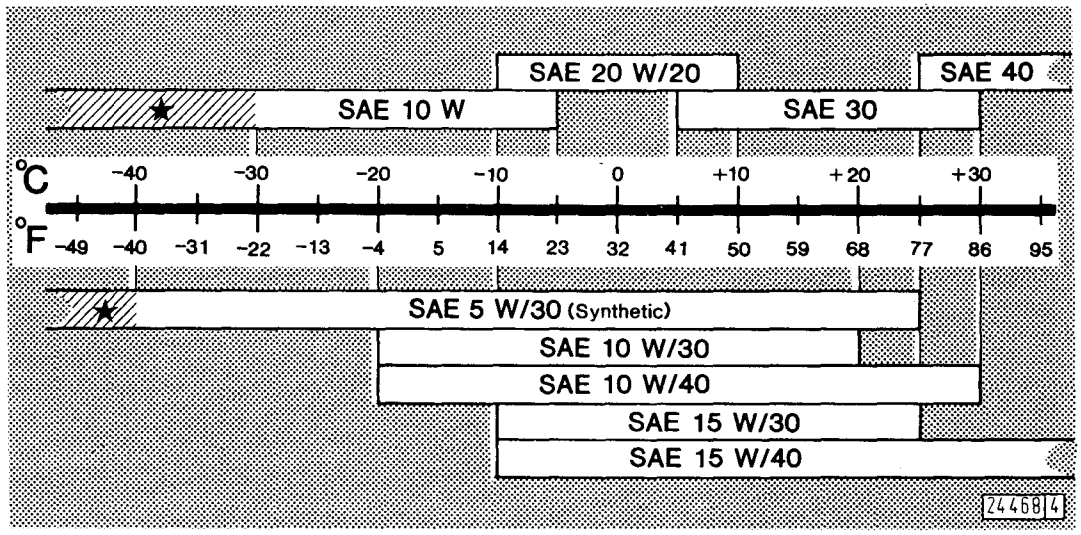


Fig. 16

Only with engine oil preheating.

Since a too viscous oil causes starting difficulties, the choice of the viscosity grade **during winter operation should be governed by the ambient temperature prevailing at the time of starting the engine.** Oil changes as a function of ambient temperatures can be avoided by using multigrade oils, which are again subject to the oil change intervals recommended on page 106. The required oil capacities are given under "Specification Data" on page 76.

3. Oil Bath Air Cleaner (if mounted)

The air cleaner bowl 1, Fig. 17, must be filled with oil before starting up (use the same grade of motor oil as for the engine). Be sure not to fill dust trap 2 of precleaner 3, if provided, with oil as it is exclusively meant for collecting dust.

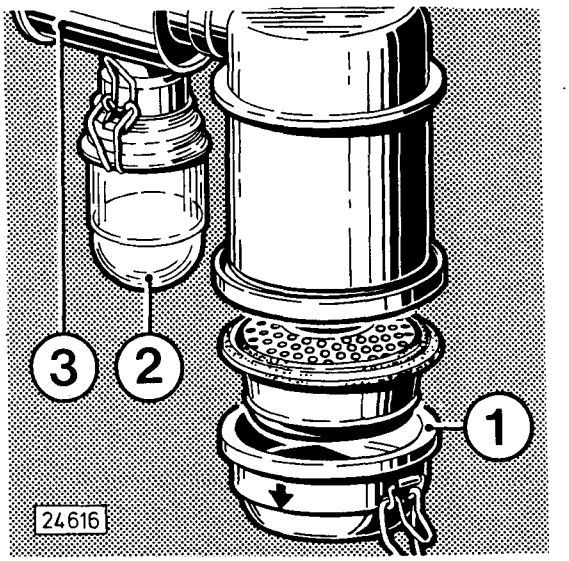


Fig. 17

Engine Operation

4. Starting

- Disengage driven equipment, where possible.
- Move speed control lever 1 (Fig. 18) to about quarter speed by hand or foot.
- Insert starter key 1 (Fig. 19), turn clockwise to detent.
- Check that charging pilot lamp 2 lights up.
- Push key in deeper and turn farther clockwise against spring pressure.
- Starter motor now turns engine; release key 1 when engine starts firing.

4.1 Starting Operation with Flame-type Heater Plug

- Disengage driven equipment, where possible.
- Move speed control lever 1 (Fig. 18) to about quarter speed by hand or foot.
- Insert starter key 4 (Fig. 19), and turn clockwise to detent, checking that charging pilot lamp 2 lights up.
- Turn heater plug/starter switch 3 to preheating position 1 and hold there for about 1 minute (preheating). Heater plug indicator 5 should glow brightly.
- Turn heater plug/starter switch 3 to starting position 2.
- Starter motor now turns engine; when engine starts firing, release heater plug/ starter switch 3, which will return to zero position.

Note:

Do not actuate the starter for more than 20 seconds at a time. You will protect your battery if you wait for 1 minute between each starting attempt. Then begin again with the preheating stage, if necessary.

If the engine does not fire after two starting attempts, find out the cause with the aid of the Trouble Chart on pages 130 and 131.

Cut the speed back as soon as the engine is firing smoothly. The charging pilot lamp 2 should by now have gone out. A few minutes' running at moderate load and varying speed will bring the engine up to its normal working temperature.

In the case of gen-set engines, the warming-up procedure has to take place at the set rated speed.

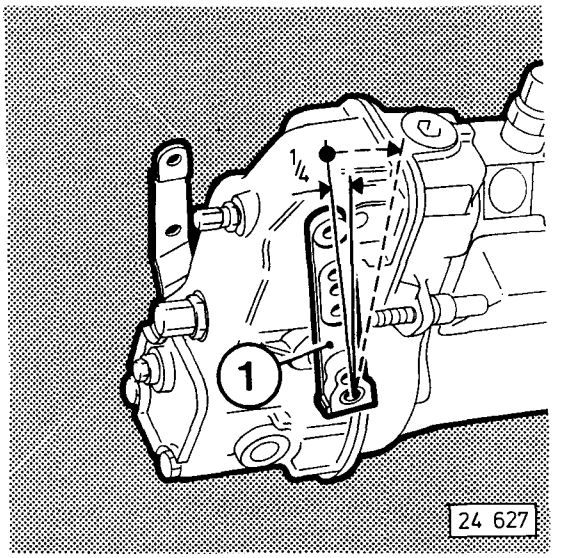


Fig. 18

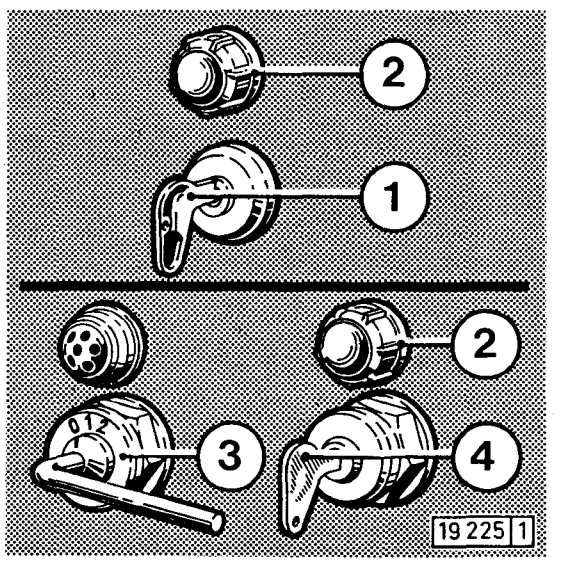


Fig. 19

Caution!

Before starting, make sure that no one is standing in the close vicinity of the engine or driven machine. After carrying out repairs: check that all safety guards have been refitted and all tools have been removed from engine.

4.2 Starting at Low Ambient Temperatures

See "Operation in Winter", page 92.

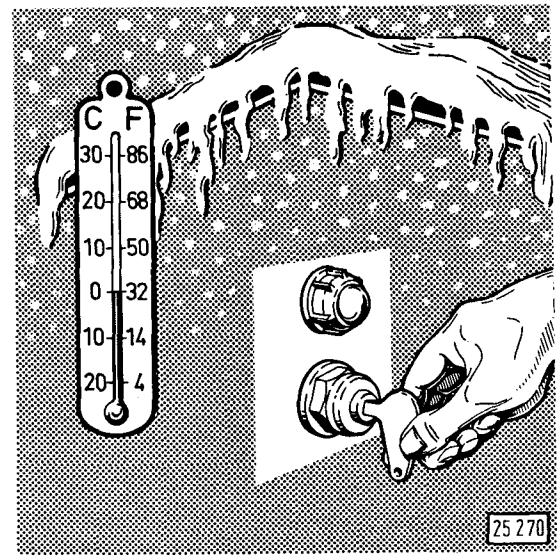


Fig. 20

5. Attendance in Service

5.1 Motor Oil Pressure

Check that, at low idling speed,

- the green oil pressure pilot lamp (if provided) has gone out, or
- the pointer of the oil pressure gauge 1 (Fig. 21) (if provided) is in the green sector, or
- The pointer of the oil pressure gauge (Fig. 22) (if provided) indicates a pressure of at least 1.0 bar.

Note:

The minimum pressure is 1.0 bar in the case of low idling at 650 + 50/min.

Lighting up of the warning lamp at low idling (engine warm) or falling of the pointer into the red sector is permissible if, when speed is increased, the lamp goes out and the pointer moves into the green sector.

Where a continuous monitoring of the oil pressure is desired also within the engine's working speed range, this will require an optional extra.

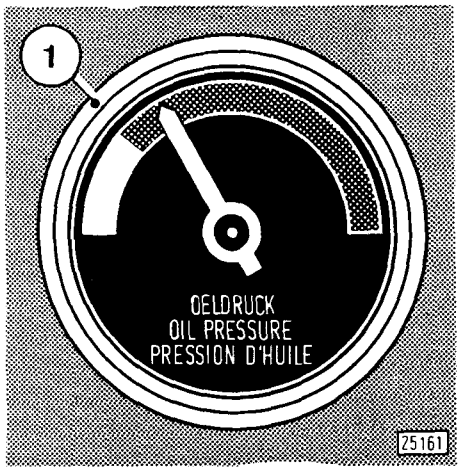


Fig. 21

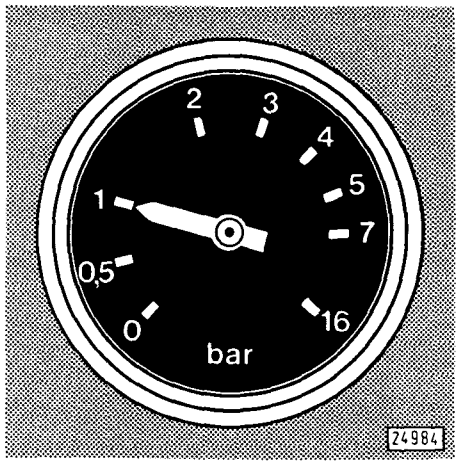


Fig. 22

5.2 Temperature

The pointer of the temperature gauge* (Fig. 23) should normally be in the green sector, and in the yellowish-green sector in exceptional cases only. **If the pointer moves into the orange sector, this means that the engine is overheated and must be shut down immediately.** In this case, the cause of the overheating must be traced with the aid of the Trouble Chart on pages 130 and 131.

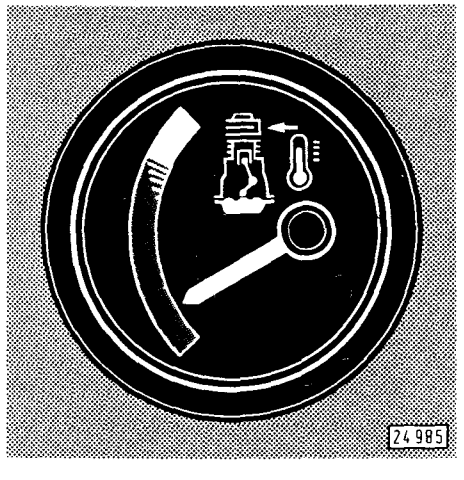


Fig. 23

Not mounted on all engine versions.

5.3 Fan Drive

Should the fan belt fail, switch 1* (Fig. 24) will release an audible or visual signal. **Stop engine immediately, to prevent overheating!**

* Not mounted on all engine versions.

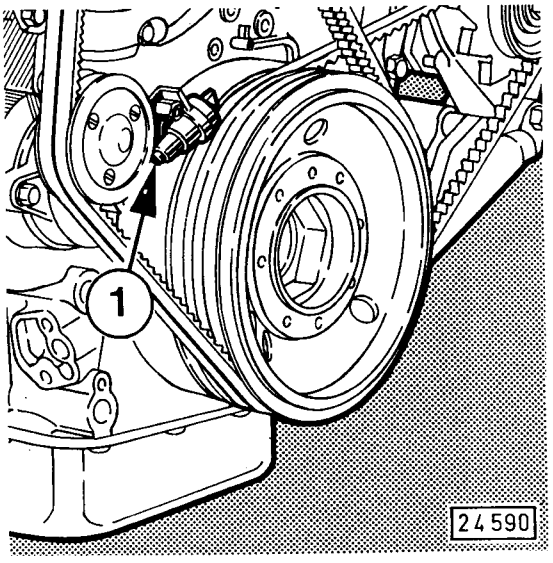


Fig. 24

6. Stopping

- Set speed control lever 1 (Fig. 25) to idling position.
- Operate stopping lever 2 (Fig. 25) on the injection pump until the engine stops, whereupon the pilot lamp 2 (Fig. 19) should light up again.
- Turn switchkey 1 or 4 (Fig. 19) fully anti-clockwise and pull out; this will cause the pilot lamp to go out.

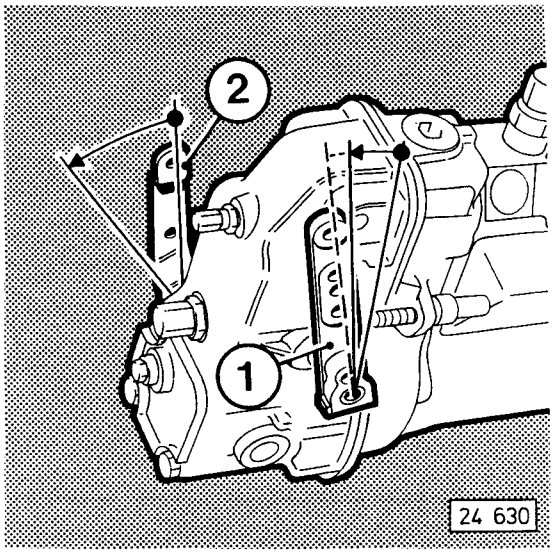


Fig. 25

Note:

Like all internal combustion engines, the air-cooled DEUTZ diesel engine should not be shut down suddenly from full-load running. It is better to let the engine idle for 1–2 minutes to allow for temperature balance.

Engine Operation

. Operation in Winter

.1. Use winter-grade motor oil

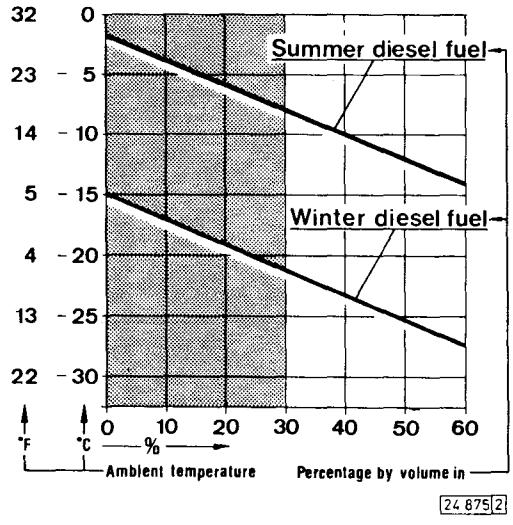
o ensure satisfactory cold starting, the choice f the viscosity grade (SAE-grades page 86) hould be governed by the ambient tempera- ıre prevailing **at the time of starting.**

s to the oil change intervals, it should be borne ı mind that operation below –10°C (+14°F) equires shorter oil change intervals (see page 06, "Changing Motor Oil").

.2. Fuel

lse winter-grade fuel in winter because with rdinary fuel, clouding may occur at low tempe- ıtures and clog the fuel filter. At excessively ıw temperatures, even winter-grade fuel may ınd to cloud.

herefore, if only summer-grade fuel is avail- ble, or if winter-grade fuel is used at excessi- ely low temperatures, we recommend the fol- ıwing percentages (see diagram) for mixtures f diesel fuel and kerosene or regular-grade asoline*. Admixture of the latter is however ermissible for a short period only, but never for ermanent operation.



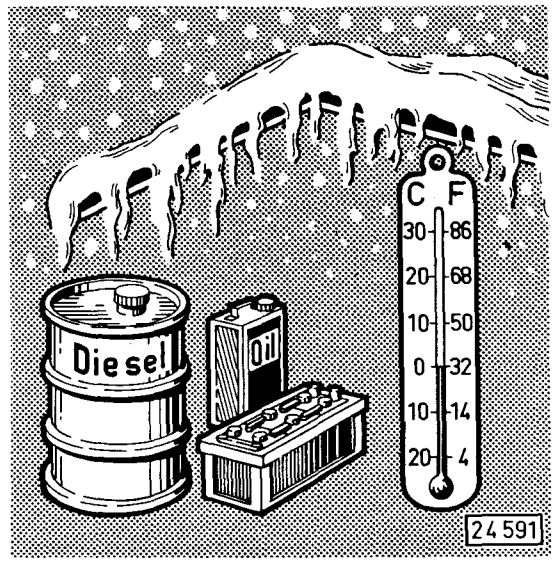


Fig. 26

Caution!

Prepare the blend in the tank itself: fill in the gasoline first, then add diesel fuel. The blend is as easily inflammable as pure gasoline.*

Maximum admixture of regular-grade gasoline* 30%; when admixing **more than 30%, use kerosene only.**

ır using a commercial additive, please consult your DEUTZ Service Station.

Never use premium fuel.

7.3 Additional Maintenance Jobs

- **The grade of oil in the oil bath air cleaner** – if fitted – should preferably suit the ambient temperature just like the engine oil.

7.4 Cold Starting Aids

7.4.1 Flame-type Heater Plug (Fig. 27)

The flame-type heater plug should be used at ambient temperatures near or below freezing point. It not only lowers the starting limit temperature, but proves also useful at temperatures normally not requiring a starting aid. This plug can also be used for afterburning for the purpose of preventing starting smoke if it is employed right from the beginning of the starting operation (preheating).

Located at the inlet of the air intake pipe, the flame-type heater plug heats up the combustion air by burning small amounts of fuel from the injection pump as metered by a solenoid valve.

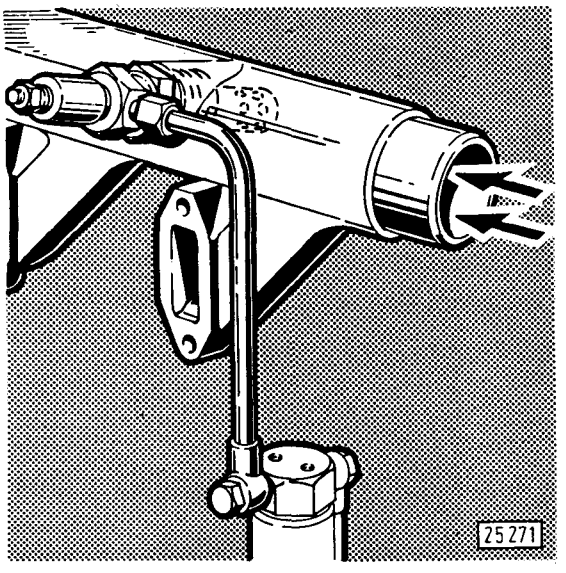


Fig. 27

Note:

Cold starting of a Diesel engine depends, among other things, on the capacity of the starter motor and that of the battery, as well as the turning resistance offered by the transmission and driven machine. Since the starting equipment of the engine may differ according to its application, no data on limit temperatures for cold starting are given in this Manual. Any DEUTZ distributor, however, will furnish you with the desired information on this subject.

The viscosity specification for lube oils should by all means be observed.

Cold starting requires satisfactory condition of the battery.
Lowering the limit temperatures by 4–5°C (39–41°F) is possible by raising the battery temperature to about +20°C (68°F). This is done by removing the battery with the engine stopped and storing it in a warm room.

When installing the battery, ensure satisfactory terminal contact by keeping contact surfaces clean and bright. To avoid distortion of terminal cones, be sure to tighten screws only moderately.

At very low temperatures (below – 30°C = – 22°F)
In the case of extremely low temperatures, the engine is to be warmed up to ensure satisfactory starting and lube oil supply. Parts for connecting preheating units, however, are provided only on engines intended for operation in very cold regions.

Engine Operation

7.5 Starting

- Disengage driven equipment, where possible.
- Move speed control lever 1 (Fig. 28) to about quarter speed by hand or foot.
- Insert starter key 4 (Fig. 29), and turn clockwise to detent, checking that charging pilot lamp 2 lights up.
- Turn heater plug/starter switch 3 to preheating position 1 and hold there for about 1 minute (preheating). Heater plug indicator 5 should glow brightly.
- Turn heater plug/starter switch 3 farther to starting position 2.
- When engine starts firing, release key 4, which will return to zero position.
- Should the engine not start smoothly or expel grey-white smoke, do not attempt to accelerate with the speed control lever 1 (Fig. 28), but
- Afterheat in position I for not more than 3 minutes.
- Cut the speed back as soon as the engine is firing smoothly. The charging pilot lamp 2 should by now have gone out. A few minutes' running at moderate load and varying speed will bring the engine up to its normal working temperature.

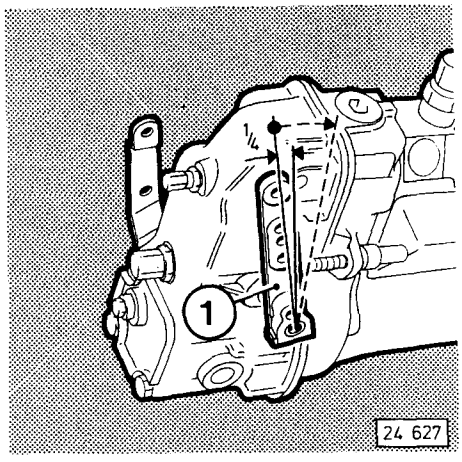


Fig. 28

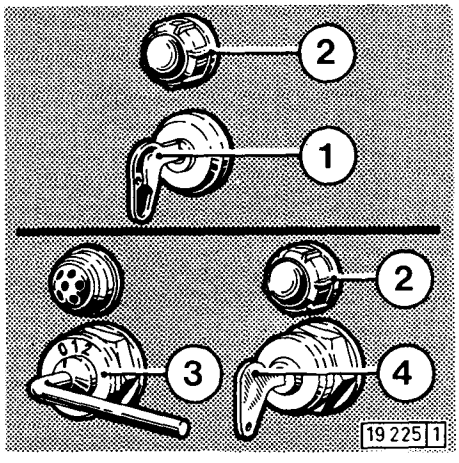


Fig. 29

Note:

Do not actuate the starter for more than 20 seconds at a time. You will protect your battery if you wait for 1 minute between each starting attempt. Then begin again with the preheating stage, if necessary.

If the engine does not fire after two starting attempts, find out the cause with the aid of the Trouble Chart on pages 130 and 131.

When starting with start pilot, fuel of very high ignition quality is sprayed into the intake pipe.

- Assist starting operation by actuating the pump until the engine fires smoothly. **Closely observe special instructions for start pilot VISO F 27** (Order No. 297 3654).

Caution!

Before starting, make sure that no one is standing in the close vicinity of the engine or driven machine. After carrying out repairs: Check that all safety guards have been fitted and all tools have been removed from the engine.

Caution!

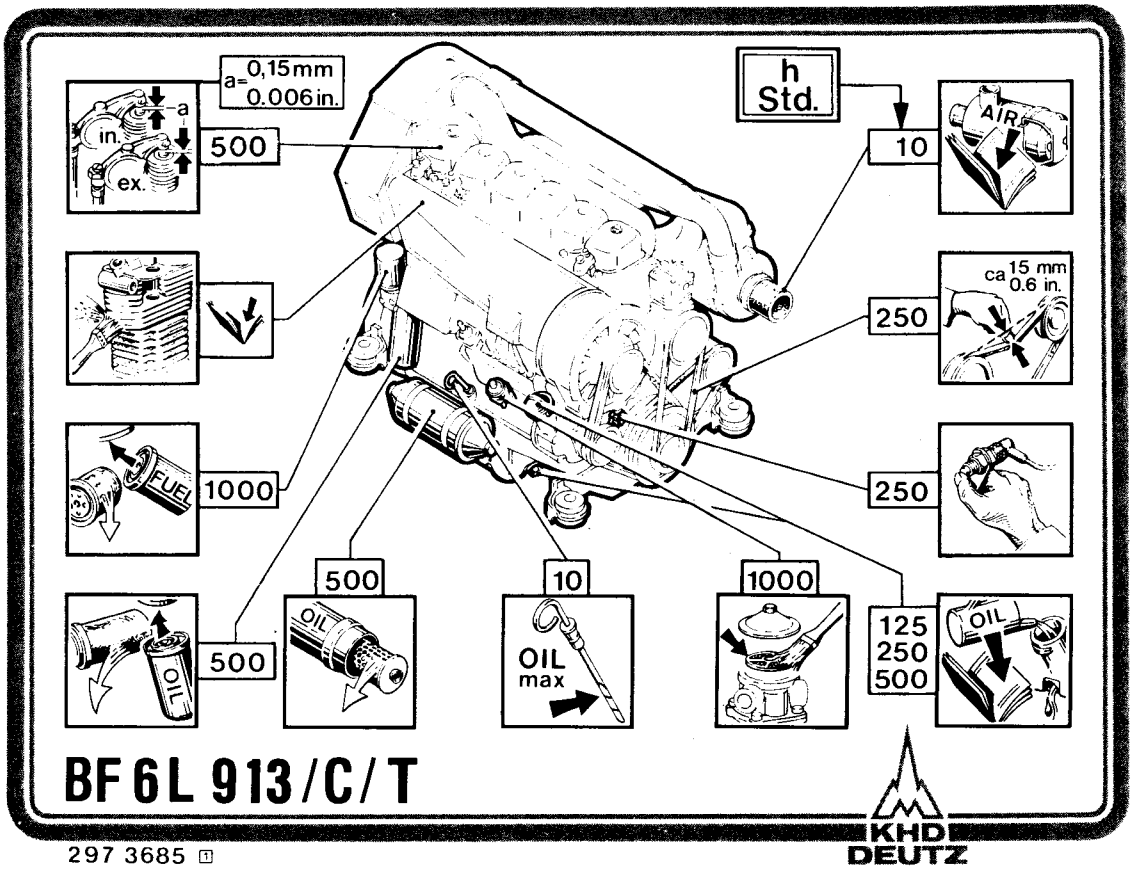
Do not inject an excessive amount of fuel. Never use the start pilot together with the flame plug preheating system.

Stop engine before carrying out any maintenance work.

IMPORTANT!

The Maintenance Chart* displayed below is supplied as a self-adhesive label along with each engine. Check that this label is stuck at a convenient location on the engine or driven equipment. If necessary, ask for a fresh supply of labels.

*** Note:**
Valid for routine maintenance work is the Maintenance Schedule on page 97.



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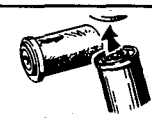
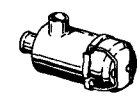
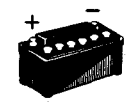
Maintenance

Engine Maintenance

The maintenance jobs described on the following pages ensure ready engine availability at all times and long life span.

Improvement of → / by servicing ↓	Engine power	Specific fuel consumption	Specific oil consumption	Bearing clearances	Exhaust emissions	Engine noise	Starting performance	Engine reliability	Long life
			O	O			O	O	O
OIL 				O				O	O
AIR 	O	O	O	O	O			O	O
FUEL 	O			O			O	O	O
				O				O	O
							O	O	
	O	O		O	O	O	O	O	O
	O	O			O	O	O	O	O

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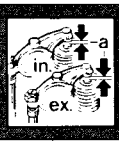
Maintenance Schedule

● Check ■ Clean ▲ Change  See Note

	●	● ■	●		Job
Every 10 hours					Maintenance point
	101	102–104	105		See page
	▲	● ■	●		Job
Every 125 hours					Maintenance point
	106/107	108/109	110		See page
	▲	●	●		Job
Every 250 hours					Maintenance point
	106/107	111	112/113		See page
	▲	▲	●		Job
Every 500 hours					Maintenance point
	106/107	114/115	116/117		See page
	■	▲			Job
Every 1000 hours					Maintenance point
	118	119–121			See page

Workshop Maintenance

Every 1000 hours	●	Air intake and exhaust manifolds	123
	●	Cylinder-head temperature indicator	124
Every 1500 hours	●	Alternator	126
	●	Starter motor	126
Every 3000 hours	●	Injectors	127

Maintenance

The maintenance jobs duly completed can be recorded and certified in the schedule below.

Completed Maintenance Jobs

Hours	Date	Signature	Hours	Date	Signature
–			–		
* 50			–		
125			250		
375			500		
625			750		
875			1000		
1125			1250		
1375			1500		
1625			1750		
1875			2000		
2125			2250		
2375			2500		
2625			2750		
2875			3000		
3125			3250		
3375			3500		
3625			3750		
3875			4000		
4125			4250		
4375			4500		
4625			4750		
4875			5000		
5125			5250		
5375			5500		
5625			5750		
5875			6000		

* See instructions on page 100

The maintenance jobs duly completed can be recorded and certified in the schedule below.

Completed Maintenance Jobs

Hours	Date	Signature	Hours	Date	Signature
6125			6250		
6375			6500		
6625			6750		
6875			7000		
7125			7250		
7375			7500		
7625			7750		
7875			8000		
8125			8250		
8375			8500		
8625			8750		
8875			9000		
9125			9250		
9375			9500		
9625			9750		
9875			10000		
10125			10250		
10375			10500		
10625			10750		
10875			11000		
11125			11250		
11375			11500		
11625			11750		
11875			12000		
12125			12250		
12375			12500		

Maintenance

Important: Commissioning New or Overhauled Engines

At the end of 15 minutes' running:

- **Retension V-belts** (Fig. 30).
  See pages 112/113.

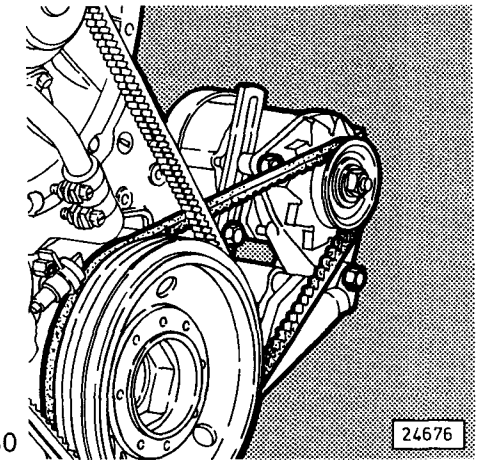


Fig. 30

At the end of 50 hours' running:

- **Change oil.**
  See pages106/107.

  At the first oil change, the following jobs are due in addition:

- **Renew lube oil filter cartridge** (item 1, Fig. 31). See pages 114/115.
- **Oil sump:**
  Retighten bolts (2).
- **Retighten engine mounting bolts.**

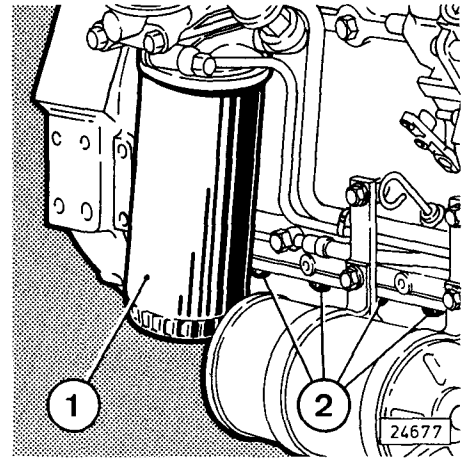


Fig. 31

- **Retighten bolts securing air intake and exhaust manifolds** to the cylinder heads (item 3, Fig. 32). See page 123.
- **Check valve clearance*** (item 4, Fig. 32), readjusting if necessary. See pages 116/117.
- **Clean fuel precleaner.** See page 118, Design 2.

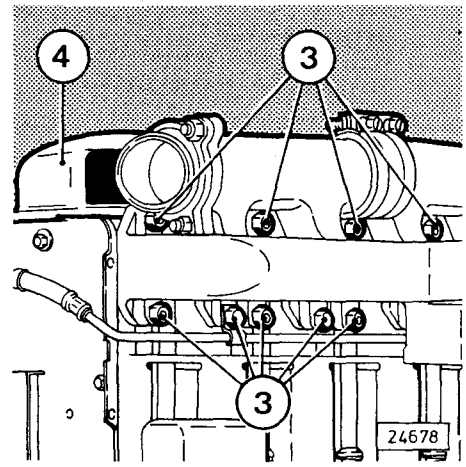


Fig. 32

Make sure that the illustrated Maintenance Chart, supplied loose, is stuck at a conspicuous point. (See page 95).

Routine Maintenance

Check Oil Level in Engine

- Engine must be in horizontal position.
- Pull out dipstick 1 (Fig. 33).
- wipe with clean, non-fraying rag,
- reinsert as far as it will go, and then
- withdraw again.

  The oil level should be between the marks 2 and 3. If the level is only up to or even below the lower mark, top up with oil immediately, preferably up to the upper mark 2, in order to prevent serious damage being caused to engine.

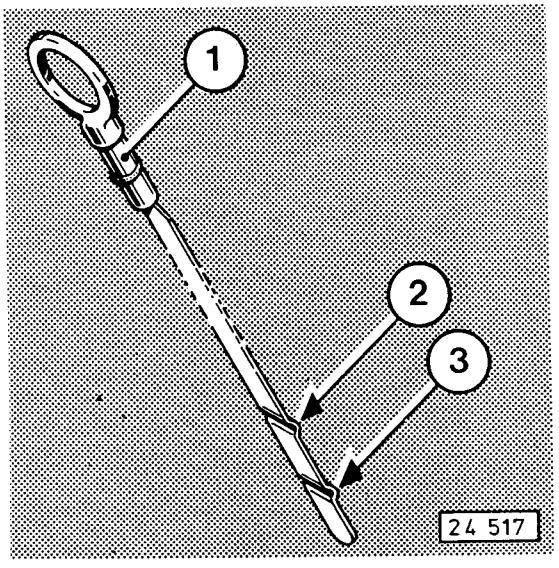


Fig. 33

Note:

Checking the oil level **before** *starting ensures that there is adequate oil in the engine ready for the start.*

A more exact check of the oil level can be made by stopping the engine after running for about one minute. The entire oil system has then become filled with oil, so that an oil level check immediately after stopping the engine indicates the amount of oil actually available in the oil sump during engine operation.

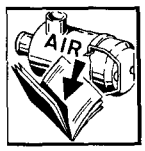
In the case of engines with mounted cab heating system utilizing the heat of the engine oil, the operating lever of the heating system must be in the position for maximum heating during the ca. 1-minute run.

We strongly recommend this double-check of the oil level prior to operation of the engine over prolonged periods, particularly if the check before starting showed the oil level to be in the vicinity of the lower dipstick mark.

Normally, new engines have a higher oil consumption. During the running-in period (about 200 running hours) it is therefore essential to check the oil level twice a day. After the running-in period, one check per day is sufficient.

Where engines are inclined, oil level should reach top mark of dipstick.

Maintenance



Checking and Cleaning Air Cleaners

Dust in the combustion air can cause premature wear of the engine. Maintenance of the air cleaners is therefore essential to ensure long life. **It is also necessary to check unions and connections of the intake manifold regularly.**

The maintenance intervals for air cleaners depend on the amount of dust fall-out. No fixed intervals can therefore be given.

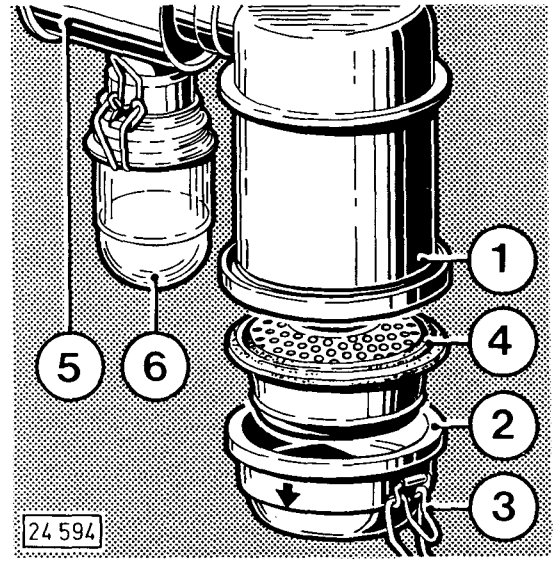


Fig. 34

1. Oil Bath Air Cleaner (if mounted, otherwise see page 103)

- Before checking, wait at least one hour after stopping the engine, so that the oil has had time to drip down from the cleaner element.
- Release the snap clips 3 (Fig. 34) and remove oil bowl 2.
- Remove element 4 by sidewise tapping with the hand or by inserting a screwdriver. Do not damage rubber gasket!
- Renew oil in bowl 2 (for motor oil viscosity, see page 86. Note oil level mark (arrow).
- Rinse filter element 4 in diesel fuel (never in gasoline!) and allow to drip-dry **thoroughly.**
- Once or twice a year (depending on amount of dust), remove also the filter upper part 1 and likewise rinse in diesel fuel. Allow to drip-dry **thoroughly.**
- Following reassembly, check all connections for leaks.

1.1 Cyclone-type Pre-cleaner 5 (Fig. 34) (if mounted)

- Empty dust trap 6 when it is half full (see mark).
- Never fill the dust trap with oil.

2. Dry-type Air Cleaner (if mounted)

The life of the expendable paper cartridges in dry-type air cleaners depends on dust collector 2 (Fig. 35) being emptied in good time. Failing this, the cartridge will clog up fast. Be sure, therefore, to empty the collector not later than when filled half-way. **Where the air is very dust-laden, this may require daily servicing.**

If a special dust ejector 8 is provided, it is only necessary to clear the discharge slot from time to time.

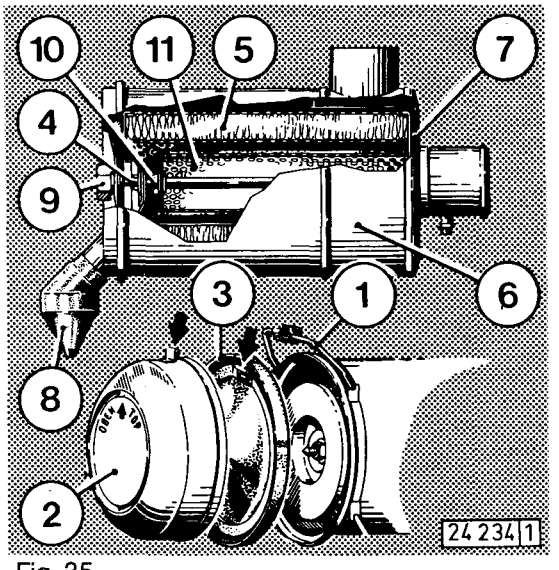


Fig. 35

2.1 Emptying the Dust Collector

- Stop engine.
- Release clip 1 (Fig. 35) and remove dust collector 2 along with cover 3.
- Take off cover 3 and empty collector.
- Refit assembly, making sure that recess on cover mates with lug on collector (see arrows, Fig. 35).
- When cleaner is installed in horizontal position, check that the "TOP" mark is actually at top.

2.2 Servicing the Cartridge

Where a service gauge (Fig. 36) is fitted and keeps displaying the red warning signal 1 when the engine is stopped, or where a yellow warning light goes on with the engine running, the cartridge is due for servicing. (Also indicated by smoking exhaust and decreasing engine output). It is not advisable to service the cartridge more frequently, as this may affect seal 7 (Fig. 35) between cartridge 5 and housing 6.

Replace cartridge not later than at the end of 12 months or when soiled by soot. If no new cartridge is to hand for replacement, the existing cartridge can also be cleaned for reuse (see Section 2.2.1), but should then be replaced at the earliest opportunity.

- Proceed by taking down dust collector 2 (Fig. 35) as described under 2.1.

  (Where a dust ejector 8 is provided, unscrew wing nut 9 and remove cover).

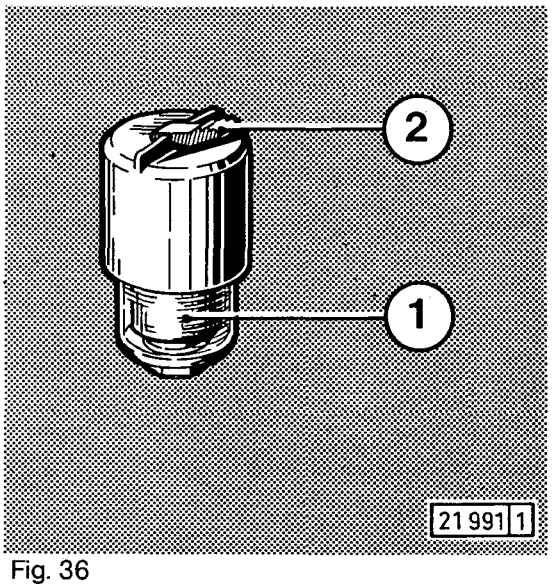


Fig. 36

- Unscrew hex. nut 4 and remove soiled cartridge 5.
- Renew or clean cartridge.
- After having serviced cartridge 5 five times, or after two years at the latest, renew also safety cartridge 11 (secured to body 6 by nut 10). Enter the number of servicings of cartridge 5 in the spaces provided on safety cartridge 11.
- **Safety cartridge 11 may not be cleaned and reused.**
- Renewal of cartridge 11 is also required when cartridge 5 is renewed because of defects, etc., or when warning signal reappears although cartridge 5 has been serviced.
- **Make sure that only genuine cartridges are used as supplied by the air cleaner manufacturer. Cartridges of other make usually do not fit and are a hazard to the engine.**

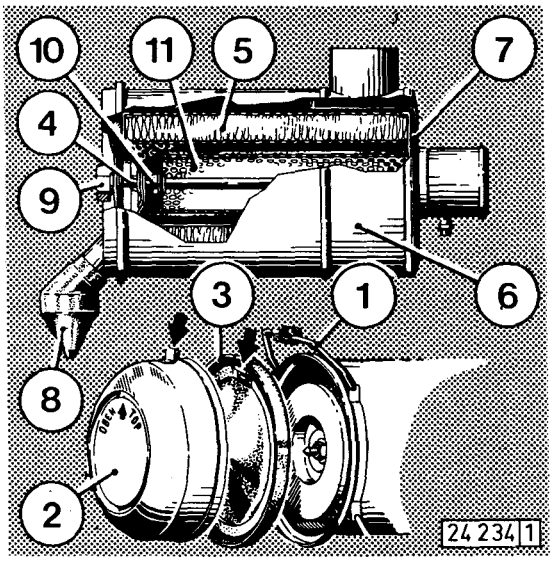


Fig. 35

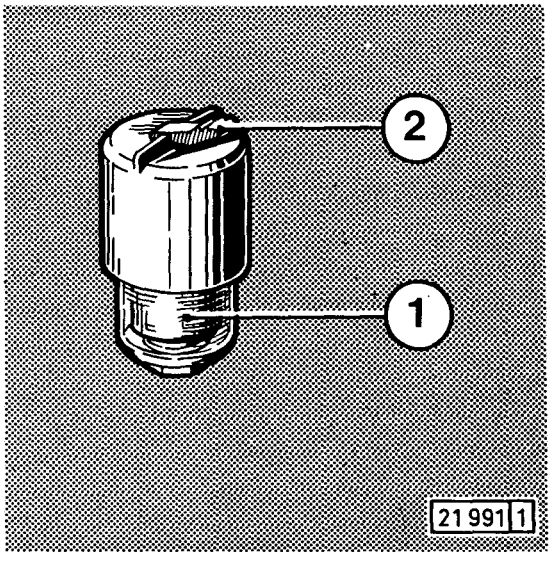


Fig. 36

2.2.1 Cleaning the cartridge:

a) by tapping (provisional): Tap cartridge 5 with its front end gently against the palm of your hand or on a soft surface, to shake off the dust. Take care not to damage the front end of the cartridge.

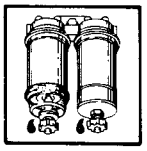
b) with air: Apply dry air blast of max. 5 bar from inside to outside until no more dust is coming out. **Do not blow out housing 6.**

Caution:

In no event use gasoline or hot liquids for washing the cartridge!

3. Checking:

Prior to reassembly, introduce a lighted bulb into filter cartridge 5 to see whether it suffered damage (damaged cartridges must definitely be renewed). Also make sure that gasket 7 is not defective. If a service gauge with visual signal is fitted (Fig. 36), press push button 2; this causes the red signal to disappear from the window.



Checking Water Separator on Two-stage Fuel Filter

(if mounted)

Some engine versions use a two-stage fuel filter with water separator for protection of the injection system. The water collects in bowls 2 and 3 (Fig. 37). In the transparent bowl 2, the water is distinguished from the fuel above by its lighter shade. Make sure that water level will not exceed the lower rim of bead 4.

The maintenance intervals for the water separator depend on the amount of water contained in the fuel and cannot be stated definitely. Initially, therefore, check daily whether there are indications of water in the transparent bowl 2.

Draining off the water:

- Loosen knurled screws 5 and bowls 2 and 3 through one or two turns.
- Observe the flow of draining liquid and the transition from water to diesel fuel.
- Gently retighten knurled screws 5.

Note:

Catch fuel in special receptacle to prevent pollution of the environment.

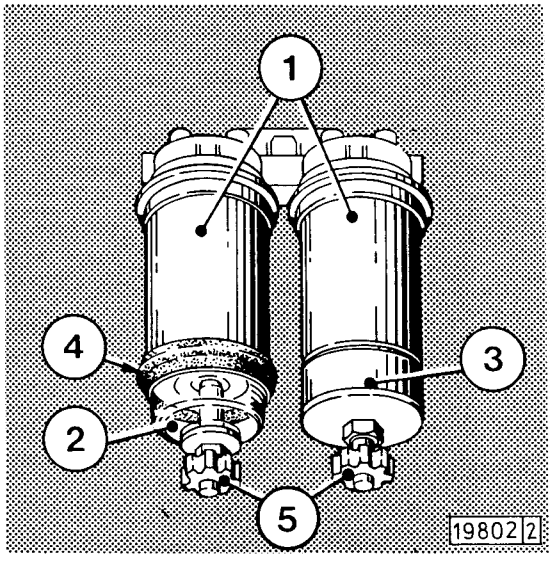


Fig. 37

Maintenance

Changing the Motor Oil

Important:
Should the engine run less than the hours stated in the following Table, the oil must be changed in any case **once a year.**

Oil Change Periods

Engine Application	Category of Oil Stressing	Oil Change Intervals (running hours)	
		Oil Grade **API: CD/SE** or **CD/SF**	Oil Grade **"SHPD"**
Tractors, Lift trucks, Cranes, Construction machinery, Rail traction units, Ships, Base-load gensets, Pumps	**A**	**250**	**500**
Farm equipment (seasonal) Underground mining, Road sweepers, Winter service, Emergency gensets, Emergency pumps	**B**	**125**	**250**

Important:
The above intervals are based on the use of a diesel fuel containing max. 0.5%b.w. of sulphur and **ambient temperatures above – 10° C (+ 14°F).**

Periods between oil changes should be cut by half
- when using fuels containing **more than 0.5% up to 1% sulphur** or
- if the ambient temperatures are permanently below –10°C (+ 14°F).
  In the case of fuels containing more than 1% up to 1.5% sulphur, the motor oil should have a TBN* of about 12 x %S-content, with the periods between oil changes being halved.

Typical examples:
1) Tropical climate, oil stressing category A, fuel containing 0.8% sulphur, lube oil grade CD/SE: Change oil every 250 hours.
2) Tropical climate, oil stressing category A, fuel containing 1.2% sulphur: Change oil every 250 hours, using CD/SE or CD/SF oil having a TBN* of about 14 mg KOH/g.

Oil Grades
The responsibility for the grading of his particular oil product to API Specification is borne by the supplier.
Oils of grade "SHPD" are approved from case to case (see pages 135 and 136).

Note
Upon changing over to a higher grade of oil following a prolonged period of operation, change oil at the end of 20 hours and renew oil filter.

* TBN = "Total Base Number", expresses the neutralising capacity of the oil. Ask your supplier to quote TBN.

Change Oil

while the engine is still hot, since the old oil will run more easily in this condition.

- Stop engine.
- Unscrew drain plug 1 (Fig. 38), after placing suitable receptacle underneath.
- When all old oil has run off, refit drain plug 1 complete with new sealing ring 2.
- Fill in fresh oil through filler neck 3 (Fig. 38) up to the upper dipstick mark (Max., Fig. 39).
- Following a short trial run, check oil level again, topping up to the upper mark (Max.) if necessary.

Oil capacity at refill
(without filter replacement): approx. 16 litres.

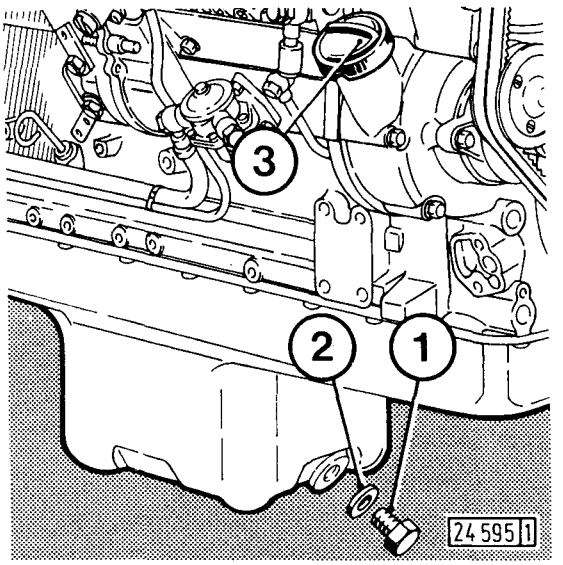


Fig. 38

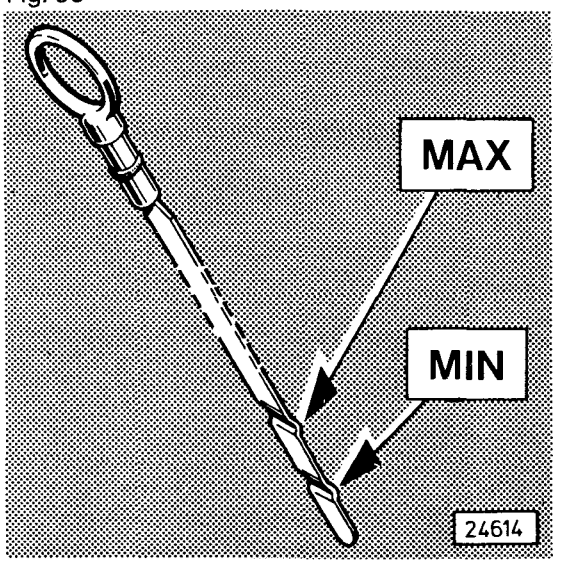


Fig. 39

Note:

In the case of engines with mounted cab heating system utilizing the heat of the engine oil, the operating lever of the heating system must be moved to the position for maximum heating before undoing the oil drain plug, to permit also draining of the oil from the heating circuit.

The operating lever of the cab heating system should also be at maximum heating position during the brief test-run prior to the final oil level check after filling in the fresh oil.

Caution:

Danger of scalding when draining off the hot oil!

Catch old oil in suitable receptacle to prevent pollution of the environment!

Maintenance

Inspecting/Cleaning the Cooling System

Cleaning the cooling system is most important since accumulation of dust on the cooling air blower blading, on the cooling fins of the cylinder heads, cylinders 1, or oil cooler 2 (Fig. 40) is liable to reduce cooling efficiency substantially, especially where the dust is retained by a film of fuel or oil. Any leaks of oil or fuel in the vicinity of the cooling air blower, cylinders, or oil cooler must therefore be eliminated at once and the cooling surfaces cleaned.

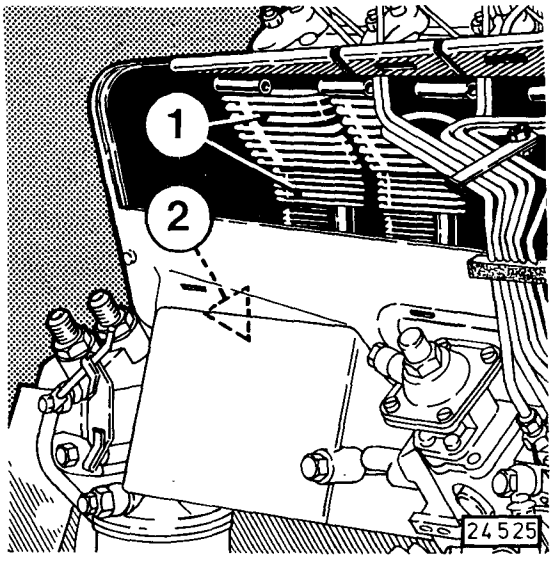


Fig. 40

Check the cooling system regularly for contamination in accordance with the following table, and clean if necessary. Please note that the inspection intervals can only be given as guide figures based on normal operating conditions, and that in the case of abnormally contaminated cooling air – check mounted cooling air sieve boxes for correct seating and good condition – the inspection and cleaning intervals may have to be shortened accordingly.

Inspection Interval (guide figures only) Running Hours	**Engine Application**
2000	Ships, Gen-sets in closed rooms, Pumps
1000	Vehicles on paved roads
500	Tractors, Lift trucks, Mobile gen-sets
250	Vehicles on building sites and unpaved roads, Construction machinery, Compressors, Underground mine units
125	Farm equipment, Tractors doing harvesting work

For inspecting and cleaning, proceed by releasing the fasteners 3 (Fig. 41) securing the air cowling hood 4 on the injection pump side, and removing the hood.

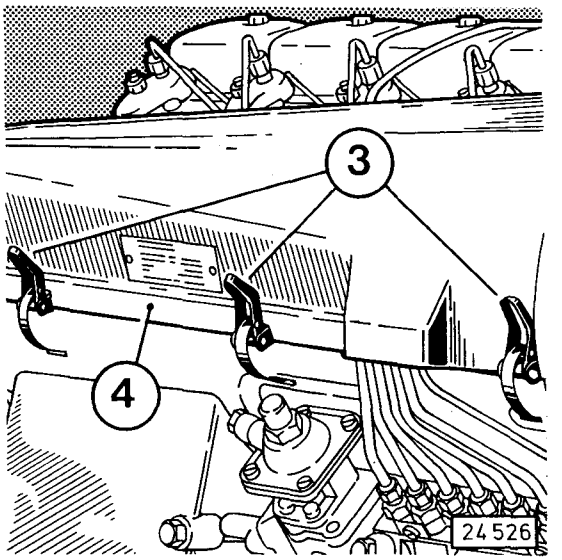


Fig. 41

Cleaning methods:

- **Dry cleaning** by means of compressed air. Start blowing through from the exhaust-air side (Fig. 41a).

  Any dirt blown into the air cowling space must be removed afterwards, of course.

- **Use of cold cleansing agent** (e.g. P3 or Nalfleet 9-040). After allowing an adequate soaking-in period, wash the engine with a powerful water jet.

- If a **high-pressure jet** is available, this method of cleaning is preferable to any other.

Note:

When cleaning the vehicle or engine by means of cold cleansing agent or steam, cover up the injection pump, alternator, voltage regulator and starter motor as protection against direct application of the jet.

After wet-cleaning, let the engine run until warm so that any water left behind will be evaporated before rust can form.

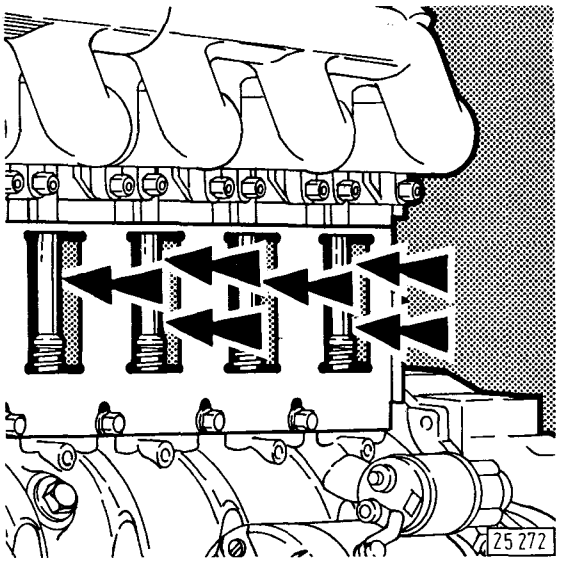
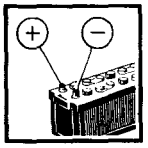


Fig. 41a

Caution:

Always stop the engine before cleaning!



Checking Electrolyte in Battery

- Remove cell caps 1 (Fig. 42).
- In some cases, electrolyte level testers 2 are provided: the level should be high enough to wet the bottom of these.
- An alternative method is to insert a clean wooden stick 3 into the cell until it touches the top of the plates. The electrolyte should wet the stick over a length of about 10–15 mm.
- If the electrolyte level is low, top up with **distilled water** only.
- Replace cell caps.
- For hints on battery care in winter, see page 93.

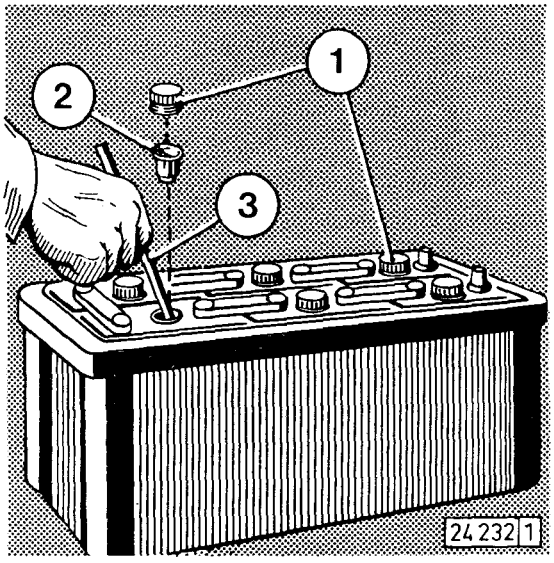


Fig. 42

Caution:

When working on the battery, keep naked lights away, do not smoke!

Do not allow acid to come into contact with the skin or clothing!

Wear protective goggles!

Do not place tools on battery!

Checking the Warning Device*

In the event of V-belt failure, the idler pulley will operate the electric switch 1 (Fig. 43), thus causing an audible or visual warning to be given.

- Stop engine.
- Switch on electric power supply to engine.
- Press in the pin 1 (Fig. 43) with finger to check function.

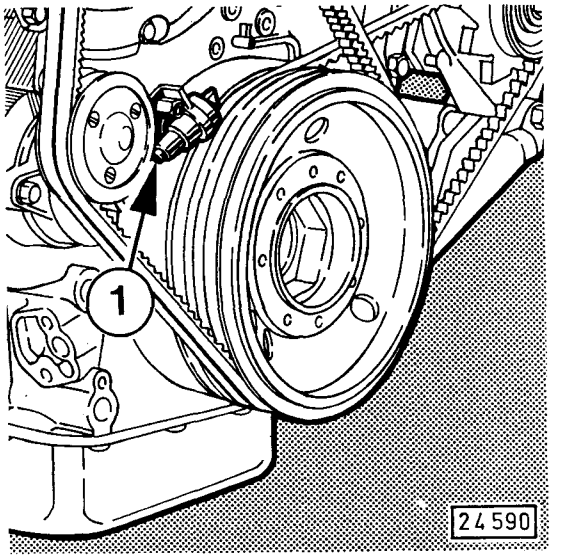
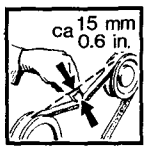


Fig. 43

Caution:

As safety precaution, always stop engine before checking function!

* Only fitted to order and on special models.



Checking V-belt/ V-belt Tension

- Inspect V-belts over entire length for damage or cracks. Renew damaged or cracked V-belts.
- Check by pressing with the thumb (Fig. 44) midway between the pulleys to see whether the V-belt deflects inwards by max. 10–15 mm (0.4–0.6 in.).

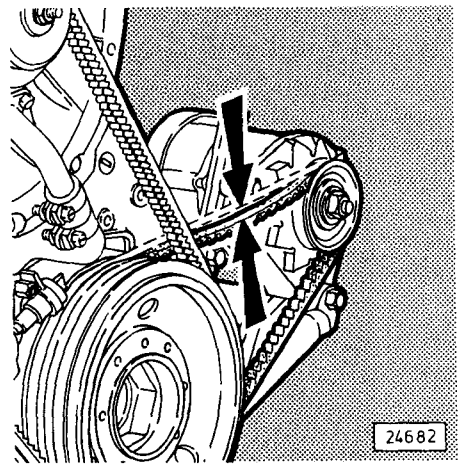


Fig. 44

Retensioning the V-belts:

- Slacken hex. bolts 1, 2 and 3 (Fig. 45).
- Pull alternator 4 in direction A until the correct belt tension is obtained.
- Then securely retighten hex. bolts 1, 2 and 3.

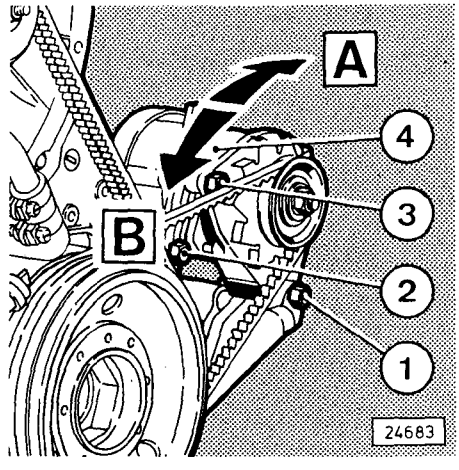


Fig. 45

Renewing the V-belts:

Blower V-belt

- Push idler pulley 1 (Fig. 46) vigorously inwards.
- Place on new belt.

Alternator V-belt

- Take off blower V-belt.
- Slacken hex. bolts 1, 2 and 3 (Fig. 45).
- Press alternator 4 in direction B against engine. In this position, it is easy to fit the new V-belt.
- Tension V-belt as described above.
- Refit blower V-belt.

Note:

Retension new V-belts after running for 30 minutes.

Not applicable to cooling blower drive with automatic tensioning pulley 1 (fig. 46).

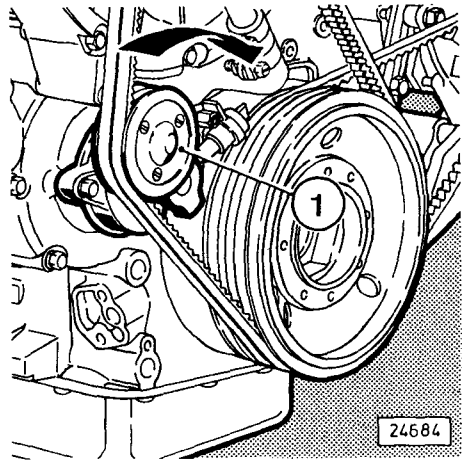


Fig. 46

Caution!

Stop engine before retensioning V-belts! Remount guards if fitted!

Retensioning Single-type V-belt on Compressor

- Unscrew hex. bolts 1 (Fig. 47).
- Take down outer half-pulley 2.
- Remove one or more shims 3 (Fig. 48) – as may be required – from inside and place removed shim(s) outside on half-pulley 2.
- Retighten bolts 1 (Fig. 47) while turning over the engine with the turning device to prevent the belt being squeezed.

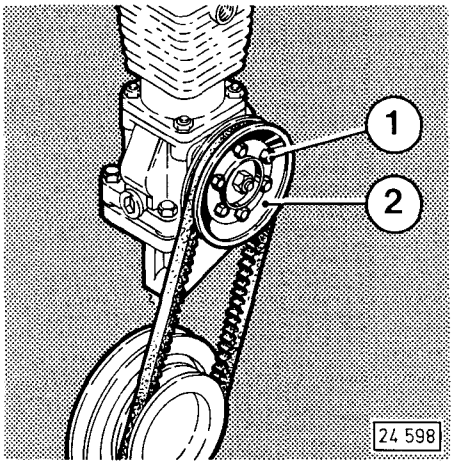


Fig. 47

Retensioning Twin-type V-belts on Compressor

- Unscrew hex. nuts 1 (Fig. 49).
- Take down half-pulleys 2 and 5 together with shim packs 6 and 7, as well as intermediate piece 4.
- For the purpose of retensioning the belts, take one or more shims – as may be required – from packs 6 and 7 and place them before or behind the half-pulleys (Fig. 49) to ensure alignment of the belts. The number of shims taken from each pack at a time must always be the same.
- Retighten hex. nuts 1 while turning over the engine with the turning device to prevent the belts being squeezed.

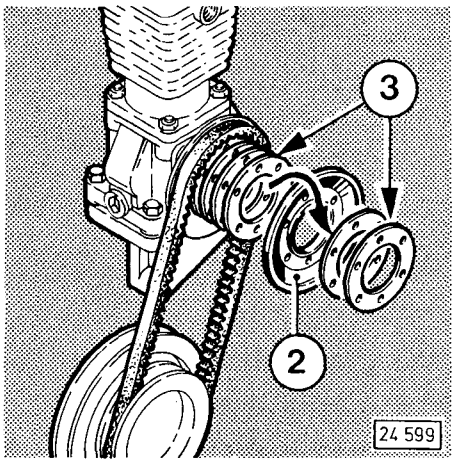


Fig. 48

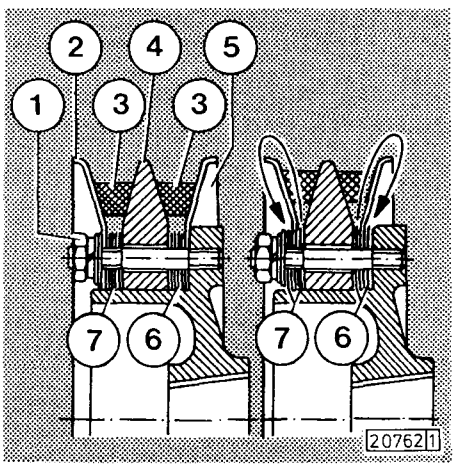


Fig. 49

Note:

When two V-belts are provided, always renew both belts when only **one** *is worn or damaged. The difference in length of the new V-belts may not exceed 0.15 %.*

Maintenance

Renewing the Oil Filter

. Main Cartridge

- Release cartridge 1 (Fig. 50) by wrench and screw off by hand.
- Clean sealing surface 2.
- After slightly oiling the rubber gasket 3, screw new cartridge in place by hand until gasket is evenly seated and give the cartridge a final half turn.

Cartridge spare Nos. are as follows:
117 4421 (AD 1.5 H 4123-R)
117 4420 (AD 2.2 H 4123-R)

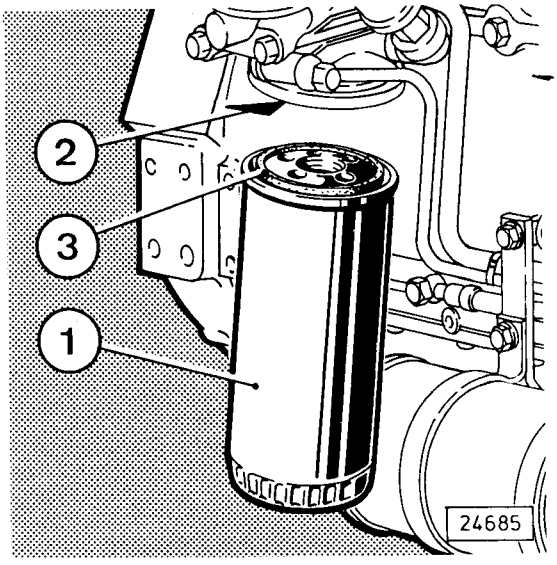


Fig. 50

Note:

During service following assembly, check oil pressure and filter tightness.

Caution!

A small amount of oil runs out when spinning off the filter.

Danger of scalding!

Catch old oil in suitable receptacle to prevent pollution of the environment!

2. Bypass Microfilter Element*

- Drain oil after removing plug 1 (Fig. 50a).
- Unscrew bolt 2 and remove filter top.
- Remove element and clean body.
- Renew top gasket if defective.
- Refit drain plug, install new element and resecure top.
- On restarting engine, make sure there are no leaks and oil pressure is correct.

Element spare No. is as follows:
116 8469

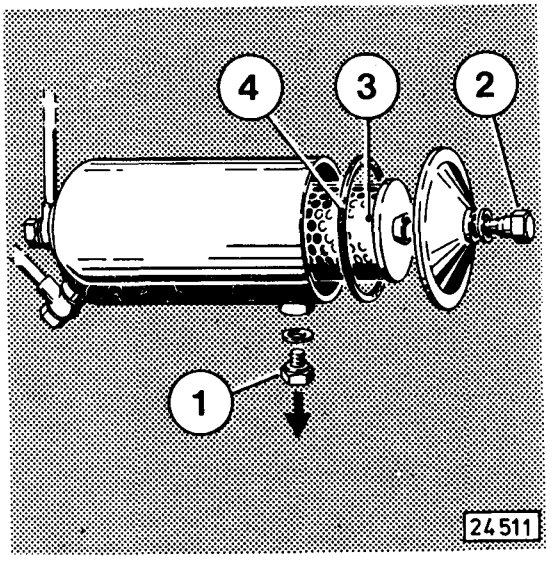


Fig. 50a

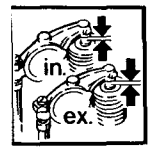
Caution!

A small amount of oil runs out when removing the filter element.

Danger of scalding!

Catch old oil in suitable receptacle to prevent pollution of the environment!

* If mounted



Checking Valve Clearance

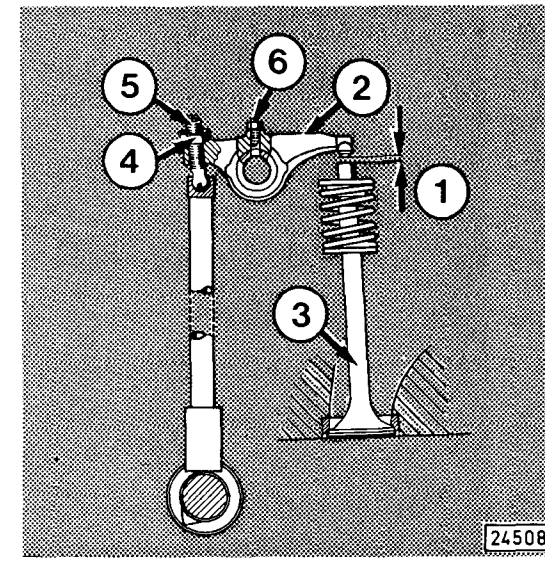


Fig. 51

- Valve clearance **to be checked with engine cold.**

Note:

The valve clearance is the requisite gap 1 between the pads of rocker arms 2 and valves 3 (Fig. 51). Good engine performance and power output depend on its correct setting which may be carried out by a skilled mechanic according to the following instructions, but preferably by a specialist.

- First remove rocker chamber covers.
- Turn crankshaft at front end with 36 mm socket until the valves of the cylinder in question are "overlapping" (exhaust valve about to close, inlet valve about to open).
- Then continue turning the crankshaft through 360°.
- Check valve clearance:
  Valve clearance 1 is correct when a **0.15 mm feeler gauge** can be inserted with a slight drag between pad of rocker arm 2 and valve 3.
- Failing this, the valve clearance must be readjusted.
- Readjust as follows:
  Loosen locknut 4 by two to three turns. Adjust setscrew 5 with screwdriver so that, when locknut is retightened, the feeler gauge can be inserted and withdrawn with slight drag.
- Check the valve clearances of each of the remaining cylinders and readjust if necessary.
- Do not change the setting of oil nozzle 6 unless required. With hot engine running at idling, an oil flow to pad of rocker arm 2 must be just noticeable! An excessive oil flow can lead to higher oil consumption.

Checking or resetting of the valve clearances at only two positions of the crankshaft is possible by means of the following method (see page 117).

Positioning the Crankshaft for Setting the Valve Clearances

Crankshaft Position 1

Turn the crankshaft until both valves at cylinder 1 are "overlapping" (exhaust valve about to close, inlet valve about to open). Fig. 52 shows under "Crankshaft Position 1" which valves can now be set.

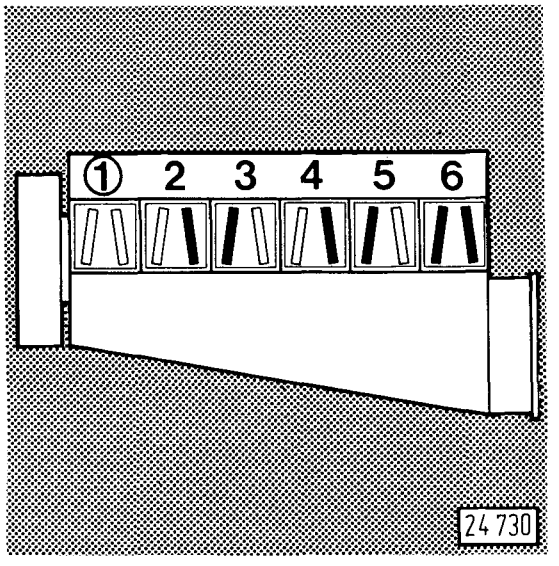


Fig. 52

Crankshaft Position 2

Having done this, turn the crankshaft further by one rotation (360°) – see Fig. 53, "Crankshaft Position 2".
Now the other valves can be set.

Not ready for setting

Ready for setting

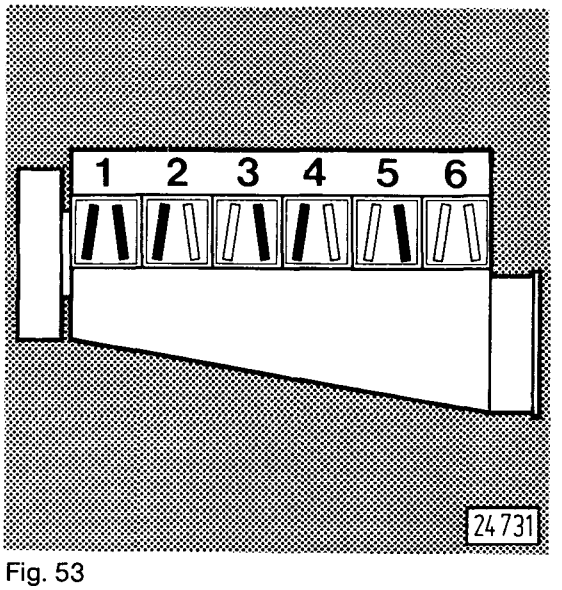


Fig. 53

Note:

After setting a valve, put a chalk mark to serve as a reminder that it has been done.

Cleaning Strainer of Fuel Feed Pump

Design 1:
Pierburg fuel feed pump

- In case of high-level tank, close fuel cock.
- Remove hex. bolt 1 (Fig. 54).
- Take off cover 2.
- Take out gasket 3 and strainer 4.
- Clean strainer in diesel fuel.
- Following reassembly, check unit for tightness.

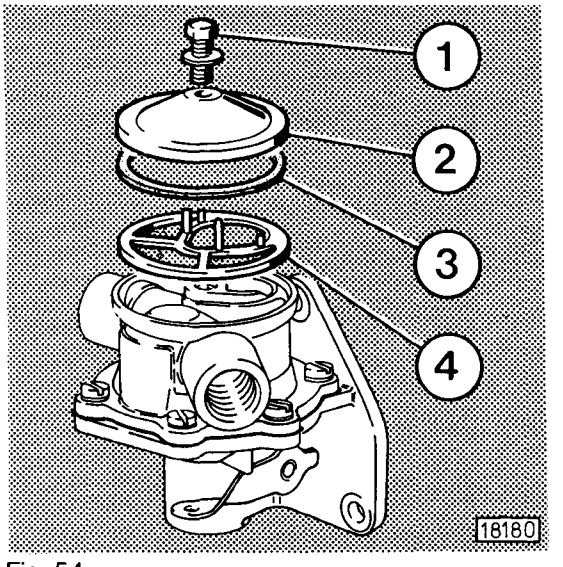


Fig. 54

Design 2:
Bosch fuel feed pump

- In case of high-level tank, close fuel cock.
- Loosen clamping nut 2 (Fig. 55).
- Swing aside wire yoke 1.
- Remove filter bell 5 together with filter strainer 4, and clean in fuel.
- Following reassembly, check for leaks.

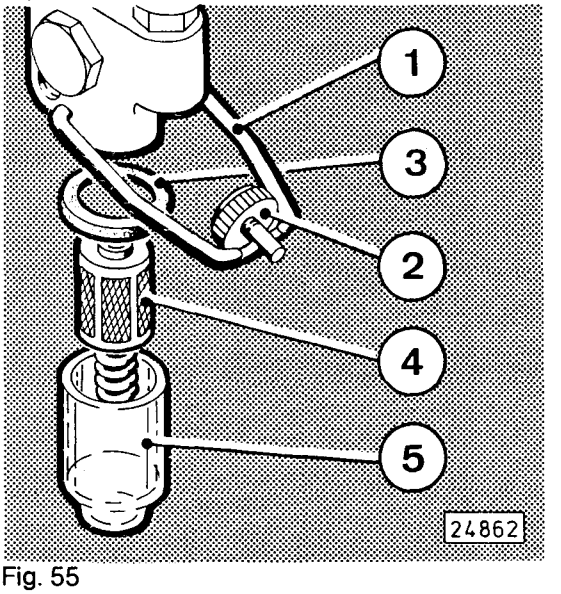


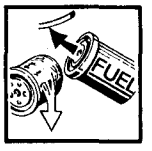
Fig. 55

Note:

Falling-off engine performance can be due to contamination of these strainers.

Caution:

When working on the fuel system, keep naked lights away, do not smoke! Do not spill any fuel!



Renewing the Fuel Filter Cartridge

- In case of high-level tank, close fuel cock.
- Place receptacle in position to catch escaping fuel.
- Screw off fuel filter cartridge 1 (Fig. 56), using special tool if necessary.
- Clean sealing surface.
- Apply a light film of oil to rubber gasket 2 of the new filter cartridge.
- Screw new cartridge in place by hand until gasket is evenly seated.
- Give cartridge a final half turn.
- Air-vent fuel system (see page 84).

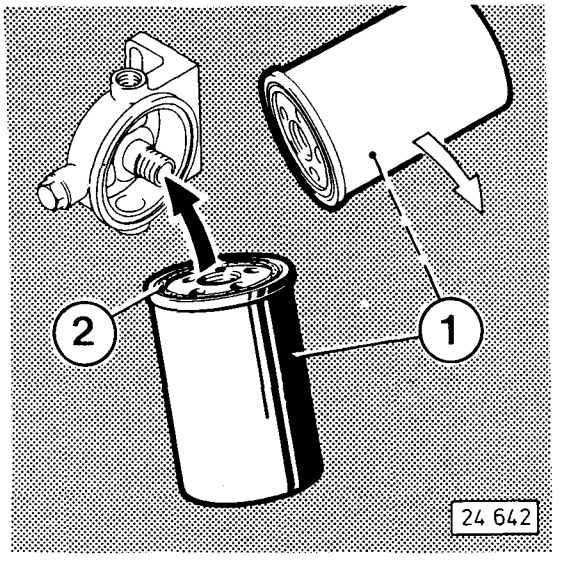


Fig. 56

Note:

Falling-off engine performance can be due to clogged filter cartridge. If the filter cartridge clogs up too quickly, check fuel for contamination, clean tank, check sealing of filler cap.

Caution:

When working on the fuel system, keep naked lights away, do not smoke!

Do not spill any fuel!

Renewing the Two-stage Fuel Filter Cartridge (1st stage)

- In case of high-level tank, close fuel cock.
- Place receptacle in position to catch draining-off fuel.
- Unscrew drain plug 2 (Fig. 57).
- Release clamping pin 3.
- Remove water bowl 5 and the two seals 4 and 6.
- Unscrew cartridge 1 from bracket and replace by new cartridge.
- Refit water bowl in reverse sequence, taking care that seals 4 and 6 are properly seated.
- Air-vent fuel system (see page 84).

Spare No. of filter cartridge:
1st stage 213 3558

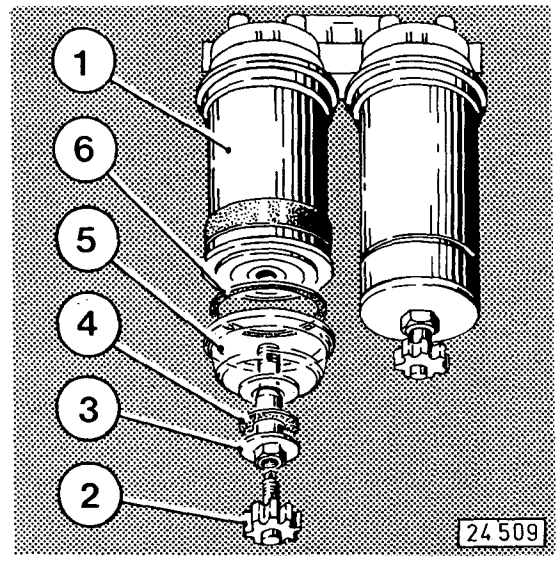
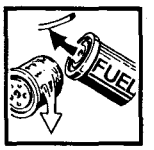


Fig. 57



Renewing the Two-stage Fuel Filter Cartridge (2nd stage)

- In case of high-level tank, close fuel cock.
- Place receptacle in position to catch escaping fuel.
- Unscrew filter cartridge 1 (Fig. 58) complete with drain plug by means of hexagon 2 at the bottom.
- Clean sealing surface.
- Apply a light film of oil to the rubber gasket of the new filter cartridge and screw new cartridge in place by hand until gasket is evenly seated, then give cartridge a final half-turn.
- Air-bleed fuel system (see page 84).

Spare No. of filter cartridge:
2nd stage 213 3943

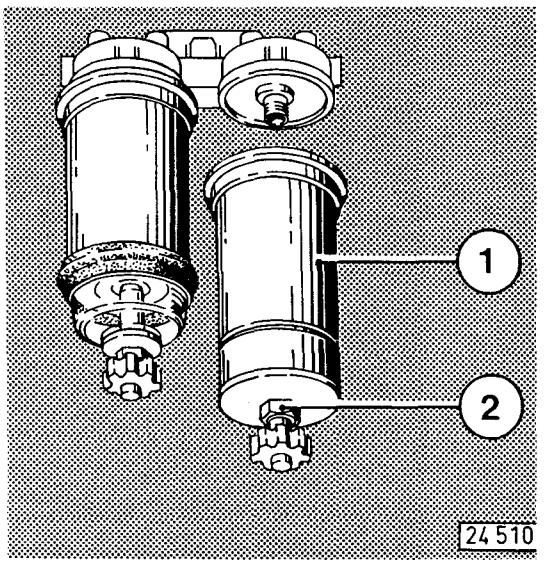


Fig. 58

Note:

Falling-off engine performance can be due to clogged filter cartridges. If the filter cartridges clog u too quickly, check fuel for contamination, clean tank, check sealing of filler cap.

Caution:

When working on the fuel system, keep naked lights away, do not smoke!
Do not spill any fuel!

Maintenance

Testing the Flame-type Heater Plug before the Cold Season begins or in Case of Starting Difficulties

Note:

When the heater plug functions properly, the intake pipe 4 (Fig. 59) should become fairly warm in the zone of the plug during the starting process with preheating (page 88). If not, check as follows:

Check 1

- Place speed control/stop lever in position "Stop".
- Insert switch key 4 (Fig. 60). Battery charging indicator lamp should then light up.
- Preheat for 1 minute in preheating position 1 of heater plug/starter switch 3 (Fig. 60). Heater plug indicator 5 should then light up brightly. If not, the plug is faulty or connection is interrupted.

Check 2

- Loosen pipe coupling 1 (Fig. 59) by a few turns.
- Turn heater plug/starter switch at once to position 2 to turn engine by starter.
- Fuel should emerge at the slackened pipe connection. If not, have the system (solenoid valve) checked by a specialist!

Check 3

- Remove flame-type heater plug and reconnect fuel line to plug.

  Turn engine with starter.

  Fuel should now emerge at plug.

  If not, plug is blocked and must be renewed.

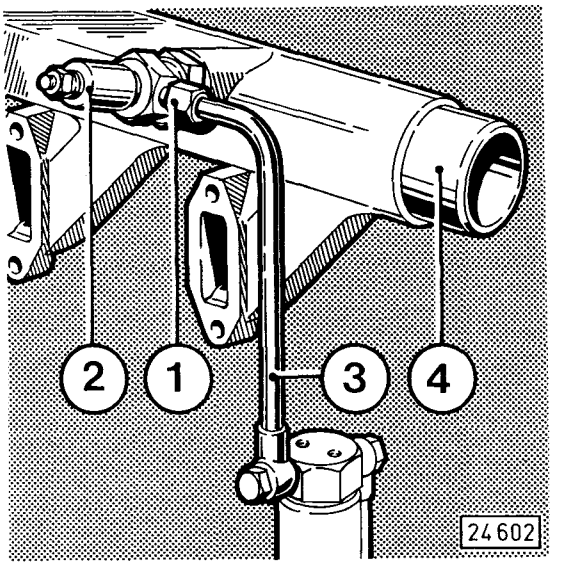


Fig. 59

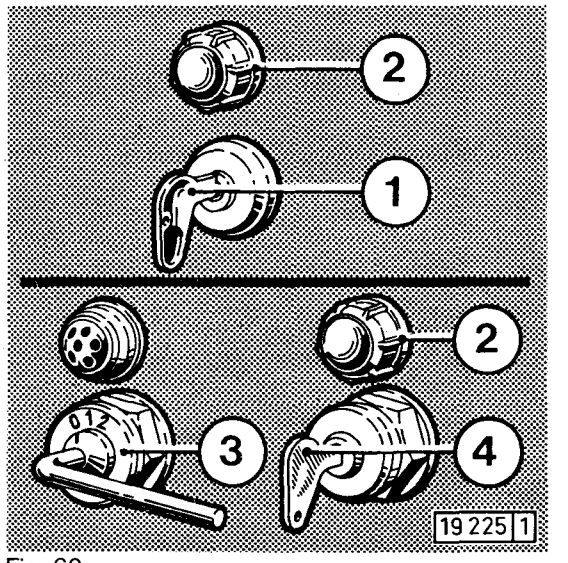


Fig. 60

Caution:

Keep away from rotating parts!

Inspecting Air Intake and Exhaust Manifolds

Check the connections of air intake manifold 1 (Fig. 61) and exhaust manifold 2 to the cylinder heads for tightness and retighten if necessary.

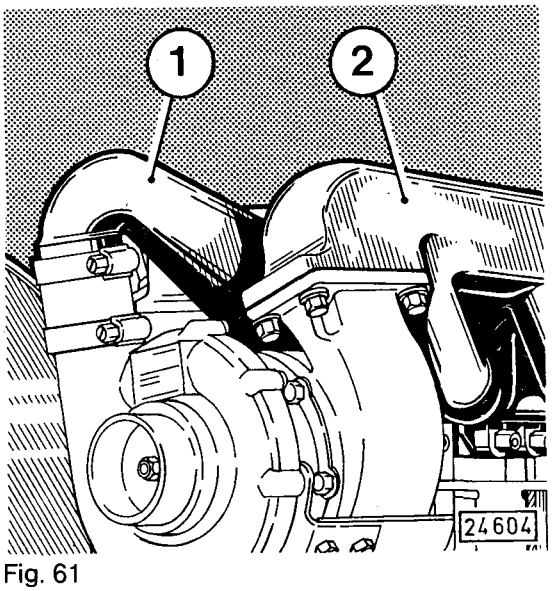


Fig. 61

Check Fastenings:

- Air intake manifold 1 and charge air line (Fig. 62),
- Charge air cooler on BF 6L 913 C,
- Exhaust manifold 2 (Fig. 62) and lube oil line 3 to and from turbocharger for firm seating and tightness.
- Connecting sleeves 4 for tight seating.

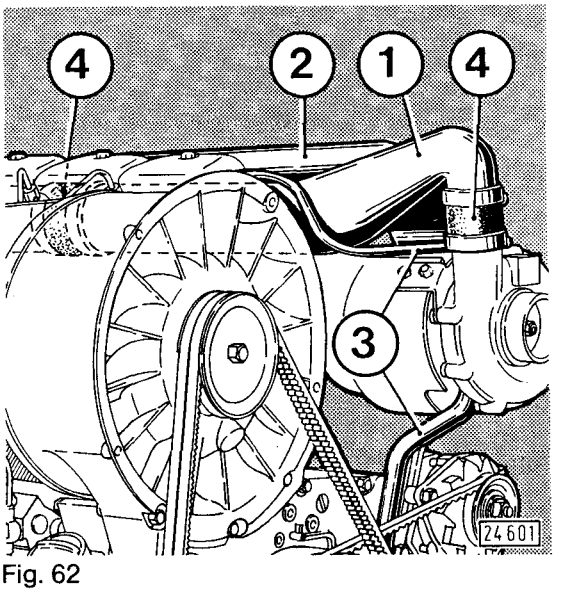


Fig. 62

Testing Temperature Indicator/Pilot Light

Unscrew sensor or switch 1, as provided (Fig. 63), from cylinder head 2 and immerse in SAE 30 or SAE 40 oil heated to 150–155° C (302–311° F). This should cause the red sector to appear in the window of the indicator or the lamp, if provided, to light up.

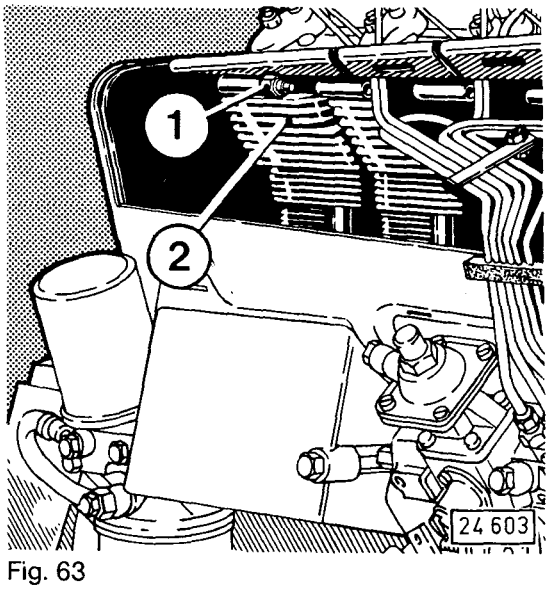


Fig. 63

Caution:

Heat the oil in a container on a hot-plate (not with welding torch). Do not exceed the specified temperature range. Danger of burns.

Note:

The temperature elements 1 (sensor or switch) are always screwed into the head of the No. 1 cylinder.

Cleaning of Exhaust Gas Turbocharger

Note:

Insufficient power, excessive engine temperature or a continually smoking exhaust may, among other items, be due to contamination on the compressor side of the exhaust turbocharger. In such a case, check the engine setting specifications (start of delivery, injectors) and clean the turbocharger if such a contamination proves to be true.

- Loosen connecting sleeves 1 (Fig. 64).
- Turn out hexagon head bolts 2 and remove compressor housing 3.
- Clean compressor housing 3 (Fig. 65) and compressor wheel 4 with a nonaggressive cleaning agent (e. g. diesel fuel, P 3 or cold cleaning agent).
- Refit in reverse order.
- Check for a proper seating of the connecting sleeves.

The exhaust gas turbocharger remains securely bolted to the exhaust gas pipe during the cleaning process.

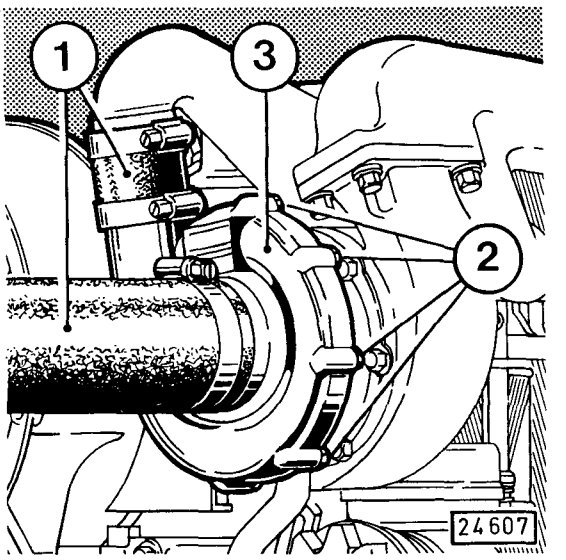


Fig. 64

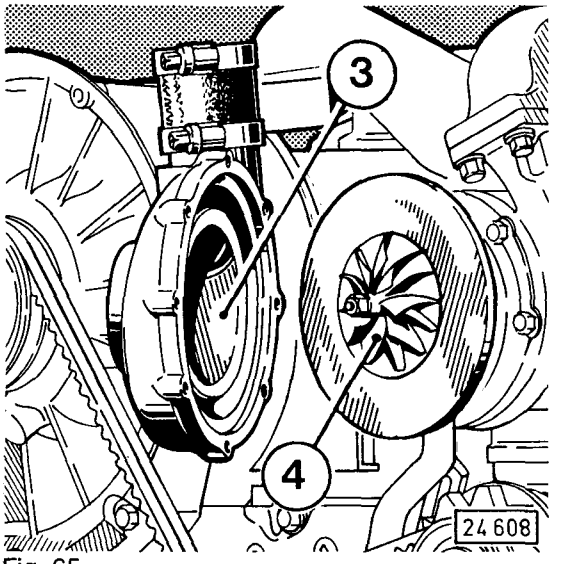


Fig. 65

Workshop Maintenance

Testing Alternator

t is advisable to have the alternator 1 (Fig. 66) tested in a specialized workshop.

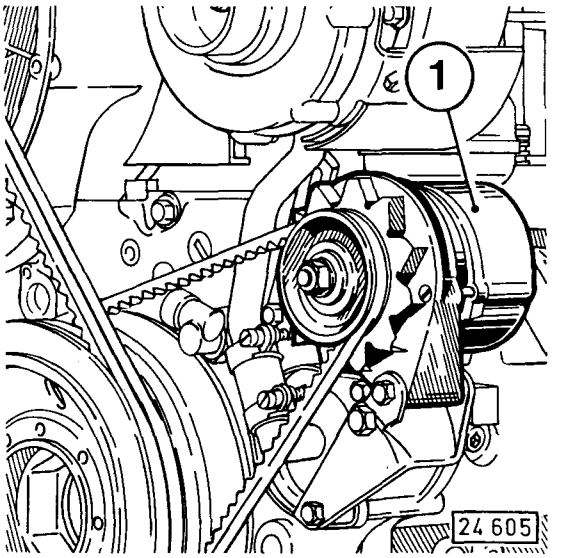


Fig. 66

Notes on three-phase system:

- When the engine is **running,** never disconnect the leads between battery, alternator and regulator. Where it is however necessary to operate the engine without battery,- disconnect, before starting, the alternator from the regulator.
- Never interchange the battery leads.
- Renew a defective charging pilot light bulb immediately.
- Before washing the engine, fit covers to protect the alternator and regulator.
- The common practice on a DC-system of touching a lead against earth for checking whether the lead is live must under no circumstances be adopted on a three-phase current system.
- In case of electric welding, connect the earth terminal of the welding unit direct to the piece to be welded.

Testing Starter Motor

t is advisable to have the starter motor 1 (Fig. 67) tested in a specialized workshop.

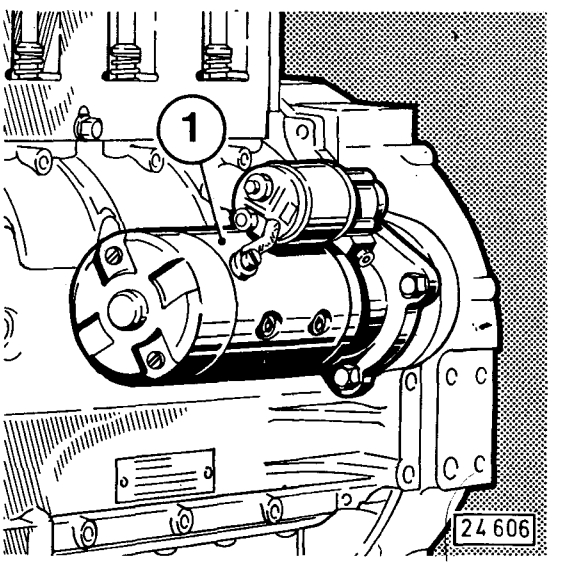


Fig. 67

Note:

Before washing engine, cover up starter motor.

Testing Injection Nozzles

- Remove injectors.
- Have the injectors tested in a specialized workshop. For specified injection pressure, see Specification Data, page 76.
- When refitting the injectors, observe tightening torque (see page 133)!

Note:

Inspection of the injectors between the times stated on page 97 is unneccessary unless the engine displays unusual symptoms (e.g. black exhaust smoke, harsh combustion noises).

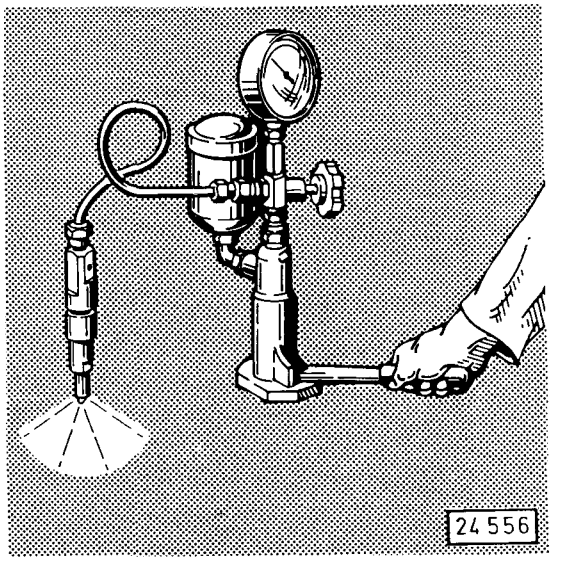


Fig. 68

Engine Preservation

If your engine is to be shut down for a major period (e. g. over the winter), we recommend the following preservation measures against rust formation.

1. Clean the engine, including the cooling system, with commercial detergent and a water-jet or, better, a high-pressure jet (see page 108).
2. Run engine up to working temperature and then shut down.
3. Drain the motor oil from the sump when still hot and fill in anti-corrosive oil.
4. Pour the oil out of the bowl of the oil bath air cleaner, clean bowl and fill up with anti-corrosive oil.
5. Drain fuel from tank, mix well with 10% anti-corrosive and fill back into tank. Instead of adding anti-corrosive oil to the fuel, the tank can be filled up with injection pump testing oil having corrosion inhibiting properties (e. g. Calibration Fluid B).
6. Run engine for about 10 minutes, so that pipes, filter, pump and nozzles are filled with the preservative mixture and the mixture is distributed to all parts.
7. After this run, detach the rocker chamber covers and spray the rocker chambers with a mixture of diesel fuel and 10% anti-corrosive or with injection pump testing oil. After this, refit the covers.
8. Now turn the engine over several times without firing in order to spray the mixture into the combustion chambers.
9. Remove V-belts and spray the grooves of the V-belt pulleys with anti-corosive. Before reusing the engine, wipe off the anti-corrosive.
10. Close intake opening and exhaust opening tightly.

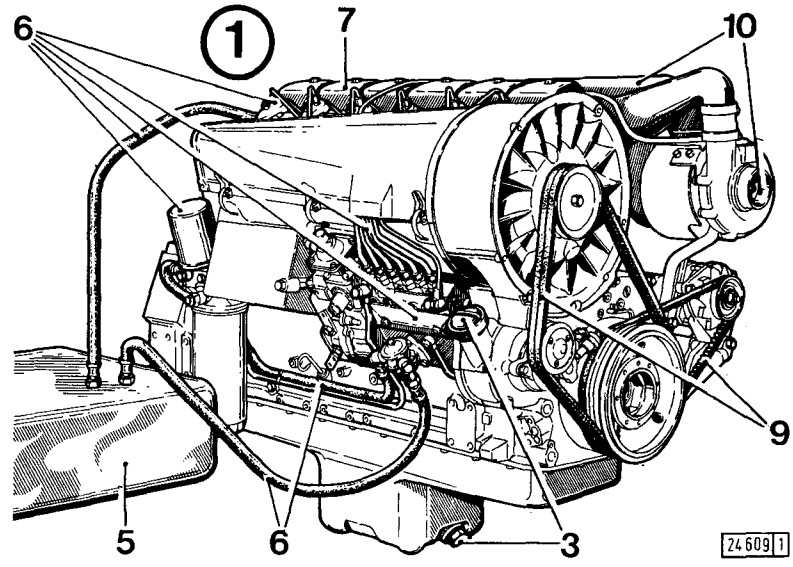


Fig. 69

Note:

These preservative measures will give the engine a protection of 6 to 12 months, depending on weather effects.

Before reusing the engine, replace the preserving mixture by regular motor oil to API-(MIL-) Specifications.*

The anti-corrosive oils used should conform to MIL-L 21260 B or TL 9150-037/2 specifications or NATO Code C 640/642.

* See page 106

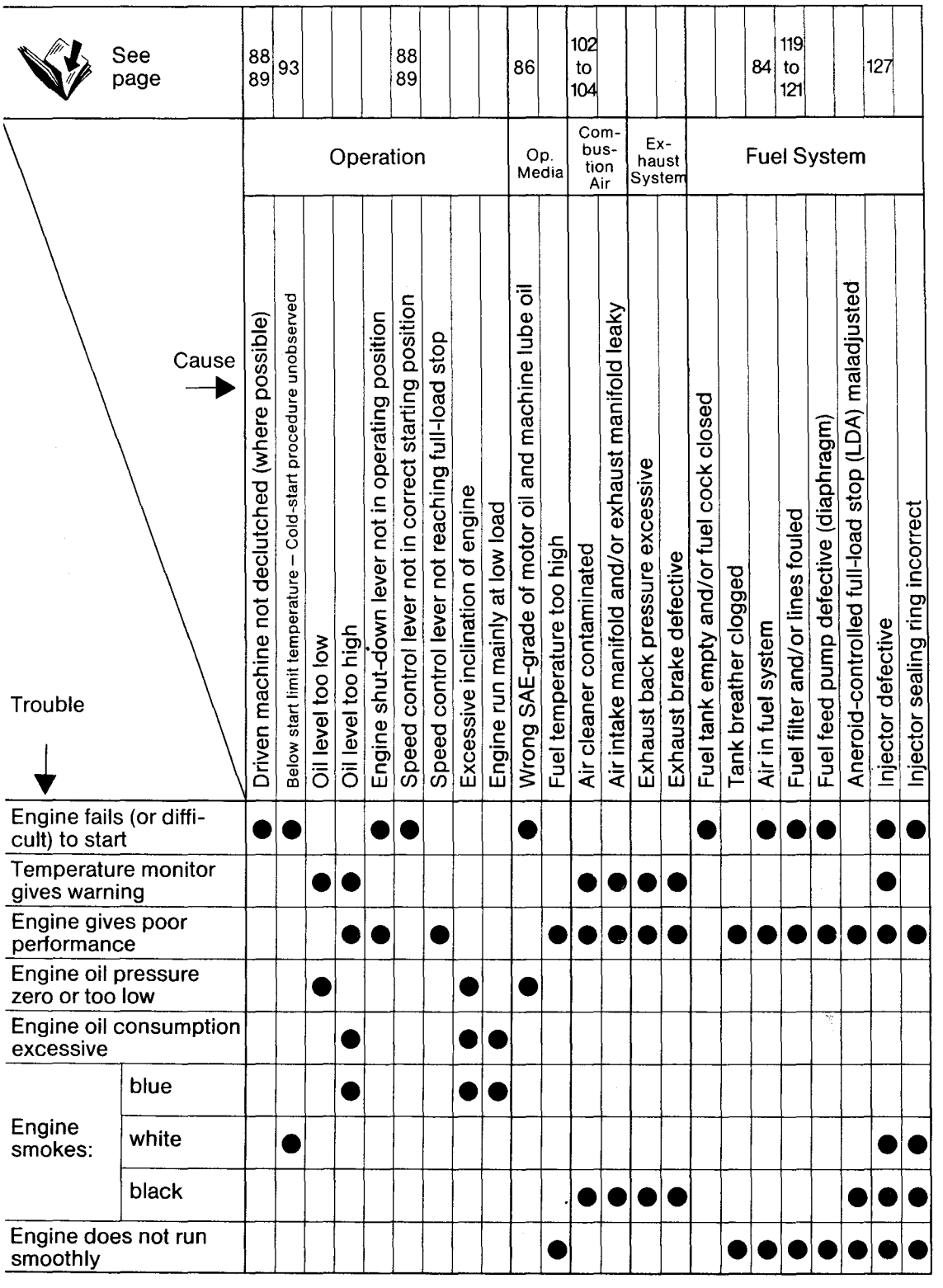
Trouble Shooting

If troubles should occur, these will be frequently due to incorrect operation, lubrication or maintenance of the engine. In such a case, therefore, make a point of thoroughly re-reading the Sections on pages 84 to 128.

If you cannot identify the cause of the trouble or are unable to put it right yourself, the best plan is to contact your local DEUTZ distributor.

See Trouble Charts on pages 130 and 131.

Trouble Chart



Trouble Chart

●	●	●				●	●	●	Commencement of delivery setting incorrect	Fuel-System	76
●	●	●				●	●		Injection advance unit defective		
●						●			Nozzle backleakage line clogged		
	●						●		Amount of fuel injected excessive		
					●		●		Oil cooler thermostat defective	Oil Circuit	
					●				Oil suction pipe strainer clogged		
					●				Suction line leaky		
					●				Pressure line leaky		
					●				Control valve defective		
					●				Lube oil pump defective		
							●		Cooling fins soiled	Cooling System	108
							●		Air cowling plates loose, cracked or missing		
							●		Blower V-belt loose or broken		112
							●		Blower and/or exhaust thermostat defective		
					●		●		Lube oil cooler soiled		108
							●		Heating-up of cooling air/Recycling of heat		
								●	Battery defective and/or flat	Electrical System	110
								●	Cable connections of starter motor circuit loose or oxidized		
								●	Starter motor defective or pinion does not engage		126
		●						●	Starting aid defective		122
					●				Oil pressure switch/oil pressure gauge defective		
●	●	●				●		●	Valve clearance incorrect/valves worn	Engine	186 187
●	●	●				●		●	Compression pressure too low		
●			●	●		●		●	Cylinders and/or piston rings worn		
				●					Plugs in cylinder heads leaky		
			●	●					Oil metering screw for rocker arm lubrication incorrectly set		
		●				●		●	Piston crown clearance excessive		76
			●	●					Valve guides worn		
					●				Main and/or big-end bearings defective		
●									Engine suspension defective and/or incorrect		
●									Flexible engine coupling defective		

Workshop Information

The Workshop Manual dealing with the engines described in this Instruction Manual bears the number 291 1842 and can be ordered from our headquarters in Cologne, Department MZA.

Tightening Heavy-duty Bolts and Nuts

To prevent faulty assembly, the following information includes instructions on the tightening of heavy-duty bolts, because the procedure differs from that normally employed. The tightening angle is particularly important and, for this reason, Fig. 70 indicates how various angles can be readily obtained by comparison with a clock face.

1. **Wet threads and seatings with motor oil before fitting.**
2. **Screw the bolts in** until they are uniformly positioned ready for pre-loading.
3. **Pre-load the bolts** to the value stated in the "Tightening Table for Bolts and Nuts" on page 133.
4. **Tighten the bolts** according to the Table, if necessary in stages, in conformity with the tightening angles specified.

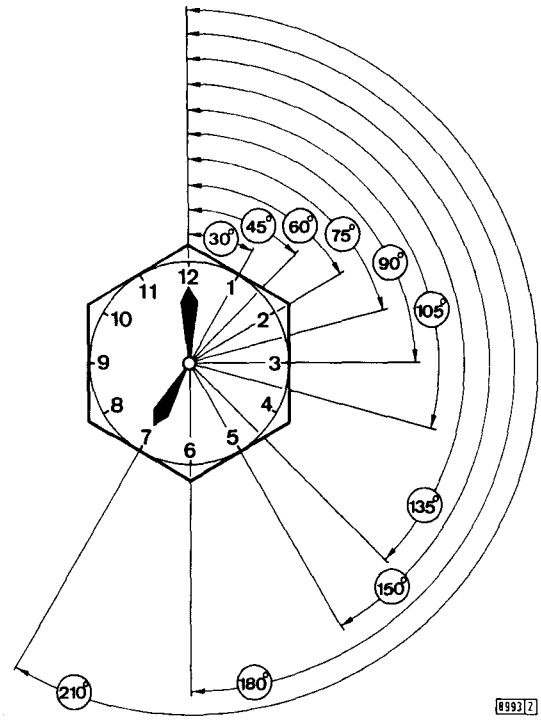


Fig. 70

Tightening Table for Bolts and Nuts

Designation		Pre-loading Nm	Tightening 1st st.	2nd st.	3rd st.	4th st.	Total	Note
Cylinder head	210 1681	30+15	45°	45°	45°	30°	165°	
Connecting rod	213 3871	30	30°	60°	–	–	90°	
Bearing cap	BM 14 x 120	30	40°	65°	–	–	105°	
Idler gear	M 10 x 60	30	60°	–	–	–	60°	
Balance weight	M 12 x 60	30	30°	30°	–	–	60°	
Flywheel	M 10 x 1 x 35	30 30	30° 30°	60° 30°	– –	– –	90° 60°	Waisted bolt H 803 Bolt DIN 961
Flywheel	M 10 x 1 x 40	30 30	30° 30°	60° 30°	– –	– –	90° 60°	Waisted bolt H 803 Bolt DIN 961
Flywheel	M 10 x 1 x 45	30 30	30° 30°	60° 30°	– –	– –	90° 60°	Waisted bolt H 803 Bolt DIN 961
Flywheel	M 10 x 1 x 50	30 30	30° 30°	60° 30°	– –	– –	90° 60°	Waisted bolt H 803 Bolt DIN 961
Injectors	M 10 DIN 934-8 B 4 C	–	–	–	–	–	–	Tightening torque 25 Nm
V-belt pulley	M 24x2x110	50	210°	–	–	–	210°	Left-hand thread
Cooling blower	M 12 x 140	30	–	–	–	–	90°	
Cooling blower	M 12 x 180	30	–	–	–	–	90°	
Filter carrier	M 10 x 160	30	30°	60°	60°		150°	
Alternator	M 10 x 180 M 14 x 230	30 30	180° 150°	–	–	–	180° 150°	
Idler pulley	213 6384	30	45°	–	–	–	45°	
Engine suspension	M 14 x 100	30	15°	60°	–	–	75°	
Engine suspension	M 14 x 110	30	45°	60°	–	–	105°	
Engine suspension	M 14 x 125	30	45°	60°	–	–	105°	
Advance/retard unit	M 12 M 14 x 1,5	–	–	–	–	–	–	60 + 10 Nm 80 + 10 Nm

Note:
When renewing main and big-end bearings or after piston seizures, be sure to **renew** *the bearing bolts as well.*

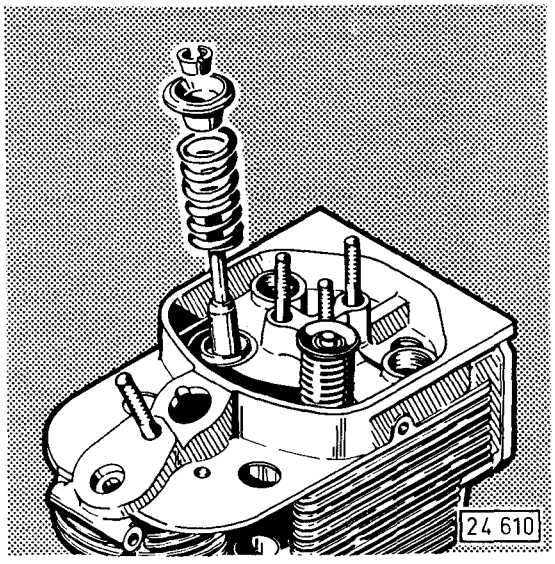


Fig. 71

Fitting Valve Springs
Be sure the close-coil end is at the bottom (Fig. 71).

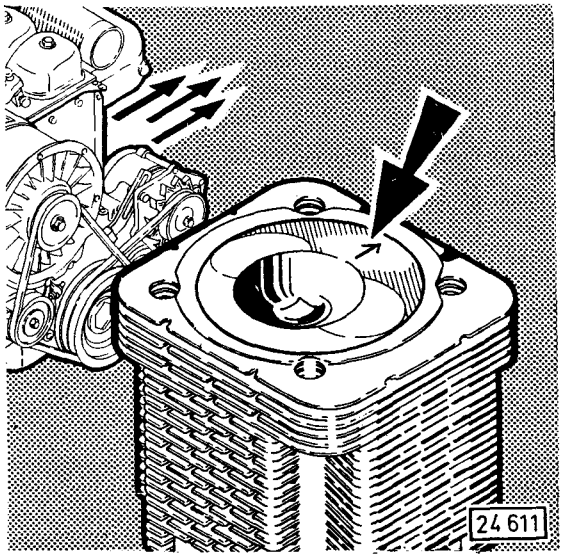


Fig. 72

When fitting a new piston, make sure that the stamped-in arrow points to the exhaust-air side of the engine (Fig. 72).

"SHPD" Oils for Turbocharged Engines (Valid: July 1985)

KHD cannot undertake any warranty for the engine if so-called "SHPD" oils are used which are not contained in the following list!

Oil Company	Oil Brand
Agip	Sigma Turbo
AMCO	AMCO Multi SHPD
Aral	Aral Multi Turboral Plus Motoröl Aral Multi Turboral DL Motoröl (SAE 10 W/40)
Autol	Valve-SHP
Avia	Avia Multigrade HDC Plus Avia Multigrade CFE Plus (SAE 10 W/40)
BayWa AG	BayWa Titan Truck 1540
Beverol	Beverol Gold Opta
Blaser & Co. AG	BLASOL Swisslube SHPD
Caltex	RPM DELO 450 Oil
Chevron	Chevron Delo 450 Motor Oil Multigrade
Cofran	Cofran Equilux C 2000 Super
de oliebron	TOR Multifleet SHPD Oil
Deutsche BP AG	Vanellus C 3 extra BP Visco Diesel BP Vanellus FE (SAE 10 W/40)
Deutsche Castrol	Castrol Turbomax
Deutsche Total	TOTAL Rubia TIR
Deutzer Oel	DEUTZ OEL TAD
ELAN	ELAN-MOTORÖL TURBO LD
Elf	ELF Multiperformance 4 D ELF PRESTI DIESEL
Esso	DIESEL MOTOR OIL 500 DIESEL MOTORENOEL SUPER TD MOTORENOEL TURBO FE (SAE 10 W/40)
Fanal	Fanal Indol X
Fiat Lubrificanti	URANIA TURBO
Fina	Fina Kappa LDO
Finke Mineralölwerke	Aviaticon Turbo
Fuchs	TITAN TRUCK 1540 TITAN UNIC 1040 (SAE 10 W/40)
Gulf	Gulf Turbo Diesel
Grönwoldt	WEGETOL DIESEL TURBO SHPD
Hinrich Witz	»HAWI« Hochl.-Motorenöl Turbo-D
Homberg	HOMBERG-Turbo-Oil SHPD
Industria Italiana Petroli	IP TARUS M
Leprince u. Siweke	Leprinxol-Super SHPD

Cont'd on page 136

Workshop Information

Oil Company	Oil Brand
Merk u. Cie	Deltinol-Multigrade SHP-D
Mineralölwerk Osnabrück	IROKAL Super plus
Mobil Oel	Mobil
Nynas	TAROLA
Oelwerke Julius Schindler	Veritas Super HDC Econo-Veritas HDC (SAE 10 W/40)
Oest	OEST DIMO SUPER S 3
Petrol de Rafinerija Maribor	Petrol Motorol SHPD
Rheinische Motor-Oel	RMV-Rhemotol SHPD
Sauerstoffwerk Westfalen	Westfalen Turbo-plus Motoröl WESTFALEN Universa XT Motorenoel (SAE 10 W/40)
Shell	Shell Myrina Shell Myrina M Shell Myrina T (SAE 15 W/30) Shell Myrina X (SAE 15 W/30)
TEXACO	Ursa Super TD Multigrade Lubroviscol Turbo Diesel
UK-Mineralölwerke	UK ProMotor CD Plus HD
UNIL	Unil ROC 3 D
Valvoline	Valvoline Super HDS LD
Veedol	Veedol Turbostar
Wenzel & Weidmann	Ecubsol Oel CD Plus
Wintershall	Wiolin Turbo-Rekord
Zeller + Gmelin	Divinol Multimax Extra

Note!

Viscosity to SAE 15 W/40.