

# WORKSHOP MANUAL

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**for**

**4.2482, 4.248**

**T4.236, 4.236,**

**4.212 & T4.38**

**diesel engines**

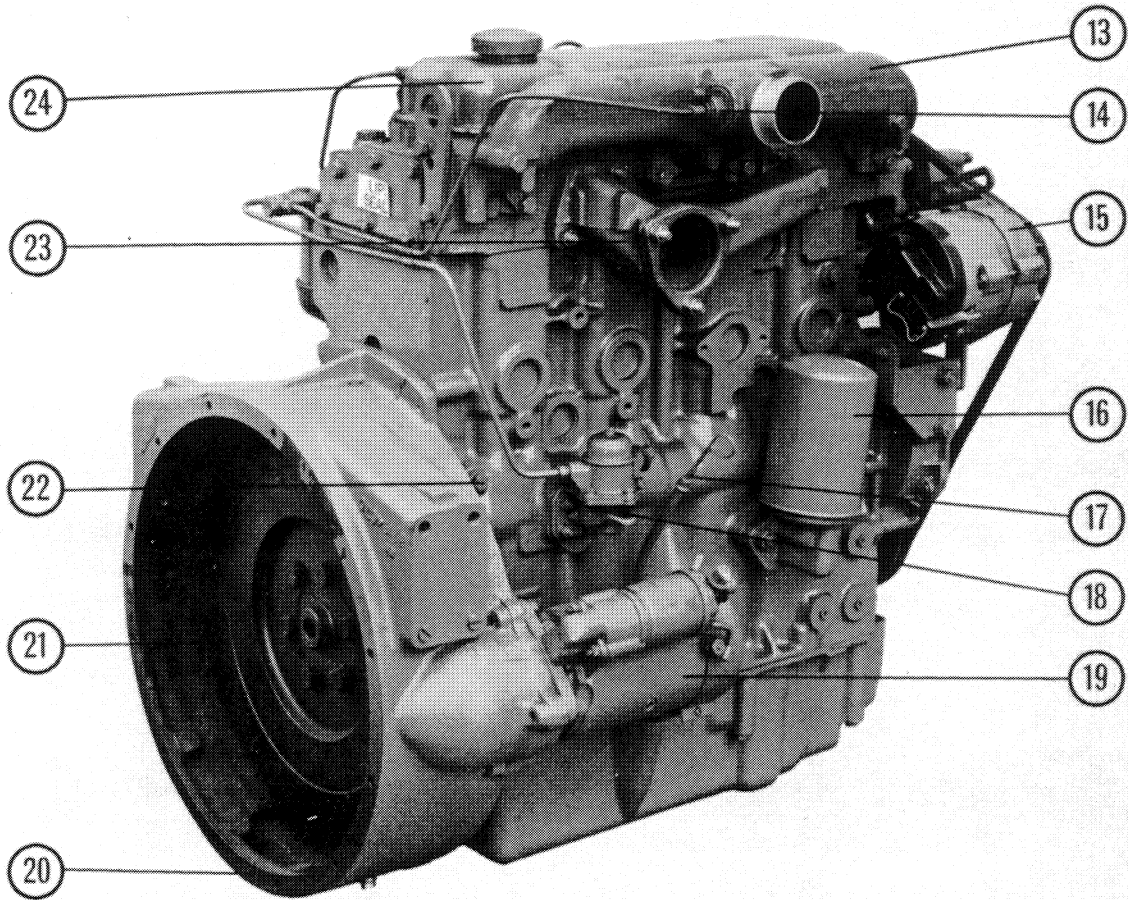
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A4

VIEW OF CAMSHAFT SIDE OF 4.248, 4.236 AND 4.212 ENGINES

- 13. Induction Manifold
- 14. Thermostart
- 15. Alternator
- 16. Lubricating Oil Filter
- 17. Dipstick
- 18. Fuel Lift Pump
- 19. Starter Motor
- 20. Flywheel Housing
- 21. Flywheel
- 22. Cylinder Block Drain Plug (Right Hand Side)
- 23. Exhaust Manifold
- 24. Cylinder Head Cover

## TECHNICAL DATA—B.9

Oil Seal Helix Dia. (rope seals only)	...	...	3.124/3.125 in (79,35/79,38 mm)
Oil Seal Helix Width	...	...	0.050/0.080 in (1,27/2,03 mm)
Oil Seal Helix Depth	...	...	0.004/0.008 in (0,10/0,20 mm)
Flange Dia.	...	...	5.247/5.249 in (133,27/133,32 mm)
Spigot Bearing Recess Depth	...	...	0.781 in (19,84 mm)
Spigot Bearing Recess Bore	...	...	1.8497/1.8502 in (46,98/47,00 mm)
Crankshaft End Float	...	...	0.002/0.015 in (0,05/0,38 mm)

Length of No. 3 main journal not to exceed 1.759 in (44,68 mm) after regrinding. Width of crankpins must not exceed 1.5965 in (40,55 mm) after regrinding. Where necessary use oversize thrust washers to suit.

Crankshafts Part No. 31315542, 31315661, 31315872, 31315884, 31315984, 31315986, 31316204, 31316224, 31316235, 31316237 and 31316241 are tufftrided and must be re-tufftrided after any regrinding has taken place (see Page H.2). Where facilities for re-tufftrided are not available then a factory replacement crankshaft should be obtained.

### Crankshaft Thrust Washers

Type	...	...	Steel Backed, Aluminium Tin or Lead Bronze Faced
Position in Engine	...	...	Centre Main Bearing
Thrust Washer Thickness (STD)	...	...	0.089/0.091 in (2,26/2,31 mm)
Thrust Washer Thickness (O/S)	...	...	0.096/0.099 in (2,44/2,51 mm)
Thrust Washer Outside Dia.	...	...	4.088/4.098 in (103,84/104,90 mm)
Thrust Washer Inside Dia.	...	...	3.420/3.430 in (86,87/87,12 mm)

### Main Bearings

Type	...	...	Pre-Finished, Steel Backed, Aluminium Tin or Lead Bronze Faced
Shell Width—Nos. 1, 2, 4, and 5	...	...	1.245/1.255 in (31,62/31,88 mm)
Shell Width—No. 3	...	...	1.435/1.445 in (36,45/36,70 mm)
Outside Dia. of Main Bearing	...	...	3.167 in (80,41 mm)
Inside Dia. of Main Bearing	...	...	3.0010/3.0026 in (76,23/76,27 mm)
Main Bearing Running Clearance	...	...	0.0018/0.0042 in (0,05/0,11 mm)
Shell Thickness	...	...	0.0822/0.0825 in (2,088/2,098 mm)

### Connecting Rod Bearings

Type	...	...	Pre-Finished, Steel Backed, Aluminium Tin or Lead Bronze Faced
Shell Width	...	...	1.245/1.255 in (31,62/31,88 mm)
Outside Dia. of Con. Rod Bearing	...	...	2.6465 in (67,22 mm)
Inside Dia. of Con. Rod Bearing	...	...	2.5008/2.5019 in (63,52/63,55 mm)
Con. Rod Bearing Running Clearance	...	...	0.0012/0.0031 in (0,03/0,08 mm)
Shell Thickness	...	...	0.0723/0.0726 in (1,836/1,844 mm)

### Camshaft

No. 1 Journal Dia.	...	...	1.9965/1.9975 in (50,71/50,74 mm)
No. 1 Cylinder Block Camshaft Bore Dia.	...	...	2.000/2.001 in (50,8/50,83 mm)
No. 1 Journal Running Clearance	...	...	0.0025/0.0045 in (0,06/0,11 mm)
No. 2 Journal Dia.	...	...	1.9865/1.9875 in (50,46/50,48 mm)
No. 2 Cylinder Block Camshaft Bore Dia.	...	...	1.990/1.992 in (50,55/50,60 mm)
No. 2 Journal Running Clearance	...	...	0.0025/0.0053 in (0,06/0,14 mm)
No. 3 Journal Dia.	...	...	1.9665/1.9675 in (49,95/49,98 mm)
No. 3 Cylinder Block Camshaft Bore Dia.	...	...	1.970/1.972 in (50,04/50,09 mm)
No. 3 Journal Running Clearance	...	...	0.0025/0.0053 in (0,06/0,14 mm)
Cam Lift	...	...	0.300/0.303 in (7,62/7,70 mm)
Oilways for Rocker Shaft Lubrication	...	...	No. 2 Journal

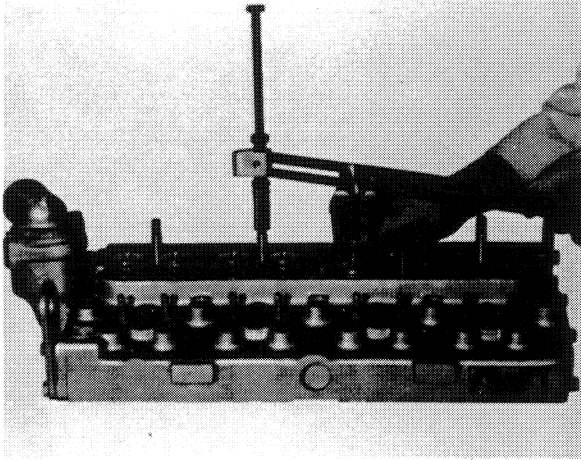
**Starter Motor**

Make	...	..	...	...	...	Lucas, C.A.V. or Perkins
Type	...	...	...	...	..	2M113, M45G, CA45, M50, S12-84, S12-85, M127/2,8
Max. Current	...	...	...	...	...	900 amps
Starter Cable Resistance	...	...	...	...	...	0.0017 ohms
No. of Teeth on Pinion	...	...	...	...	...	10

NOTE: The above data is general and can vary with individual applications.

**Cold Starting Aid**

Make	...	...	...	...	C.A.V.	C.A.V.
Voltage	...	...	...	...	12 Volt	24 Volt
Maximum Current Consumption	...	...	...	...	18 A	7.5 A
Flow Rate through Thermostart	...	...	...	...	9 cm <sup>3</sup> /min	9 cm <sup>3</sup> /min



**E5**  
**Valve Guides**

Engines are fitted with either detachable valve guides or the valve bores are machined direct into the cylinder head.

When wear takes place in the valve bores of cylinder heads without detachable valve guides, valves with oversize stems should be fitted.

Three service valves are available for both inlet and exhaust with oversize stems of 0.003 in, 0.015 in and 0.030 in (0.08, 0.38 and 0.76 mm) respectively.

To fit 0.015 and 0.030 in oversize valves, the bores in the cylinder head must be reamed with a piloted reamer. Suitable reamers for carrying out this operation can be obtained from Messrs. V. L. Churchill and Co. Ltd. (see Appendix).

Where detachable valve guides are fitted, these can be replaced.

To fit new guides; clean the parent bore, smear the outer surface of the guide with clean oil and press home the guide until 0.594 in (15.10 mm) is protruding above the cylinder head. The guides are manufactured from cast iron and are brittle.

### Valves and Valve Seats

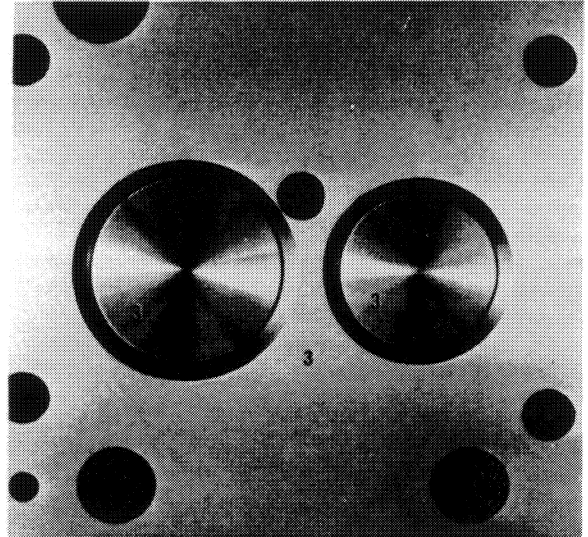
Check the valve stems for wear and their fit in the guides.

Examine the valve faces for pitting or distortion. Valve refacing should be at an angle of 45° or 30° for inlet valves on T4.236 engines (see Page B.10).

*Valves should always be refitted to their original seats and any new valve fitted should be suitably marked to identify its position if removed at a later date. Refer to Fig. E.6. for illustration of valve numbering.*

Note current exhaust valve depths on Page B.10 became effective from the following engine numbers:—

212U3810L  
236U135765  
236U147150L  
236US24721L  
248U31918L  
212UA200084L  
236UA110048L  
248UA135686L



**E6**

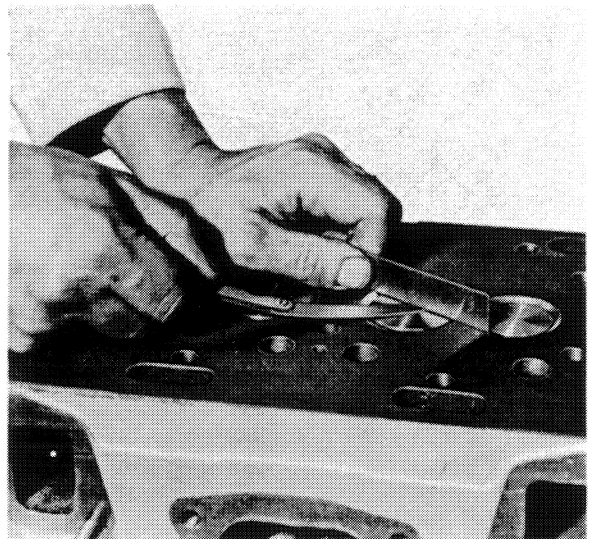
The valve seats in the cylinder head should be reconditioned by means of cutters or specialised grinding equipment, at an angle of 45° or 30° for inlet valves on T4.236 engines. Suitable valve seat cutters for 45° seats are included in kit 21825064 (see Appendix) and these cutters give a differential valve seat to reduce the width of the valve seat. A special cutter 21825065 is required for 30° valve seats.

As narrow a seat as possible should always be maintained.

### Hand Grinding

When grinding in valves it is essential that no signs of pitting are left on the seatings. At the same time care should be taken to avoid unnecessary grinding away of the seat.

After grinding operations have been completed, check the valve head depths relative to the cylinder head face (Fig. E.7) and wash the cylinder head.



**E7**

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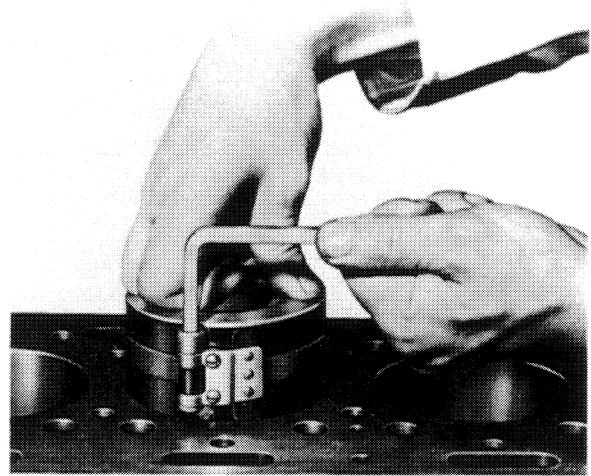


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**To Fit the Pistons and Connecting Rods to the Cylinder Bore**

1. Before fitting the piston and connecting rod assemblies to their respective cylinder bores, liberally coat each bore and piston with clean engine oil.
2. Using a ring guide (Fig. F.7), insert the pistons and connecting rod into the top of their respective cylinder bores. The piston and rod number must relate to the cylinder into which it is being fitted and the rod identification number must be on the fuel injection pump side of engine. The word "Front" or arrow marked on the piston crown must be towards the front of the engine (Fig. F.9). (T4.236 engines, refit piston cooling jets; where applicable).
3. Fit the bearing shells and cap with the numbers on the same side of the rod and cap (Fig. F.8).
4. Refit the two connecting rod bolts so that the flat on the head of each bolt is located against the shoulder of the rod. Secure with two new nuts. See Page B.2 for Recommended Torque Tensions.
5. Refit the lubricating oil sump.
6. Refit the cylinder head (Page E.7).



F7

**Fitting New Pistons**

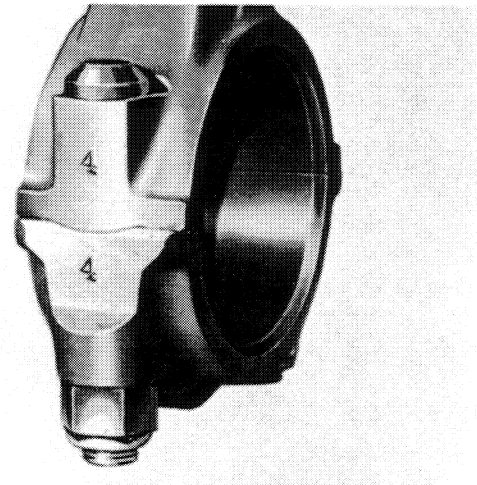
The piston height can be checked by means of a straight edge and feeler gauges.

Correct piston heights above the cylinder block top face are as follows:—

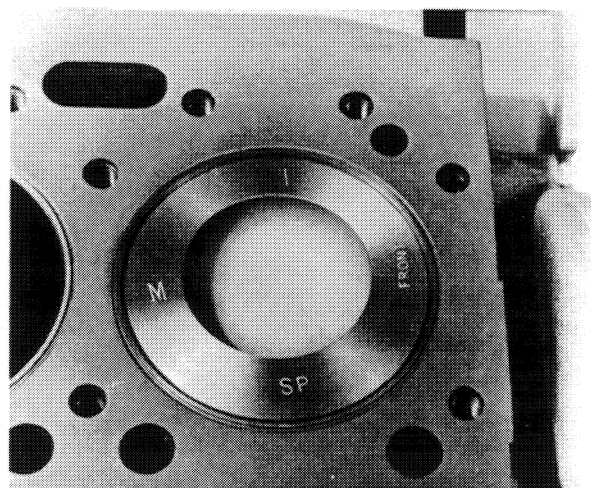
**4.2482	0.016/0.023 in (0,41/0,59 mm)
4.248	0.002/0.010 in (0,05/0,26 mm)
T4.236, 4.236 (2600 rev/min	
and below)	0.014/0.023 in (0,35/0,58 mm)
4.236 at 2800 rev/min	0.011/0.019 in (0,28/0,48 mm)
4.212	0.015/0.021 in (0,38/0,53 mm)

\*\*The pistons have hard anodised crowns and must not be topped. To achieve this tolerance in production three grades of piston are used, H, M and L but for service use, only the L grade is available which can be below the tolerance figure given.

| Note: See page B5 for engine cut in numbers.



F8



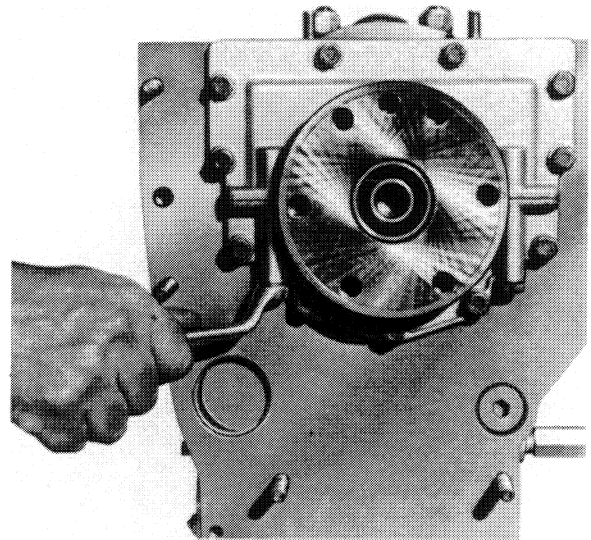
F9

**Rope Type Rear End Oil Seal**

The housing consists of two halves bolted around the rear of the crankshaft which has a shallow spiral oil return groove machined in it to a depth of 0.004/0.008 in (0,10/0,20 mm). The bore of the housing accommodates a rubber cored asbestos strip comprising two sections.

When fitting the seal the following procedure should be adopted:—

1. Set up a half housing in the vice with the seal recess uppermost and settle approximately 1 in (25 mm) of the strip, at each end, into the ends of the groove so that each end of the strip protrudes 0.010/0.020 in (0,25/0,50 mm) beyond the half housing joint face.
2. With the thumb or finger press the remainder of the strip into the groove, working from the centre. Use a round bar to further bed in the strip by rolling and pressing its inner diameter (Fig. H.7).
3. Fit the sealing strip to the other half housing in a similar manner.
4. Fit a new joint using jointing compound applied both sides.
5. Spread a film of graphite grease over the exposed inside diameter surface of the strip.
6. Assemble the half housings around the crankshaft rear journal and fasten together (Fig. H.8).
7. Swivel the complete seal housing on the shaft to bed in the strips and to establish that the assembly turns easily on the shaft.
8. Bolt the seal housing to the block and rear bridge piece.



H8

can be pressed in to 1/8 in (3,2 mm) for old type seals or position 'B' for new type seals or, if this position has been used, to 1/4 in (6,4 mm) for old type seals or position 'C' for new seals.

If a new type seal is used in place of an existing old type seal, position 'C' should be used if the old seal was fitted 1/8 in (3,2 mm) below the housing face.

If all three positions have been used, it may be permissible to machine the worn sealing area of the crankshaft flange (See Page H.2), but not the spigot area on which the flywheel locates (see Fig. H.11).

**Lip Type Rear End Oil Seal**

Later engines will be fitted with a circular spring loaded lip seal that locates around the periphery of the flange of the crankshaft. The seal is designed to function correctly with the direction of rotation of the engine and for identification purposes the seal is marked with an arrow.

The lip type oil seal assembly and its counterpart crankshaft are not interchangeable with previous types.

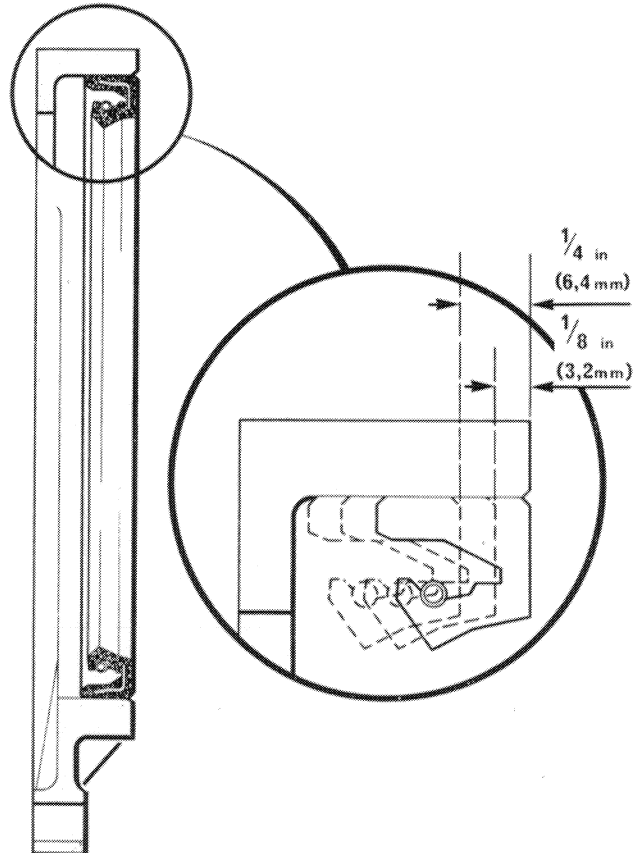
This seal is easily damaged and extreme care should be taken when handling and fitting it. Any visual damage across the lip of a new seal will cause leakage and prevent bedding in of the seal.

Earlier seals have a flat rear face as shown in Fig. H.9. Later seals have a protruding dust lip from the rear face as shown in Fig. H.10.

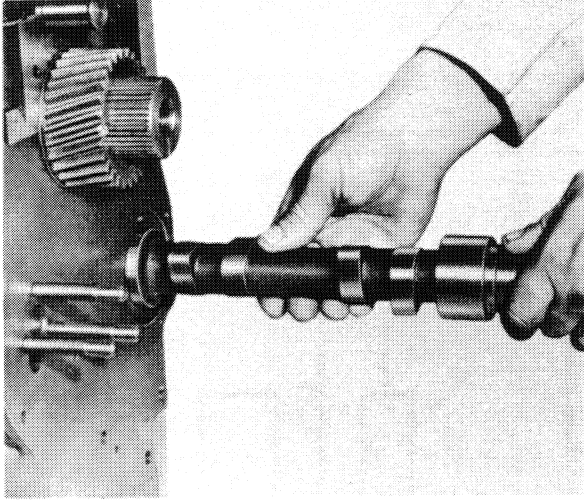
**To Fit Lip Seal in its Housing**

On production, the old type seal was fitted flush with the rear face of the housing (Fig. H.9) but the new type seal is fitted deeper into the housing at 'A', Fig. H.10.

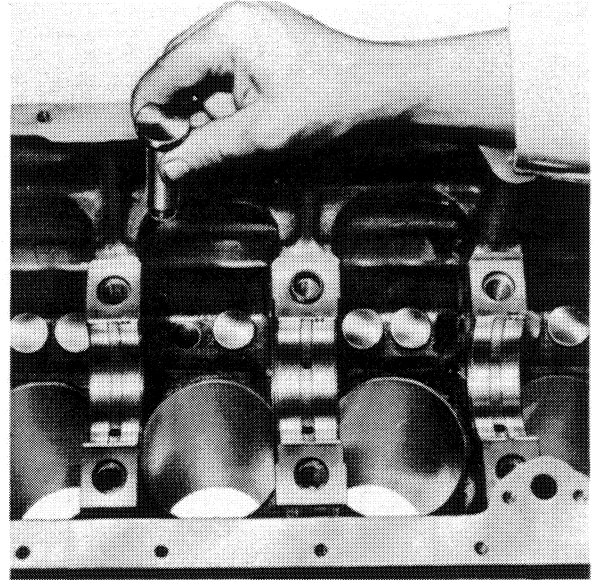
In service, when a new seal is fitted to a worn crankshaft, it should be pressed further into the housing. In the first instance it



H9



K19



K20

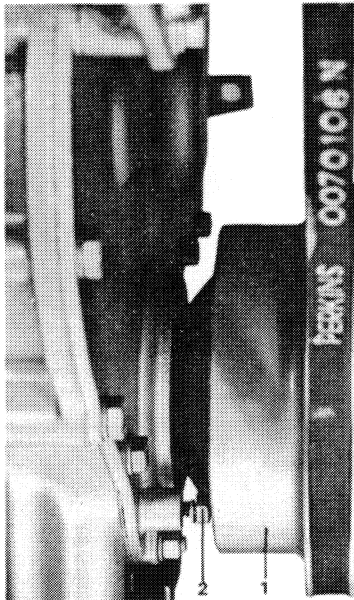
### Checking Valve Timing

1. Turn the crankshaft until the valves on No. 4 cylinder are "on the rock".
2. Set the valve clearance of No. 1 inlet valve according to the cam form of the camshaft fitted.
3. Turn the engine in the normal direction of rotation until the valve clearance of No. 1 inlet valve is just taken up.

4. Check that Nos. 1 and 4 pistons are now at T.D.C. by means of the timing pin or pointer. Unscrew the pin until it locates in the hole machined in the rear face of the crankshaft pulley as shown in Fig. K21.

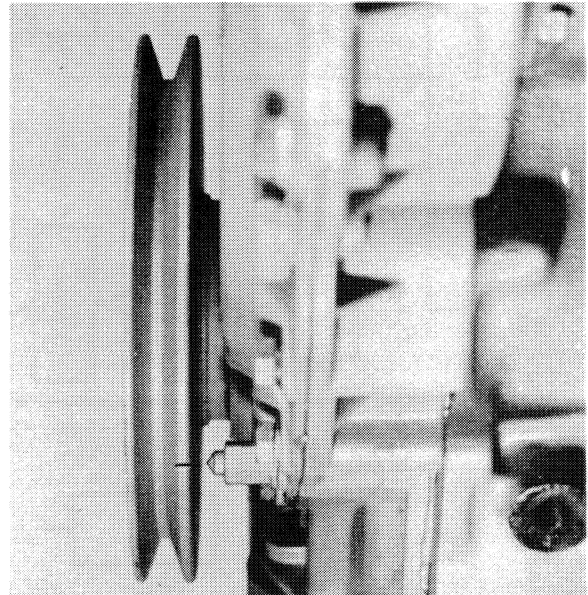
Later engines have a fixed timing pointer and a T.D.C. groove on the edge of the crankshaft pulley (Fig. K22).

The valve timing tolerance is  $\pm 2\frac{1}{2}^\circ$ . When the timing is found to be correct, return the timing pin to its location and reset the valve clearance of No. 1 inlet valve to 0.012 in (0,30 mm) cold. The only error possible is in the fitting of the timing gears.



K21

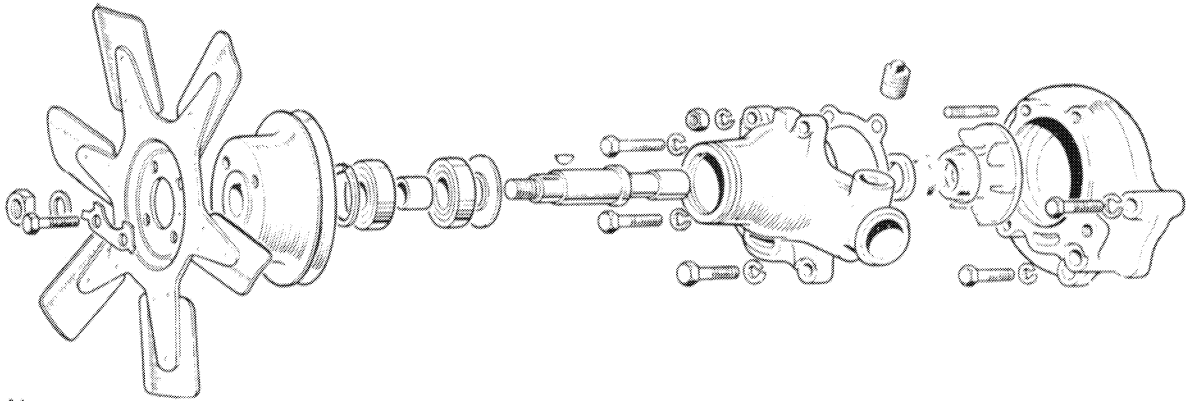
1. Crankshaft Pulley.
2. Timing Pin.



K22

# SECTION M

## Cooling System



M1

The engine is cooled by water circulation through passages in the cylinder block and head. Circulation is by thermo-syphon action assisted by an impeller type water pump driven by a "V" belt from the crankshaft pulley.

A high or low position water pump may be fitted on the front face of the cylinder block.

The water pump bearings are pre-packed with a special grease during assembly and do not require attention in service.

A thermostat is fitted in the water outlet connection.

### To Remove and Refit Water Pump— High Position Type

1. Remove fan belt.
2. Remove fan.
3. Disconnect connections to water pump.
4. Remove pump.
5. Refit pump in reverse sequence. Reset fan belt tension.

### To Adjust the Driving Belt

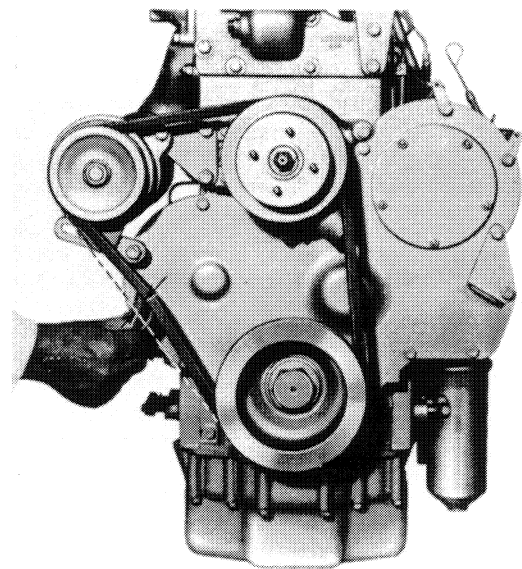
Fan and dynamo or alternator belt tension should be adjusted so that it is possible to depress the belt, approximately  $\frac{3}{8}$  in (10 mm). This should be checked between crankshaft and water pump pulleys (high position water pump) or between crankshaft and dynamo or alternator pulleys (low position water pump) see Fig. M.2.

Correct tension of the fan and dynamo or alternator belt should be maintained by periodical checking and adjustment as given in Section C.

Belt adjustment is obtained by altering the position of the dynamo or alternator with an adjustable link.

**Note:** When a new belt is fitted it is advisable to re-check the adjustment after a short running period.

For those engines which have twin fan belts fitted, they should not be renewed individually but in pairs.



M2

**To Remove the Pump**

Lift pumps which are in an upright position (with the top cover uppermost) are fitted to later engines. These are secured with four studs, nuts and spring washers or setscrews and two keeper plates fitted vertically between the washers and the outside of the pump mounting flange.

1. Disconnect the pipes.
2. Remove the pump and joint.

**To Dismantle the Pump (Fig. N.10)**

1. Before dismantling, make a file mark across the two flanges for guidance in re-assembly.
2. Separate the two halves of the pump.
3. Remove the diaphragm by unhooking it from the rocker arm link. The diaphragm spring can now be withdrawn.
4. Drive out the rocker arm pivot pin and withdraw the rocker arm, spring and link.
5. Dismantle the priming lever by removing the lever retaining pin.
6. Remove the valves by levering from their locations. Remove the valve gaskets.
7. Remove the pump cover and pulsator diaphragm.

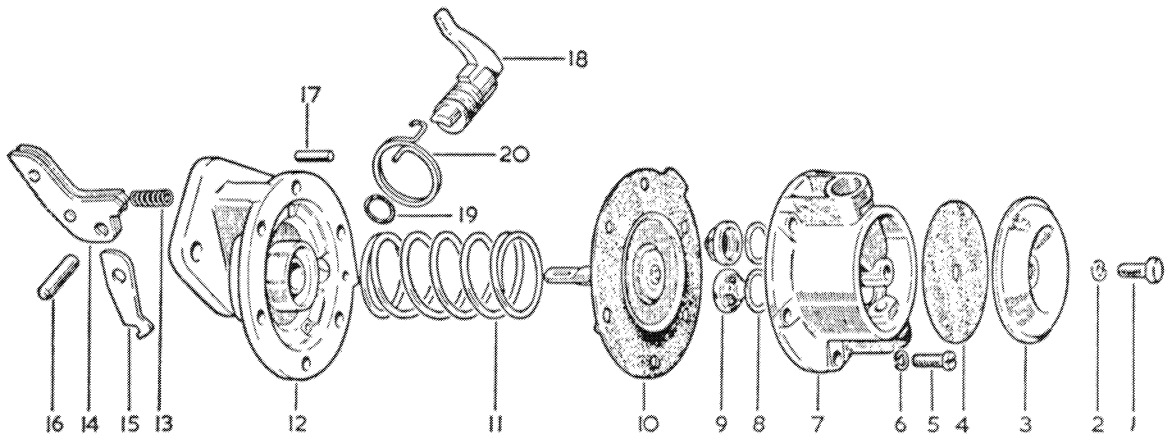
**Inspection of Parts**

1. Check the diaphragm for hardening or cracking and examine the pull rod for wear at the point where it connects with the rocker lever link. A stem seal fitted over the diaphragm shaft may be found on some applications and should be renewed if worn.
2. The diaphragm spring should be renewed if corroded or distorted. Ensure the new spring has the same colour identification as the original.

3. The valves should be replaced. The two valves are identical and may be used for inlet or outlet (Fig. N.10).
4. Examine the rocker, arm, link, spring and pin for wear.
5. Check the pulsator diaphragm for condition.
6. Examine the flanges of the two pump halves for distortion. If necessary lightly finish to restore flatness.

**To Re-Assemble the Pump**

1. Fit the new valve gaskets and valves to the body. The inlet valve must be fitted so that it can open to admit fuel. The outlet valve must be fitted in the reverse position to the inlet valve. Valves are retained by retaining plate or alternatively by staking in six places with a suitable punch.
2. Fit the pulsator diaphragm and cover.
3. Insert the rocker arm pin through its hole in the body, at the same time engaging the link and the rocker arm. Tap the rocker arm pin in until it is flush with the pump body. Stake the casting in three places each side to retain the pin.
4. Place the diaphragm spring in position.
5. Place the diaphragm assembly over the spring, the pull rod being downwards, and centre the upper end of the spring in the lower diaphragm protector washer.
6. Press downward on the diaphragm and make sure that the downward tag on the lower diaphragm protecting washer is on the priming lever side of the body. This tag is required to be in the hole of the body ready for fitment of the priming lever. Engage the diaphragm pull rod with the link and at the same time match up the holes in the diaphragm.



N10

- |                          |                       |
|--------------------------|-----------------------|
| 1. Pulsator Cover Screw  | 11. Diaphragm Spring  |
| 2. Pulsator Cover Washer | 12. Body              |
| 3. Pulsator Cover        | 13. Rocker Arm Spring |
| 4. Pulsator Diaphragm    | 14. Rocker Arm        |
| 5. Cover Screw           | 15. Link              |
| 6. Cover Screw Washer    | 16. Rocker Arm Pin    |
| 7. Cover                 | 17. Primer Pin        |
| 8. Valve Gasket          | 18. Primer            |
| 9. Valve Assembly        | 19. Sealing Ring      |
| 10. Diaphragm Assembly   | 20. Primer Spring     |

# SECTION Q

## Exhauster

### Description

The A.350 type exhauster, which is fitted to the 4.236 engine, is a rotary sliding vane pump, with an eccentrically mounted rotor.

The exhauster body and end covers are of cast iron, and house an aluminium rotor, die-cast on to a steel shaft. The rotor has four equi-spaced slots to accommodate fibre blades.

The shaft runs in a sintered bronze plain bearing in the rear end cover, and a roller race in the drive end cover, or, alternatively, two sintered bronze bearings. Drive end covers with a roller race have two shaft seals which contact a hardened steel collar pressed on to the rotor shaft. The seals are arranged to prevent ingress of air and dirt, and leakage of oil from the exhauster. Drive end covers with a plain bearing have only one seal, preventing oil leakage.

The shaft drive end is splined to take the drive gear.

The intake port in the exhauster is pipe connected to the vacuum reservoir. The outlet port formed in the end cover of the exhauster aligns with the aperture in the timing case.

Lubrication is by engine pressure feed, oil entering through a connection in the rear end cover to an annular groove in the bearing housing. The oil passes through a hole in the bearing to oilways in the rotor shaft communicating with the slots in the rotor. The oil passes through the end of the rotor slots to lubricate the drive end roller bearing. When a plain bearing is fitted in the drive end cover, it receives oil through an extension of the main oilway in the rotor shaft.

A passage in the drive end cover to the vacuum side of the pump relieves oil pressure on the seal.

### Operation

*At all speeds the rotor blades are kept in contact with the bore of the body by centrifugal force, assisted by the hydraulic action of the oil beneath the blades. When the rotor turns, the spaces between the blades vary because of the eccentric mounting of the rotor in the exhauster body. As a blade passes the inlet port, the space between it and the following blade is increasing and air is drawn from the vacuum reservoir. This air is then compressed and expelled, with the lubricating oil, through the outlet port to the engine timing case.*

### Periodic Inspections and Preventive Maintenance

#### Every 5,000 miles (7,500 km) or 250 Hours

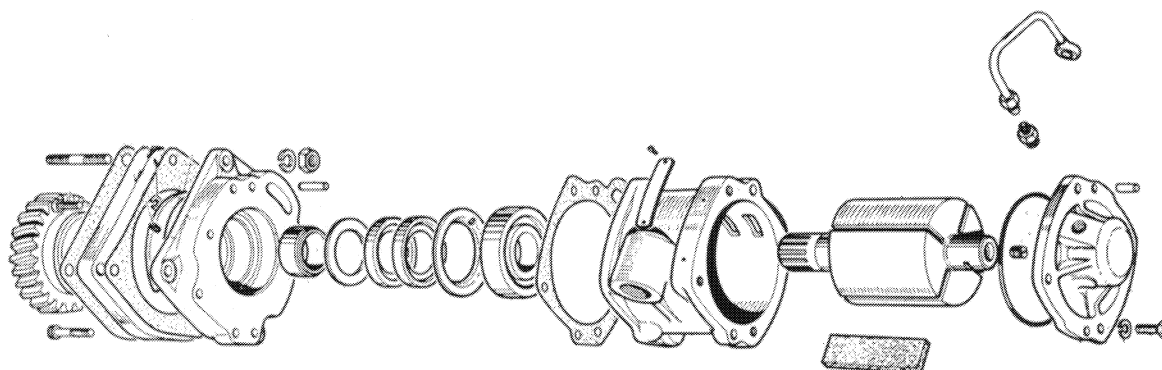
Check the vacuum lines and fittings. (Vacuum leakage may occur through the line, or reservoir mounted non-return valve if the valve seat is dirty or pitted). Examine the exhauster for evidence of oil leakage, particularly at end cover joints, and at shaft oil seal.

Check the oil supply line for leaks at fittings and connections.

Check the mounting and end cover nuts and bolts for tightness.

#### Every 60,000 Miles (90,000 km) or 2,500 Hours

Remove and dismantle exhauster, thoroughly clean all parts and inspect for wear and damage. Repair or replace the exhauster with a Factory Replacement Unit.



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