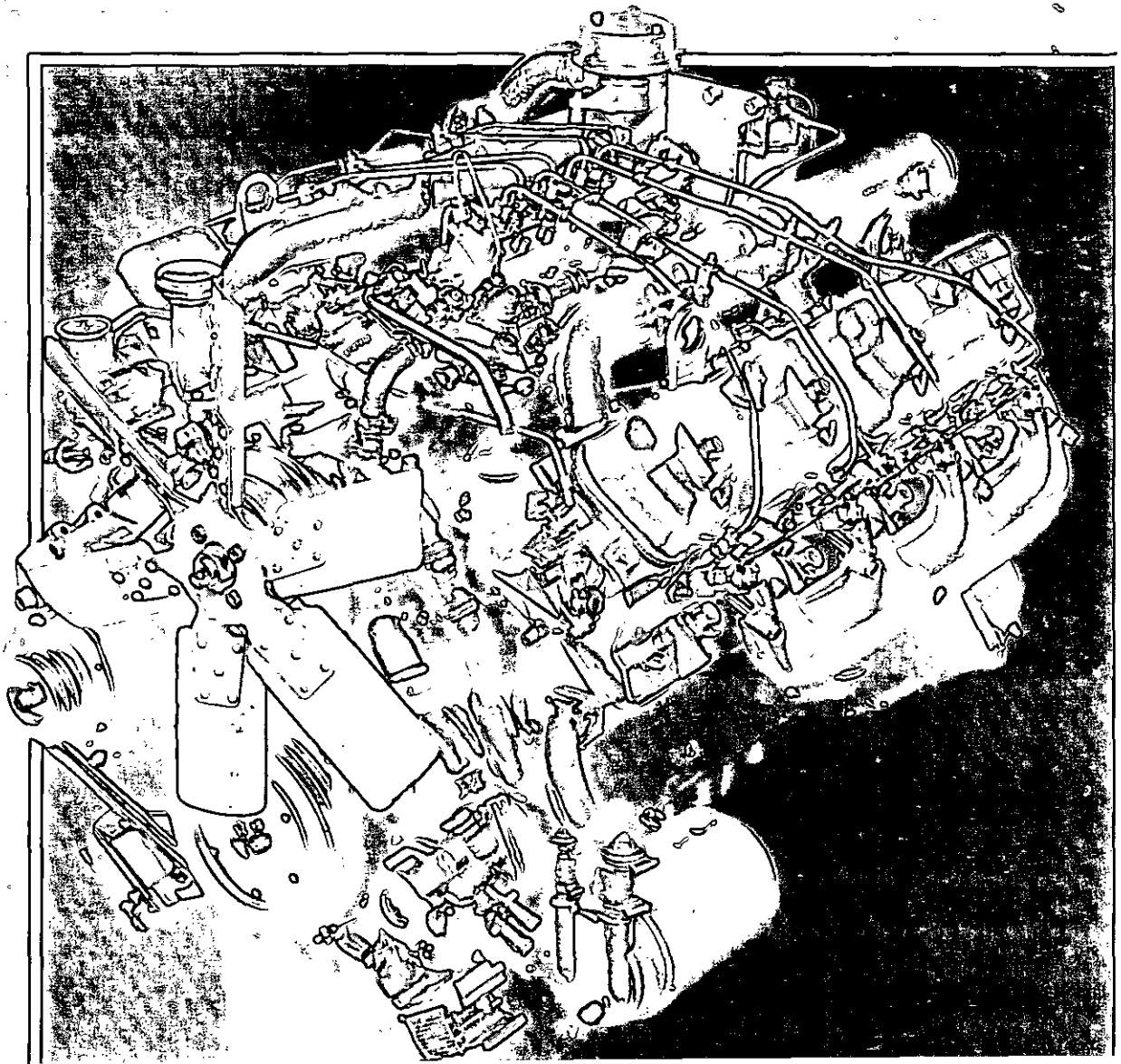
WORKSHOP MANUAL

V8.510, V8.540 Series



Workshop Manual for V8.510 & V8.540 Diesel Engines

(For V8.510 engines, commencing engine number 510U2000)

Publication No. 601 TPD 1082 1096

This publication supersedes the previous edition numbered 601 SER 1079 1096

This publication is written for world wide use. In territories where legal requirements govern engine smoke emission, noise, safety factors etc., then all instructions, data and dimensions given must be applied in such a way that, after servicing (preventive maintenance) or repairing the engine, it does not contravene the local regulations when in use.

Published by the Technical Publications Department of Perkins Engines Limited and printed in England by Peterborough Central Printers Limited.

PERKINS COMPANIES

AUSTRALIA

Perkins Engines Australia Pty Ltd.,
P.O. Box 156, Dandenong, Victoria 3175, Australia.
Telephone: 792-0431. Telex: 30816. Cables: 'Perkoil' Melbourne.

BRAZIL

Motores Perkins S.A.
Caixa Postal 30.028, 01000 Sao Paulo, SP—Brazil.
Telephone: 448-1499. Telex: 0114013 and 0114294. Cables: 'Perkoil' Sao Paulo.

FRANCE

Moteurs Perkins S.A.
9-11 Ave. Michelet, Boite Postale 69, 93042 Saint Ouen Cedex, France.
Telephone: 257-14-90. Telex: 642924 FSD. Cables: 'Perkoil' Paris.

GERMANY

Perkins Motoren G.m.b.H.
8752 Kleinhostheim, Postfach 1180, Germany.
Telephone: 06027/5010. Telex: 4188869.

GREAT BRITAIN

Perkins Engines Limited
Peterborough, England, PE1 5NA.
Telephone: Peterborough 67474. Telex: 32501. Cables: 'Perkoil' Peterborough.

ITALY

Motori Perkins S.p.A.
Via Gorizia 11, P.O. Box 12, 22070 Portichetto/Luisaga (Como), Italy.
Telephone: (031) 927364. Telex: 380658. PERKIT I Cables: 'Perkoil' Camerlata.

JAPAN

Perkins Engines K.K.
Reinanzaka Building, 6th Floor, 1-14-2 Akasaka, Minato-Ku, Tokyo 107, Japan.
Telephone: (03) 586-7377. Telex: J2424823 PERKOIL J Facsimile (03) 593-0616.

U.S.A.

Perkins Engines Inc.
P.O. Box 697, Wayne, Michigan 48184 U.S.A.
Telephone: (313) 595-9600. Telex: 234002. Cables: PERKENG WANE.

In addition to the above, there are Perkins Distributors in the majority of countries. For further details, apply to Perkins Engines Ltd., Peterborough, or to one of the above companies.

CONTENTS

FOREWORD

This manual is designed to be of assistance to all personnel involved with the maintenance and overhaul of Perkins V8.540 and V8.510 engines, the information applying to both types of engine unless specified otherwise. It does not deal with V8.510 engines built before engine numbered 510U2000.

In some instances different procedures have to be adopted depending upon the type of fuel injection pump fitted. The pump type fitted to a particular engine can be ascertained by reference to Section N.

Engines built for Massey Ferguson applications are designated AV8.540 and AV8.510 and where the information differs for these particular engines, it is specified.

Overhaul of the engine or components should only be carried out by skilled personnel. To assist in overhauling the engine, the manufacturing dimensions and in some instances the wear limits are given in Section B.

When fitting setscrews into "through" holes into the interior of the engine, a suitable sealant should be used.

When left or right hand bank or side is referred to in this manual, this denotes the side looking towards the front of the engine from the rear or gearbox end, unless specified otherwise.
This publication is produced by the Technical Publications Department of Perkins Engines Limited. and every endeavour is made to ensure that the information contained in this manual is correct at the date of publication but due to continuous developments the manufacturers reserve the right to alter this specification without notice.

SAFETY PRECAUTIONS

THESE SAFETY PRECAUTIONS ARE MOST IMPORTANT. Reference must also be made to the local regulations in the country of operation.

Do not use these engines in marine applications.

Do not change the specification of the engine.

Do not smoke when you put fuel in the tank.

Clean away any fuel which has fallen and move material which has fuel contamination to a safe place.

Do not put fuel in the tank during engine operation (unless really necessary).

Never clean, lubricate or adjust the engine during operation (unless you have had the correct training when extreme caution must be used to prevent injury).

Do not make any adjustments you do not understand.

Ensure the engine is not in a position to cause a concentration of toxic emissions.

Persons in the area must be kept clear during engine and equipment or vehicle operation.

Do not permit loose clothing or long hair near parts which move.

Keep away from parts which turn during operation. Note that fans can not be seen clearly while the engine is run.

Do not run the engine with any safety guards removed.

Do not remove the radiator cap while the engine is hot and the coolant is under pressure as dangerous hot coolant can be discharged.

Do not use salt water in the cooling system or any other coolant which can cause corrosion.

Keep sparks or fire away from batteries (especially while during charge) or combustion can occur. The battery fluid can burn and is also dangerous to the skin and especially the eyes.

Disconnect the battery terminals before you make a repair to the electrical system.

Only one person must be in control of the engine.

Ensure the engine is only operated from the control panel or operators position.

If your skin comes into contact with high pressure fuel, get medical assistance immediately.

Diesel fuel can cause skin damage to some persons. Use protection on the hands (gloves or special skin protection solutions).

Do not move equipment unless the brakes are in good condition.

Ensure that the transmission drive control is in "Out of Drive" position before the engine is started.

Fit only correct Perkins Parts.

POWERPART Consumable Products

To give assistance in the correct operation, service and maintenance of your engine and machine, Perkins Engines Ltd., have made available the products shown below.

The instructions for the use of each product are given on the outside of each container.

These products are available from your Perkins distributor.

POWERPART Antifreeze
Gives corrosion protection and also a more efficient coolant in hot conditions. See Page C.6.

POWERPART Lay-Up 1
A diesel fuel additive for protection against corrosion. See Page C.5.

POWERPART Lay-Up 2
Gives inside protection to the engine and other closed systems. See Page C.5.

POWERPART Lay-Up 3
Gives outside protection to any metal parts. See Page C.5.

POWERPART De-Icer
To remove frost.

POWERPART Silent Spray
Silicone lubrication to lubricate and prevent noise from hinges, slide doors, etc.

POWERPART Damp Displacer
To make damp electrical equipment dry and to give future protection.

POWERPART Hylomar
Universal sealing compound to seal joints.

POWERPART Hylosil
Silicone rubber sealant to prevent leakage.

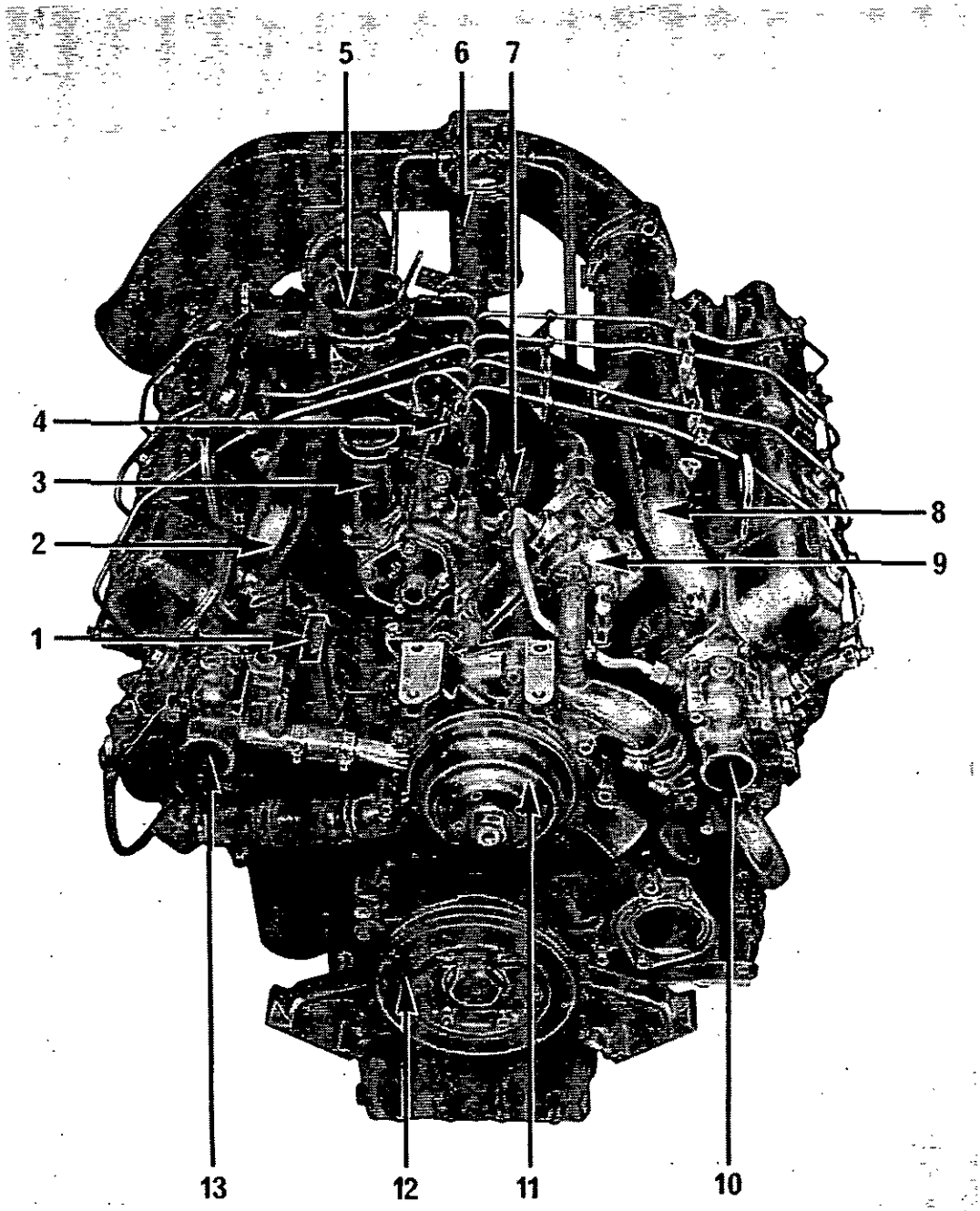
POWERPART Impact Adhesive
To keep joints in position during installation and other general attachment purposes.

POWERPART Solvent
To thoroughly clean metal faces before assembly.

POWERPART Locking Agent
Used to securely install fasteners, sleeves, etc.

SECTION A
Engine Views

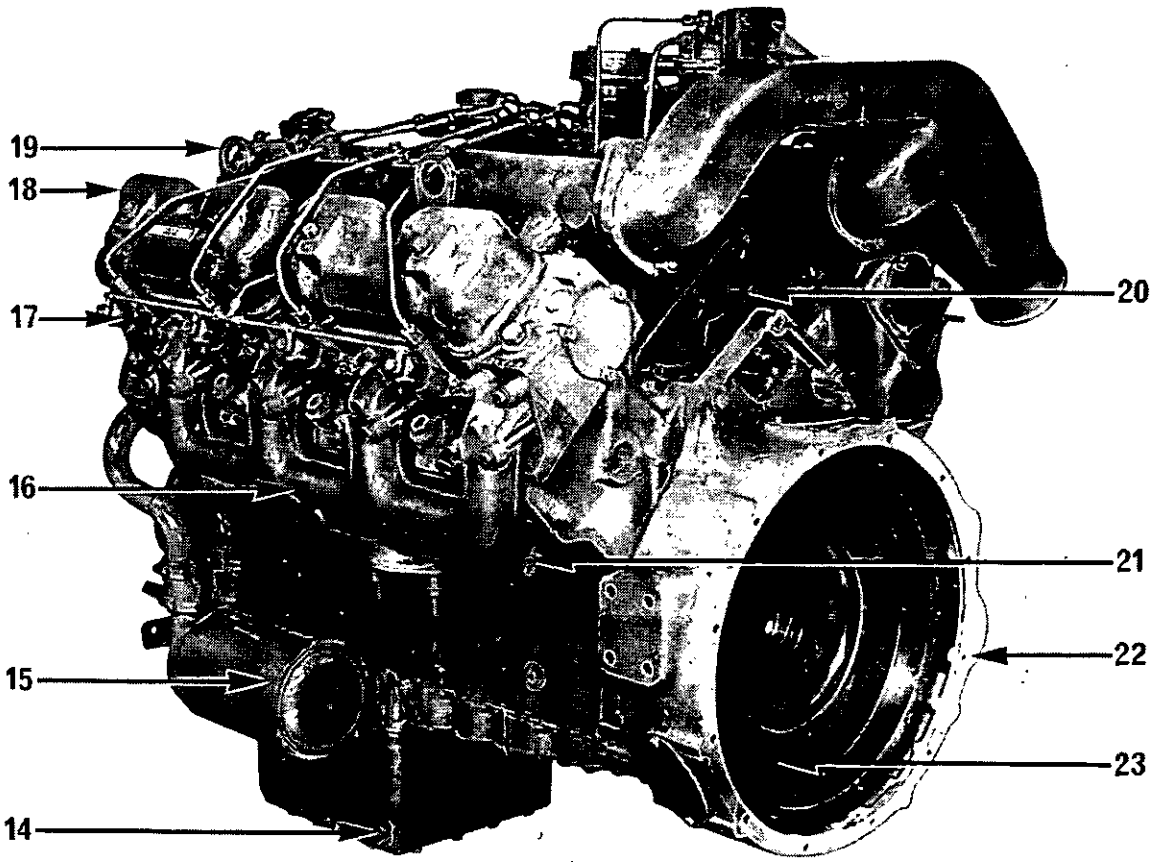
Perkins engines are built to individual requirements to suit the applications for which they are intended and the following engine views do not necessarily typify any particular specification.



A1

VIEW OF TOP FRONT OF ENGINE

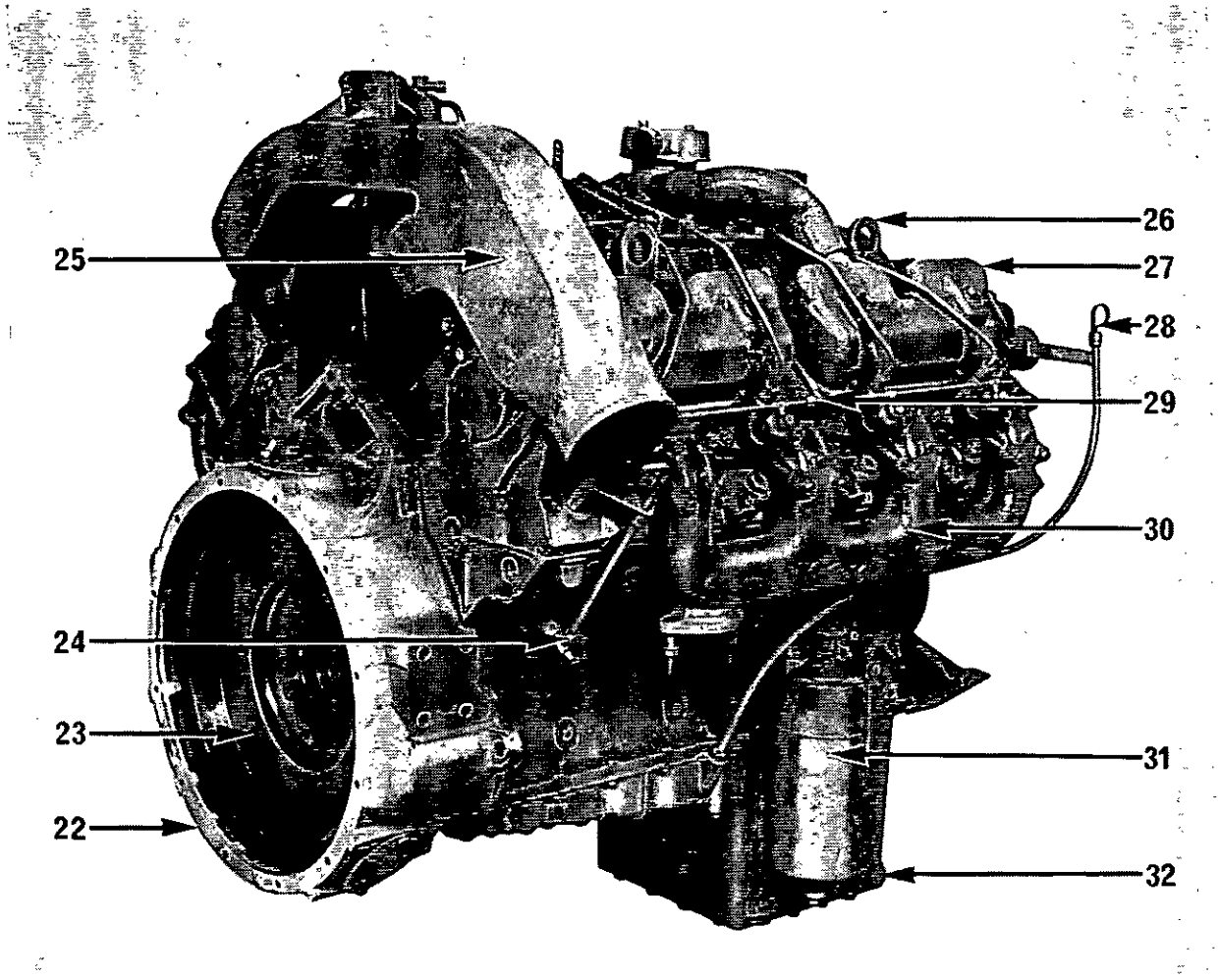
1 Engine Number Location
2 Inlet Manifold (Right Hand)
3 Lubricating Oil Filter
4 Fuel Injection Pump
5 Engine Breather
6 Fuel Filter
7 Fuel Lift Pump
8 Inlet Manifold (Left Hand)
9 Compressor
10 Water Outlet (Left Hand)
11 Water Pump Pulley
12 Crankshaft Pulley
13 Water Outlet (Right Hand)



A2

VIEW OF REAR LEFT HAND SIDE OF ENGINE

14 Sump Drain Plug (Left Hand)
15 Oil Cooler
16 Exhaust Manifold (Left Hand)
17 Atomiser
18 Front Rocker Cover (Left Hand)
19 Front Lifting Bracket (Left Hand)
20 Fuel Injection Pump Anti-Stall Device
21 Cylinder Block Drain Tap (Left Hand)
22 Flywheel Housing
23 Flywheel



A3

VIEW OF REAR RIGHT HAND SIDE OF ENGINE

22 Flywheel Housing
23 Flywheel
24 Cylinder Block Drain Tap (Right Hand)
25 Inlet Manifold Cross Over Pipe
26 Front Lifting Bracket (Right Hand)
27 Front Rocker Cover (Right Hand)
28 Lubricating Oil Dipstick
29 Atomiser Leak-Off Pipe (Right Hand)
30 Exhaust Manifold (Right Hand)
31 Lubricating Oil Filter
32 Sump Drain Plug (Right Hand)

SECTION B
Technical Data

Engine Data

Type	Eight cylinder, four stroke, direct injection, 90°V.
Nominal Bore	4.25 in (108 mm)*
Stroke (V8.540)	4.75 in (120,7 mm)
Stroke (V8.510)	4.5 in (114,3 mm)
Compression Ratio	16.5 : 1
Cubic Capacity (V8.540)	539.1 in³ (8,84 litres)
Cubic Capacity (V8.510)	510.7 in³ (8,36 litres)
Firing Order	1, 8, 7, 5, 4, 3, 6, 2.
Lubricating Oil Pressure	*40 lbf/in² (2,8 kgf/cm²) or 279kN/m² minimum at maximum* engine speed and normal operating temperature.
Valve Tip Clearance	0.012 in (0,30 mm) COLD
Lubricating Oil Sump Capacity (Standard Vehicle)	27 Imperial pints (15,3 litres)
Cooling Water Capacity (Engine Only)	40 Imperial pints (22,7 litres)

* For actual bore size, see Page B.5.

Rating Details

V8.540

Rated Output (Gross)	180 b h p (134 kW) at 2,600 rev/min
Maximum Torque	410 lbf ft (56,7 kgf m) at 1,650 rev/min

V8.510

Rated Output (Gross)	180 b h p (134 kW) at 2,800 rev/min
Maximum Torque	398 lbf ft (5,5 kgf m) at 1,650 rev/min

Note: The above ratings are maximum and can vary according to application. For details of individual ratings, apply to Technical Services Department, Perkins Engines Ltd., Peterborough.

De-Rating for Altitude

If the engine is to operate continuously at altitudes higher than 5000 ft (1500 m), the fuel delivery should be reduced to minimise exhaust smoke and fuel consumption.

The reduced fuel delivery rate for operating at a particular altitude can be obtained through your Perkins Distributor providing that the information specified below is submitted.

Engine number, fuel injection pump type number and application into which engine is fitted.

Site barometric pressure, ambient temperature and humidity. If these are not available, specify altitude and location.

Whether or not the machine is working at a constant altitude or moving from one altitude to another.

Whether conventional gearbox or torque converter is fitted. If using a torque converter, give stall speed of transmission.

If possible, horsepower requirements of machine operating at site conditions.

Any alterations to fuel pump settings must be made by an authorised fuel pump specialist or Perkins Distributor.

Engine Number

The engine number is stamped on the top of the inside forward end of the right bank of the cylinder block (see Engine Views, Item 1) and should be quoted when requesting information or ordering parts.

The number consists of a combination of figures and letters. A typical engine number in the current engine numbering system is XC22656U514424E and in the earlier numbering system is 540U12929L.

Other letters can be included in the combination denoting specific information and the full engine number should be quoted in all cases.

Recommended Torque Tensions

The securing arrangement for a component part may vary according to application or because of design alteration therefore, before fitment, determine the correct torque value for the particular size or type of securing arrangement used.

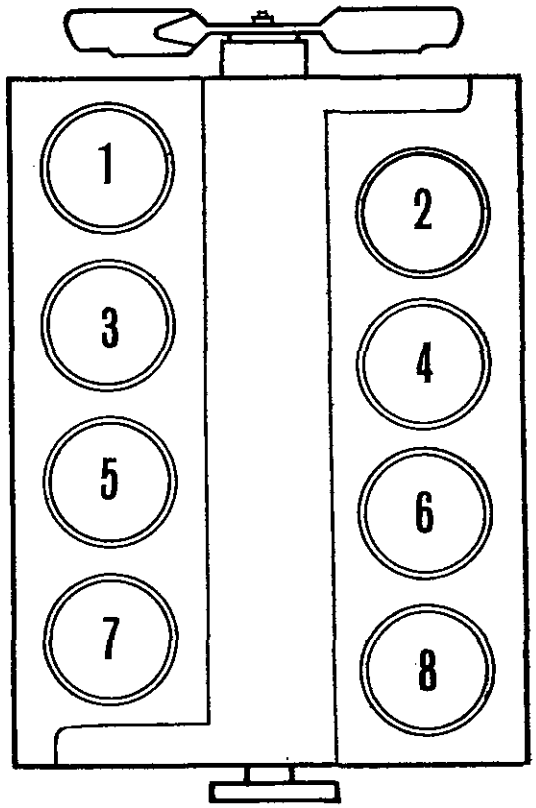
The following figures will apply with the components lightly oiled before assembly.

Securing Items	Screw Size U.N.F.	lbf ft	Nm	kgf m
Cylinder Head Setscrews	9/16	125	169	17,3
Cylinder Head Nuts	9/16	125	169	17,3
Rocker Shaft Bracket Setscrews/Nuts	3/8	36	49	5,0
Big End Setscrews (V8.540)	9/16	105	142	14,5
Big End Setscrews (V8.510)	9/16	95	129	13,2
Main Bearing Cap Setscrews	5/8	210	285	29,0
Main Bearing Cap Transverse Setscrews ("S" range)	1/2	75	102	10,4
Main Bearing Cap Transverse Setscrews ("W" range)	1/2	100	136	13,8
Main Bearing Cap Transverse Setscrews	7/16	50	68	6,9
Crankshaft Balance Weight Setscrews	1/2	85	115	11,8
Crankshaft Balance Weight Studs	1/2	25	34	3,5
Crankshaft Balance Weight Nuts	1/2	80	108	11,1
Fuel Injection Pump Gear Setscrews	3/8	30	41	4,1
Fuel Injection Pump Gear Nuts or Setscrews	5/16	21	28	2 9
*Fuel Injection Pump Gear Capscrews (With Washers)	5/16	21	28	2,9
(With Hardened Plate)	5/16	28	38	3,9
Fuel Injection Pump Gear Capscrews (DP 15 Pump)	3/8	35	47	4,8
Fuel Injection Pump Gear Capscrews (Bosch MW Fuel Pump)	3/8	37	50	5,1
Fuel Pump Drive Shaft Thrustplate Setscrews (DP 15 Pump)	1/4	7	9,5	1.0
Fuel Pump Adaptor Shaft Setscrews	5/16	15	20	2,1
Fuel Pump Adaptor Shaft Nuts	5/16	21	28	2,9
Camshaft Gear Setscrews (Part Threaded)	5/16	21	28	2,9
(Fully Threaded)	3/8	30	41	4,1
(Waisted)	3/8	40	54	5,5
Camshaft Thrust Plate Setscrews	1/4	12	16	1,7
Crankshaft/Camshaft Idler Gear Hub Nuts (Nyloc)	3/8	30	41	4,1
Crankshaft/Camshaft Idler Gear Hub Nuts (Philidas)	3/8	24	33	3,3
Crankshaft/Oil Pump Idler Gear Hub Setscrews	5/16	19	26	2,6
Camshaft/Fuel Pump Drive Idler Gear Hub Nuts (Alternative Drive – CAV In-Line Pump)	3/8	24	33	3,3
Camshaft/Fuel Pump Idler Gear Hub Setscrews (DP15 or Bosch Fuel Pumps)	3/8	30	41	4,1
Crankshaft Pulley Retaining Setscrew	7/8	300	407	41,5
Crankshaft Pulley Retaining Setscrews (3)	7/16	65	88	9,0
Flywheel Setscrews	1/2	80	108	11,1
Water Pump Pulley Retaining Setscrew	1/2	40	54	5,5
Water Pump Pulley Retaining Nut	7/8	70	95	9,7
Atomiser Securing Nuts	5/16	12	16	1,7
Lubricating Oil Filter Bowl Securing Setscrew		10	14	1,4
High Pressure Fuel Pipe Nuts	12 x 1,5 mm	15	20	2,1

*A hardened plate is fitted under the fuel pump gear retaining capscrews of later V8 510 engines which replaces the plain and spring washers formerly fitted. New type capscrews are also fitted and the torque loading on the capscrews has been increased. Where a tachometer drive adaptor is fitted to the V8.510 fuel pump gear, the adaptor, washers and capscrews have been replaced by a hardened adaptor with new capscrews without washers and the higher torque loading should be used for this later arrangement. On no account should the washers be removed or the higher torque used on the earlier V8.510 gear securing arrangement.

Cylinder Numbering

The cylinders are numbered from front to rear, No. 1 cylinder is at the front of the left bank, No. 2 is at the front of the right bank (see Fig. B.1).



B1

Engine Weights (Vehicle Application)

Approximate Dry Weight :—

Bare Engine	1415 lb (642 kg)
V8.540 Engine With Accessories	1650 lb (748 kg)
V8.510 Engine With Accessories	1660 lb (753 kg)

Note : Four lifting brackets are provided at the ends of the cylinder heads and these must all be used, preferably with a horizontal spreader bar. On no account should attempts be made to lift a V8.540 or V8.510 engine using only two lifting brackets.

If, when lifting the engine, the lifting brackets are subjected to any shock loading, e.g. if the engine is allowed to fall several inches before being arrested by the lifting tackle, the brackets and bracket securing setscrews must be checked and renewed, if damaged in any way.

DATA AND DIMENSIONS

All threads used, except perhaps on proprietary equipment, are Unified Series and American Pipe Series. The crankshaft and pulley retaining setscrew are threaded $\frac{7}{8}$ in U.N.F. of 14 T.P.I.

The following data of clearances and tolerances are given as a guide for personnel engaged upon major overhauls and the figures are mainly based upon those used in the factory for production. Unless specified otherwise, the information applies to both V8.540 and V8.510 engines.

Cylinder Block

Height Between Top Face of Cylinder Banks and Periphery of Main Bearing Parent Bore	11.967/11.972 in (303,96/304,09 mm)
Depth of Recess for Cylinder Liner	0.102/0.104 in (2,59/2,64 mm)
Diameter of Recess for Cylinder Liner	4.612/4.616 in (117,14/117,25 mm)
Parent Bore Diameter for Cylinder Liner	4.4565/4.4575 in (113,195/113,221 mm)
Main Bearing Parent Bore Diameter	4.185/4.186 in (106,30/106,325 mm)
Camshaft Bush Parent Bore Diameter, No. 1 ...	2.500/2.501 in (63,50/63,53 mm)
Camshaft Bearing Bush Internal Diameter	2.375/2.377 in (60,32/60,38 mm)
Max. Permissible Worn Bush Internal Diameter ...	2.3795 in (60,44 mm)
Camshaft Bearing Bore Diameter — No. 2	2.245/2.247 in (57,02/57,07 mm)
Max. Permissible Worn Bore Diameter — No. 2 ...	2.2493 in (57,13 mm)
Camshaft Bearing Bore Diameter — No. 3	2.235/2.237 in (56,77/56,82 mm)
Max. Permissible Worn Bore Diameter -- No. 3 ..	2.2393 in (56,88 mm)
Camshaft Bearing Bore Diameter — No. 4	2.225/2.227 in (56,52/56,57 mm)
Max. Permissible Worn Bore Diameter — No. 4 ...	2.2293 in (56,62 mm)
Camshaft Bearing Bore Diameter — No. 5	2.215/2.217 in (56,26/56,31 mm)
Max. Permissible Worn Bore Diameter — No. 5 ...	2.2193 in (56,37 mm)

Cylinder Liners

Type	Dry — Interference Fit (Production) — Slip Fit (Service)
Outside Diameter of Production Liner	4.4585/4.4595 in (113,246/113,271 mm)
Outside Diameter of Service Liner (early)	4.4555/4.4565 in (113,17/113,20 mm)
Outside Diameter of Service Liner (current)	4.4565/4.4575 in (113,195/113,221 mm)
Interference Fit of Production Liner in Cylinder Block Parent Bore	0.001/0.003 in (0,025/0,076 mm)
Clearance Fit of Service Liner in Cylinder Block Parent Bore (early)	0.000/0.002 in (0,00/0,05 mm)
Transition Fit of Service Liner in Cylinder Block Parent Bore (current)	0.001/0.001 in (0,025/0,025 mm)
Flange Thickness	0.100/0.102 in (2,54/2,60 mm)
Outside Diameter of Flange	4.590/4.595 in (116,59/116,71 mm)
Depth of Liner Flange Below Top Face of Cylinder Block	0.000/0.004 in (0,00/0,10 mm)
Height of Liner Above Top Face of Cylinder Block	0.020/0.026 in (0,51/0,66 mm)
Inside Diameter of Finished Production Liner in Cylinder Block	4.250/4.251 in (107,95/107,975 mm)
Inside Diameter of Pre-Finished Service Liner in Cylinder Block (early)	4.251/4.252 in (107,975/108,00 mm)
Inside Diameter of Pre-finished Service Liner in Cylinder Block (current)	4.252/4.253 in (108,000/108,026 mm)
Max. Permissible Worn Inside Diameter of Liner — New Rings Fitted	4.255 in (108,08 mm)
Max. Permissible Ovality of Worn Liner Bore	0.002 in (0,05 mm)
Overall Length of Liner	8.894/8.906 in (225,91/226,21 mm)

Pistons (V8.540)

Type	Toroidal Cavity in Crown, Recessed for Valves, Inserted Top Ring Groove
Piston Height in relation to Cylinder Block Top Face	0.000/0.0085 in (0,00/0,216 mm) BELOW
Bore Diameter for Gudgeon Pin	1.7500/1.7503 in (44,45/44,458 mm)
Top Compression Ring Groove Width	0.097/0.098 in (2,464/2,489 mm)
2nd Compression Ring Groove Width	0.0957/0.0967 in (2,431/2,456 mm)
Scraper Ring Groove Width	0.1895/0.1905 in (4,813/4,839 mm)

Pistons (V8.510)

Type	Toroidal Cavity in Crown, Recessed for Valves, Latest pistons have bonded insert for top ring groove
Piston Skirt Diameter — Across Thrust	4.244/4.245 in (107,80/107,82 mm)
Piston Height in relation to Cylinder Block Top Face	0.000/0.0085 in (0,00/0,216 mm) BELOW
Bore Diameter for Gudgeon Pin (Inserted Piston)	1.62495/1.62515 in (41,274/41,279 mm)
Bore Diameter for Gudgeon Pin (Plain Piston)	1.625/1.6253 in (41,275/41,283 mm)
Top Compression Ring Groove Width (Inserted)	0.0962/0.0972 in (2,444/2,469 mm)
Top Compression Ring Groove Width (Plain)	0.0977/0.0987 in (2,482/2,507 mm)
2nd and 3rd Compression Ring Groove Width	0.0957/0.0967 in (2,431/2,456 mm)
Scraper Ring Groove Width	0.252/0.253 in (6,40/6,425 mm)

Piston Rings (V8.540)

Top Compression	Chromium Plated, Copper Finished, Barrelled Faced
2nd Compression	Chromium Faced, Internally Stepped or Chamfered
3rd and 4th Scraper	Chromium Faced, Coil Spring Loaded, Oil Control
Compression Ring Width	0.0928/0.0938 in (2,357/2,383 mm)
Scraper Ring Width	0.1865/0.1875 in (4,737/4,763 mm)
Ring Clearance in Groove — Top	0.003/0.005 in (0,08/0,13 mm)
Max. Permissible Ring Clearance in Groove — Top	0.008 in (0,20 mm)
Ring Clearance in Groove — 2nd, 3rd and 4th	0.002/0.004 in (0,05/0,10 mm)
Ring Gap — Top Ring	0.008/0.030 in (0,20/0,76 mm)
Ring Gap — 2nd	0.013/0.036 in (0,33/0,91 mm)
Ring Gap — Scraper	0.017/0.036 in (0,43/0,91 mm)

Piston Rings (V8.510)

Top Compression	Chromium Plated, Copper Finished, Barrelled Faced
Second Compression	Chromium Faced, Internally Stepped or Chamfered
Third Compression	Chromium Faced, Internally Stepped or Chamfered
Scraper	Chromium Faced, Coil Spring Loaded, Oil Control
Compression Ring Width	0.0928/0.0938 in (2,357/2,383 mm)
Scraper Ring Width	0.249/0.250 in (6,32/6,35 mm)
Top Ring Clearance in Groove (Inserted Piston)	0.002/0.004 in (0,05/0,10 mm)
Top Ring Clearance in Groove (Plain Piston)	0.004/0.006 in (0,10/0,15 mm)
Max. Permissible Ring Clearance in Groove — Top	0.008 in (0,20 mm)
Ring Clearance in Groove — 2nd, 3rd and Scraper	0.002/0.004 in (0,05/0,10 mm)
Ring Gap — Top Ring	0.008/0.030 in (0,20/0,76 mm)
Ring Gap – 2nd and 3rd	0.013/0.036 in (0,33/0,91 mm)
Ring Gap – Scraper	0.017/0.036 in (0,43/0,91 mm)

Gudgeon Pins (V8.540)

Type	Fully Floating
Outside Diameter	1.7498/1.7500 in (44,445/44,450 mm)
Clearance Fit in Piston Boss	0.000/0.0005 in (0,00/0,013 mm)
Clearance Fit in Small End Bush	0.0007/0.0018 in (0,018/0,046 mm)

Gudgeon Pins (V8.510)

Type	Fully Floating
Outside Diameter	1.6248/1.625 in (41,270/41,275 mm)
Transition Fit in Piston Boss (Inserted Piston)	*—0.00005/+0.00025 in (—0,001/+0,006 mm)*
Clearance Fit in Piston Boss (Plain Piston)	0.000/0.0005 in (0,00/0,013 mm)
Clearance Fit in Small End Bush	0.0007/0.0018 in (0,018/0,046 mm)

Small End Bushes (V8.540)

Type	Steel Backed, Lead Bronze Lined
Outside Diameter	1.9405/1.9420 in (49,29/49,33 mm)
Length	1.261/1.271 in (32,03/32,28 mm)
Interference Fit in Connecting Rod	0.002/0.0045 in (0,05/0,11 mm)
Inside Diameter after Reaming	1.7507/1.7516 in (44,47/44,49 mm)

Small End Bushes (V8.510)

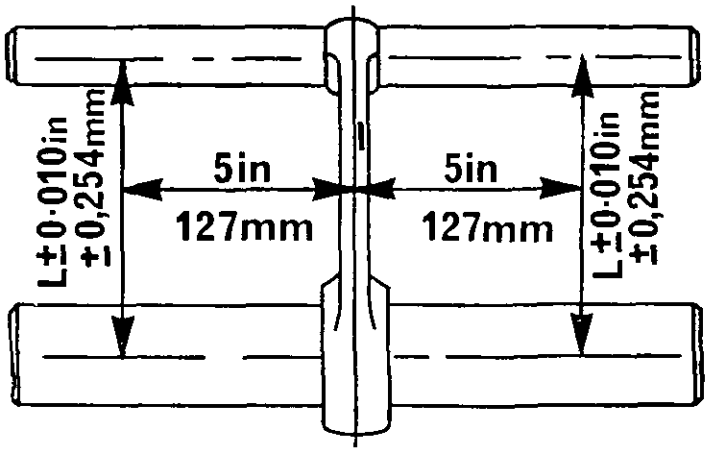
Type	Steel Backed, Lead Bronze Lined
Outside Diameter	1.785/1.7865 in (45,34/45,38 mm)
Length	1.477/1.487 in (37,52/37,77 mm)
Interference Fit in Connecting Rod	0.003/0.0055 in (0,08/0,13 mm)
Inside Diameter after Reaming	1.6257/1.6266 in (41,293/41,316 mm)

Connecting Rods

Type	'H' Section
Cap Location to Connecting Rod	Saw Tooth
Big End Parent Bore Diameter (V8.540)	3.166/3.167 in (80,42/80,44 mm)
Big End Parent Bore Diameter (V8.510)	3.416/3.417 in (86,77/86,79 mm)
Small End Parent Bore Diameter (V8.540)	1.9375/1.9385 in (49,21/49,24 mm)
Small End Parent Bore Diameter (V8.510)	1.781/1.782 in (45,24/45,27 mm)
Big End Width	1.443/1.445 in (36,65/36,70 mm)
Big End Side Clearance on Crankpin (Two Rods Fitted)	0.015/0.022 in (0,38/0,56 mm)
Length Between Bore Centres (V8.540)	8.999/9.001 in (228,57/228,63 mm)
Length Between Bore Centres (V8.510)	8.749/8.751 in (222,22/222,28 mm)

Connecting Rod Alignment

Large and small end bores must be square and parallel to each other within the limits of ±0.010 in (0,25 mm). measured 5 in (127 mm) each side of the axis of the rod on test mandrel as shown in Fig. B.2.
With the small end bush fitted, the limit of ±0.010 in (0,25 mm) is reduced to ±0.0025 in (0,064 mm).



B2

Connecting Rod Bearings (V8.540)

Type	Pre-Finished, Steel Backed, Aluminium Tin Faced
Shell Thickness	0.0826/0.08285 in (2,098/2,104 mm)
Inside Diameter	3.0003/3.0018 in (76,21/76,25 mm)
Bearing Running Clearance	0.0018/0.0038 in (0,05/0,10 mm)

Connecting Rod Bearings (V8.510)

Type	Pre-Finished, Steel Backed, Aluminium Tin Faced
Shell Thickness	0.0824/0.0826 in (2,093/2,098 mm)
Inside Diameter	3.2508/3.2523 in (82,57/82,61 mm)
Bearing Running Clearance	0.0023/0.0043 in (0.058/0,109 mm)

Crankshaft

Main Journal Diameter	3.9967/3.9972 in (101,516/101,529 mm)
Min. Permissible Worn Main Journal Diameter	3.9942 in (101,45 mm)
Max. Permissible Ovality of Worn Journal	0.0015 in (0,04 mm)
Main Journal Width — No. 1	1.557/1.567 in (39,55/39,80 mm)
Main Journal Width — Nos. 2 and 4	1.931/1.935 in (49,05/49,15 mm)
Main Journal Width — No. 3	1.655/1.658 in (42,04/42,11 mm)
Main Journal Width — No. 5	1.675/1.679 in (42,55/42,65 mm)
Fillet Radii — Main Journals	0.125/0.140 in (3,18/3,56 mm)
Crankpin Diameter (V8.540)	2.9980/2.9985 in (76,149/76,162 mm)
Crankpin Diameter (V8.510)	3.248/3.2485 in (82,50/82,512 mm)
Min. Permissible Worn Crankpin Diameter (V8.540)	2.9955 in (76,09 mm)
Min. Permissible Worn Crankpin Diameter (V8.510)	3.2455 in (82,44 mm)
Max. Permissible Ovality of Worn Crankpin	0.0015 in (0,04 mm)
Crankpin Width	2.905/2.908 in (73,79/73,86 mm)
Fillet Radii — Crankpins	0.125/0.140 in (3,18/3,56 mm)
Surface Finish — All Pins and Journals	16 micro-inches (0,4 microns) Maximum
Oil Seal Helix Diameter (Rope Seal only)	3.374/3.375 in (85,70/85,73 mm)
Oil Seal Helix Depth (Rope Seal only)	0.004/0.008 in (0,10/0,20 mm)
Spigot Bearing Recess Depth	0.594 in (15,09 mm)
Spigot Bearing Recess Bore	2.046/2.0465 in (51,97/51,98 mm)
Crankshaft End Float	0.002/0.017 in (0,05/0,43 mm)
Max. Permissible Worn Crankshaft End Float	0.020 in (0,51 mm)
Regrind Undersizes — Main Journals and Pins	0.010 in (0,25 mm), 0.020 in (0,51 mm) and 0.030 in (0,76 mm)

Fillet radii and surface finish must be maintained during crankshaft regrinding. Length of No. 3 main journal must not

exceed 1.673 in (42,49 mm) after regrinding ; where necessary use oversize thrust washers to suit. Length of crankpins not to exceed 2.913 in (73,99 mm).

The crankshaft fitted to some V8.540 engines is nitride hardened and where facilities are not available for re-nitriding after regrinding, a replacement crankshaft should be fitted. The nitrided crankshaft can be recognised by the assembly part number 41111663 or 41111684, stamped on the No. 1 web of the crankshaft.

When regrinding, only very light cuts should be used, especially around the fillet radii and adequate cooling should be ensured. After regrinding, the crankshaft should be crack detected and de-magnetised and the oil holes chamfered 0.020/0.060 in (0,51/1,52 mm) at 45°.

When the above operations have been carried out, nitrided V8.540 crankshafts should be re-hardened by the 20 hour nitriding process and then crack detected and de-magnetised. The plain machined diameter at the front end of the crankshaft, where the pulley clamping ring seats, should be left soft. Finally the crankpins and main journals should be lapped to remove the residue from the nitriding process.

Crankshaft Thrust Washers

Type	Steel Backed, Aluminium Tin Faced
Position in Engine	Cylinder Block, Centre Main Bearing Housing
Thrust Washer Thickness — Standard	0.122/0.125 in (3,10/3,18 mm)
Thrust Washer Thickness — Oversize	0.1295/0.1325 in (3,29/3,37 mm)

Main Bearings

Type	Pre-Finished, Steel Backed, Aluminium Tin Faced
Shell Width, Nos. 1, 3 and 5	1.370/1.380 in (34,80/35,05 mm)
Shell Width, Nos. 2 and 4	1.620/1.630 in (41,15/41,40 mm)
Shell Thickness	0.0915/0.0919 in (2,324/2,334 mm)
Inside Diameter	4.0012/4.003 in (101,63/101,68 mm)
Main Bearing Running Clearance	0.004/0.0063 in (0,10/0,16 mm)

Camshaft

No. 1 Journal Diameter	2.371/2.373 in (60,24/60,26 mm)
Min. Permissible Worn Journal Dia. — No. 1	2.370 in (60,20 mm)
No. 2 Journal Diameter	2.241/2.243 in (56,93/56,96 mm)
Min. Permissible Worn Journal Dia. — No. 2	2.240 in (56,90 mm)
No. 3 Journal Diameter	2.231/2.233 in (56,68/56,71 mm)
Min. Permissible Worn Journal Dia. — No. 3	2.230 in (56,64 mm)
No. 4 Journal Diameter	2.221/2.223 in (56,43/56,45 mm)
Min. Permissible Worn Journal Dia. — No. 4	2.220 in (56,39 mm)
No. 5 Journal Diameter	2.211/2.213 in (56,17/56,20 mm)
Min. Permissible Worn Journal Dia. — No. 5	2.210 in (56,13 mm)
Running Clearance— All Journals	0.002/0.006 in (0,05/0,15 mm)
Max. Permissible Worn Clearance — All Journals	0.0095 in (0,24 mm)
Cam Lift	0.3325/0.3355 in (8,45/8,52 mm)
Camshaft End Float	0.0015/0.015 in (0,04/0,38 mm)
Max. Permissible Worn Camshaft End Float	0.020 in (0,51 mm)
Oilways for Rocker Shaft Lubrication	No. 3 Journal

Cylinder Heads

Cylinder Head Depth	3.985/4.015 in (101,22/101,98 mm)
Cylinder Head Skimming Allowance	0.015 in (0,38 mm) Max. providing nozzle protrusion does not exceed 0.143 in (3,63 mm) and head depth is not less than 3.970 in (100,84 mm) after skimming Nozzle holes must be radiused after skimming.
Leak Test Pressure	30 lbf/in² (207 kN/m²) 2,11 kgf/cm²
Valve Seat Angle	45°
Valve Guide Parent Bore Diameter	0.6247/0 6257 in (15,87/15,89 mm)

Valve Guides

Inside Diameter	0.03745/0.3765 in (9,51/9,56 mm)
Outside Diameter	0.626/0.6265 in (15,90/15,91 mm)
Interference Fit of Guide in Cylinder Head	0.0003/0.0018 in (0,008/0,046 mm)
Overall Length (Current)	2.594 in (65,89 mm)
Overall Length (Early)	2.688 in (68,28 mm)
Guide Protrusion above Spring Seating Face (Current)	0.783/0.800 in (19,89/20,32 mm)
Guide Protrusion above Spring Seating Face (Early)	0.879/0.896 in (22,33/22,76 mm)
Seal Diameter of Current Guide	0.555/0.569 in (14,10/14,45 mm)

Inlet Valves

Valve Stem Diameter	0.3725/0.3735 in (9,46/9,49 mm)
Clearance Fit of Valve in Guide	0.001/0.004 in (0,03/0,10 mm)
Max. Permissible Worn Clearance in Guide	0.0055 in (0,14 mm)
Valve Head Diameter	1.776/1.786 in (45,11/45,36 mm)
Valve Face Angle	45°
Valve Head Protrusion above Cylinder Head Face	0.042/0.052 in (1,07/1,32 mm)
*Min. Permissible Valve Head Protrusion (Service)	0.001 in (0,03 mm)
Overall Length	5.484/5.500 in (139,29/139,70 mm)
Sealing Arrangement (Current)	Spring Loaded Rubber Seal
Sealing Arrangement (Early)	Rubber 'O' Ring and Steel Deflector

*Note: Where vehicle engines have to conform to the smoke density regulation BSAU141a: 1971, then the valve head protrusion must not fall below the production limits.

Exhaust Valves

Valve Stem Diameter	0.372/0.373 in (9,45/9,47 mm)
Clearance Fit of Valve in Guide	0.0015/0.0045 in (0,04/0,11 mm)
Max. Permissible Worn Clearance in Guide	0.0055 in (0,14 mm)
Valve Head Diameter	1.526/1.536 in (38,76/39,01 mm)
Valve Face Angle	45°
Valve Head Protrusion above Cylinder Head Face	0.0485/0.0585 in (1.23/1,49 mm)
*Min. Permissible Valve Head Protrusion (Service)	0.0085 in (0,22 mm)
Overall Length	5.497/5.513 in (139,61/140,03 mm)
Sealing Arrangement (Current)	Spring Loaded Rubber Seal
Sealing Arrangement (Early)	Rubber 'O' Ring and Steel Deflector

*Note: Where vehicle engines have to conform to the smoke density regulation BSAU141a: 1971, then the valve head protrusion must not fall below the production limits.

Inner Valve Springs

Fitted Length	1.553 in (39,45 mm)
Load at Fitted Length	30.3/33.5 lb (13,73/15,2 kg)
Free Length	1.983 in (50,37 mm)
No. of Active Coils	5.67
No. of Damper Coils	1
Coiled	Right Hand — Damper Coil to Cylinder Head

Outer Valve Springs

Fitted Length	1.833 in (46,56 mm)
Load at Fitted Length	68.8/76 lb (31,21/34,47 kg)
Free Length	2.28 in (57,91 mm)
No. of Active Coils	4.75
No. of Damper Coils	1
Coiled	Left Hand — Damper Coil to Cylinder Head

Tappets

Overall Length	2.97 in (75,44 mm)
Tappet Shank Diameter	0.7475/0.7485 in (18,99/19,01 mm)
Running Clearance in Tappet Block	0.006/0.0085 in (0,15/0.22 mm)

Tappet Blocks

Bore Diameter for Tappet	0.7545/0.756 in (19,16/19,20 mm)

Rocker Shafts

Outside Diameter	0.7485/0.7495 in (19,01/19,04 mm)
Clearance of Rocker Shaft to Bush	0.002/0.005 in (0,05/0,13 mm)

TECHNICAL DATA—B.10

Rocker Levers and Bushes

Bore Diameter for Bush	0.875/0.876 in (22,23/22,26 mm)
Outside Diameter of Bush	0.877/0.878 in (22,28/22,30 mm)
Interference Fit of Bush in Lever	0.001/0.003 in (0,025/0,076 mm)
Inside Diameter of Bush	0.7515/0.7535 in (19,09/19,14 mm)

Push Rods

Overall Length	11.309/11.393 in (287,25/289,38 mm)
Shank Diameter	0.313 in (7,95 mm)

Camshaft Gear

No. of Teeth	54
Inside Diameter of Camshaft Flange Location	1.969/1.970 in (50,01/50,04 mm)
Outside Diameter of Camshaft Flange	1.968/1.969 in (49,98/50,01 mm)
Transition Fit of Gear to Flange	0.000/+0.002 in (0,00/+0,07 mm)

Crankshaft Gear

No. of Teeth	27
Diameter of Bore	1.875/1.876 in (47,63/47,65 mm)
Outside Diameter of Crankshaft	1.875/1.8755 in (47,63/47,64 mm)
Transition Fit of Gear to Crankshaft	−0.0005/+0.001 in (−0,01/+0,03 mm)

Crankshaft/Camshaft Idler Gear and Hub (Standard Drive – V8.510 and Earlier V8.540 Engines)

No. of Teeth	49
Parent Bore Diameter for Bush	2.438/2.439 in (61,92/61,95 mm)
Outside Diameter of Bush	2.441/2.443 in (62,00/62,05 mm)
Interference Fit of Bush in Gear	0.002/0.005 in (0,05/0,13 mm)
Inside Diameter of Bush — Fitted	2.250/2.252 in (57,15/57,21 mm)
Outside Diameter of Hub	2.248/2.249 in (57,10/57,12 mm)
Clearance Fit of Hub in Bush	0.001/0.004 in (0,03/0,10 mm)
Width of Gear	1.005/1.007 in (25,53/25,58 mm)
Bearing Length of Hub	1.019/1.028 in (25,88/26,11 mm)
Idler Gear End Float	0.012/0.023 in (0,30/0,58 mm)
Max. Permissible Worn Idler Gear End Float	0.030 in (0,76 mm)

Crankshaft/Camshaft Idler Gear and Hub (Alternative Drive – V8.510 and Earlier V8.540 Engines)

No. of Teeth	49
Parent Bore Dia. for Bushes	2.5625/2.5637 in (65,09/65,12 mm)
Outside Dia. of Bushes	2.5655/2.5662 in (65,16/65,18 mm)
Interference Fit of Bushes in Gear	0.0018/0.0037 in (0,05/0,09 mm)
Inside Dia. of Bushes, Finished in Situ	2.2502/2.2520 in (57,16/57,20 mm)
Outside Dia. of Hub	2.2483/2.2490 in (57,11/57,12 mm)
Clearance Fit of Bushes on Hub	0.0012/0.0037 in (0,03/0,09 mm)
Width of Gear Assembly, Bushes Machined After Fitting	1.008/1.010 in (25,60/25,65 mm)
Bearing Length of Hub	1.019/1.028 in (25,88/26,11 mm)
Idler Gear End Float	0.009/0.020 in (0,23/0,51 mm)
Max. Permissible Worn Idler Gear End Float	0.030 in (0,76 mm)

Crankshaft/Camshaft Idler Gear and Hub (All Later V8.540 Engines)

No. of Teeth	49
Parent Bore Dia. for Bush	2.4375/2.4387 in (61,91/61,94 mm)
Interference Fit of Bush in Gear	0.0026/0.0057 in (0,07/0,14 mm)
Inside Dia. of Bush – Fitted	2.2500/2.2522 in (57,15/57,21 mm)
Outside Dia. of Hub	2.2483/2490 in (57,11/57,12 mm)
Clearance Fit of Bush on Hub	0.0010/0.0039 in (0,03/0,10 mm)
Bearing Width of Gear	0.912/0.9135 in (23,16/23,20 mm)
Thrust Washer Thickness	0.110/0.115 in (2,79/2,92 mm)
Idler Gear End Float	0.0215/0.0250 in (0,55/0,64 mm)
Max. Permissible Worn Idler Gear End Float	0,035 in ((0,89 mm)

Camshaft/Fuel Pump Idler Gear and Hub (Alternative Drive – V8.510 Engines)

No. of Teeth	32
Parent Bore Dia. for Bush	2.3125/2.3143 in (58,74/58,78 mm)
Outside Dia. of Bush	2.3168/2.3188 in (58,85/58,90 mm)
Interference Fit of Bush in Gear	0.0025/0.0063 in (0,06/0,16 mm)
Inside Dia. of Bush, Fitted	2.125/2.1278 in (53,98/54,05 mm)
Outside Dia. of Hub	2.123/2.1238 in (53,92/53,94 mm)
Clearance Fit of Bush on Hub	0.0012/0.0048 in (0,03/0,12 mm)
Idler Gear End Float	0.014/0.020 in (0,36/0,51 mm)
Max. Permissible Worn End Float	0.030 in (0,76 mm)

Camshaft/Fuel Pump Idler Gear and Hub (V8.540 Engines)

No. of Teeth	40
Parent Bore Dia. for Bush	2.4375/2.4387 in (61,91/61,94 mm)
Interference Fit of Bush in Gear	0.0026/0.0057 in (0,07/0,14 mm)
Inside Dia. of Bush — Fitted	2.2500/2.2522 in (57,15/57,21 mm)
Outside Dia. of Hub	2.2483/2.2490 in (57,11/57,12 mm)
Clearance Fit of Bush on Hub	0.0010/0.0039 in (0,03/0,10 mm)
Bearing Width of Gear	0.9120/0.9135 in (23,16/23,20 mm)
Thrust Washer Thickness	0.110/0.115 in (2,79/2,92 mm)
Idler Gear End Float	0.0215/0.0250 in (0,55/0,64 mm)
Max. Permissible Worn Idler Gear End Float	0.035 in (0,89 mm)

Compressor/Auxiliary Drive Gear (Standard Drive)

No. of Teeth	36
Inside Locating Diameter	1.375/1.376 in (34,93/34,95 mm)
Outside Diameter of Shaft Spigot	1.375/1.3755 in (34,93/34,94 mm)
Transition Fit of Gear on Shaft	—0.0005/+0.001 in (—0,013/+0,025 mm)

Fuel Pump Drive Gear (Standard Drive)

No. of Teeth	24
Inside Locating Diameter	0.750/0.751 in (19,05/19,07 mm)
Shaft Spigot Diameter	0.750/0.7505 in (19,05/19,06 mm)
Transition Fit of Gear on Shaft	—0.0005/+0.001 in (—0,013/+0,025 mm)

Fuel Pump Gear (Standard Drive)

No. of Teeth	36
Inside Locating Diameter	2.0625/2.0635 in (52,39/52,41 mm)
Outside Diameter of Mounting Flange	2.0615/2.062 in (52,36/52,37 mm)
Clearance Fit of Gear on Flange	0.0005/0.002 in (0,01/0,06 mm)

Fuel Pump Drive Gear (Alternative Drive – CAV In-Line Pump)

No. of Teeth	54
Inside Locating Dia.	1.9687/1.9703 in (50,01/50,05 mm)
Shaft Spigot Dia.	1.9674/1.9684 in (49,97/50,00 mm)
Clearance Fit of Gear on Shaft	0.0003/0.0029 in (0,008/0,07 mm)

Fuel Pump Drive Gear (DP15 Pump)

No. of Teeth	54
Inside Locating Dia.	0.625/0.626 in (15,88/15,90 mm)
Shaft Spigot Dia.	0.6240/0.6247 in (15,85/15,87 mm)
Clearance Fit of Gear on Shaft	0.0003/0.0020 in (0,01/0,05 mm)

Fuel Pump Drive Gear (Bosch In-Line Pump)

No. of Teeth	54
Inside Locating Diameter	1.4961/1.4970 in (38,00/38,03 mm)
Shaft Spigot Diameter	1.4951/1.4957 in (37,98/37,99 mm)
Clearance fit of Gear on Shaft	0.0004/0.0019 in (0,01/0,05 mm)

Timing Gear Backlash

All Gears	0.003 in (0,08 mm) minimum

Fuel Pump Drive Housing and Shaft (Alternative Drive — In Line Pump)

Parent Bore Dia. for Front Bush	2.500/2.5018 in (63,50/63,55 mm)
Outside Dia. of Front Bush	2.5043/2.5063 in (63,61/63,66 mm)
Parent Bore Dia. for Rear Bush	2.5625/2.5643 in (65,09/65,13 mm)
Outside Dia. of Rear Bush	2.5668/2.5688 in (65,20/65,25 mm)
Interference Fit of Bushes in Housing	0.0025/0.0063 in (0,06/0,16 mm)
Inside Dia. of Front Bush, Finished in Situ	2.3125/2.3143 in (58,74/58,78 mm)
Front Journal Dia. of Shaft	2.3082/2.310 in (58,63/58,67 mm)
Min. Permissible Worn Journal Dia.	2.3072 in (58,60 mm)
Inside Dia. of Rear Bush, Finished in Situ	2.375/2.3768 in (60,33/60,37 mm)
Rear Journal Dia. of Shaft	2.3707/2.3725 in (60,22/60,26 mm)
Min. Permissible Worn Journal Dia.	2.3697 in (60,19 mm)
Running Clearance of Shaft in Bushes	0.0025/0.0061 in (0,06/0,15 mm)
Drive Shaft Thrust Plate Thickness	0.185/0.187 in (4,70/4,75 mm)
Drive Shaft End Fioat	0.004/0.014 in (0,10/0,36 mm)
Max. Permissible Worn End Float	0.020 in (0,51 mm)

Fuel Pump Drive Housing and Shaft (DP15 Pump)

Parent Bore Dia. for Bush	2.5625/2.5643 in (65,09/65,13 mm)
Interference Fit of Bush in Housing	0.0025/0.0063 in (0,06/0,16 mm)
Inside Dia. of Bush —Finished in Situ	2.3750/2.3768 in (60,33/60,37 mm)
Journal Dia. of Shaft	2.3722/2.3735 in (60,25/60,29 mm)
Running Clearance of Shaft in Bush	0.0015/0.0046 in (0,04/0,12 mm)
Drive Shaft Thrust Plate Thickness	0.185/0,187 in (4,70/4,75 mm)
Drive Shaft End Float	0.006/0.010 in (0,15/0,25 mm)

Crankshaft/Oil Pump Idler Gear and Hub

No. of Teeth	33
Parent Bore Diameter for Bush	2.188/2.189 in (55,56/55,59 mm)
Outside Diameter of Bush	2.191/2.193 in (55,66/55,71 mm)
Interference Fit of Bush in Gear	0.002/0.005 in (0,05/0,13 mm)
Inside Diameter of Bush — Fitted	2.000/2.002 in (50,80/50,86 mm)
Outside Diameter of Hub	1.998/1.999 in (50,75/50,77 mm)
Clearance Fit of Hub inside Bush	0.001/0.004 in (0,03/0,10 mm)
Width of Gear	0.880/0.882 in (22,35/22,40 mm)
Bearing Length of Hub	0.897/0.902 in (22,78/22,91 mm)
Idler Gear End Float	0.015/0.022 in (0,38/0,56 mm)
Max. Permissible Worn Idler Gear End Float	0.030 in (0,76 mm)

Lubricating Oil Pump Drive Gear (Keyed)

No. of Teeth	24
Bore Diameter for Drive Shaft	0.622/0.6228 in (15,80/15,82 mm)
Drive Shaft Diameter	0.623/0.6235 in (15,82/15,84 mm)
Interference Fit of Gear on Shaft	0.0002/0.0015 in (0,005/0,04 mm)

Lubricating Oil Pump Drive Gear (Non Keyed)

No. of Teeth	24
Bore Diameter for Drive Shaft	0.7476/0.7484 in (18,99/19,01 mm)
Drive Shaft Diameter	0.749/0.7495 in (19,02/19,04 mm)
Interference Fit of Gear on Shaft	0.0006/0.0019 in (0,02/0,05 mm)

Lubricating Oil Pump

Type	Gear
No. of Drive Gears	1
No. of Driven Gears	2
Internal Diameter of Drive Shaft Bush — Small	0.6245/0.626 in (15,86/15,89 mm)
Drive Shaft Diameter — Small	0.623/0.6235 in (15,82/15,84 mm)
Running Clearance of Drive Shaft in Small Bush	0.001/0.003 in (0,03/0,08 mm)
Internal Diameter of Drive Shaft Bush — Large	0.7505/0.752 in (19,06/19,10 mm)
Drive Shaft Diameter — Large	0.749/0.7495 in (19,02/19,04 mm)
Running Clearance of Drive Shaft in Large Bush	0.001/0.003 in (0,03/0,08 mm)
Driven Shaft Diameter	0.686/0.6865 in (17,42/17,44 mm)
Internal Diameter of Driven Gear Bush	0.6875/0.6885 in (17,46/17,49 mm)
Running Clearance of Driven Gear Bushes on Driven Gear Shaft	0.001/0.0025 in (0,03/0,06 mm)

Lubricating Oil Pump — continued

Radial Clearance between Gears and Pump Body	0.002/0.008 in (0,05/0,20 mm)
Max. Permissible Worn Radial Clearance	0.010 in (0,25 mm)
End Float of Oil Pump Gears	0.002/0.006 in (0,05/0,15 mm)
Max. Permissible Worn End Float of Gears	0.010 in (0,25 mm)
Drive Gear to Driven Gear Backlash (9 tooth pump)	0.014/0.018 in (0,36/0,46 mm)
Drive Gear to Driven Gear Backlash (10 tooth pump)	0.024/0.039 in (0,61/0,99 mm)

Oil Pressure Relief Valve

Pressure Setting	60/65 lbf/in² (414/448 kN/m²) 4,2/4,6 kgf/cm²
Outside Diameter of Plunger	0.872/0.874 in (22,15/22,20 mm)
Bore Diameter of Valve Housing	0.875/0.876 in (22,23/22,25 mm)
Clearance of Plunger in Bore	0.001/0.004 in (0,03/0,10 mm)
Outside Diameter of Spring	0.783/0.798 in (19,89/20,27 mm)
Load at 2.605 in (66,17 mm) Spring Length	27.5 lb ≐ 13 oz (12,47 kg ≐ 369 g)

Lubricating Oil Sump

Capacity (Standard Vehicle Engines)	27 Imperial Pints (15,3 litres)

Lubricating Oil Filter

Type	Full Flow
Element Type	Paper or Renewable Canister
By-Pass Valve Setting	13/17 lbf/in² (89/117 kN/m²) 0,91/1,19 kgf/cm²

Oil Cooler

Make	Clayton Dewandre or Serck
By-Pass Valve Setting (Clayton Dewandre)	15/20 lbf/in² (103/138 kN/m²) 1,05/1,41 kgf/cm²
Leak Test Air Pressure — Oil Side	90/150 lbf/in² (620/1030 kN/m²) 6,33/10,55 kgf/cm² depending upon maximum air line pressure available.
Leak Test Air Pressure — Water Side	30 lbf/in² (207 kN/m²) 2,11 kgf/cm²

Cooling System

Type	Water Pump Circulation
Engine Water Capacity	40 Imperial Pints (22,7 litres)

Thermostats (Standard)

Type	Wax
Opening Temperature (V8.540)	177/183°F (80,5/84,9°C)
Opening Temperature (V8.510)	157/163°F (69,4/72,8°C)
Fully Open Temperature (V8.540)	208°F (97,7°C)
Fully Open Temperature (V8.510)	188°F (86,7°C)
Valve Lift	0.350 in (8.89 mm)

Thermostats (By-Pass Blanking)

Type	Wax Capsule
Opening Temperature	171/185°F (77/85°C)
Fully Open Temperature	199/205°F (93/96°C)
Valve Travel	0.374/0.500 in (9,53/12,70 mm)

Water Pump — One-Piece Shaft

Type	Centrifugal
Outside Diameter of Shaft for Pulley	1.125/1.1255 in (28,58/28,59 mm)
Inside Diameter of Pulley Bore	1.125/1.126 in (28,58/28,60 mm)
Transition Fit of Pulley on Shaft	—0.0005/+0.001 in (—0,01/+0,03 mm)
Outside Diameter of Shaft for Impeller	0.626/0.6265 in (15,90/15,91 mm)
Inside Diameter of Impeller Bore	0.625/0.6255 in (15,88/15,89 mm)
Interference Fit of Impeller on Shaft	0.0005/0.0015 in (0,01/0,04 mm)
Impeller Protrusion above Water Pump Body Rear Face	0.021/0.026 in (0,53/0,66 mm)

Water Pump — Two-Piece Shaft

Type	Centrifugal
Outside Diameter of Main Shaft for Pulley	1.1242/1.1247 in (28,55/28,57 mm)
Diameter of Pulley Bore	1.1250/1.1258 in (28,58/28,60 mm)
Clearance Fit of Pulley on Shaft	0.0003/0.0016 in (0,01/0,04 mm)

Water Pump — Two-Piece Shaft — continued

Inside Diameter of Main Shaft	0.6250/0.6257 in (15,88/15,89 mm)
Diameter of Impeller Bore	0.6250/0.6257 in (15,88/15,89 mm)
Outside Diameter of Impeller Shaft	0.6260/0.6263 in (15,90/15,91 mm)
Interference Fit of Impeller Shaft in Main Shaft and Impeller	0.0003/0.0013 in (0,01/0,03 mm)
Impeller Protrusion above Water Pump Body Rear Face	0.015/0.020 in (0,38/0,51 mm)

Compressor

Make	Clayton Dewandre
Type	SC 12
Rating	12 ft³/min (0,34 m³/min) at 1250 rev/min
Cylinder Bore Diameter	3.3465/3.3475 in (85,00/85,026 mm)
Max. Permissible Worn Bore Diameter	3.3525 in (85,15 mm)
Clearance of Piston Skirt in Bore	0.0075/0.009 in (0,19/0,23 mm)
Clearance of Compression Rings in Piston Grooves	0.0013/0.0033 in (0,033/0,084 mm)
Clearance of Scraper Ring in Piston Groove	0.0005/0.0025 in (0,013/0,064 mm)
Compression Ring Gap in Cylinder	0.003/0.007 in (0,08/0,18 mm)
Scraper Ring Gap in Cylinder	0.010/0.015 in (0,25/0,38 mm)
Crankpin Diameter	1.2490/1.2495 in (31,725/31,737 mm)
Big End Bearing Running Clearance	0.0005/0.002 in (0,013/0,051 mm)
Max. Permissible Worn Big End Bearing Running Clearance	0.003 in (0,08 mm)
Main Journal Diameter	1.3740/1.3745 in (34,90/34,912 mm)
Main Bearing Running Clearance	0.0005/0.002 in (0,013/0,051 mm)
Max. Permissible Worn Main Bearing Running Clearance	0.003 in (0,08 mm)
Crankshaft End Float	0.001/0.011 (0,03/0,28 mm)

Approved Fuel Oil Specifications

United Kingdom	BS.2869 : 1967 - Class A1 and A2.
United States	A.S.T.M/D.975 - 66T - Nos. 1-D or 2-D. VV - F - 800a : Grades DF-A, DF-1 or DF-2.
Germany	DIN-51601 (1967).
France	(J.O. 14/9/57) Gas Oil or Fuel Domestique.
Italy	CUNA - Gas Oil NC-630-01 (1957).
India	IS : 1460/1968 - Grade Special or Grade A.
Sweden	SIS. 15 54 32 (1969).
Switzerland	Federal Military Specification 9140-335-1404 (1965).

Fuel oils available in territories other than those listed above which are to an equivalent specification may be used.

Fuel Lift Pump (For CAV In-Line Fuel Injection Pump)

Type	A.C. Delco V P. Series
Method of Drive	Eccentric on Fuel Injection Pump Shaft
Static Pressure (No Delivery)	
Green Spring	2.75/4.25 lbf/in² (19/29 kN/m²) 0,19/0,30 kgf/cm²
Blue Spring	5.0/8.0 lbf/in² (34/55 kN/m²) 0,35/0,56 kgf/cm²

Fuel Lift Pump (For DP15 Fuel Injection Pump)

Type	AC Delco 'Z' Type
Method of Drive	Eccentric on Fuel Pump Drive Shaft
Stall Pressure	26/36 lbf/in² (179/248 kN/m²) 1,83/2,53 kgf/cm²
Operating Pressure	10 lbf/in² (69 kN/m²) 0,7 kgf/cm²

Fuel Lift Pump Operating Rod ('Z' Type Pump)

Diameter	0.4362/0.4367 in (11,08/11,09 mm)
Length	1.249/1.251 in (31,72/31,78 mm)

Fuel Lift Pump (For Bosch In-Line Fuel Injection Pump)

Type	Plunger — mounted on side of fuel pump
Method of Drive	Eccentric on fuel injection pump camshaft
Operating Pressure	22 lbf/in² (1,5 kgf/cm²) 152 kN/m²— controlled by spring loaded valve.

Fuel Filter

Element Type	Paper

In-Line Fuel Injection Pump

Make	CAV or Bosch
Type	Minimec or MW
Pump Rotation	Clockwise (from drive end)

Spill Timing Position for CAV In-Line Pump

The Spill Timing Position can be ascertained by reference to the service setting code stamped on the data plate attached to the top right hand side of the fuel injection pump.

Service Setting Code	Spill Timing Position B.T.D.C.	Equivalent Piston Position B.T.D.C.
V8.510 and AV8.510 Engines LB60/800/11/2700 LB60/800/11/2800 LB60/800/11/3130 LB60/800/22/2100 LB60/800/22/2350 LB60/800/22/2430 LB60/800/22/2520 LB60/800/32/2160 LB60/800/32/2200 LB60/800/32/2260 LB60/800/32/2390 LB60/800/32/2430 LB63/800/22/2350 LB63/800/22/2520 LB63/800/32/2200 LB63/800/32/2390 MB60/800/B02/1800 MB60/800/B02/1880 MB60/800/C02/1560 MB63/800/C02/1560 MB63/800/C02/1575	26°	0.284 in (7,21 mm)
V8.510 and AV8.510 Engines LB51-53/800/11A/2700 LB54/800/11A/2240 LB54/800/11A/2800 LB54/800/11A/2910 LB60/800/11/2420 LB60/800/11/2520 LB60/800/11/2600 LB60/800/11A/2510 LB60/800/11A/2620 LB60/800/11A/2735 LB60/800/11A/2800 LB60/800/11A/3130 LB61/800/11A/2910 LB61/800/11A/2930 LB61/800/11A/3130 LB63/800/11/2520 LB63/800/11/2600 LB63/800/11A/2620 LB63/800/11A/2735 LB63/800/11A/2800 LB63/800/11A/2900 LB63/800/11A/3130 MB63/800/B02/2520 SB63/800/11A/2800 SB63/800/11A/3130 SB64/800/11A/3130 VB64/800/44A/2800	28°	0.325 in (8,26 mm)
AV8.510 Engines LB82/800/22/2480 LB82/800/22/2550	30°	0.373 in (9,47 mm)
V8.540 and AV8.540 Engines MB71/800/A02/1800 MB71/800/A02/1880 MB71/800/C02/1560 MB71/800/C02/1575 RB69/800/41A/2350 RB69/800/41A/2530 RB69/800/44A/2830 RB71/800/41A/2350 RB71/800/41A/2390 RB71/800/41A/2480 RB71/800/41A/2530 RB72/800/41A/2380 RB72/800/41A/2530 RB71/800/41A/2560	26°	0.303 in (7,70 mm)
V8.540 and AV8.540 Engines LB71/800/12/2500 LB71/800/22/2500 MB71/800/D01/2340 MB71/800/D01/2380 MB71/800/D01/2400 MB71/800/D01/2520 MB71/800/E01/2720 RB70/800/44A/2910 RB71/800/41A/2680 RB71/800/44A/2630 RB71/800/41A/2730 RB71/800/44A/2830 RB71/800/44A/2850*	28°	0.352 in (8,94 mm)
V8.540 Engines LG68E/800/44A/2960 RB71/800/44A/2850** RB71/800/44A/2910 RB71/800/44A/2960 YB68E/800/44A/2960	29°	0.375 in (9,53 mm)
AV8.540 Engines PB81E/1100/E01/2550 PB81E/1100/E01/2650 PB81E/1100/E01/2740	30°	0.400 in (10,16 mm)

*Non-Vehicle
**Vehicle

DP15 Fuel Injection Pump

Make	CAV
Pump Rotation	Clockwise (on drive end)
Static Timing	16° B.T.D.C.
Timing Checking Angle Using Tool MS67B	312°

Atomisers (Code Letters VA and VB)

	VA	VB
Make	Simms	
Type	N 1321	N 1344
Atomiser Nozzle	NL 550	NL 588
Atomiser Body	HB54S639	HB54S657
Working Pressure	170 atmospheres (176 kgf/cm²) 2500 lbf/in²	
Setting Pressure	185 atmospheres (191 kgf/cm²) 2720 lbf/in²	

Atomisers (Code Letters VJ)

Make	C.A.V.
Atomiser Nozzle	BDLL150S6573
Atomiser Body	BKBL54S5312
Working Pressure	200 atmospheres (207 kgf/cm²) 2940 lbf/in²
Setting Pressure	215 atmospheres (222 kgf/cm²) 3160 lbf/in²

Atomisers (Code Letters VN)

Nozzle Part Number	2646862
Holder Part Number	2646562
Working Pressure	200 atmospheres (207 kgf/cm²) 2940 lbf/in²
Setting Pressure	210 atmospheres (217 kgf/cm²) 3090 lbf/in²

Atomisers (Code Letters WC)

Nozzle Part Number	2646871
Holder Part Number	2646568
Working Pressure	195 atmospheres (201 kgf/cm²) 2870 lbf/in²
Setting Pressure	210 atmospheres (217 kgf/cm²) 3090 lbf/in²

Atomisers (Code Letters FG Spares Only)

Make	C.A.V.
Atomiser Nozzle	BDLL150S6662
Atomiser Body	BKBL54S5383
Working Pressure	200 atmospheres (207 kgf/cm²) 2940 lbf/in²
Setting Pressure	215 atmospheres (222 kgf/cm²) 3160 lbf/in²

Atomisers (Code Letters GU)

Make	C.A.V.
Atomiser Nozzle	JB6801006
Atomiser Body	LRB67007
Working Pressure	230 atmospheres (237 kgf/cm²) 3380 lbf/in²
Setting Pressure	250 atmospheres (258 kgf/cm²) 3670 lbf/in²

Atomisers (Code Letters VW)

Nozzle Part Number	2646869
Holder Part Number	2646562
Working Pressure	195 atmospheres (201 kgf/cm²) 2870 lbf/in²
Setting Pressure	210 atmospheres (217 kgf/cm²) 3090 lbf/in²

Atomiser (Code Letters WW)

Nozzle Part Number	2645C602
Holder Part Number	2645C302
Working Pressure	240 atmospheres (248 kgf/cm²) 3530 lbf/in²
Setting Pressure	250 atmospheres (258 kgf/cm²) 3670 lbf/in²

Alternator

Make	C.A.V.
Type	AC524 or AC7B
Rotation	Clockwise
Maximum Output (Hot) at 27 5 V	31A for AC524, 58A for AC7B

Starter Motor

Make	C.A.V.	Lucas
Type	SL5A24 or CA45F	3M127
Starter Cable Resistance	0.0008 ohm maximum	
No. of Teeth on Pinion	10	

Note. The above electrical data is general and can vary with individual applications.

SECTION C
Operating and Maintenance

Starting the Engine

Where an engine is fitted with an in-line fuel injection pump and has been standing for a period exceeding one month, one pint (0,6 litre) of clean engine lubricating oil should be added to the injection pump before the engine is started. A filler plug is provided on the governor housing. With CAV injection pumps, the filler plug is on top of the governor housing. With Bosch injection pumps, the filler plug is on either side of the governor housing.

Starting a Warm Engine

Ensure that the stop control (where fitted) is in the run position.

Adjust the accelerator to the fully open position for CAV in-line fuel injection pumps or to the half open position for DP15 pumps and Bosch in-line pumps.

Switch on by turning the starter key to position "R" (see Fig. C.1 or C.2).

Engage the starter motor by turning the key to position "S" or "HS".

As soon as the engine starts, release the key which should return to position "R".

Always be sure that the engine and starter motor have stopped rotating before re-engaging the starter motor, otherwise the flywheel starter ring or the starter pinion may be damaged.

Starting a Cold Engine (Without Heat Start)

In extreme cold conditions, an approved ether starting aid may have to be used (See Page C.3).

Ensure that the stop control (where fitted) is in the run position.

Switch on by turning the starter key to position "R" (see Fig. C.1).

With CAV in-line and DP15 fuel injection pumps, adjust the accelerator to the fully open position and operate the excess fuel control.

With Bosch in-line fuel injection pumps, move the accelerator to the fully closed position and then to the fully open position. This operation will engage the excess fuel control.

Engage the starter motor by turning the key to position "S".

As soon as the engine starts, release the key which should return to position "R".

Always be sure that the engine and starter motor have stopped rotating before re-engaging the starter motor, otherwise the flywheel starter ring or the starter pinion may be damaged.

Starting a Cold Engine (With Heat Start)

In extreme cold conditions, an approved ether starting aid may have to be used (See Page C.3).

Where heater type starting aids are fitted, they may be operated by a combined heat/start switch as shown in Fig. C.2 or by a separate press switch. When the engine is cold, the starting procedure is as follows :—

Ensure that the stop control (where fitted) is in the run position.

Adjust the accelerator to the fully open position.

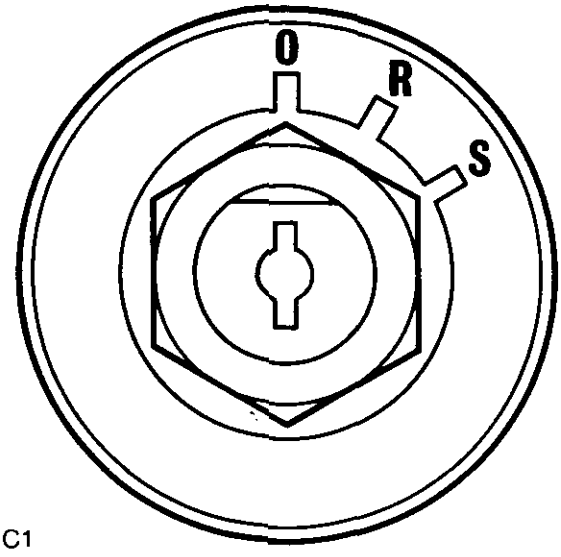
Operate the excess fuel control.

Switch on by turning the starter key to position "R" (see Fig. C.1 or C.2).

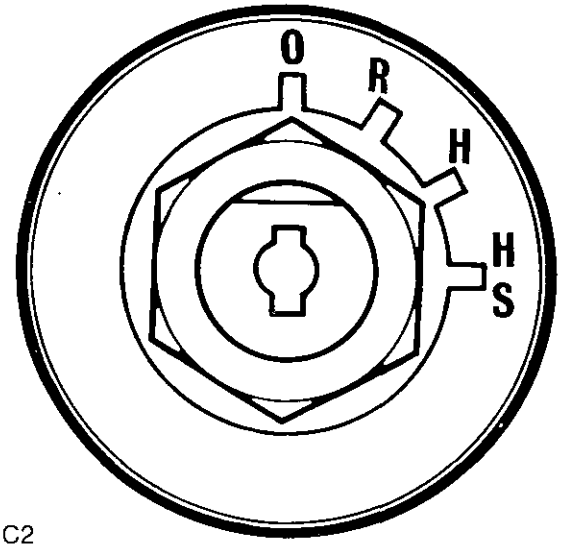
Operate the heaters by turning the key to position "H" or by pressing the separate heater switch and hold in this position for 15 to 20 seconds.

Keeping the heaters in operation, engage the starter by turning the key to the "HS" or "S" position. If the engine does not start in 20 seconds, switch off the starter and return to the "heat" condition for 10 seconds before re-engaging the starter.

Where a tap is fitted in the fuel supply line to the heater type starting aids, this should be switched on for starting the engine and switched off whilst the engine is running.



C1



C2

To Check the CAV In Line Pump Excess Fuel Device

If it is suspected that the excess fuel device used for cold starting is faulty, it can be checked as follows :—

Ensure that the stop control is in the run position.

Position engine speed control lever (1, Fig. C.3) of the fuel pump in the fully open position.

Press in the excess fuel button (2, Fig. C.3) which should stay in.

Operate the stop control lever and the excess fuel button should spring out to the off position.

Note : When the engine starts under cold conditions, the excess fuel device is automatically returned to the off position by the operation of the fuel control rod inside the fuel pump.

Notes on Heat Start

If any difficulty is experienced with the heat start, check that fuel is reaching the starting aids. Operation of the heaters can be checked by removing the trunking to the inlet manifolds. The units should glow when the "Heat" position is selected and the fuel should ignite when the starter is engaged.

The engine is fitted with efficient cold starting equipment and no responsibility can be accepted for any damage caused by the use of unauthorised starting aids

Extreme Cold Weather Starting Aid

V8.540 and V8.510 engines may be fitted with the Start Pilot VISO-F starting aid for starting in extremely cold conditions.

When using this starting aid, the use of any heater device is strictly prohibited but the excess fuel device of the fuel injection pump should still be operated.

The pump should not be used until the starter motor has been engaged. In very cold conditions it may be necessary to assist engine running with a further one or two strokes of the pump to attain steady running.

To charge the container with fluid using only Start Pilot Multi-fill Can Type F, lift the hinged cover of the VISO-F reservoir. Press the can, head down, onto the filler valve and retain in a square position until fluid flows into the transparent bowl. **Do not allow the fluid level to rise above the maximum indicated by arrow markings on the bowl.**

The Start Pilot Viso-F unit incorporates an outlet check valve which minimises the risk of fluid loss during engine running time. Experience will show how much fluid is required for a single start under various temperatures and it is desirable to charge the reservoir with just sufficient fluid for a single start especially when the unit is mounted near the engine.

Very little maintenance is required for the Start Pilot equipment but observation of the following points will ensure efficient operation.

The air filter fitted at the outward end of the V20S pump cylinder should occasionally be examined and if necessary, removed and washed in Kerosene. A thin smear of light lubricating oil may be applied to the cylinder.

The spray nozzle may become partially blocked and this can be cleaned by dismantling from the engine induction manifold and washing in Kerosene.

If any starting difficulty is experienced do not continue using the Start Pilot pump but have the problem investigated by an experienced fitter

Caution

The Start Pilot VISO-F unit uses high energy fuel with a low combustion temperature or flash point, therefore you are warned that this aid should only be used to start very cold engines.

If used carelessly or excessively or for the purpose of obtaining a boost of power, serious damage can occur to the engine for which we, as diesel engine manufacturers, cannot be held liable. If any damage does occur for the reasons stated, it is usually readily identified.

Stopping the Engine

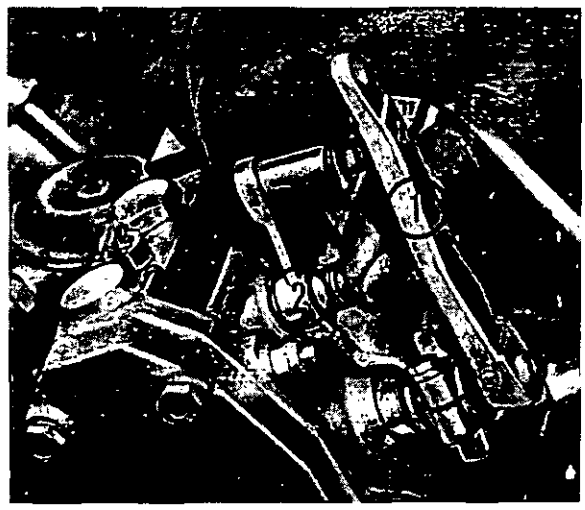
Usually a spring loaded stop control is located near the normal engine controls and functions by cutting off the fuel at the fuel pump.
To operate, pull the knob and hold in this position until the engine ceases to rotate. Ensure that the control returns to the run position, otherwise difficulty may be experienced in re-starting the engine.

In some instances the engine stop control is electrically operated and may be controlled through the ignition switch. In these cases, the stop control is automatically moved to the "engine run" position as the ignition is switched on and the control cuts off the fuel when the ignition is switched off.

Running In

It is not necessary to gradually run-in a new or factory rebuilt engine and any prolonged light load running during the early life of the engine can in fact prove harmful to the bedding in of piston rings and liners.

Full load can be applied on a new or factory rebuilt engine as soon as the engine is used, **provided that the engine is first allowed to reach a temperature of at least 140°F (60°C).**



Preventive Maintenance

As the following preventive maintenance periods are general in application, they should be compared with the schedules specified by the manufacturer of the application to which the engine is fitted and where necessary, the shorter periods adopted. The periods are given in Miles, Hours and Months and the maintenance work should be carried out at the period that comes first in the normal operation of the vehicle or machine. On stop-start low mileage work, the hours run are more applicable than the mileage covered.

The time limits for servicing air filters and breather gauzes depend upon operating conditions and if operating under dusty or adverse conditions, the time limits given should be reduced. The correct maintenance of the air filter will greatly assist in extending the life of the engine.

Where a depression indicator is fitted, this will give a positive indication that the element needs servicing and the period given below for servicing the element can be disregarded.

It is good maintenance practice that the checking of coolant, fuel or oil leaks and the tightness of nuts, setscrews and hose clips be carried out at each servicing period.

It should be noted that the periods given are on the assumption that the fuels and lubricating oils are to the specifications given in this manual.

The lubricating oil change period is for oil to the Perkins approved specification, see Appendix. This period should be reduced if operating under dusty or adverse conditions.

V8.540 ENGINES ONLY

Daily or Every 8 Hours (whichever occurs first)

Check coolant level in radiator.
Check oil level in sump (with vehicle or machine standing level).
Check oil pressures (where gauge is fitted).
In extreme dust conditions, empty dust bowl of dry type air filter.

Every 6,250 Miles (10,000 km) 250 Hours or 4 months (whichever occurs first)

Drain and renew engine lubricating oil.
Renew lubricating oil filter elements.
Empty dust bowl of dry type air filter.
Clean water trap.

Every 12,500 Miles (20,000 km), 500 Hours or 12 months (whichever occurs first)

Check drive belt tension.
Check and adjust valve tip clearances (see Section E).
Clean or renew element of dry type air filter (if not indicated earlier).

Every 18,750 Miles (30,000 km) or 750 Hours

Renew final fuel filter element.

Every 25,000 Miles (40,000 km) or 1,000 Hours

Clean wire gauzes in engine breather and pipe between breather and cylinder head cover (where applicable).

Every 50,000 Miles (80,000 km) or 2,000 Hours

Arrange for examination and service of proprietary equipment, i.e. Compressor/Exhauster, Starter Motor, etc.

Atomisers

Atomisers should be serviced as required.

V8.510 ENGINES ONLY

Daily or Every 8 Hours (whichever occurs first)

Check coolant level in radiator.
Check oil level in sump (with vehicle or machine standing level).
Check oil pressures (where gauge is fitted).
in extreme dust conditions, empty dust bowl of dry type air fiter.

Every 5,000 Miles (7,500 km), 250 Hours or 4 months (whichever occurs first)

Drain and renew engine lubricating oil.
Renew lubricating oil filter elements.
Check drive belt tension.
Empty dust bowl of dry type air filter.
Clean water trap.

Every 10,000 Miles (15,000 km), 500 Hours or 12 months (whichever occurs first)

Renew final fuel filter element of T.A. and Industrial engines.
Check and adjust valve tip clearances (See Section E).
Clean or renew element of dry type air filter (if not indicated earlier).

Every 20,000 Miles (30,000 km) or 1,000 Hours

Renew final fuel filter element of Vehicle engines.
Clean wire gauzes in engine breather and pipe between breather and cylinder head cover (where applicable).
Service atomisers.

Every 50,000 Miles (80,000 km) or 2,000 Hours

Arrange for examination and service of proprietary equipment, i.e., Compressor/Exhauster, Starter Motor, etc.

Post Delivery Checkover

After a customer has taken delivery of his Perkins Diesel engine, a general checkover of the engine must be carried out after the first 500/1,000 miles (800/1,500 km) or 25/50 hours in service.

The checkover should comprise the following points:

1. Drain the lubricating oil sump and fill to the "MAX" level on the dipstick with new oil. Renew the elements of the lubricating oil filter.
2. Reset the valve tip clearances to 0.012 in (0,30 mm) with the engine cold. Check the oil flow to rockers. Ensure fuel injection pipes are correctly fitted to in line pumps (see Section E).
3. Check coolant level in radiator and inspect for leaks.
4. Check external nuts, setscrews, hose clips, mountings, etc. for tightness.
5. Check the tension of the fan belts (see Section M).
6. Check electrical equipment and connections.
7. Check for lubricating and fuel oil leaks.
8. Check slow running speed.
9. Check general performance of engine

Protection of an engine not in service

The recommendations given below are to ensure that damage is prevented when an engine is removed from service for an extended period. Use these procedures immediately the engine is removed from service. The instructions for the use of POWERPART products are given on the outside of each cotainer.

1. Thoroughly clean the outside of the engine.
2. Where a preservative fuel is to be used, drain the fuel system and fill with the preservative fuel. **POWERPART Lay-Up 1** can be added to the normal fuel to change it to a preservative fuel. If preservative fuel is not used, the system can be kept charged with normal fuel but this will have to be drained and discarded at the end of the storage period together with the fuel filter.
3. Run the engine until it is warm. Correct any fuel, lubricating oil or air leakage. Stop the engine and drain the lubricating oil sump.
4. Renew the lubricating oil filter canister.
5. Fill the sump to the full mark on the dipstick with clean new oil or with a correct preservative fluid. **POWERPART Lay-Up 2** can be added to the lubricating oil to give protection against corrosion during the period in storage. If a preservative fluid is used, this must be drained and normal lubricating oil used when the engine is returned to service.
6. Drain the cooling system, see Page C.6. To give protection against corrosion, it is better to fill the cooling system with a coolant that has a corrosion inhibitor, see Page C.6. If frost protection is needed, use an antifreeze mixture. If no frost protection is needed, use water with an approved corrosion inhibitor mixture.
7. Run the engine for a short period to send the lubricating oil and coolant around the engine.
8. Clean out the engine breather pipe and seal the end of the pipe.
9. Remove the atomisers and spray **POWERPART Lay-Up 2** into each cylinder bore. If this is not available, clean engine lubricating oil will give a degree of protection. Spray into the cylinder bores 140 ml ($^1/_4$ pint) of lubricating oil divided evenly between the eight cylinders.
10. Slowly turn the crankshaft one revolution and then install the atomisers complete with new seat washers.
11. Remove the air filter and any pipe installed between the air filter and induction manifold. Spray **POWERPART Lay-Up 2** into the induction manifold. Seal the manifold with waterproof tape.
12. Remove the exhaust pipe. Spray **POWEPART Lay-Up 2** into the exhaust manifold. Seal the manifold with waterproof tape.
13. Remove the rocker covers. Spray **POWERPART Lay-Up 2** around the rocker shaft assemblies. Fit the rocker covers.
14. Disconnect the battery and put it into safe storage in a fully charged condition. Before the battery is put into storage, give the battery terminals a protection against corrosion. **POWERPART Lay-Up 3** can be used on the terminals.
15. Seal the vent pipe of the fuel tank or the fuel filler cap with waterproof tape.
16. Remove the fan belt and put it into storage.
17. To prevent corrosion, spray the engine with **POWERPART Lay-Up 3**. Do not spray inside the alternator cooling fan area.

NOTE:

Before the engine is started, after a period in storage, operate the starter motor with the engine stop control in the 'off' position until oil pressure shows on the oil pressure gauge or the oil warning light goes out. If a solenoid stop control is used, this will have to be disconnected for this operation.

If the engine protection is done correctly according to the above recommendations, no corrosion damage will normally occur. Perkins Engines Ltd. are not responsible for any damage that occurs in relation to a service storage period.

Engine Coolant

The quality of the coolant used can have a large effect on the efficiency and life of the cooling system. The recommendations given below can be of assistance in the maintenance of a good cooling system with frost and/or corrosion protection.

1. Where possible, use clean soft water.

2. If an antifreeze mixture is used to prevent frost damage, it must have an ethylene glycol (ethanediol) base. An antifreeze that is to one of the standards given below or to an equal standard is acceptable if the pH value is kept within the range of 7.0-8.5 when diluted.

   U.K. BS 3151:1959
   'Ethanediol Antifreeze Type B with Sodium Benzoate and Sodium Nitrite Inhibitors.'

   U.S.A. ASTM D3306-74
   'Ethylene Glycol Base Engine Coolant'.

   Australia AS 2108-1977
   'Antifreeze Compounds and Corrosion Inhibitors for Engine Cooling Systems .

   When Perkins POWERPART antifreeze is used, the correct mixtures of antifreeze and water are as given below. Perkins POWERPART Antifreeze fully passes the above standards.

Lowest temperature of protection needed	% Volume of POWERPART antifreeze	Mixture ratio by volume POWERPART antifreeze: water
−12°C (10°F)	25	1:3
−18°C (0°F)	33	1:2
−25°C (−13°F)	40	1:1.5
−37°C (−34°F)	50	1:1
−60°C (−76°F)	66	2:1

   The quality of the antifreeze coolant must be checked at least once a year, for example, at the start of the cold period.

3. When frost protection is not necessary, it is still an advantage to use an approved antifreeze mixture as this gives protection against corrosion *and also raises the boiling point of the coolant.* A minimum concentration of 25% by volume of antifreeze is necessary, but it is our recommendation that 33% concentration by volume is used.

   If an antifreeze is not used, add a correct corrosion inhibitor mixture to the water.

   Change the water/corrosion inhibitor mixture every six months or check according to the inhibitors manufacturer's recommendations.

   Note : *Some corrosion inhibitor mixtures contain* soluble oil which can have an adverse effect on some types of water hose.

If the correct procedures are not used, Perkins Engines Ltd., can not be held responsible for any frost or *corrosion damage.*

To Drain the Cooling System

1. Ensure that the vehicle or machine is on level ground.

2. Remove the radiator filler cap.

3. Remove the drain plugs from the sides of the cylinder block (see engine views) to drain the engine. Ensure that the drain holes do not have any restriction.

4. Open the tap or remove the drain plug at the bottom of the radiator to drain the radiator. If a tap or plug is not fitted to the radiator, disconnect the bottom radiator hose.

5. Where necessary, flush the system with clean water.

6. *Fit the drain plugs and radiator tap or connect* the radiator hose.

Note: If the cooling system is drained, it is advisable to further safeguard the oil cooler by inserting a $^1/_2$ pint (250 ml) of undiluted anti-freeze into the cooler to prevent freezing of any water that may drain into the cooler if the machine is moved. This can be inserted through the compressor cooling hose connection or blanking plug tapping at the top of the water pump outlet to oil cooler, providing that a suitable funnel and pipe are used to direct the anti-freeze towards the cooler.

SECTION D
Fault Finding

FAULT FINDING—D.2

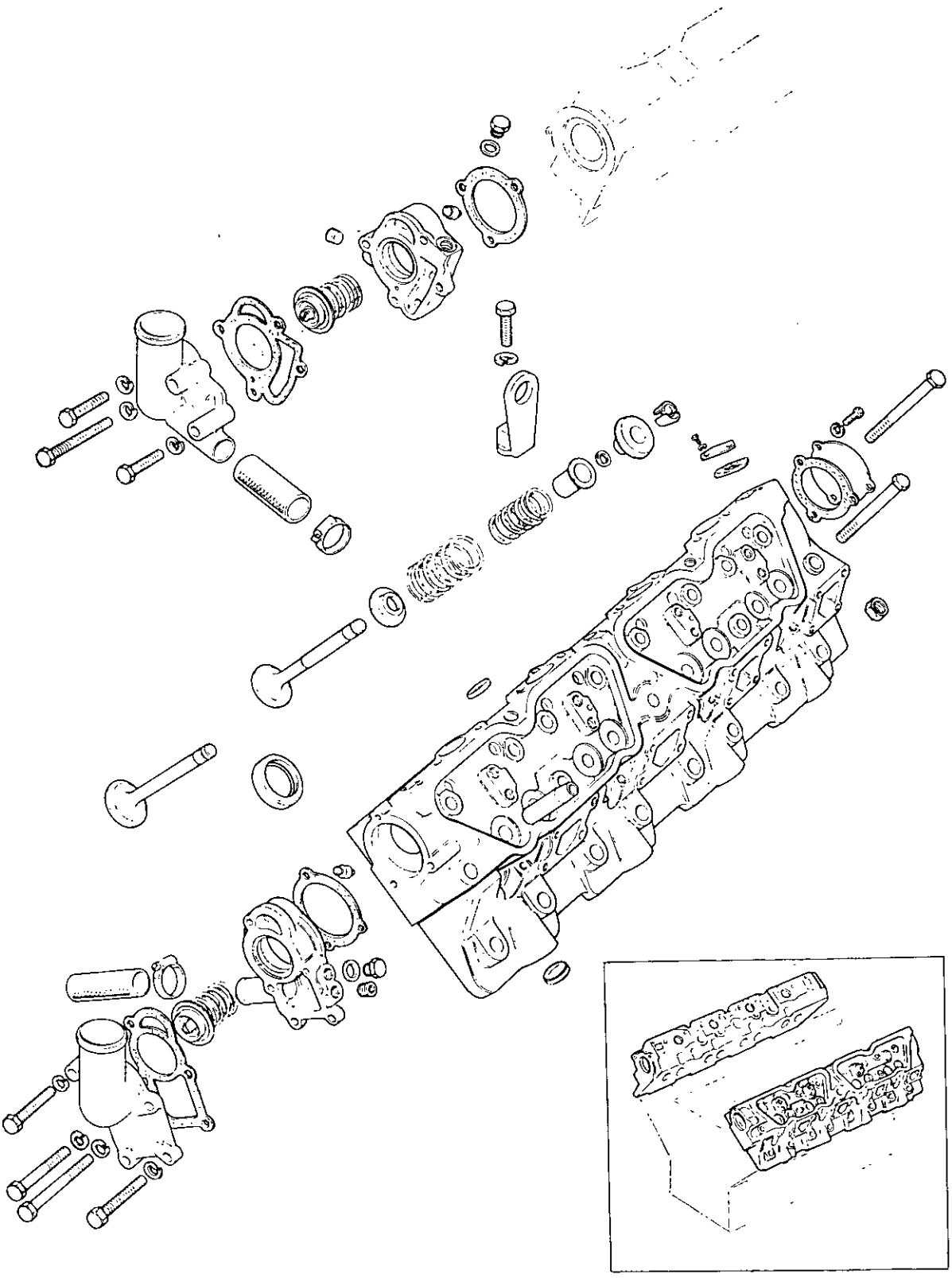
Fault Finding Chart

Fault	Possible Cause
Low cranking speed.	1, 2, 3, 4.
Will not start	5, 6. 7, 8, 9, 10, 12. 13, 14, 15. 16. 17. 18. 19. 20. 22. 31, 32, 33.
Difficult starting	5. 7, 8, 9. 10, 11. 12, 13. 14. 15. 16, 18, 19. 20. 21. 22. 24, 29. 31. 32, 33.
Lack of power	8, 9. 10, 11, 12, 13, 14, 18. 19, 20, 21, 22, 23. 24. 25, 26. 27, 31, 32, 33.
Misfiring	8, 9, 10. 12, 13, 14, 16, 18, 19. 20, 25. 26. 28. 29. 30, 32.
Excessive fuel consumption	11, 13. 14, 16. 18. 19, 20, 22, 23. 24, 25, 27. 28. 29, 31, 32, 33.
Black exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31. 32, 33.
Blue/white exhaust	4, 16. 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56.
Low oil pressure	4, 36, 37, 38, 39, 40, 42, 43, 44. 58.
Knocking	9, 14, 16, 18, 19, 22, 26, 28. 29, 31, 33, 35, 36, 45, 46, 59.
Erratic running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59.
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 48, 49.
High oil pressure	4, 38, 41.
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 50, 51, 52, 53, 54, 57.
Excessive crankcase pressure	25, 31, 33, 34, 45, 55.
Poor compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59.
Starts and stops	10, 11, 12.

Key to Fault Finding Chart

1. Battery capacity low
2. Bad electrical connections.
3. Faulty starter motor.
4. Incorrect grade of lubricating oil.
5. Low cranking speed.
6. Fuel tank empty.
7. Faulty stop control operation.
8. Blocked fuel feed pipe.
9. Faulty fuel lift pump.
10. Choked fuel filter.
11. Restriction in air cleaner or induction system.
12. Air in fuel system.
13. Faulty fuel injection pump.
14. Faulty atomisers or incorrect type.
15. Incorrect use of cold start equipment.
16. Faulty cold starting equipment.
17. Broken fuel injection pump drive.
18. Incorrect fuel pump timing.
19. Incorrect valve timing.
20. Poor compression.
21. Blocked fuel tank vent.
22. Incorrect type or grade of fuel.
23. Sticking throttle or restricted movement.
24. Exhaust pipe restriction.
25. Cylinder head gasket leaking.
26. Overheating.
27. Cold running.
28. Incorrect tappet adjustment.
29. Sticking valves.
30. Incorrect high pressure pipes.
31. Worn cylinder bores.
32. Pitted valves and seats.
33. Broken, worn or sticking piston ring/s.
34. Worn valve stems and guides.
35. Overfull air cleaner or use of incorrect grade of oil.
36. Worn or damaged bearings.
37. Insufficient oil in sump.
38. Inaccurate gauge.
39. Oil pump worn.
40. Pressure relief valve sticking open.
41. Pressure relief valve sticking closed.
42. Broken relief valve spring.
43. Faulty suction pipe.
44. Choked oil filter.
45. Piston seizure/pick up.
46. Incorrect piston height.
47. Damaged fan.
48. Faulty engine mounting (Housing).
49. Incorrectly aligned flywheel housing, or flywheel.
50. Faulty thermostat.
51. Restriction in water jacket.
52. Loose fan belt.
53. Choked radiator.
54. Faulty water pump.
55. Choked breather pipe.
56. Damaged valve stem oil deflectors (if fitted).
57. Coolant level too low.
58. Blocked sump strainer.
59. Broken valve spring.

SECTION E
Cylinder Head



CYLINDER HEAD—E.2

To Remove a Cylinder Head

Drain cooling system.

Remove high pressure fuel pipes, mark pipes to facilitate correct replacement and blank off pump outlets and atomisers.

Disconnect water outlet hose and water temperature gauge connection.

Disconnect water by-pass hose and compressor pipe, where fitted, from water outlet elbow.

Disconnect hose between air cleaner and inlet manifold and remove compressor air inlet pipe, where necessary.

Remove breather assembly, where fitted.

Remove inlet and exhaust manifolds.

Remove breather pipe, where fitted.

If necessary, disconnect dipstick tube.

Disconnect fuel leak-off pipes and remove atomisers and washers.

Disconnect rocker shaft oil feed pipe (1, Fig. E.1).

Remove rocker covers, rocker shafts and push rods.

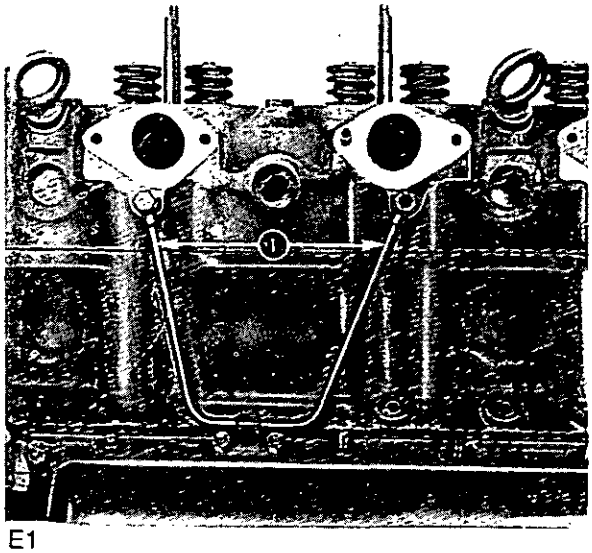
Remove cylinder head securing setscrews and nuts in reverse order to tightening sequence (Fig. E.4).

Remove head and place on a flat surface, preferably wooden.

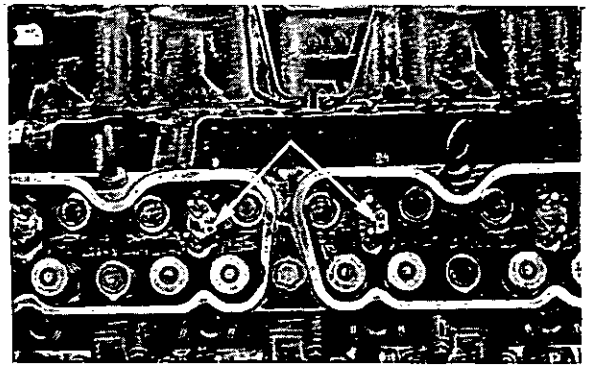
To Fit a Cylinder Head

Ensure that head and cylinder bores are clean and that oil drillings in cylinder head (Fig. E.2) are clear.

Apply a very light and even coat of Perkins (Hylomar) Jointing Compound to both sides of head gasket and place gasket in position with word "TOP" uppermost.



E1



E2

Place cylinder head in position ensuring that gasket is not displaced.

Lightly oil threads of cylinder head securing studs and setscrews and locate nuts and setscrews in position. The latest cylinder head securing arrangement is shown in Fig. E.3. On earlier V8.510 engines, the outermost row consists of studs and nuts.

Progressively tighten cylinder head securing nuts and setscrews in the order shown in Fig. E.4 to a torque of 125 lbf ft (169 Nm) 17,3 kgf m.

Replace push rods and rocker assemblies. Tighten rocker shaft bracket setscrews/nuts to torque given on Page B.3. On engines where rocker shaft nuts are extended to provide locations for rocker cover securing setscrews, fit these nuts with chamfer uppermost.

Set valve tip clearances to 0.012 in (0,30 mm) as detailed on Page E.3.

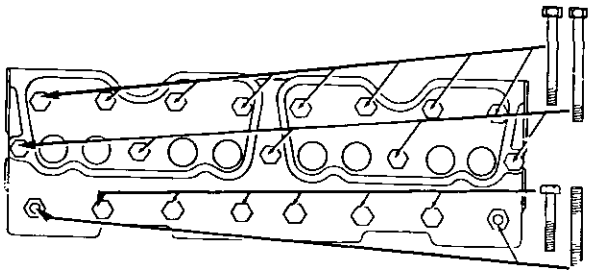
Refit rocker covers.

Reconnect dipstick tube, where necessary

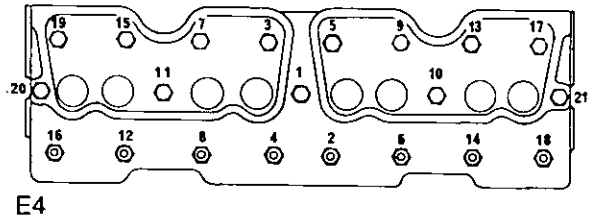
Refit breather pipe, where fitted.

Refit inlet and exhaust manifolds. Ensure that inlet manifold to cylinder head corrugated joints are coated on both sides with Perkins 'Hylomar' Jointing Compound and are fitted with the square corner to the bottom right when viewing induction side of head.

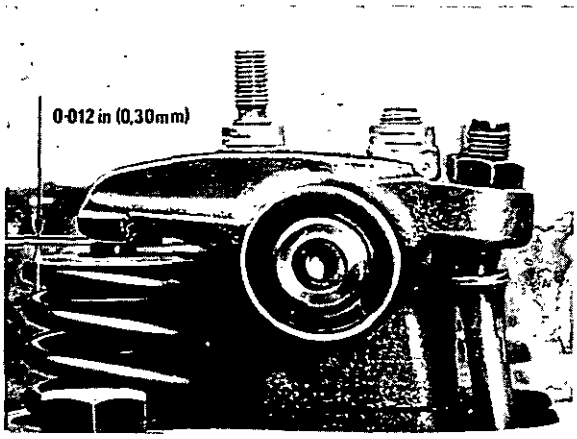
Refit breather assembly, where necessary.



E3



E4



E5

Reconnect water by-pass and outlet connections.

Reconnect water temperature gauge connection.

Reconnect compressor air and water pipes, if fitted.

Refit atomisers, with new washers, ensuring that they are seated squarely and tighten nuts evenly to a torque of 12 lbf ft (16 Nm) 1,7 kgf m.

Refit fuel leak-off pipes.

Refit high pressure fuel pipes as detailed later.

Bleed fuel system as detailed on Page N.10.

Fill cooling system.

Run engine until operating temperature is reached, shut down and retighten cylinder head securing setscrews and nuts to correct torque as detailed previously.

Note: When retightening cylinder head setscrews/ nuts, the engine coolant outlet temperature should not be less than 170°F (77°C).

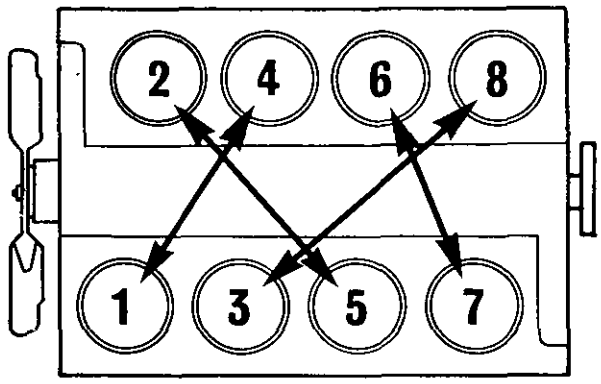
If the setscrew/ nut moves when retightening, then tighten up to the torque previously detailed.

If the setscrew/nut does not move before the correct torque is achieved, then slacken off 1/12 to 1/6 of a turn (30° to 60°) and retighten to the correct figure.

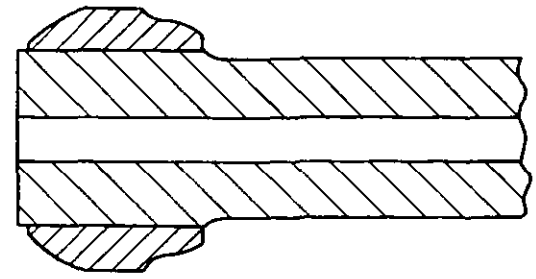
After retightening all the setscrews/nuts, the first 10 positions should be rechecked without further slackening off to ascertain they are still tightened to the torque quoted.

To Check or Adjust Valve Tip Clearances

The valve tip clearances (Fig. E.5) should be set to 0.012 in (0,30 mm) by using a feeler gauge between



E6



E7

top of valve and rocker lever, with the engine cold. Each bank can be set separately in the following manner :—

Left Bank (Fig. E.6)

With valves rocking on No. 4 cylinder (i.e. the period between opening of inlet valve and closing of exhaust valve), set valve tip clearances of No. 1 cylinder.

With valves rocking No. 6 — set clearances No. 7.

With valves rocking No. 2 — set clearances No. 5.

With valves rocking No. 8 — set clearances No. 3.

Right Bank

With valves rocking No. 3 — set clearances No. 8.

With valves rocking No. 1 — set clearances No. 4.

With valves rocking No. 7 — set clearances No. 6

With valves rocking No. 5 — set clearances No. 2.

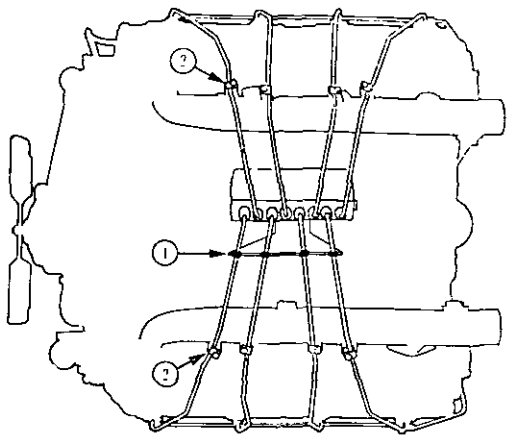
If desired, valve tip clearances can be set in the firing order 1, 8, 7, 5, 4, 3, 6, 2 by bringing the valves of the corresponding cylinders (Fig. E.6) to rocking position in the order 4, 3, 6, 2, 1, 8, 7, 5.

To Fit High Pressure Fuel Pipes

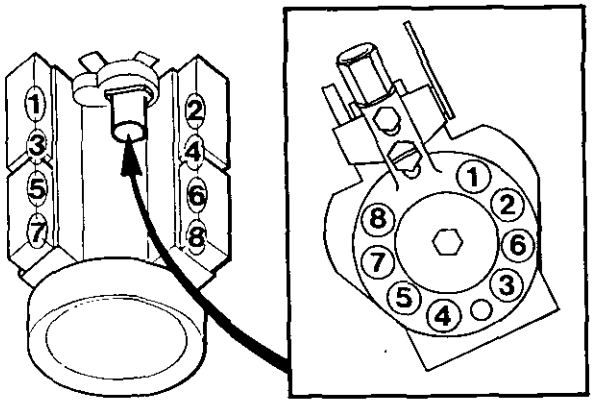
For standardisation purposes, high pressure fuel pipe assemblies are now supplied with olives fitted as shown in Fig. E.7. The earlier type pipe assemblies with olives fitted in the reversed position are still satisfactory.

When replacing high pressure fuel pipes, care shou'd be taken that each pipe is fitted in its correct position and no excess force is used to position a pipe.

The front outlet of the in line pump should be connected to front cylinder of left bank, the second outlet to front cylinder of right bank and remaining outlets to alternately left and right banks (Fig. E.8).



E8



E9

A guide plate (1) is fitted to current in line pumps to locate the pipes to the left hand bank, these pipes having grommets fitted which locate in slots in the guide plate. Some earlier in line pumps had guide plates which located the right hand pipes and if this earlier pump is replaced by a later type, the guide plate should be removed and fitted to the replacement pump. Ensure that grommets are located in guide slots.

When fitting pipes to vibration dampers (2), ensure that each pipe lays squarely on damper block before top retainer plate is secured in position.

The relationship between the DP15 fuel pump outlets and relative cylinder positions is given in Fig. E.9. The high pressure pipes for this pump have a 1,75 mm bore and are currently fitted with a rubber grommet to distinguish them from similar pipes fitted to other engine types which have a 2 mm bore.

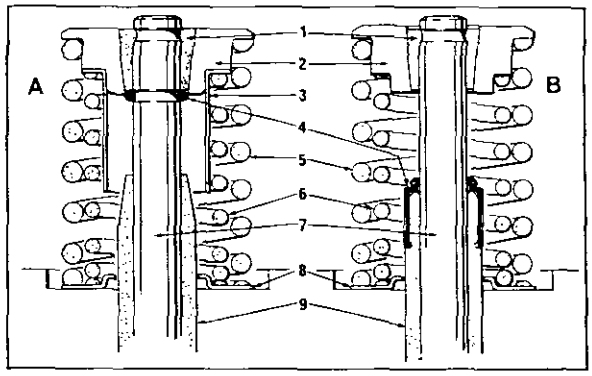
Valve Assemblies

Two springs are fitted to each valve, the outer springs are left hand coiled and the inner springs right hand coiled.

The valve sealing arrangement of earlier V8.510 engines (A, Fig. E.10) consists of a deflector and an "O" ring seal that fits in a groove in the valve stem. The valve seals fitted to V8.540 and current V8.510 engines are located around a reduced diameter at the top of the new type guides (B, Fig. E.10). The valves and spring retaining caps have also been changed.

Key to Fig. E.10.

1. Split collets.
2. Spring retaining cap
3. Deflector



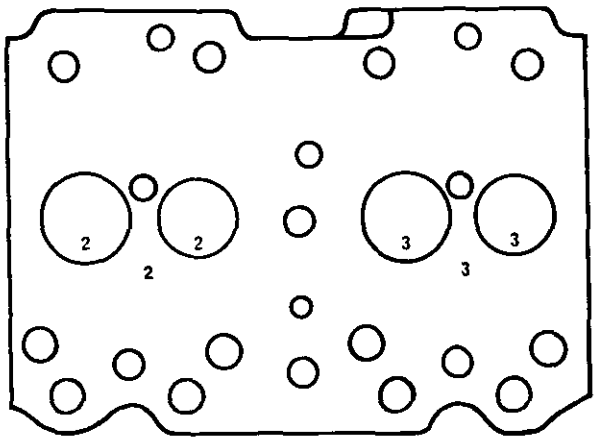
E10

4. Oil seal
5. Outer valve spring
6. Inner valve spring
7. Valve
8. Spring seating washer
9. Valve guide

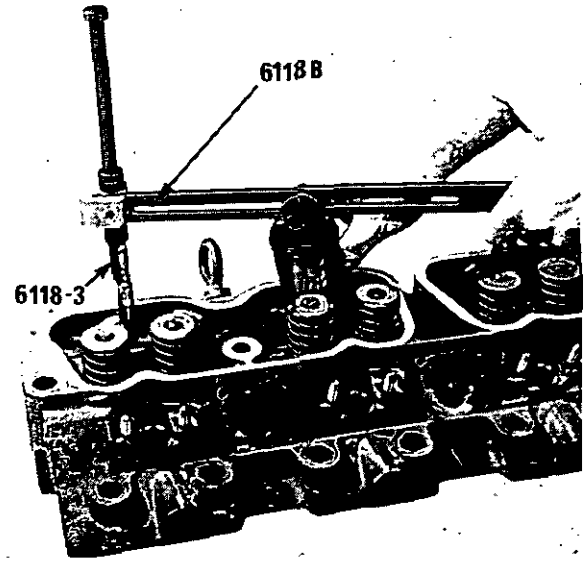
To Remove Valves

On earlier engines the valves were numbered to each cylinder head (Fig. E.11) but, as this is no longer carried out, if valves are to be refitted, they should be suitably marked where necessary and kept with their applicable head for reassembly in their original positions.

With head placed on bench, depress valve springs and remove split collets. The springs can be compressed by using valve spring compressor 6118B with adaptor



E11



E12

6118-3 on rocker shaft retaining studs (Fig. E.12). When compressing valve springs, ensure that spring retaining cap does not score valve stem.

Remove spring retaining caps, springs, oil deflectors, oil seals and spring seating washers or valve rotators. Valves can now be removed after head has been turned.

To Fit Valves

Lightly oil valve stems.

Position valves in their respective guides (Fig. E.11) and carefully turn head so that it rests on the valve heads.

Position spring seating washers, spacers or rotators and fit oil seals to guides or valve stems, where applicable.

Place springs on the seating washers or rotators with the closed up damper coil of standard springs towards cylinder head. Springs fitted with rotators do not have damper coils.

Position oil deflectors, where applicable, and spring retaining caps, compress springs with compression tool (Fig. E.12) and fit split collets.

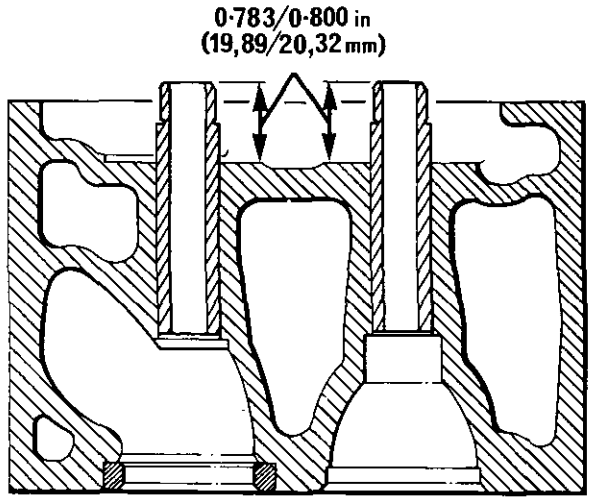
When compressing springs, ensure that spring retaining cap does not score valve stem.

Valve Guides

Replaceable cast iron guides are pressed in the cylinder head, the same guide is used for both inlet and exhaust valves.

Valve guides fitted to V8.540 and later V8.510 engines have a reduced diameter at the top on which the oil seal fits whereas earlier V8.510 guides have a taper at the top.

Valve guides should be checked for damage or excessive wear and renewed, where necessary. The maximum permissible worn clearance of valve stem in guide is



E13

0.0055 in (0,14 mm) and if the clearance with a new valve fitted exceeds this figure the guide should be replaced.

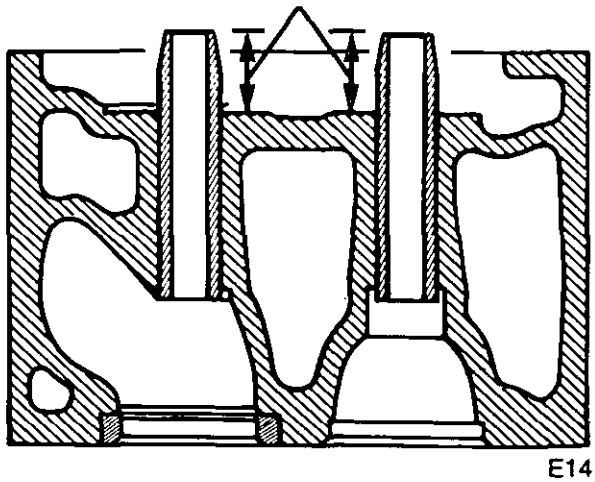
A new guide should also be fitted if a new valve seat insert is being fitted.

Where new valve guides are necessary on earlier V8.510 engines, it is suggested that the latest type are fitted and the latest valve sealing arrangement used as shown in "B" Fig E.10.

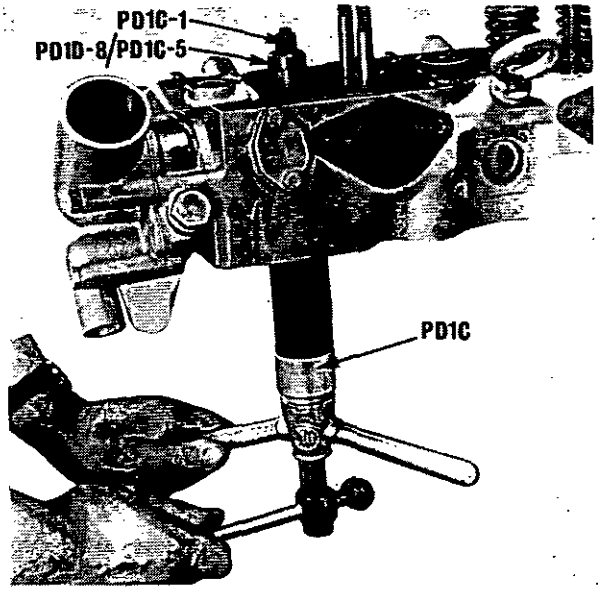
Press or drive out existing guide and clean out parent bore. Press in new guide, with reduced diameter or tapered end uppermost, until protrusion of guide above spring seating face on cylinder head is 0.783/0.800 in (19,89/20,32 mm) for latest type (Fig. E.13) or 0.879/0.896 in (22,33/22,76 mm) for earlier type guide (Fig. E.14).

Tool PD1C with adaptor PD1C-1 can be used to remove and fit guides.

When refitting guides, stop PD1D-8 (current guides) or PD1C-5 (early guides) can be fitted over the top of the guide to ensure correct protrusion (Fig. E.15).



E14



E15

Cylinder Head Overhaul

If water jacket of cylinder head shows signs of scale, a proprietary descaling solution should be used in accordance with the manufacturers instructions.

After cleaning head, check for cracks or other damage.

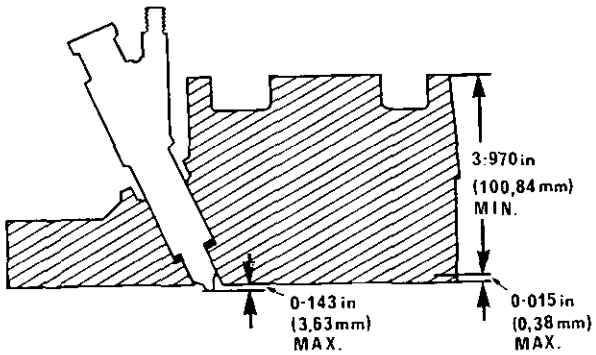
Maximum permissible longitudinal bow of cylinder head is 0.008 in (0,20 mm) and maximum permissible transverse bow is 0.004 in (0,10 mm).

The head can be skimmed by a maximum of 0.015 in (0,38 mm) provided that nozzle protrusion does not exceed 0.143 in (3,63 mm) and depth of head is not less than 3.970 in (100,84 mm) after skimming (Fig. E.16).

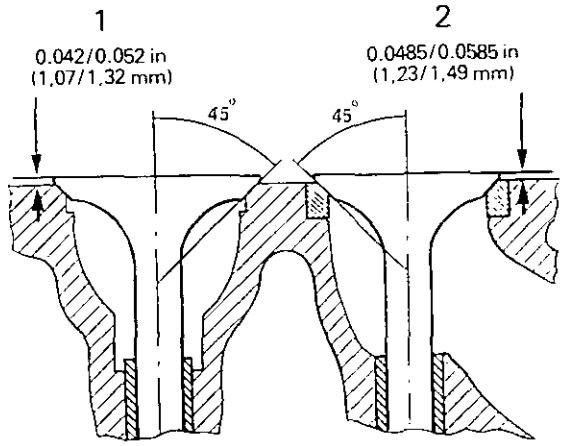
On no account should nozzle protrusion be altered by the addition of extra washers.

After skimming head the nozzle holes should be radiused at the cylinder head face and valve seats and valve protusion should be checked and seats reworked if necessary.

When any machining or valve seat grinding has been carried out on the cylinder head, it should be thoroughly cleaned afterwards. Ensure that oil feed drillings (Fig. E.2) are clear.



E16



E17

Valves and Valve Seats

Examine valves and seats for damage and seating condition and valve stems for wear.

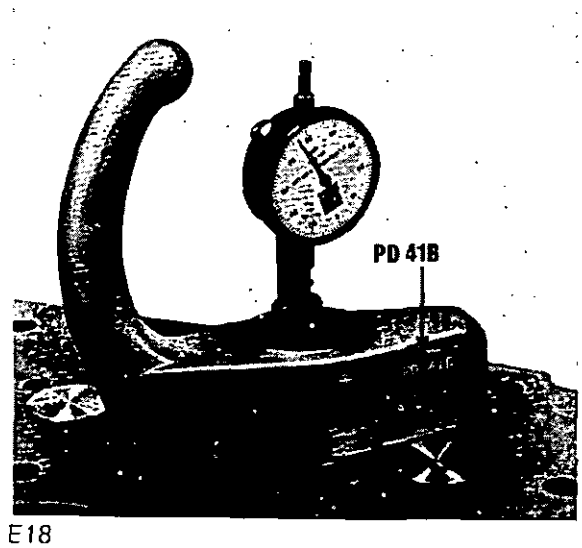
If valves or seats show signs of leakage in one position where valve rotators are fitted, it could indicate that valve rotators are not functioning correctly and they should be renewed. Damage to valve head and valve seat may be caused by weak valve springs.

The valve heads protrude beyond the cylinder head face and this protrusion should be checked before refacing a valve to see if the valve protrusion will still be within limits after refacing and if necessary a new valve should be fitted.

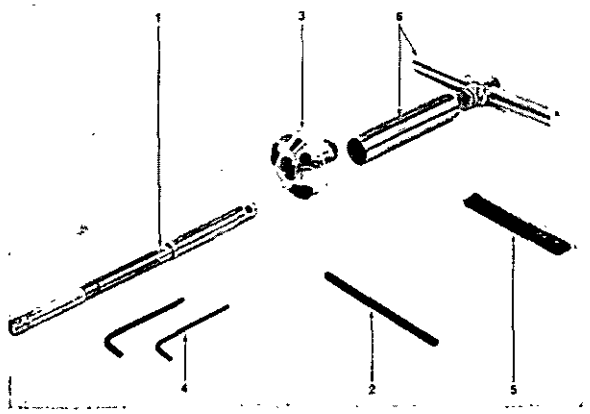
When new, inlet valve protrusion (1, Fig. E.17) is within the limits of 0.042/0.052 in (1,07/1,32 mm). In service, protrusion of inlet valve should not be less than 0.001 in (0,03 mm) beyond cylinder head face (see Note).

Exhaust valve protrusion (2, Fig. E.17) is 0.0485/0.0585 in (1,22/1,49 mm) when new and service limit is 0.0085 in (0,22 mm) (see Note).

Valve protrusion can be measured with tool PD41B (Fig. E.18). Set the clock gauge to zero with tool rest-



E18



E19

ing on a flat surface, place tool on head with plunger resting on valve head and measure protrusion directly off clock gauge.

Valves should be refaced at an angle of 45° ensuring that minimum of metal is removed to achieve a good seat. Where valve guides are to be renewed, the new guides should be fitted before the valve seats are reworked.

Seats can be recut using appropriate cutter from adjustable cutter set MS73. These cutters give an included valve seat angle of 88° to provide a differential valve seat and it is not necessary to lap in valves after cutting seats.

Position appropriate sized pilot (1, Fig. E.19) in valve guide with expandable section of pilot inside guide and shoulder of pilot approximately $\frac{1}{8}$ in (3 mm) above guide. Tighten pilot in guide using knurled nut with puller pin (2) in pilot hole. Select appropriate cutter (3), adjust blades to approximately same locations in slots and tighten blade screws finger tight only using small key (4). Clean blades with brush (5). Lower cutter into position, with 46° blades towards seat — do not drop onto seat as blades are brittle and can easily be chipped. Fit handle (6) to cutter and cut seat by turning cutter clockwise using only very light hand pressure ensuring that pressure is applied centrally above pilot.

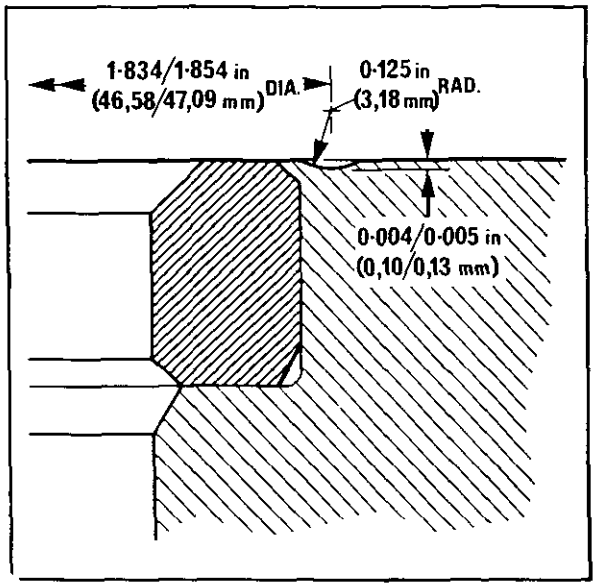
Only very few turns should be necessary to achieve a good seat which will have a velvety finish not polished or shiny. Check valve to seat contact and that valve protrusion is within limits given previously.

After reconditioning, valves and seats should be lightly lapped in, keeping as narrow a seat as possible and after lapping, valve protrusion should be checked.

Note : Where vehicle engines have to conform to the smoke density regulation B.S. AU 141a : 1971, then the valve head protrusion must not fall below the production limits.

Exhaust Valve Seat Inserts

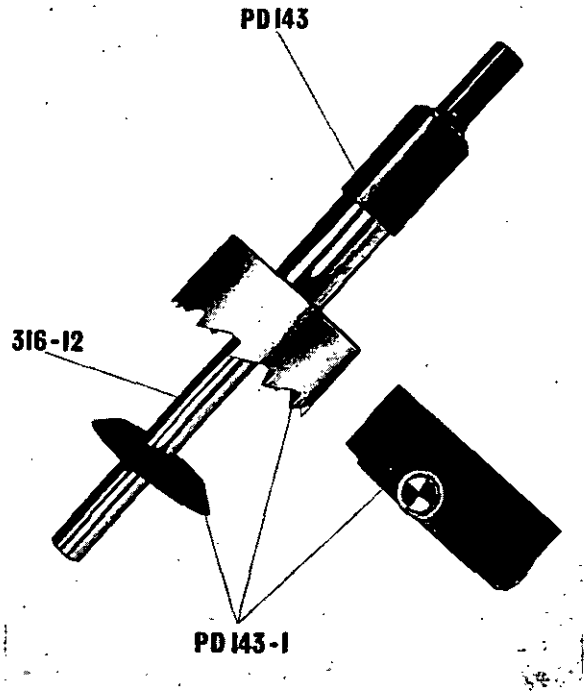
Except for a few early V8.510 engines, exhaust valve seats are formed by inserts pressed into the cylinder head. Inlet valve seats are not formed by inserts and should not be inserted in service.



E20

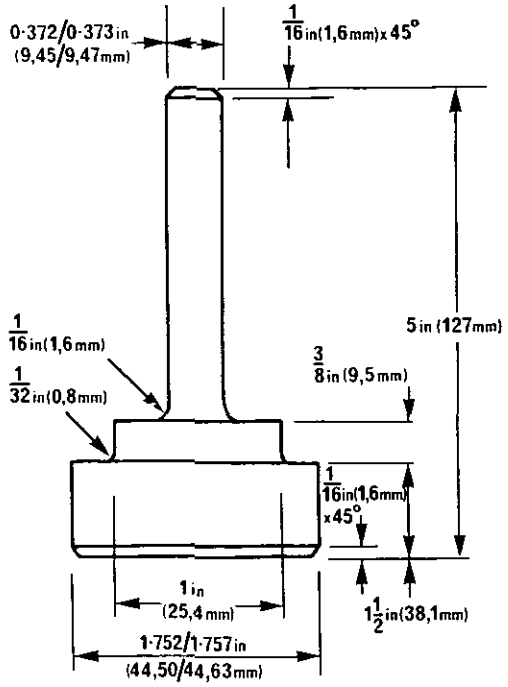
The exhaust valve seat inserts fitted to V8.540 and later V8.510 engines are secured in position by rolling metal of the cylinder head face over a chamfer on the insert (Fig. E.20). The insert and the recess for the insert are the same as on earlier engines except for the 0.015/0.020 in (0.38/0,51 mm) x 45° chamfer that is machined on the insert to accommodate the rolling in.

Rolled-in inserts can be renewed, and the head re-rolled **once only** using tools PD143, PD143-1 and pilot 316-12 (Fig. E.21) in a pillar drill of at least $\frac{3}{8}$ in (9,5 mm) capacity, as detailed below. If a letter "R" is stamped on the cylinder head adjacent to the insert, this indicates that the head has been re-rolled.



E21

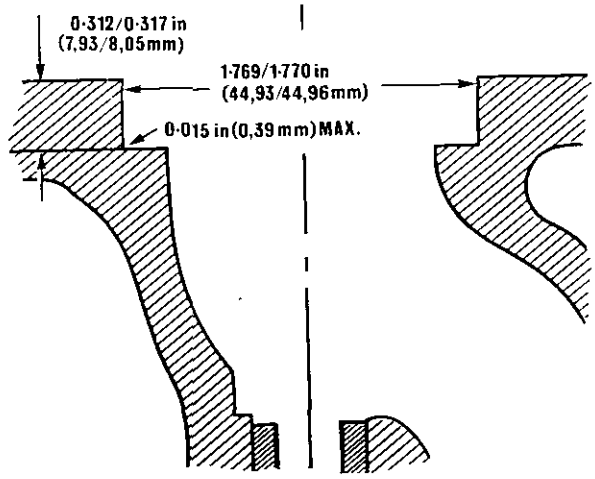
CYLINDER HEAD—E.8



E22

Rolled-in inserts can be renewed as follows :—

1. Fit main tool into chuck, locate cutter on external taper and fit pilot into main tool.
2. With cylinder head in position on drill bed, locate depth stop on valve seat with chamfered side uppermost.
3. Carefully lower cutter assembly to valve seat with pilot locating in valve guide and depth stop locating around main tool and under cutter.
4. Ensure that cutter and pilot run freely, lubricate with oil and start drill at approximately 100 rev/min.
5. Bring cutter into contact with cylinder head and using light pressure only, carefully cut to depth stop. When depth stop is reached, operation is complete and no further cutting should be attempted.
6. Disengage tool and remove insert from head.
7. Thoroughly clean insert recess, valve guide and exhaust passage. Check that insert recess is undamaged and that recess diameter does not exceed 1.770 in (44.96 mm).
8. Degrease new insert and suspend in liquid nitrogen until rapid boiling ceases. Do not touch insert with bare hand during or after freezing.
9. Press in insert with single small chamfer away from valve guide, using a tool case hardened and ground to the dimensions given in Fig. E.22. Ensure that insert is seated on bottom of recess.
10. Remove cutter from main tool and fit rolling assembly.
11. Locate cylinder head on drill bed, carefully lower main tool with pilot in valve guide and ensure free running.
12. Lubricate rollers and pilot with oil and start drill at approximately 100 rev/min.
13. Lower rollers to cylinder head and continue rolling with an approximate load of 600 lbf (270 kgf) until depth stop on roller body abuts valve seat insert.
14. Remove rolling equipment and clean away swarf, etc.
15. Fit new guide, as previously detailed and cut valve seat, at an angle of 45° until valve head protrusion is 0.0485/0.0585 in (1,23/1,49 mm). When machining seat, it is advisable to work to upper limit to allow for later servicing.
16. Lightly lap in valve and seat, keeping as narrow a seat as possible.
17. Stamp a letter "R" on the head, adjacent to the re-rolled seat.



E23

Note : When an earlier non-rolled insert is unserviceable, it should be removed and a rolled-in insert fitted as detailed in operations 7 - 16 above.

If a cylinder head is skimmed, new inserts should be fitted and secured by rolling in the head around the insert, as detailed above. It should not be necessary to cut away the rolling around the old inserts as this will be removed by the skimming operation.

Before fitting new inserts to a skimmed head, the valve face of the insert should be ground to allow for the decreased depth of recess and the chamfer to accommodate the rolling should be replaced.

On earlier V8.510 engines where exhaust valve seat inserts are not fitted as standard, they can be fitted in service provided that the recess is machined, using a new valve guide as a pilot, to the dimensions given in Fig. E.23. After machining, remove all swarf from head before fitting insert as detailed in Page E.7.

Valve Springs

Valve springs fitted to standard valve assemblies are identical for both inlet and exhaust. Where valve rotators are fitted, the springs are shorter than standard.

New springs should normally be fitted at every major overhaul.

Condition of existing springs can be checked by visual examination for damage and squareness of ends and by finding load necessary to compress spring to fitted length.

New standard outer springs (1, Fig. E.24) require a load of 68.8/76.0 lbf (31,2/34,5 kgf) to compress them to the fitted length of 1.833 in (46,56 mm).

New standard inner springs (2, Fig. E.24) require a load of 30.3/33.5 lbf (13,7/15,2 kgf) to compress them to the fitted length of 1.553 in (39,45 mm).

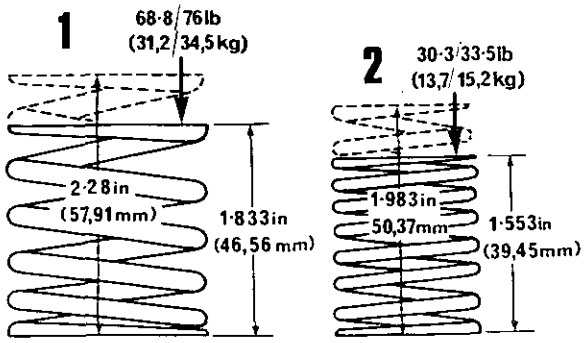
New outer rotator valve springs have a free length of 1.666 in (42,32 mm) and require a load of 61.3/67.7 lbf (27,8/30,7 kgf) to compress them to fitted length of 1.333 in (33,86 mm).

New inner rotator valve springs have a free length of 1.577 in (40,06 mm) and require a load of 30.6/34.0 lbf (13,9/15,4 kgf) to compress them to a fitted length of 1.243 in (31,57 mm).

Rocker Assemblies

The four rocker assemblies fitted to the engine are identical but assemblies fitted to V8.540 and later V8.510 engines differ from those fitted to earlier V8.510 engines in that the oil feed through the brackets and shaft and the inner circlip arrangement have been changed.

The latest arrangement (Fig. E.25) differs from the earlier arrangement (Fig. E.26) in that the brackets have two oil drillings, the right hand oil feed in the shaft has been moved towards the centre and wire circlips with locating washers replace the inner "E" clips and plain washers. The later shaft can be fitted to earlier engines provided that the later type brackets, wire circlips and circlip retaining washers are also fitted but on no account should the earlier type brackets be fitted with the later type shaft.



E24

To Dismantle Rocker Assembly

Release rocker shaft locating setscrew in rocker bracket.

Remove "E" clips from ends of shaft.

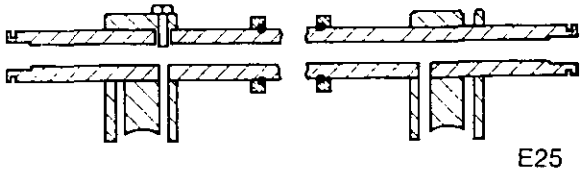
Rocker levers, washers, brackets and inner circlips can now be removed from shaft.

If inner wire circlip is removed, ensure that ends of circlip do not score shaft.

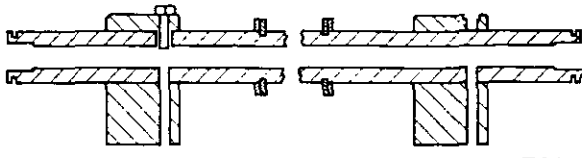
To Assemble Rocker Shaft Assembly (Fig. E.27)

Ensure that all oil drillings in shaft, brackets and rocker levers are clear.

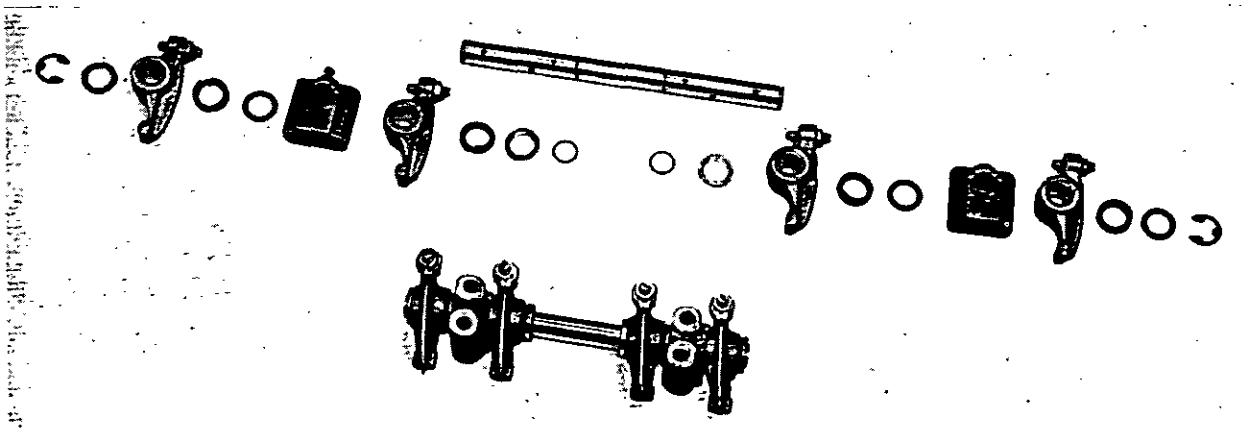
The rocker shaft has a larger drilling opposite one of the oil entry drillings to accommodate the locating setscrew which ensures correct relationship of the various oil passages. Position shaft with this larger drilling to left hand side and assemble components in following order :—



E25



E26



E27

Left Side :

Wire Circlip — seated in inner recess of shaft (or "E" clip on earlier assembly).

Circlip Retaining Washer — with washer encompassing wire circlip (or plain washer on earlier assembly).

Spring Washer. Rocker Lever.

Rocker Bracket — with boss to right hand side and locating setscrew fitted into larger drilling in shaft.

Plain Washer. Spring Washer. Rocker Lever.

Plain Washer. "E" Clip.

Right Side :

Wire Circlip (or "E" clip).

Circlip Retaining Washer (or plain washer).

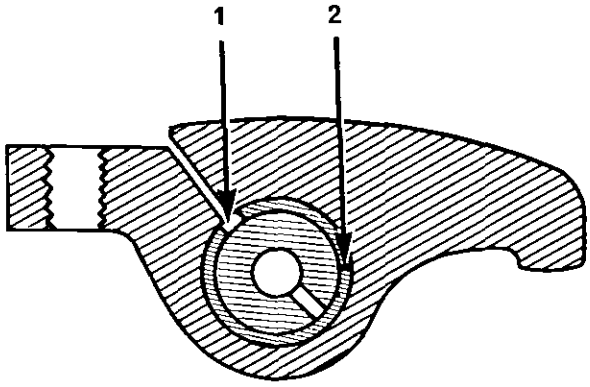
Rocker Lever. Spring Washer. Plain Washer.

Rocker Bracket — with boss to right hand side.

Rocker Lever. Spring Washer. Plain Washer. "E" Clip.

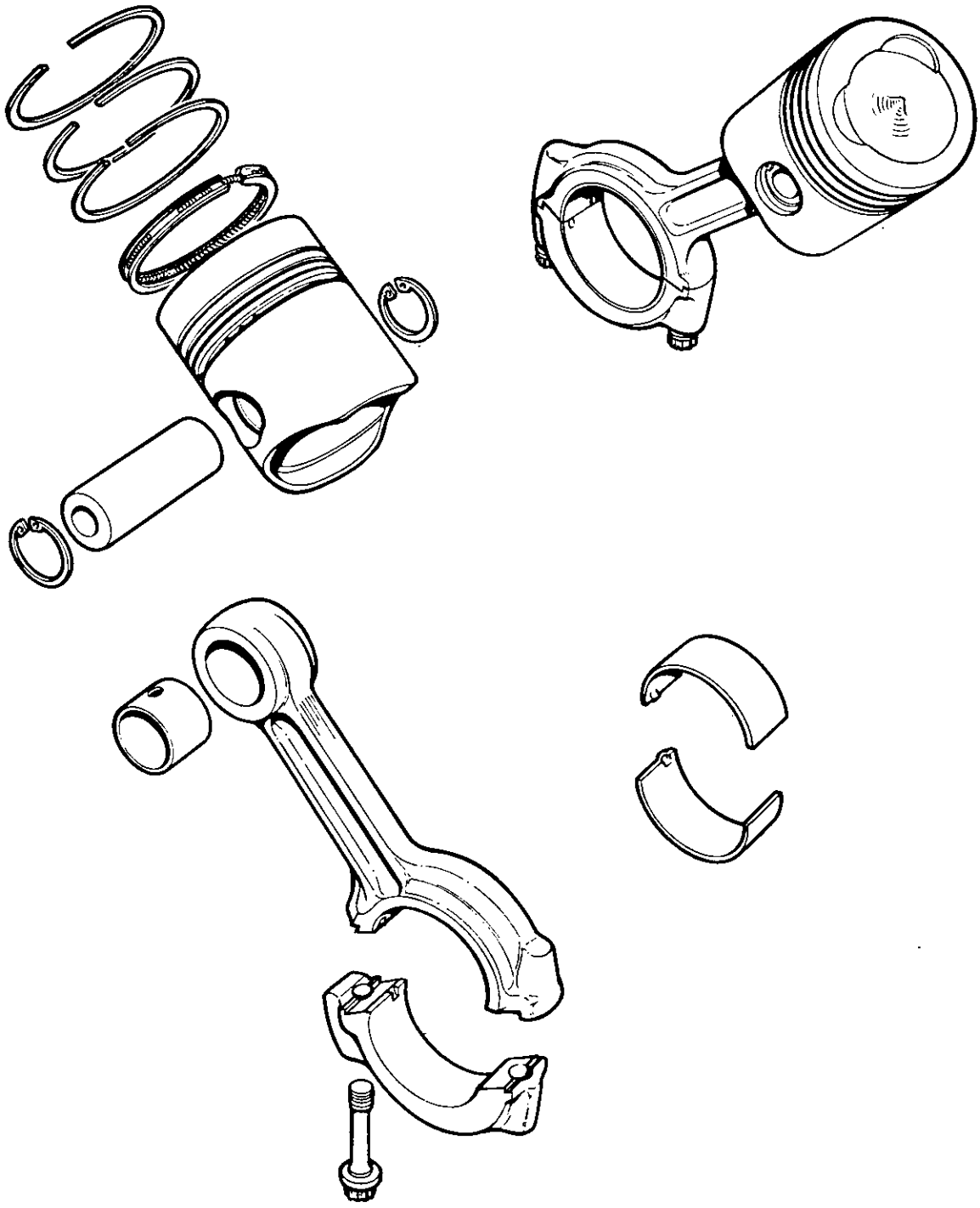
Rocker Lever Bush (Fig. E.28)

If a rocker lever bush is renewed, the new bush should be fitted with oil hole (1) and bush split (2) in positions shown, relative to rocker lever.



E28

SECTION F
Pistons and Connecting Rods



PISTONS AND CONNECTING RODS—F.2

General

The pistons fitted to V8.540 vehicle engines have two compression and one scraper ring fitted above the gudgeon pin and one scraper ring fitted below. The bottom scraper ring is omitted on some other V8.540 applications.

V8.510 pistons have three compression and one scraper ring, all fitted above the gudgeon pin.

V8.540 and later V8.510 pistons have a bonded insert into which the top ring groove is machined, as shown in Fig. F.6, whereas the top ring groove is machined directly into the piston on earlier V8.510 engines.

Connecting rods fitted to V8.540 engines are longer than V8.510 connecting rods and have a smaller big end and a larger small end.

To Remove Piston and Rod Assembly

Remove cylinder head (Page E.2).

Drain lubricating oil and remove sump (Page L.6).

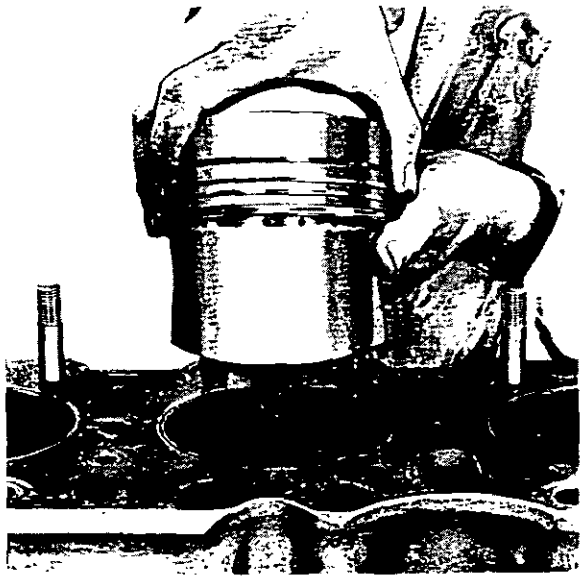
Remove carbon deposits from top of cylinder liner bore.

Turn crankshaft until relevant crankpin is towards bottom of engine.

Release big end securing setscrews and remove big end cap.

Remove piston and rod through top of cylinder liner (Fig. F.1).

The pistons, connecting rods and caps (Fig. F.2) are marked with their respective cylinder number and should be kept together as an assembly with the relevant big end bearings.



F1

To Remove Piston and Rings from Connecting Rod

Remove the compression rings and oil control ring(s) from piston, taking care not to score side of piston.

Remove gudgeon pin retaining circlips.

If gudgeon pin cannot be easily pushed out by hand, heat piston to 100 - 120°F (40 - 50°C) and remove gudgeon pin.

Inspection

Check piston for scoring or other damage.

Check piston ring grooves by checking clearance of new rings fitted in grooves.

The manufacturing clearance for the top ring in its groove is as follows :—

V8.540 pistons	0.003/0.005 in (0,08/0,13 mm)
Inserted V8.510 pistons	0.002/0.004 in (0,05/0,10 mm)
Non-inserted V8.510 pistons	0.004/0.006 in (0,10/0,15 mm)

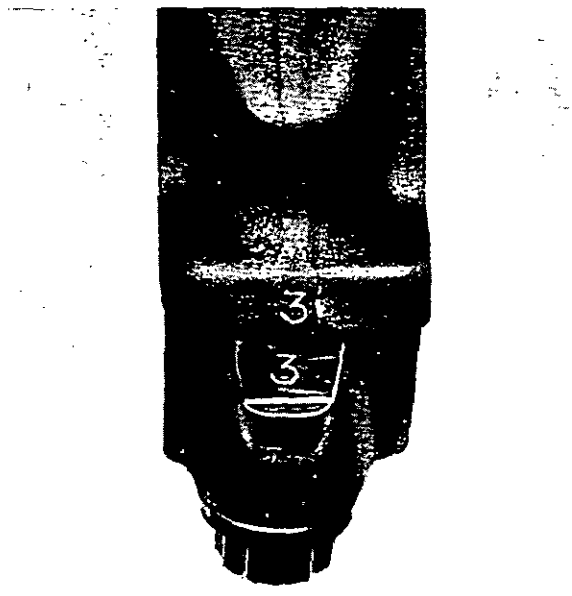
The maximum permissible clearance of a new top ring in its groove, in service, is 0.008 in (0,20 mm).

The manufacturing clearance for the remaining rings in their grooves is 0.002/0.004 in (0,05/0,10 mm).

Examine gudgeon pin and piston bores for wear and check fit of pin in small end bush.

Check connecting rod alignment. The large and small end bores must be square and parallel to each other within limits of ±0.010 in (0,254 mm) measured 5 in (127 mm) each side of axis of rod on test mandrel as shown in Fig. B.2.

With small end bush fitted, limit of ±0.010 in (0,254 mm) is reduced to ±0.0025 in (0,064 mm).



F2

To Renew Small End Bush (Fig. F.3)

Using suitable adaptor, press out old bush.

Remove any sharp edges from around small end parent bore.

Press in new bush ensuring that oil hole in bush (1) aligns with drilling in rod (2).

Ream out bush to give correct clearance to gudgeon pin.

Check for parallelism with big end bore.

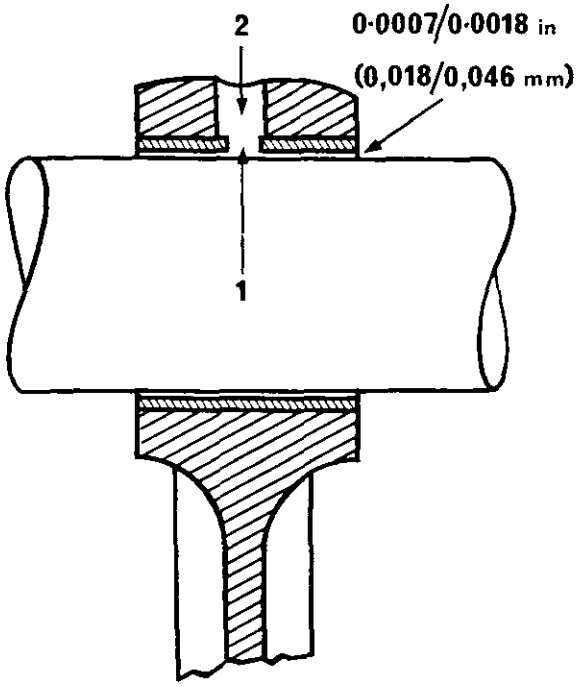
To Check Piston Ring Gaps

In a worn cylinder, ring gaps should be checked at extreme top of cylinder (Fig. F.4) after any carbon has been removed.

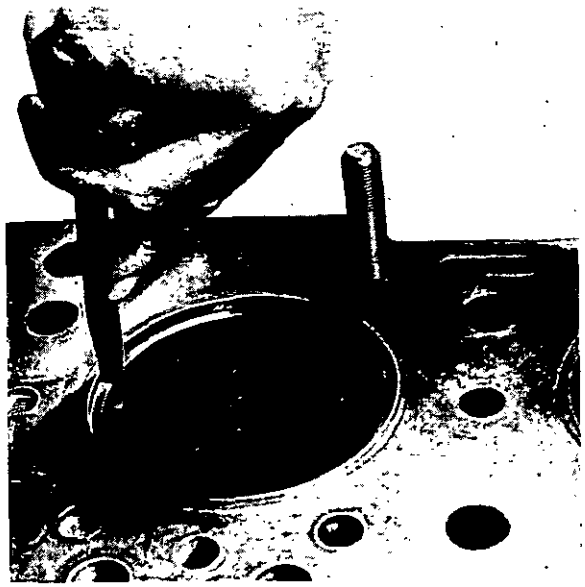
Gaps of new rings should be 0.008/0.030 in (0,20/0,76 mm) for top ring and 0.017/0.036 in (0,43/0,91 mm) for remaining rings. When measuring ring gap of scraper rings, the expander rings should be fitted inside the rings to press rings against bore.

The top ring has a thin copper plating on its periphery which will quickly disappear in service giving a ring gap of 0.017/0.024 in (0,43/0,61 mm) in a 4.250 in (107,95 mm) diameter bore.

Service ring packs are available for fitment with de-glazed V8.510 cylinder liners and these can include cast iron rings for which the ring gap is 0.013/0.032 in (0,33/0,81 mm).



F3



F4

To Assemble Piston and Connecting Rod

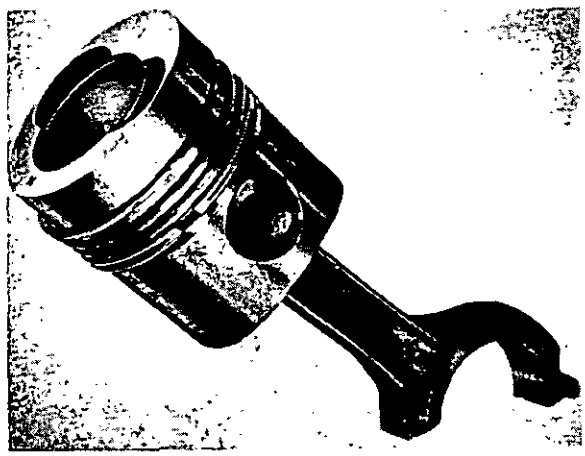
Fit rod to piston so that valve recesses in piston crown are on same side as longer side of big end (Fig. F.5).

Position one of the gudgeon pin retaining circlips in its recess in piston.

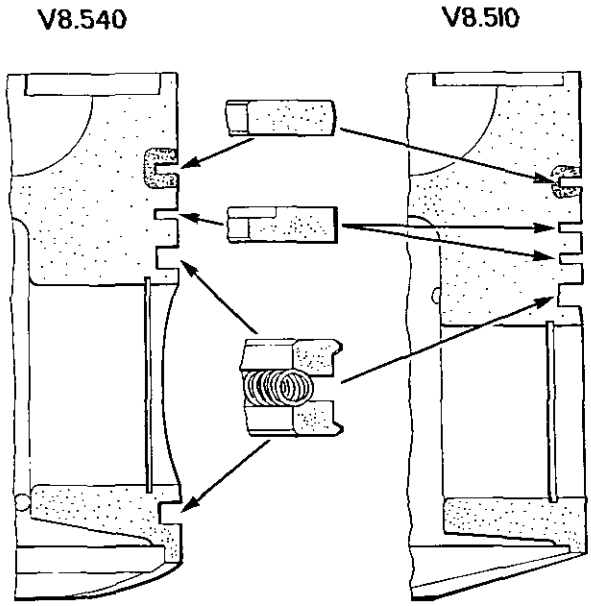
Heat piston to 100 - 120°F (40 - 50°C) and fit gudgeon pin into piston and small end of connecting rod.

Fit remaining gudgeon pin retaining circlip.

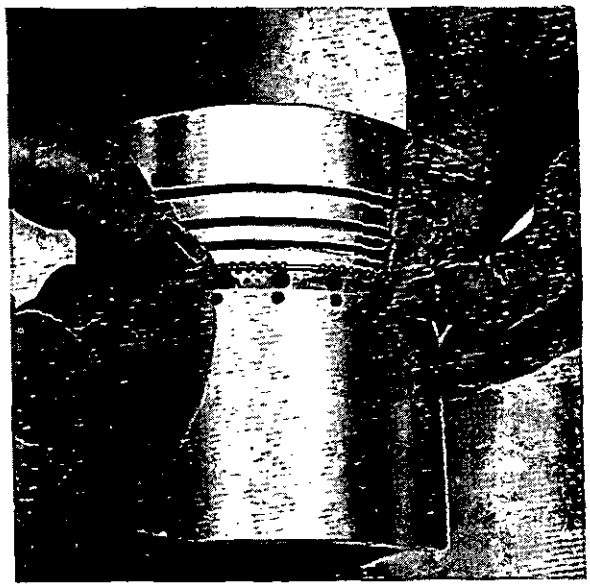
If new parts are being fitted, mark piston crown and adjacent faces of rod and cap (Fig. F.2) with their corresponding cylinder number.



F5



F6



F7

To Fit Piston Rings

Piston ring layout (Fig. F.6) is as follows :—

V8.540

Top Barrel Faced Chrome Plated Copper Finished Compression

2nd. Chrome Faced Internally Stepped or Chamfered Compression

3rd. Chrome Faced Spring Loaded Oil Control

4th. Chrome Faced Spring Loaded Oil Control (Not fitted to early AV8.540 engines).

V8.510

Top Barrel Faced Chrome Plated Copper Finished Compression

2nd Chrome Faced Internally Stepped or Chamfered Compression

3rd Chrome Faced Internally Stepped or Chamfered Compression

4th. Chrome Faced Spring Loaded Oil Control

Fit spring of oil control ring in bottom groove(s), ensuring that latch pin enters both ends of spring (Fig. F.7).

Position oil control ring over spring with spring correctly located in groove of ring (Fig. F.6) and ring gap diametrically opposite to latch pin.

Fit internally stepped or chamfered ring in second groove (V8.540) or second and third grooves (V8.510) with "step" of ring or chamfer and word "TOP" or manufacturers symbol towards piston crown.

Fit barrel faced compression ring in top groove.

Ensure that ring gaps are equally spaced around piston and not in line.

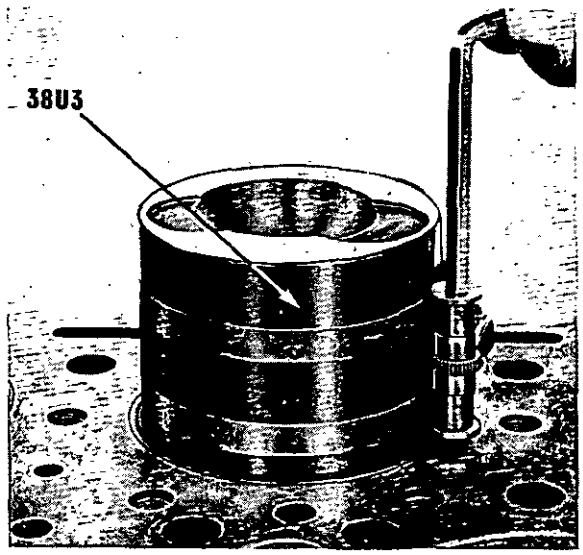
To Fit Piston and Connecting Rod

Clean cylinder bore, piston and bearings and liberally coat with clean engine oil.

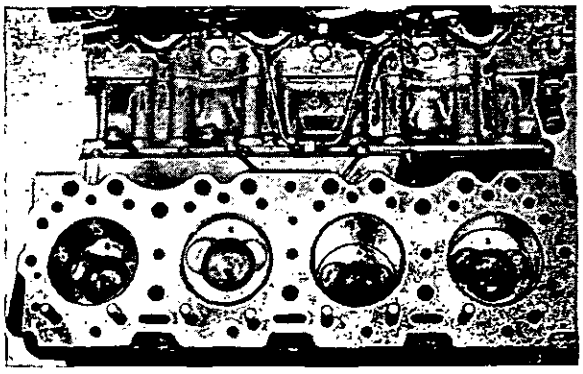
Turn crankshaft until relevant crankpin is towards sump face.

Compress piston rings with squeezer 38U3 (Fig. F.8) and enter assembly in bore with valve recesses in piston crown towards centre of engine (Fig. F.9).

Press assembly through liner and locate big end on crankpin ensuring that upper half bearing is correctly located in big end and tab fits in recess of rod (Fig. F.10).



F8



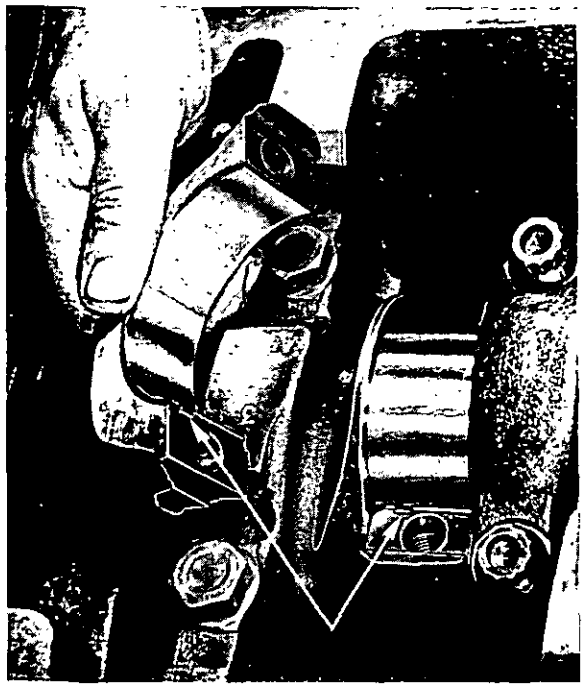
F9

Fit cap with lower half bearing correctly positioned and numbers of cap and rod coinciding (Fig. F.2). Tighten big end setscrews to a torque of 105 lbf ft (142 Nm) 14,5 kgf m for V8.540 engines or 95 lbf ft (129 Nm) 13,2 kgf m for V8.510 engines.

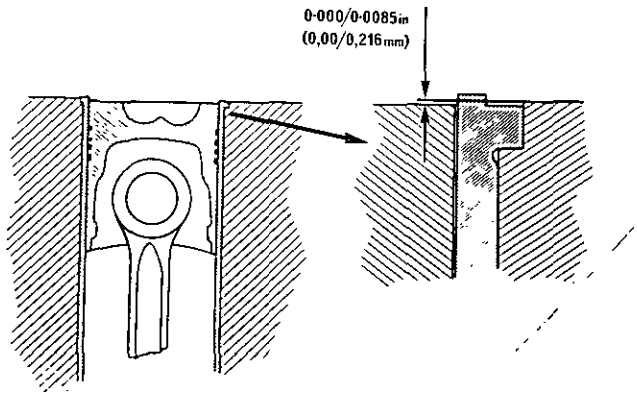
Check that, with piston in the T.D.C. position (Fig. F.11), *piston crown is 0.000/0.0085 in (0,000/0,216* mm) BELOW top face of cylinder block. This can be checked using tool PD41B (Fig. F.12).

Refit cylinder head (Page E.2).

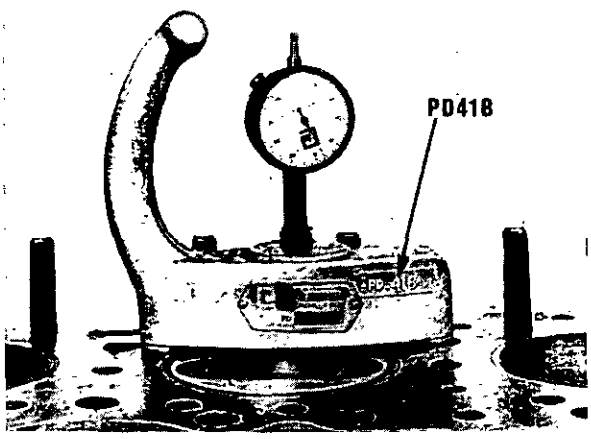
Refit lubricating oil sump (Page L.7) and refill with approved oil to correct level.



F10

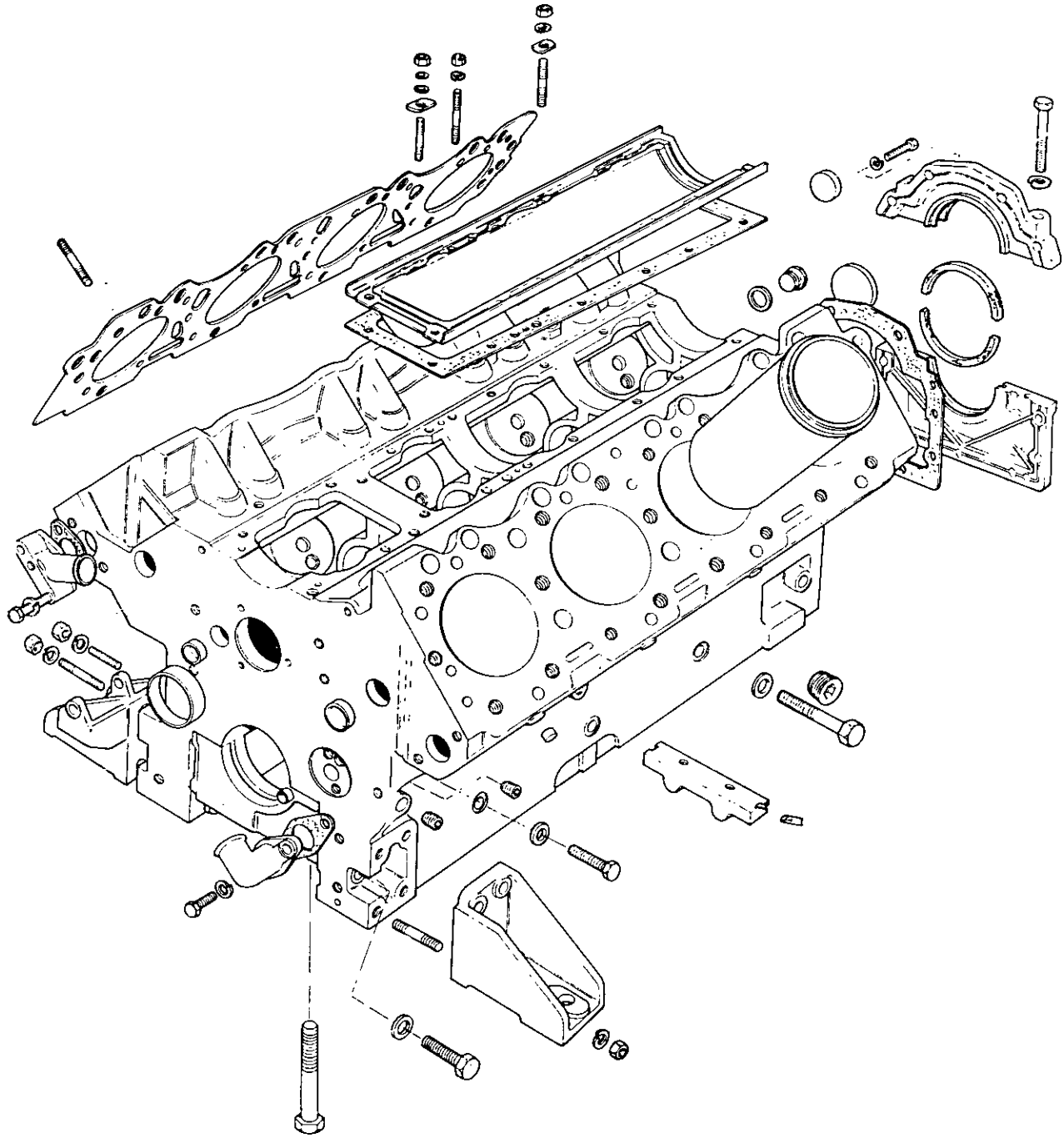


F11



F12

SECTION G
Cylinder Block and Liners



Cylinder Block

The top faces of the cylinder block cannot be machined as this would interfere with the liner flange recess depth. The bush for No. 1 camshaft journal can be renewed, if necessary, using tool PD140 with adaptor PD140-1 (Fig. G.1). When fitting a new bush, ensure that the oil hole in the bush corresponds with the oil passage in the cylinder block and that word "FRONT" on bush is fitted towards the front face of cylinder block.

Cylinder Liners

Production liners are an interference fit of 0.001/0.003 in (0,025/0,076 mm) in the cylinder block and are bored and honed in the block to a diameter of 4.250/4.251 in (107,95/107,975 mm).

The maximum permissible worn inside diameter of a liner, in service, is 4.255 in (108,08 mm) and maximum permissible ovality is 0.002 in (0,05 mm). If a V8.510 liner is not excessively worn, new cast iron service ring packs can be fitted after the glaze has been removed from the cylinder bore.

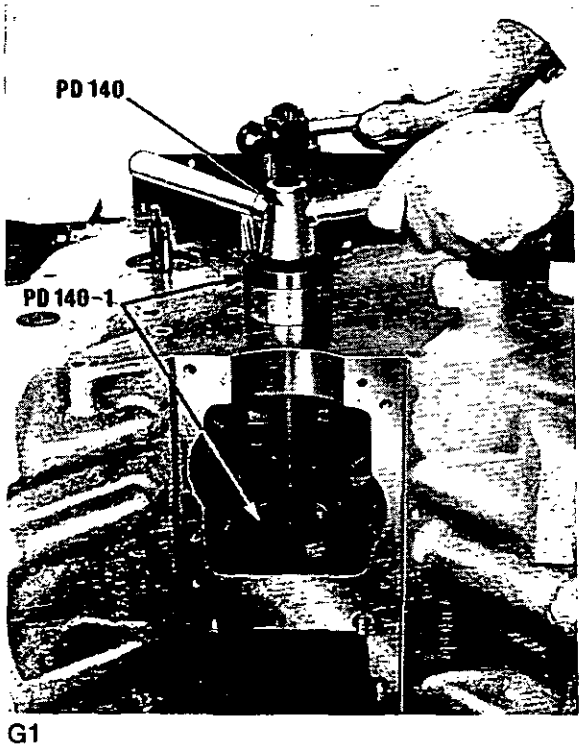
Glaze can be removed using a 4½ in "Flex-Hone" and a 300/750 rev/min drill as follows :—

Mask crank journals and pins to guard against any debris.

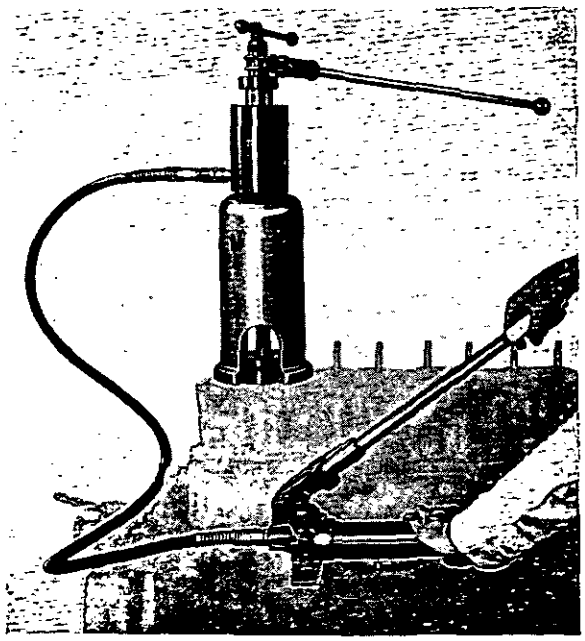
Lubricate bore with clean engine oil — do not over lubricate.

Rest "Flex-Hone" against cylinder block and switch on whilst pressing into bore. **Do not force tool into bore when not running.**

Actuate up and down bore once per second for 20-40 seconds and remove tool whilst rotating. This should give the required 30° cross hatched pattern.



G1

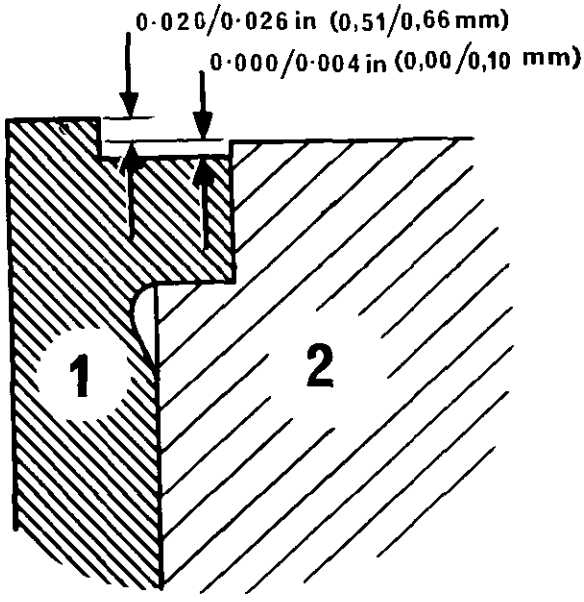

G2

Thoroughly wash bore and crankcase to remove residue from honing operation, using a coarse nylon brush and kerosene, scrub bores and then *dry off.*

Remove masking from crankshaft and thoroughly clean.

"Flex-Hone tools are made by the Brush Research Manufacturing Co. Inc., Los Angeles, California, U.S.A. Enquiries concerning supply in the United Kingdom or outside the United States where no Brush Research Distributor is available should be addressed to Nicro (Leamington) Ltd., Unit 19A, Chalford Industrial Estate, Chalford, Stroud, Gloucestershire, England.

Pre-finished service liners are available as replacements. Earlier service liners are a 0.000/0.002 in



G3

(0,00/0,05 mm) clearance fit in the parent bore and have an internal diameter of 4.251/4.252 in (107,975/108,000 mm) when fitted. Later service liners are 0.001/0.001 in (0,025/0,025 mm) transition fit and have an internal diameter of 4.252/4.253 in (108,000/108,026 mm) when fitted.
Service liners should not be bored or honed and the normal production ring pack should be used.

To Remove and Fit Cylinder Liner

Remove piston and connecting rod assembly (Section F).

Remove liner through top of block using tool PD150B with adaptor PD150-6. Lubricate centre thread and ratchet of tool with Shell Spirax Oil or its equivalent. It is recommended that, where several production liners are to be removed or a particular liner is very tight, a 30 ton hollow hydraulic ram (e.g. Epco P382, Pickavant LRH30) should be used between liner removal dome and thrust race. After initial movement of a tight liner, it should be possible to remove it by means of the hand lever. When removing liner, it is advisable to position replacer pad in top of liner to ensure that screw is central to liner. When liner is nearly withdrawn, support assembly to prevent toppling.

Check parent bore and liner recess for cleanliness and damage.

When fitting liners, ensure that liner, parent bore, cylinder block, main bearing housings or crankpins and tools are clean and lubricate outside diameter of liner with clean engine oil.

It may be necessary to pull a tight liner into the parent bore as detailed below.

If crankshaft is fitted, liner can be pulled into position using centre screw and ratchet of PD150B, replacement pad PD150-6, stirrup PD150-13 and end cap PD150-15 for V8.540 engines or end cap PD150-14 for V8.510 engines.

As liner is a transition fit, tools may only be necessary for last few inches of liner fitment. Turn relevant crankpin to T.D.C., position stirrup and fit end cap with a big end bearing between cap and pin to prevent damage to pin. Engage screw in stirrup and pull liner fully home using replacer pad and ratchet. If crankshaft is removed, liner can be pulled in using arbor PD150-12 in place of stirrup and end cap.

No excess pressure should be applied with the liner fully home in the block.
It is advisable to allow a settling period after fitting before checking liner bore diameter.

When fully home, the liner (1, Fig. G.3) should protrude 0.020/0.026 in (0,51/0,66 mm) above the top face of the cylinder block (2, Fig. G.3) and the liner flange should be 0.000/0.004 in (0,00/0,10 mm) below the top face. If the liner is low, either one or two 0.005 in (0,12 mm) shims may be fitted under the liner flange.

Oversize Cylinder Liners

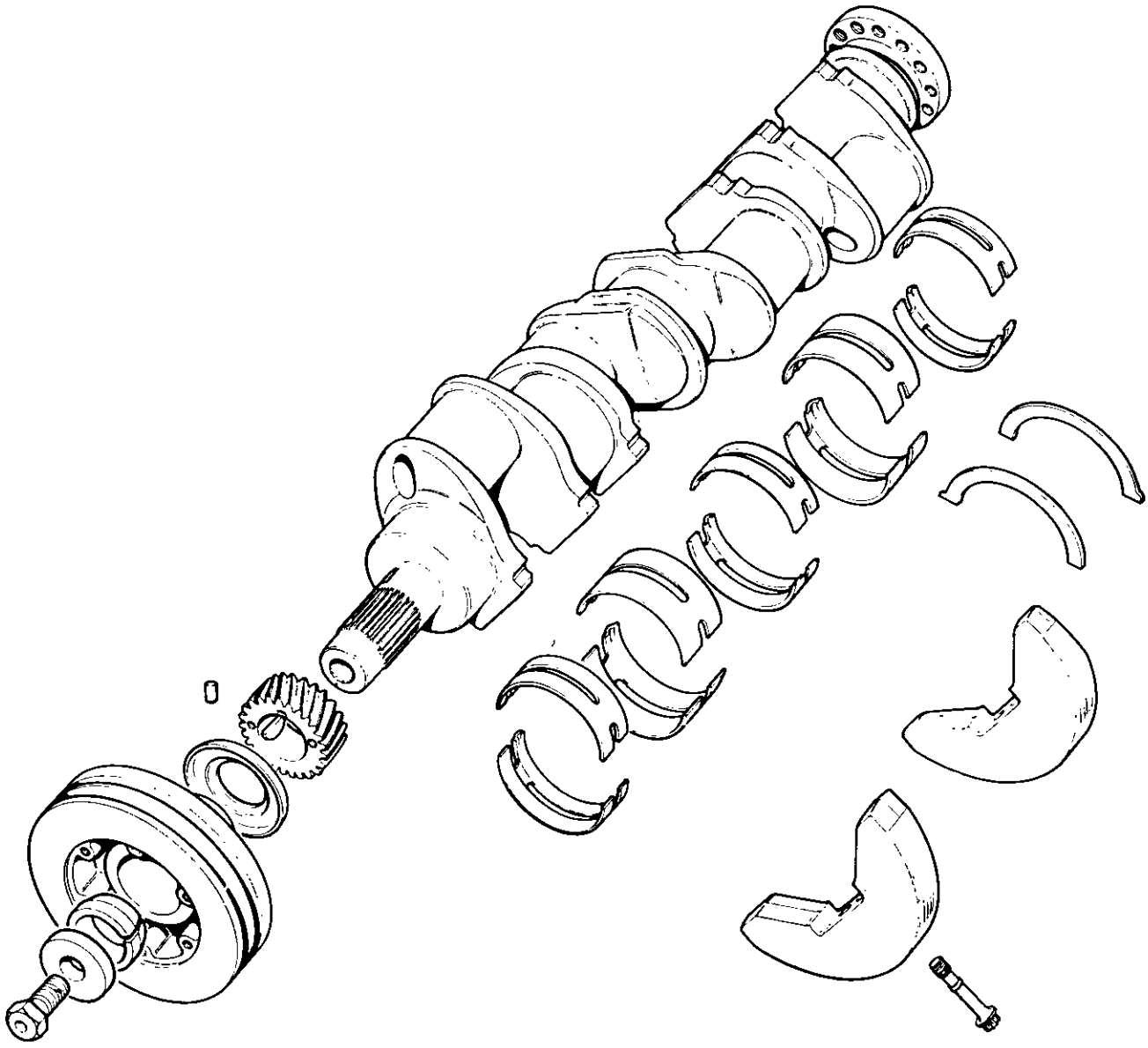
Oversize outside diameter cylinder liners may be fitted to V8.510/V8.540 factory rebuilt engines and are available for fitment in service where the standard parent bore is enlarged to remove damage.

These liners are 0.010 in (0,25 mm) oversize and require boring and honing after fitting.

Where a parent bore is reclaimed in service, it should be machined to the dimension obtained by adding 0.010 in (0,25 mm) to the standard parent bore diameter given on Page B.4. The top of the parent bore must be re-chamfered after machining.

Where oversize liners are fitted, the liner oversize is stamped on the cylinder block top face between liner and the edge of the cylinder block.

SECTION H
Crankshaft and Main Bearings



CRANKSHAFT AND MAIN BEARINGS—H.2

General

The crankshaft runs in five pre-finished replaceable shell bearings lined with aluminium tin.

The main bearing caps are secured by four setscrews. two of which are transverse setscrews through the sides of the cylinder block. Two shim washers are fitted with each vertical main bearing cap setscrew on later V8.510 engines. When the vertical setscrews are removed from earlier V8.510 engines that may have one or no shim washer fitted, they should be replaced with two shim washers. Where plain washers are fitted with these setscrews. the correct plain washers should be used on re-assembly.

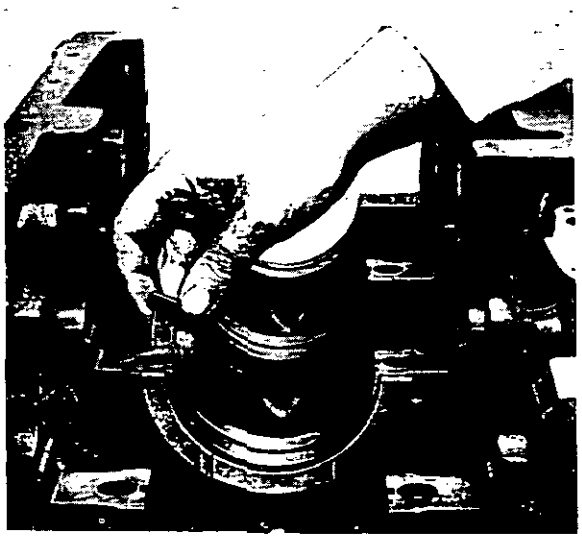
The pulley clamping ring fitted to V8.540 and later V8.510 crankshafts locates on a plain machined diameter on the front of the crankshaft whereas the front end of earlier V8.510 crankshafts and the inside of earlier clamping rings were completely splined.

Crankshaft End Float

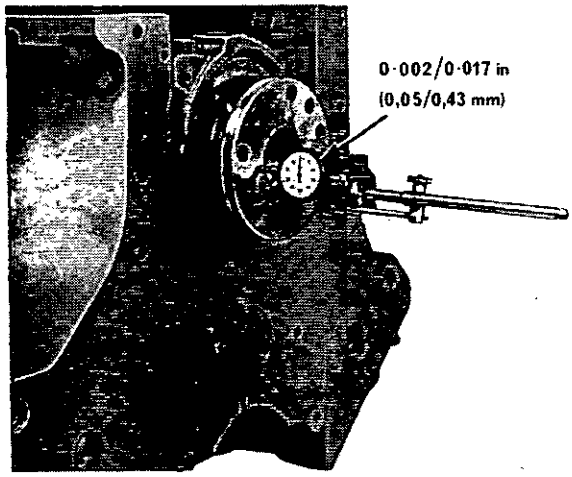
This is controlled by two 180° thrust washers fitted each side of the upper half centre main journal housing (Fig. H.1).

On production, end float is 0.002/0.017 in (0,05/0,43 mm) and maximum permissible worn end float, in service, is 0.020 in (0,51 mm). Two 0.007 in (0,18 mm) oversize thrust washers may be fitted, to reduce end float.

The end float can be checked by using a feeler gauge between the thrust washer and crankshaft web or by using a dial test indicator on one end of the crankshaft (Fig. H.2)



H1



H2

To Change Thrust Washers

Drain lubricating oil and remove sump (Page L.6). Where necessary. remove lubricating oil pump suction pipe and strainer.

Remove centre main bearing cap transverse setscrews from each side of cylinder block (Fig. H.3).

Disengage centre main bearing cap setscrews and remove cap.

Using a suitable thin wedge, slide out thrust washers by pressing on narrower end of washer (Fig. H.4).

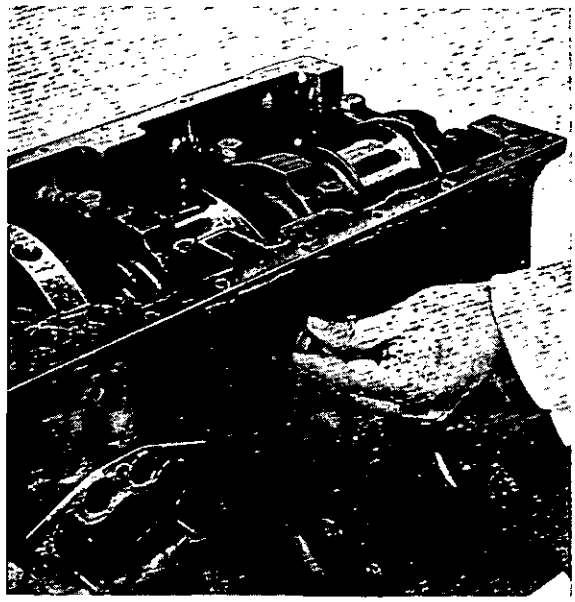
Clean and oil new washers.

Fit replacement washers with stepped ends fitting in recesses in cylinder block and grooved faces towards crankshaft webs.

Clean and oil crankshaft journal and lower half bearing and cap.

Ensure that bearing is correctly fitted in cap with tongue of bearing located in groove in cap.

Place cap in position with number on top of cap reading in line with remaining numbers on caps and



H3

block (Fig. H.6).

Locate transverse and main bearing cap setscrews and washers.

Tighten vertical main bearing cap setscrews to 210 lbf ft (285 Nm) 29,0 kgf m and then tighten transverse setscrews to 50 lbf ft (68 Nm) 6,9 kgf m if $\frac{7}{16}$ in U.N.F. setscrews are used, 75 lbf ft (102 Nm) 10,4 kgf m if "S" range $\frac{1}{2}$ in U.N.F. setscrews are used or 100 lbf ft (136 Nm) 13,8 kgf m if "W" range setscrews are used. The range of the setscrews can be ascertained by the letter "S" or "W" on the head of the setscrew.

Check end float as detailed previously.

If necessary, refit lubricating oil pump suction pipe and strainer.

Refit lubricating oil sump (Page L.7) and refill with approved oil to correct level.

To Remove Crankshaft

Remove flywheel and flywheel housing (Section P).

Drain lubricating oil and remove sump (Page L.6).

Remove cylinder heads (Page E.2).

Remove crankshaft pulley.

Remove timing case (Page J.2) and oil thrower or distance piece.

Remove crankshaft/camshaft idler gear (Page J.5).

Remove rear oil seal housing and bridge piece.

Remove pistons and connecting rods (Page F.2).

Invert engine and remove main bearing cap transverse setscrews from each side of cylinder block (Fig. H.3). It may be necessary, on some applications, to remove front engine bearer feet to gain access to front transverse setscrews.

Remove main bearing cap setscrews, caps and lower half bearings. Keep bearings with appropriate caps.

Turn the rear balance weights to the oil filter side of crankcase and lift out crankshaft, keeping it level with crankcase.

Remove upper half bearings and thrust washers, making note of fitted positions.

Note : If the existing crankshaft is to be removed and refitted without any further work on pistons, liners, etc., it is not absolutely necessary to remove the cylinder head and pistons. However, great care should be taken that connecting rod big ends do not jam against balance weights and the rocker shafts should be removed to prevent a piston striking a valve.

To Fit Crankshaft

If necessary, fit crankshaft gear and key with timing mark on gear towards front of crankshaft. Before fitting the crankshaft gear, treat the gear bore and spigot with "Loctite Grade 601". Ensure that the gear abuts the front face of the No. 1 crankshaft journal.

Check that oil passages are clear.

Clean main bearing housings.

Fit upper half main bearings in their housings, ensuring that tongues of bearings locate in their recesses in block (Fig. H.5) and liberally oil bearings.

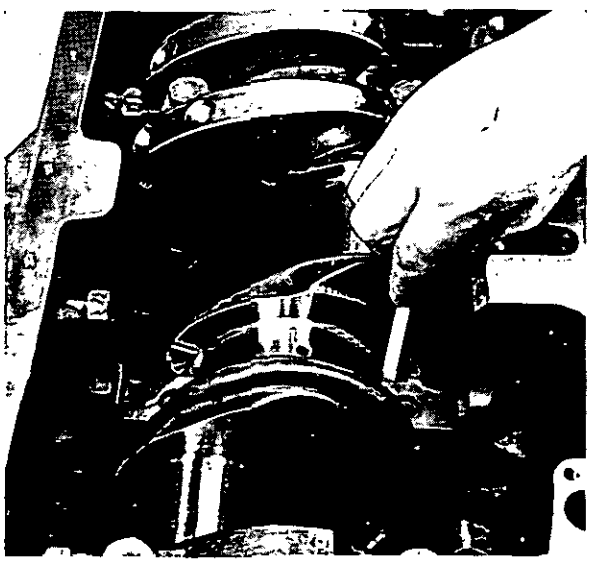
Clean and oil crankshaft journals and lower crankshaft into position with rear balance weights towards oil filter side of block.

Fit thrust washers (Page H.2).

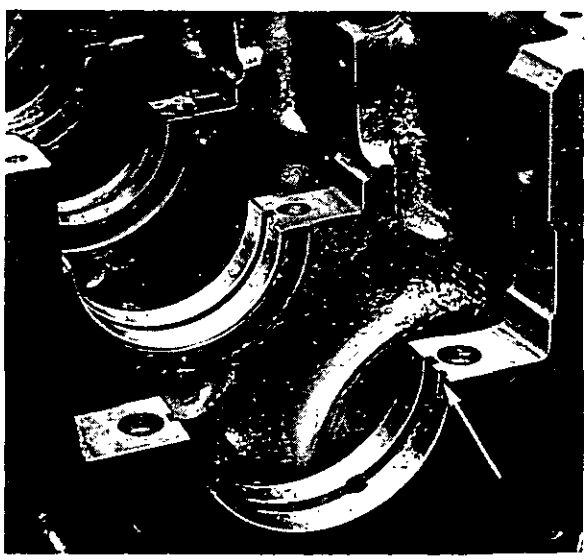
Fit lower half bearings in caps with tongues of bearings correctly located and oil bearings.

Place caps in position with numbers on caps and block reading in line (Fig. H.6). Main bearing caps are numbered from front to rear and are stamped with a serial number which corresponds with the number on the block.

Lightly oil transverse and main bearing cap setscrews and locate in their positions, fitting each vertical main bearing cap setscrew with two shim washers or a special plain washer, if this type was originally fitted. Where the main bearing cap securing arrangement



H4



H5

utilises eight long and two short vertical setscrews, the two short setscrews must be fitted with the rear main bearing cap. With this arrangement, the longer setscrews can be identified in position by a small pip on the head face of the setscrew.

Tighten vertical main bearing setscrews (Fig. H.7) to 210 lbf ft (285 Nm) 29,0 kgf m and then tighten transverse setscrews to 50 lbf ft (68 Nm) 6,9 kgf m if 7/16 in U.N.F. setscrews are used, 75 lbf ft (102 Nm) 10,4 kgf m if "S" range ½ in U.N.F. setscrews are used or 100 lbf ft (136 Nm) 13,8 kgf m if "W" range ½ in U.N.F. setscrews are used. The range of the setscrew can be ascertained by the letter "S" or "W" on the head of the setscrew.

Check crankshaft end float (Page H.2).

Fit pistons and connecting rods and check piston height (Page F.4).

Fit rear oil seal housing and bridge piece (Page H.6).

Fit lubricating oil pump and relief valve (Pages L.8 and L.9).

Fit crankshaft/camshaft idler gear and hub (Page J.5).

Position oil thrower or distance piece on crankshaft and fit timing case (Page J.2).

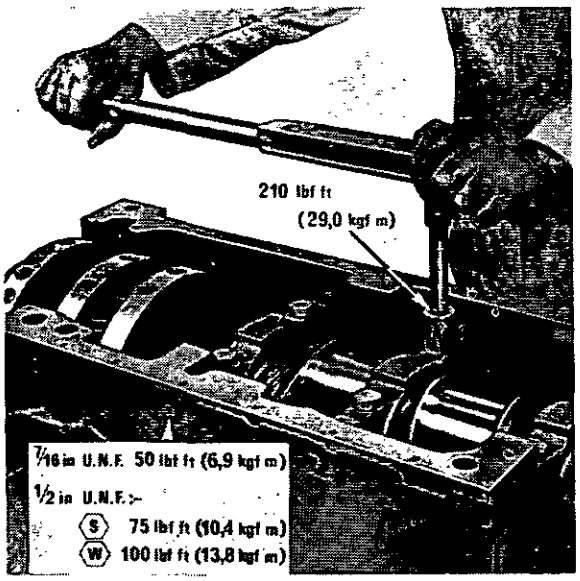
Position crankshaft pulley on crankshaft ensuring that slot in pulley is fitted over pin in crankshaft (Fig. H.8). The pin fitted to V8.540 and later V8.510 crankshafts is a large solid pin, compared with the small hollow type fitted in earlier V8.510 crankshafts as shown in Fig. H.8 and consequently the size of the location slot in the crankshaft pulley has been increased.

Fit pulley clamping ring, or two half rings, washer and setscrew and tighten setscrew to 300 lbf ft (407 Nm) 41,5 kgf m.

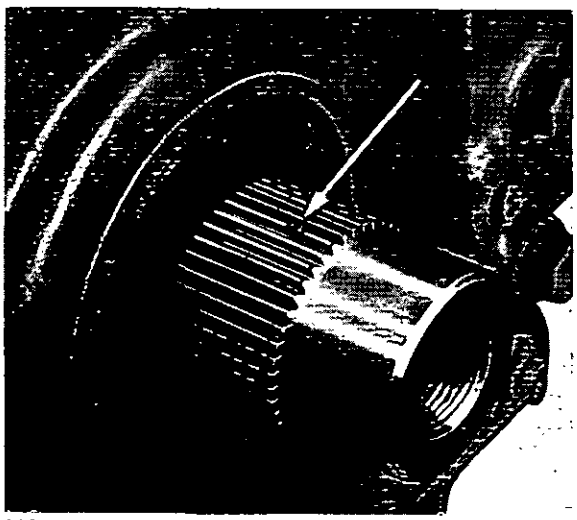
Fit cylinder heads (Page E.2).

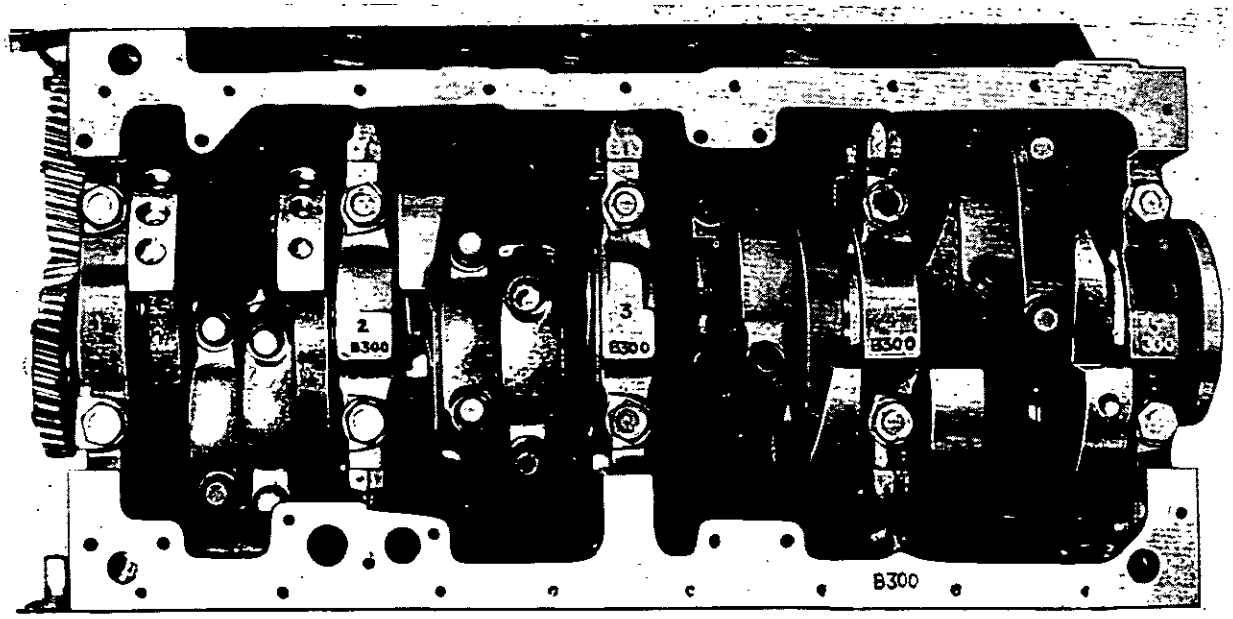
Fit lubricating oil sump (Page L.7) and refill with approved oil to correct level.

Fit flywheel housing and flywheel (Section P).

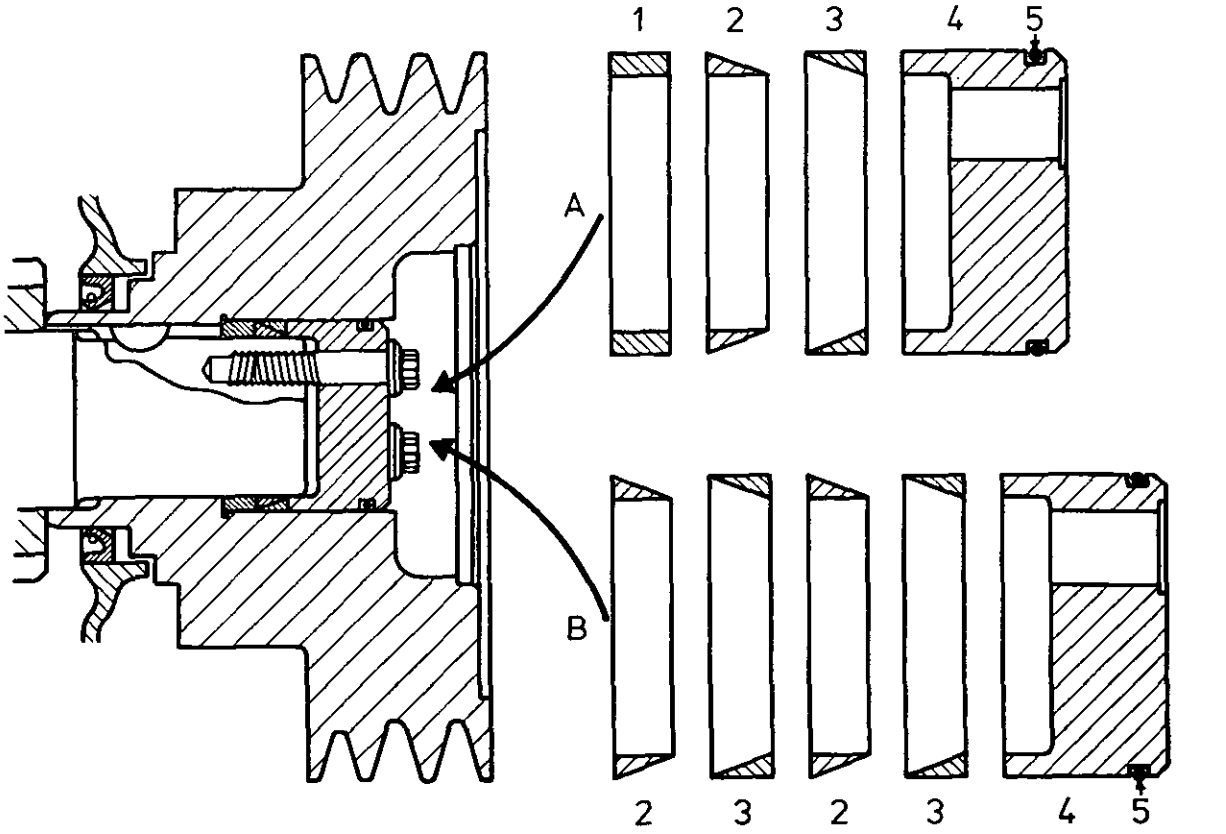


H7


H8



H6



H9

Later V8.540 Crankshaft Pulley Clamping Arrangement

Commencing Engine No. XC - - - - U514937E, the crankshaft pulley clamping arrangement on V8.540 engines has been changed from a single tapered ring acting against a tapered pulley face to a single pair or double pair of opposed taper rings against a flat pulley face (Ringfeder System). In addition to the change of crankshaft and pulley, the lower half timing case has also been changed, where applicable, to incorporate a close clearance type dust seal between the pulley and the timing case, and the washer between the pulley and the crankshaft gear has been removed.

With the later arrangement, the pulley is secured by three $\frac{7}{16}$ in U.N.F. setscrews for which the tightening torque is 65 lbf ft (88 Nm) or 9,0 kgf m. The removal and fitting procedures for the new arrangement are given below. It is essential that the tapered rings are assembled correctly, otherwise difficulty will be experienced in removing the pulley.

To Remove and Fit Crankshaft Pulley with Ringfeder Locking

Do not use an extractor to remove the pulley. Remove the securing setscrews and the thrust block (4; Fig. H.9) and if the pulley is not free, loosen the locking rings by giving the inner hub of the pulley a light jarring blow rearwards using a suitable block of wood between the pulley and the hammer.

Before fitting the pulley, thoroughly clean the crankshaft, pulley bore and locking components — do not use a degreasing solution. The tapered rings should not be expanded beyond their free state.

Position the pulley on the shaft with the key engaged and push it fully home.

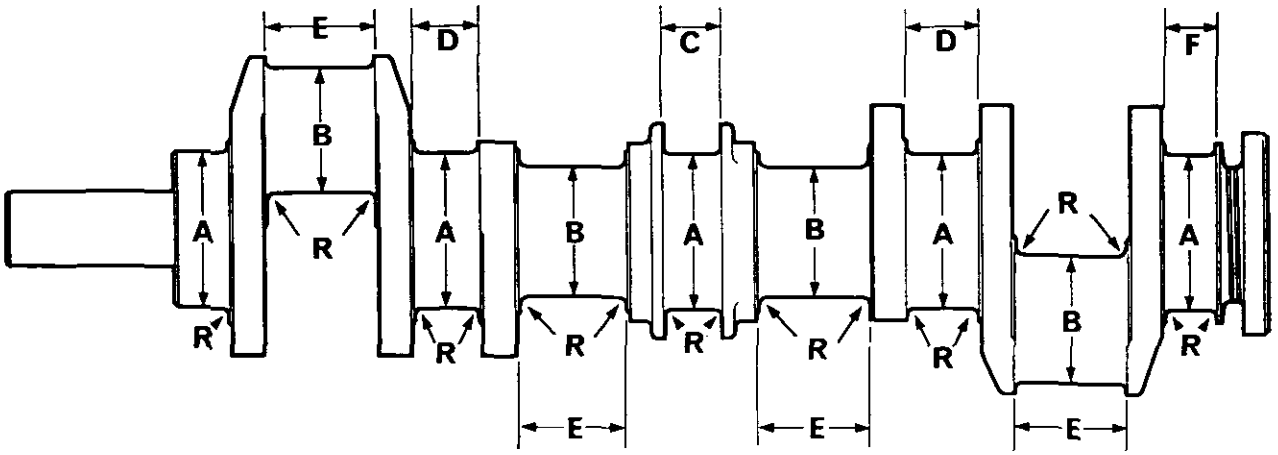
If a single pair of rings (A) is used, insert the spacer (1) first then the inner ring (2) and then the outer ring (3) ensuring that the ring gaps do not coincide.

If two pairs of rings (B) are used, insert the inner ring (2) and then the outer ring (3), followed by the second inner ring and then the second outer ring. Ensure that the ring gaps do not coincide.

Lightly oil the 'O' ring (5) of the thrust block and the threads and thrust faces of the securing setscrews and fit the block and setscrews into position.

Whilst pressing the pulley fully home, tighten the setscrews evenly in several stages to a final torque of 65 lbf (88 Nm) or 9,0 kgf m.

Note : If desired, the later crankshaft can be used on V8.540 engines prior to Engine No. XC - - - - U514937E provided that the later pulley and pulley securing components are used for the particular engine build list concerned. Do not fit a washer between the crankshaft gear and the later pulley.



H10

Crankshaft Regrinding

With a standard crankshaft, the minimum permissible worn diameter of the main journals is 3.9942 in (101,453 mm) and of the crankpins is 2.9955 in (76,086 mm) for V8.540 crankshafts or 3.2455 in (82,436 mm) for V8.510 crankshafts. Maximum permissible ovality for crankpins and main journals is 0.0015 in (0,04 mm).

The crankshaft can be reground, if necessary, to 0.010 in (0,25 mm), 0.020 in (0,51 mm) and 0.030 in (0,76 mm) undersize and special bearings are available for these regrind undersizes.

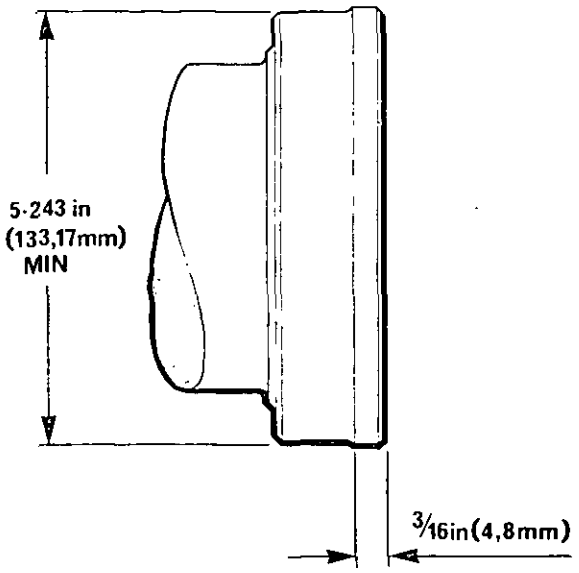
The crankshaft fitted to some V8.540 engines is nitride hardened and where facilities are not available for re-nitriding after regrinding a replacement crankshaft should be fitted. The nitrided crankshaft can be recognised by the assembly part number 41111663 or 41111684, stamped on the No. 1 web of the crankshaft. Some crankshafts have a rear flange with an extended width of over one inch (25 mm) to provide a seat for the lip type rear oil seal (Page H.8). If all the three positions for this seal have been used, it is permissible to regrind the sealing area of the flange to a minimum diameter of 5.243 in (113,17 mm), leaving an unmachined diameter for a distance of 3/16 in (4,8 mm) *from the rear end as shown in Fig. H.11. Only the minimum* of metal should be removed to ensure eradication of the seal wear grooves and the surface finish should be the same as for the crankpins and journals. It is not necessary to re-nitride the flange after this operation.

When regrinding, only very light cuts should be used, especially around the fillet radii and adequate cooling should be ensured. After regrinding, the crankshaft should be crack detected and demagnetised and the oil holes chamfered 0.020/0.060 in (0,51/1,52 mm) at 45°.

When the above operations have been carried out, nitrided V8.540 crankshafts should be re-hardened by the 20 hour nitriding process and then crack detected and demagnetised. The plain machined diameter at the front end of the crankshaft, where the pulley clamping ring seats, should be left soft. Finally the crankpins, main journals and outside diameter of the rear flange should be lapped to remove the residue from the nitriding process.

The regrind dimensions (Fig. H.10) are as follows :—

	0.010 in (0,25 mm) Undersize	0.020 in (0,51 mm) Undersize	0.030 in (0,76 mm) Undersize
A	3.9867/3.9872 in (101,262/101,275 mm)	3.9767/3.9772 in (101,008/101,021 mm)	3.9667/3.9672 in (100,754/100,767 mm)
B	V8.540—2.9880/2.9885 in *(75,895/75,908 mm)* V8.510—3.2380/3.2385 in (82,245/82,258 mm)	V8.540—2.9780/2.9785 in *(75,641/75,654 mm)* V8.510—3.2280/3.2285 in (81,991/82,004 mm)	V8.540—2.9680/2.9685 in *(75,387/75,400 mm)* V8.510—3.2180/3.2185 in (81,737/81,750 mm)
C	1.673 in (42,49 mm) maximum		
D	1.940 in (49,28 mm) maximum		
E	2.913 in (73,99 mm) maximum		
F	1.684 in (42,77 mm) maximum		
R	*0.125/0.140 in (3,18/3,56 mm) radius all pins and journals*		



H11

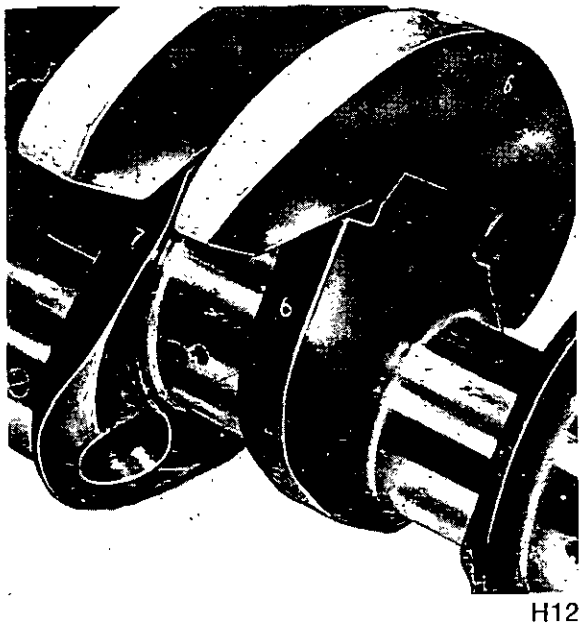
Fillet radii (R) and surface finish of 16 micro inches (0,4 microns) of all crankpins and journals must be maintained during regrinding.

Crankshaft Balance Weights

Weights cannot be renewed individually as crankshaft is balanced as an assembly.

If weights are removed for crankshaft regrinding they should be refitted in their original positions with number on weight corresponding with number on crankweb (Fig. H.12).

On V8.540 and later V8.510 engines the weights are secured by setscrews and on earlier V8.510 engines they are secured by studs and nuts.



H12

Fit weights as follows :—

Where weights are secured by setscrews :

Lightly oil bearing faces and threads of balance weight setscrews.

Place weights in their respective positions, as indicated by the numbers stamped on the weights and crankshaft.

Fit the balance weight setscrews and tighten them to 85 lbf ft (115 Nm) 11,8 kgf m.

Release setscrews to finger tight and then retighten to 85 lbf ft (115 Nm) 11,8 kgf m.

Where weights are secured by studs and nuts :

Lightly oil stud threads and bearing surfaces of nuts.

Fit studs with plain shank in web and tighten to 25 lbf ft (34 Nm) 3,5 kgf m.

Position balance weights with numbers corresponding.

Fit correct type nuts only and tighten to 80 lbf ft (108 Nm) 11,1 kgf m. Slacken nuts to a torque of 30 lbf ft (41 Nm) 4,1 kgf m and finally retighten to 80 lbf ft (108 Nm) 11,1 kgf m.

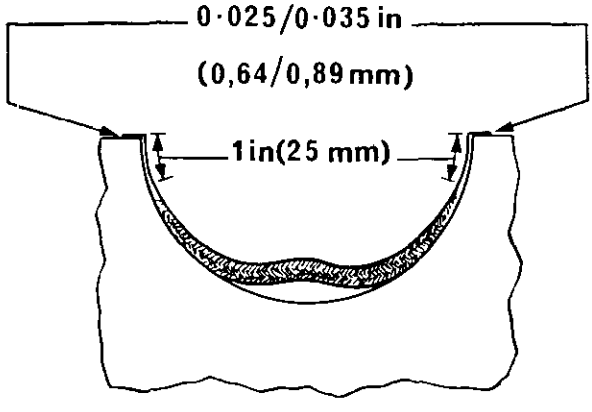
To Fit Rope Type Crankshaft Rear Oil Seal and Housing

Settle approximately 1 in (25 mm) of each end of seal into groove of half housing with seal ends protruding 0.025/0.035 in (0,64/0,89 mm) above joint face as shown in Fig H.13.

Press remainder of seal into position starting from centre and working outwards (Fig. H.14).

Using a suitable round bar, roll and press seal into position (Fig. H.15).

Degrease the butt faces of the two half housings and apply a thin layer of Perkins (Hylomar) Jointing Compound, in accordance with the manufacturers instructions. Lightly coat the forward faces of the half housings with a suitable jointing compound and spread graphite



H13

grease over the seal.

Oil the crankshaft rear end around the oil return groove.

Place joint and half housings in position on engine and locate setscrews in cylinder block, finger tight only.

Tighten housing clamping setscrews to a torque of only 6 lbf ft (8 Nm) 0,83 kgf m.

Tighten setscrews in cylinder block to a torque of 12 lbf ft (16 Nm) 1,66 kgf m.

Finally tighten clamping setscrews to a torque of 12 lbf ft (16 Nm) 1,66 kgf m.

Lip Type Crankshaft Rear Oil Seal

A circular spring loaded lip seal that locates on the periphery of the rear flange of the crankshaft is fitted to V8.540 and some V8.510 engines.

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

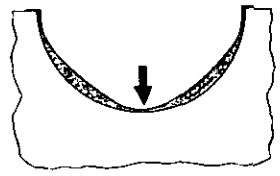
To Fit Lip Seal in its Housing

On production, the seal is fitted with its rear face flush with the rear face of the housing. In service, when a new seal is to be fitted to a worn crankshaft, it should be pressed further into the housing, in the first instance to $\frac{1}{8}$ in (3,2 mm) or, if this position has been used, to $\frac{1}{4}$ in (6,4 mm) from the rear face of the housing (Fig. H.16). If all three positions have been used, it may be permissible to machine the worn sealing area of the crankshaft flange, see page H.6. When a new seal is to be fitted to a new or reconditioned crankshaft in service, it should be fitted with its rear face flush with the housing.

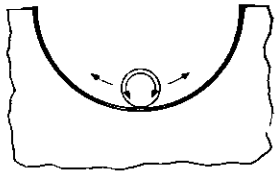
Before fitting the seal in the housing, carefully examine the seal for damage especially on the lip and outside diameter.

Using clean engine lubricating oil, lubricate the outside diameter of the seal and the inside diameter of the housing.

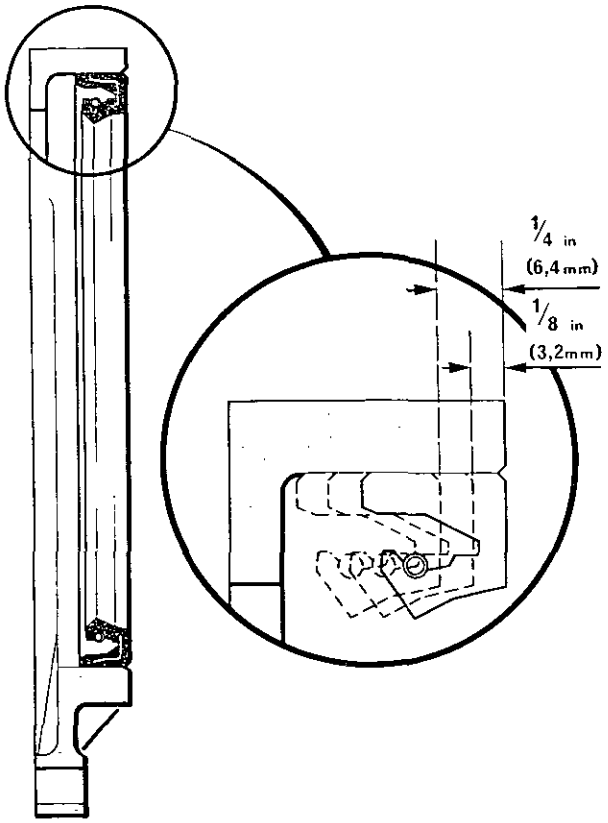
Press the seal into the housing to the required position, taking care that the seal is entered and pressed in squarely, otherwise damage to the outside diameter of the seal may occur or, if it is not square in the housing when fitted to the engine, it may leak.



H14



H15



H16

To Fit Lip Seal and Housing

The seal and housing should be fitted, using seal guide PD145, as follows :—

Clean the faces of the cylinder block and the oil seal housing and the outside diameter of the crankshaft flange.

Check that the seal and the outside diameter of the crankshaft flange are not damaged. Where a new seal has been fitted, check that it is in the correct position in the housing, as detailed above.

Ensure that the two dowels are fitted in the cylinder block. Coat both sides of the housing joint with Perkins (Hylomar) Jointing Compound and position the joint over the dowels in the block.

Using clean engine lubricating oil, lubricate the crankshaft flange, the seal and the seal guide. The lubrication of the seal is necessary to prevent damage that may be caused by initial dry running.

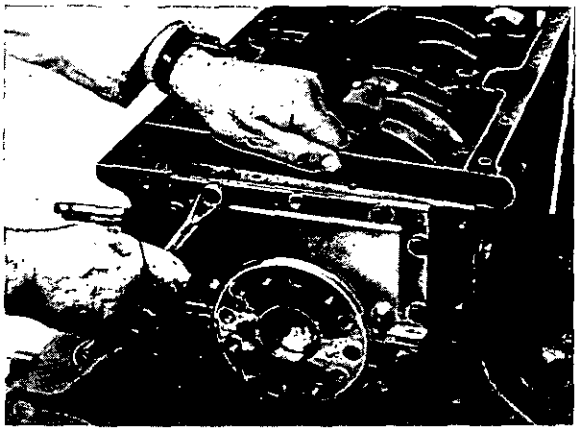
Position the seal and housing on the seal guide, locate the guide on the crankshaft flange and gently press the seal and housing into position on the flange, locating the housing on its dowels.

Withdraw the guide and secure the housing with setscrews and washers.

H17

To Fit Bridge Piece

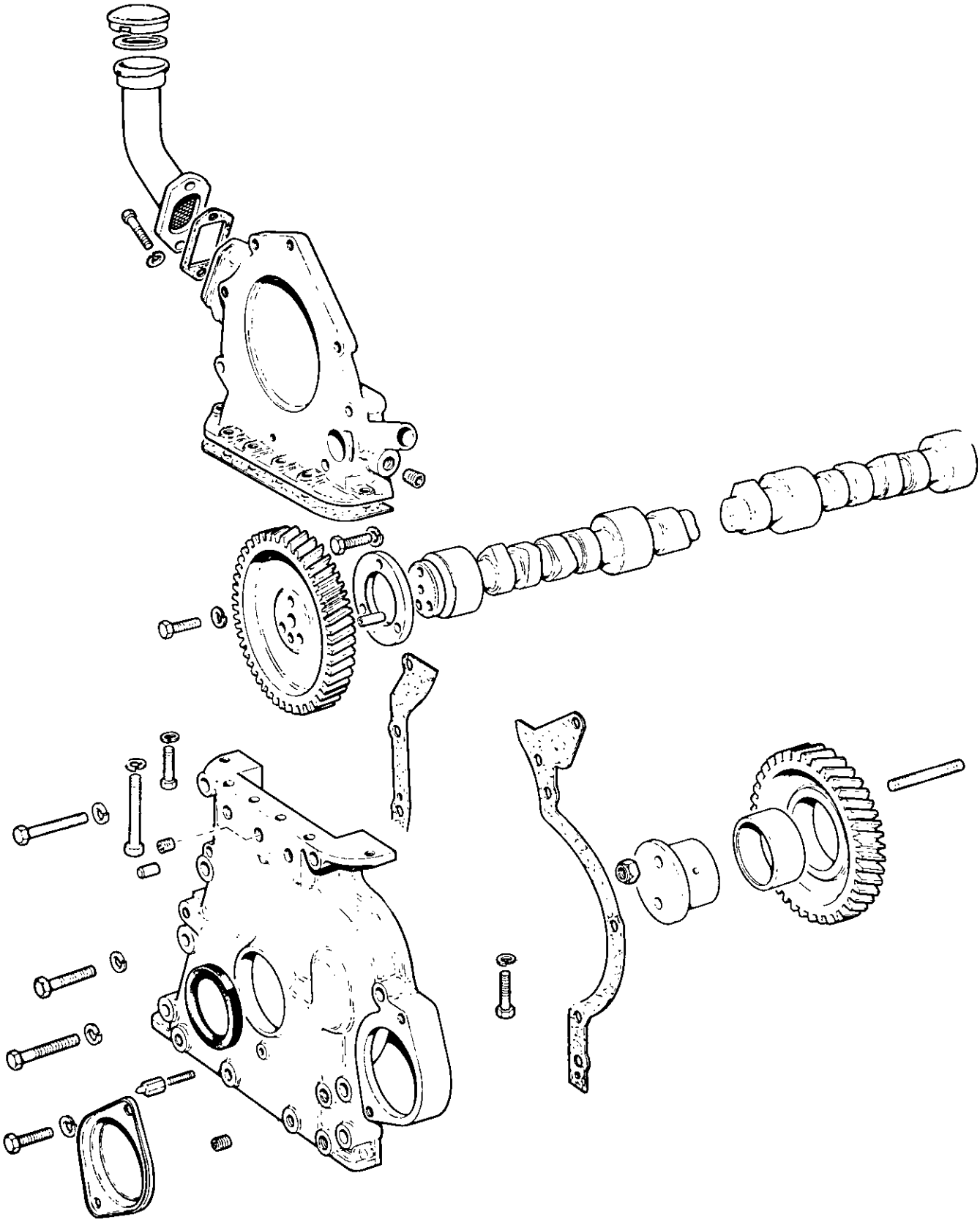
The bridge piece sealing arrangement of V8.540 and later V8.510 engines consists of two small cylindrical rubber seals that fit into recesses in the ends of the bridge piece bottom face (Fig. H.17). These seals should be fitted with the length of the seal across the engine, after the bridge piece is in position. The seals fitted to earlier V8.510 engines are two cork type seals, fitting in grooves in the end faces of the bridge piece. These earlier seals have to be trimmed flush with the faces of the bridge piece.



H18

When fitting the bridge piece to the oil seal housing, use a straight edge to ensure that the bottom face of the bridge piece is flush with the sump face of the cylinder block (Fig. H.18).

SECTION J
Timing Case and Drive



To Remove Timing Case

Slacken alternator mounting nuts and bolts and remove drive belts.

Remove crankshaft pulley.

Remove water pump (Page M.3).
Drain lubricating oil and remove sump (Page L.6).

Where necessary, remove front engine bearer cross member.

Where necessary, disconnect water by-pass from left bank.

Remove setscrews securing timing case to cylinder block and compressor/auxiliary drive housing and remove timing case.

To Refit Timing Case

Fit new joints in position, suitably coated with jointing compound.

Position timing case ensuring that dowels are correctly located in lower half casing.

Where necessary, fit water by-pass connection from left bank to upper half timing case.

Fit and secure setscrews securing timing case to cylinder block and compressor/auxiliary drive housing. Where necessary, fit front engine bearer cross member.

Fit crankshaft pulley (Page H.4).

Fit water pump (Page M.3).

Fit fan belts and adjust tension (Page M.2).

Refit lubricating oil sump and refill to correct level with approved oil.

To Remove and Refit Upper Half Timing Case

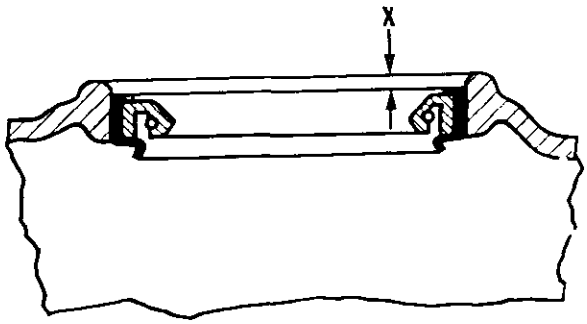
If required, upper half timing case can be removed from engine separately, but as side joints of timing case are in one piece, this will necessitate cutting of joints on replacement. Extreme care must be taken when cutting and fitting joints to ensure that no leaks will occur.

Drain cooling system.

Release water pump drive belt tension, remove belts and if necessary, tensioner assembly.

Remove water pump.

Where necessary, disconnect water by-pass connection from left bank.



J1

Remove setscrews securing upper half timing case to lower half noting position of timing bracket if fitted.

Remove upper half of timing case.

If timing case side joints have been damaged, remove exposed portions of joints and position new portions of joints suitably coated with Perkins "Hylomar" jointing compound. Fit new upper to lower timing case joint. Position upper half timing case, ensuring that joints are not displaced and secure to bottom half case, cylinder block and auxiliary drive housing, tightening setscrews progressively to enure correct fit.

Where necessary, reconnect water by-pass connection to left bank.

Refit water pump, belt tensioner, if applicable, and belts (Section M).

Refill cooling system.

To Renew Front Oil Seal

Remove timing case, as detailed previously.

Press out old seal from timing case using a suitable dolly and supporting case in vicinity of seal bore.

Earlier engines were fitted with a black nitrile seal and a crankshaft oil thrower.

Later engines have a red silicone seal and the oil thrower is replaced by a distance piece. This seal should not be fitted with an oil thrower.

Press in new seal, with lip towards inside of case (Fig. J.1), to the applicable dimension below the front face of the timing case as shown below.

Tool PD.141 can be used to ensure the correct position for standard V8.510 engines.

Refit timing case, as detailed previously.

Application	*Dimension "X" (Fig. J.1).*
Standard V8.510 engines	3/32 in (2,4 mm)
V8.510 engines with dust shroud fitted to crankshaft pulley	0.161/0.166 in (4,09/4,22 mm)
V8.540 engines	0.161/0.166 in (4,09/4,22 mm)
AV8.510 engines with single lip seal	0.310/0.320 in (7,87/8,13 mm)
AV8.510 engines with double lip seal (before engine number 510UA5931)	0.310/0.320 in (7,87/8,13 mm)
AV8.510 engines with double lip seal (from engine number 510UA5931)	0.435/0.445 in (11,05/11,30 mm)
AV8.540 engines	0.435/0.445 in (11,05/11,30 mm)
AV8.540 and V8.540 engines with DP15 fuel pump ...	0.380/0.400 in (9,65/10,16 mm)
AV8.540 engine fitted to MF2745 Tractor	0.290/0.300 in (7,37/7,62 mm)

To Remove Camshaft Gear

It is advisable, where possible, to position No. 1 piston at T.D.C. compression stroke (Page K.2) before commencing dismantling, in order to facilitate later reassembly.

Remove timing case, as detailed previously.

On engines incorporating alternative fuel pump drive arrangements (see Fig. J.13, 14 or 15), there are no timing marks on fuel pump gear and camshaft/fuel pump idler gear. If fuel pump gear or auxiliary drive housing are not going to be disturbed, ensure that marked teeth of crankshaft and camshaft gears are in mesh with crankshaft/camshaft idler gear and mark mating teeth of fuel pump and camshaft/fuel pump idler gears and the two teeth of camshaft/fuel pump idler gear which are in mesh with single marked tooth of camshaft gear (see Fig. J.2).

Unscrew camshaft gear securing setscrews and remove gear (Fig. J.3).

To Fit Camshaft Gear

The camshaft gear location of V8.540 and later V8.510 engines consists of a hollow dowel fitting into drillings in the gear and camshaft whereas on earlier V8.510 engines, the location arrangement consists of a small solid dowel in the gear locating in a slot in the camshaft.

Check that dowel location slot or drilling of camshaft (1, Fig. J.3) is towards centre of compressor/auxiliary drive shaft or camshaft/fuel pump idler gear. If camshaft needs to be turned, remove rocker covers and release rocker assemblies.

On engines incorporating standard fuel pump drive arrangement, remove fuel injection pump timing plug and turn compressor/auxiliary drive gear until timing groove or slot is correctly positioned (Page K.2) and the two marked teeth of gear are towards camshaft.

On engines incorporating alternative fuel pump drive arrangements (see Fig. J.13, 14 or 15), ensure that previously marked teeth of fuel pump gear and camshaft/fuel pump idler gear are in mesh (Fig. J.2) and the two marked teeth of camshaft/fuel pump idler gear are toward camshaft. If there are no timing marks on these gears, remove the fuel pump timing inspection plug and align the timing marks (see Section K). These marks must be kept in line as the remaining gears are assembled.

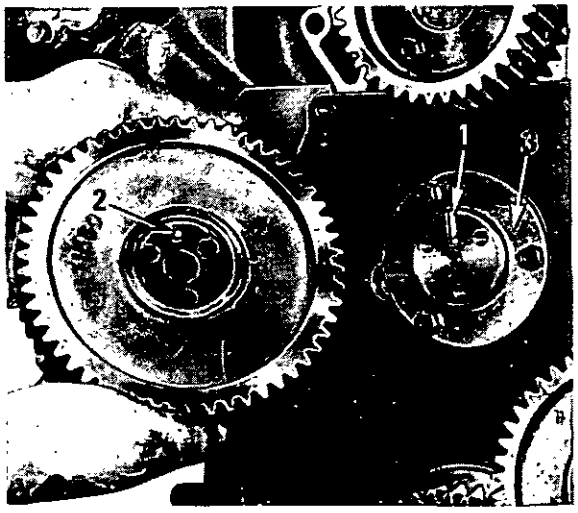
Remove crankshaft/camshaft idler gear.

If necessary, turn crankshaft until the marked tooth is towards centre of crankshaft/camshaft idler gear hub position. If difficulty is experienced in turning crankshaft, it may be that a piston is striking an open valve, in which case the rocker assemblies should be released.

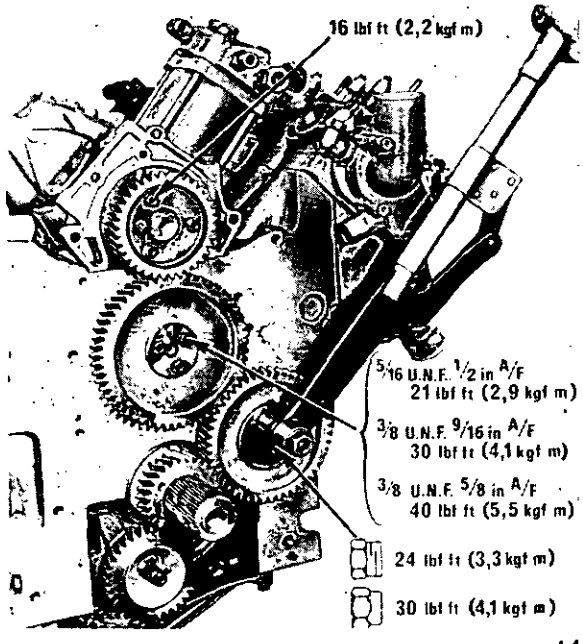
Fit camshaft gear ensuring that dowel (2, Fig. J.3) enters location in camshaft and single marked tooth of gear meshes with marked teeth of compressor/auxiliary drive gear.

Tighten gear retaining setscrews to correct torque (Fig. J.4) for type of setscrew fitted as shown in table below. Where fully threaded $\frac{3}{8}$ U.N.F. setscrews with $\frac{7}{16}$ in A/F heads are fitted to earlier V8.510 engines, it is recommended that service setscrews, part no. 32181239 be fitted as replacements, during overhaul.

J2

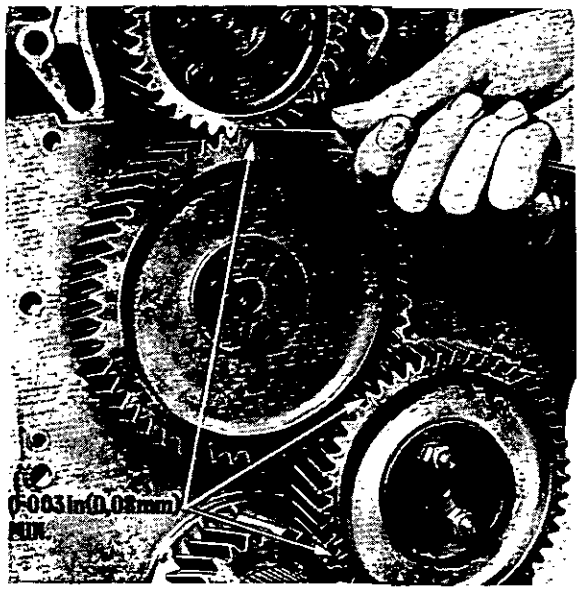


J3



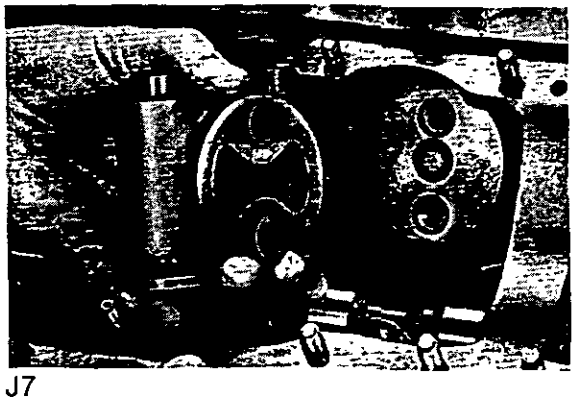
J4

Engine No.	Camshaft Gear Setscrew			Torque lbf ft (kgf m)
	Thread, U.N.F.	Head, A/F	Type	
510U2000 to 2373	5/16	1/2 in	Part Threaded	21 (2,9)
510U2374 to 12645	3/8	9/16 in	Fully Threaded	30 (4,1)
510U12646 onwards	3/8	5/8 in	*Waisted*	40 (5,5)
V8.540 engines	3/8	5/8 in	Waisted	40 (5,5)



J5


J6


J7

Fit idler gear (Page J.5) with marked teeth in mesh with marked teeth of camshaft and crankshaft gears.

Check that gear backlash (Fig. J.5) is at least 0.003 in (0,08 mm).

If necessary, secure rocker assemblies and reset valve tip clearances (Page E.3).

Refit timing case (Page J.2).

Check valve and fuel injection timing (Section K).

Fit lubricating oil sump and fill to correct level with oil of an approved grade.

Refit rocker covers and fuel injection pipes (Page E.3).

To Remove Camshaft

It is advisable, where possible, to position No. 1 piston at T.D.C. compression stroke (Page K.2) before commencing dismantling, in order to facilitate later reassembly.

Remove rocker assemblies and push rods.

Remove timing case (Page J.2).

Remove camshaft gear and thrust plate (3, Fig. J.3).

If possible, invert engine and carefully remove camshaft, turning camshaft as it is being withdrawn.

When engine cannot be inverted, proceed as follows:

Remove fuel filter, filter bracket and fuel pipes.

Remove fuel injection pump and compressor/auxiliary drive housing (Section Q).

Remove tappet cover. Tappets will now be fully visible (Fig. J.6).

Hold up tappets or remove tappet blocks, complete with tappets (Fig. J.7).

Carefully remove camshaft (Fig. J8).

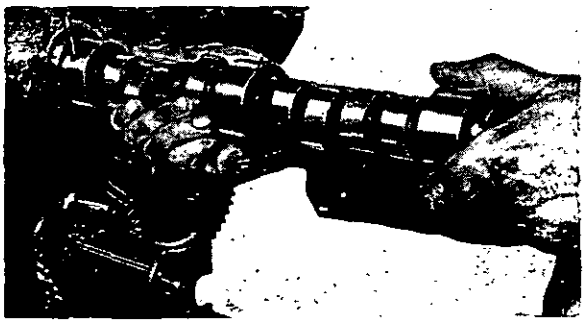
To Fit Camshaft

Lightly oil camshaft and carefully enter into cylinder block.

Fit camshaft thrust plate and tighten securing setscrews to 12 lbf ft (1,7 kgf m).

Fit camshaft gear (Page J.3).

Check camshaft end float with a dial test indicator as shown in Fig. J.9. On production, end float is 0.0015/0.015 *in (0,04/0,38 mm) and in service, maximum* permissible worn end float is 0.020 in (0,51 mm). If necessary, renew thrust washer.



J8

Where necessary, refit tappets and tappet blocks. The drillings for the tappet block securing setscrews enter the cylinder liner parent bore. When refitting the tappet blocks, ensure that these drillings are clear of oil and other foreign matter, otherwise damage to the cylinder liners may occur.

Ensure that hollow dowels are correctly located and tighten tappet block retaining setscrews to 58 lbf ft (79 Nm) 8,0 kgf m.

Where necessary, refit tappet cover, compressor/auxiliary drive housing (Section Q) and fuel injection pump and filter (Section N).

Refit timing case (Page J.2).

Refit push rods and rocker assemblies and reset valve tip clearances (Page E.3).

Check valve and fuel injection timing (Section K).

Refit rocker covers and fuel pipes (Page E.3).

Where necessary, fill lubricating oil sump to correct level with approved grade of oil.

To Remove and Refit Crankshaft/Camshaft Idler Gear and Hub

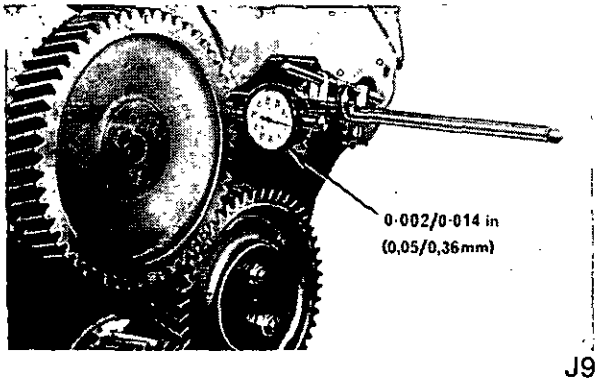
It is advisable, where possible, to position No. 1 piston at T.D.C. compression stroke (Page K.2), before commencing dismantling in order to facilitate later reassembly.

Remove timing case (Page J.2).

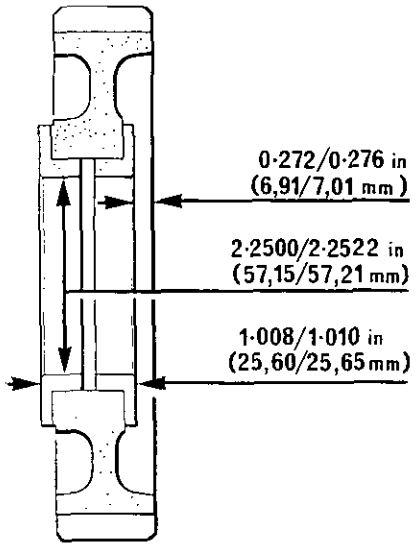
Release securing nuts and remove idler gear and hub.

With the standard drive arrangement the gear bush is pre-finished and if renewing bush, ensure that it does not project beyond gear.

With the earlier drive arrangement for DP15 pump and alternative drive for CAV in line pump, the gear has two half



J9



J10

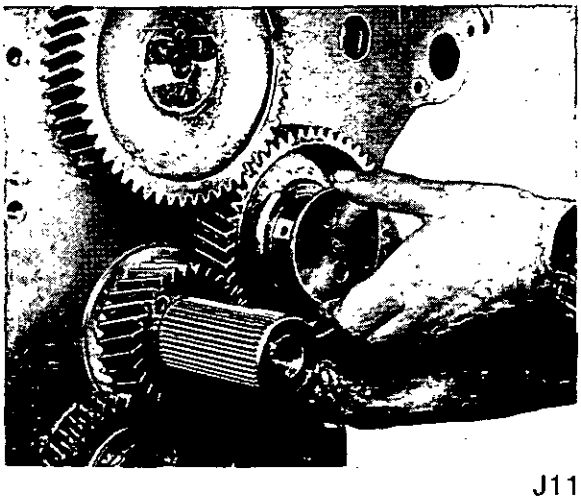
bushes. If these bushes are renewed, they must be machined, after being pressed into gear, to dimensions shown in Fig. J10.

Refit gear and hub, with marked teeth of idler gear meshing with marked teeth of crankshaft and camshaft gears. The holes in the hub for the securing studs are slightly off-centre and when fitting hub, ensure that oil drilling in hub is towards camshaft (Fig. J.11).

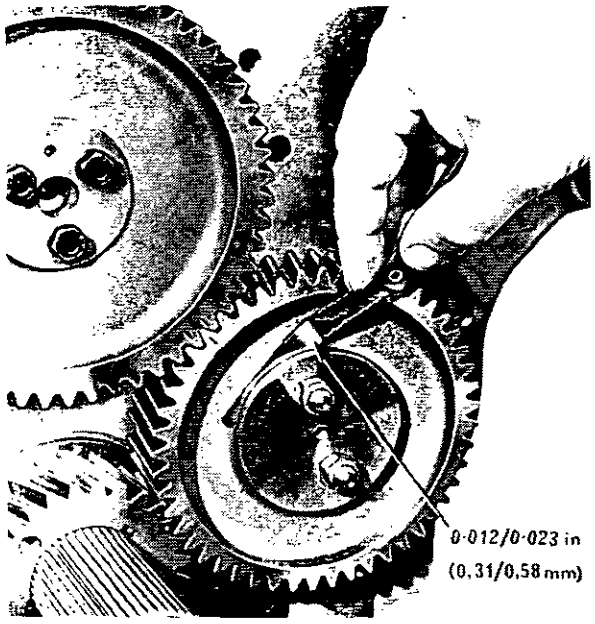
Tighten hub securing nuts (Fig. J.4) to 30 lbf ft (41 Nm) 4,1 kgf m if 'Nyloc' nuts are fitted or 24 lbf ft (33 Nm) 3,3 kgf m if 'Philidas' nuts are fitted. 'Nyloc' nuts can be identified by the nylon type insert in the top of the nut and 'Philidas' nuts can be identified by the two slits through the side of the head of the nut.

Check that backlash (Fig. J.4) is at least 0.003 in (0,08 mm).

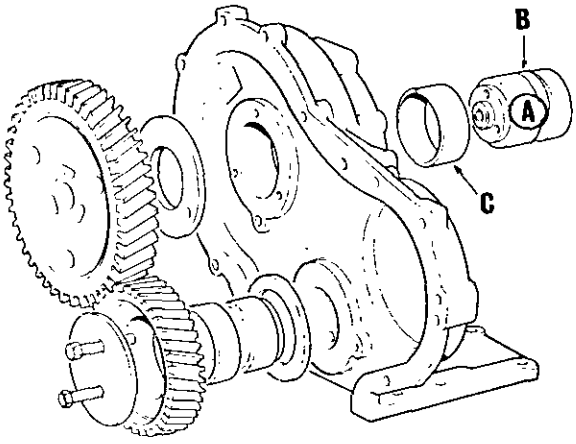
Check idler gear end float (Fig. J.12). On production, end float is 0.012/0.023 in (0,31/0,58 mm) and in service, maximum permissible worn end float is 0.030 in (0,76 mm).



J11



J12



J14

Alternative Fuel Pump Drive Arrangements

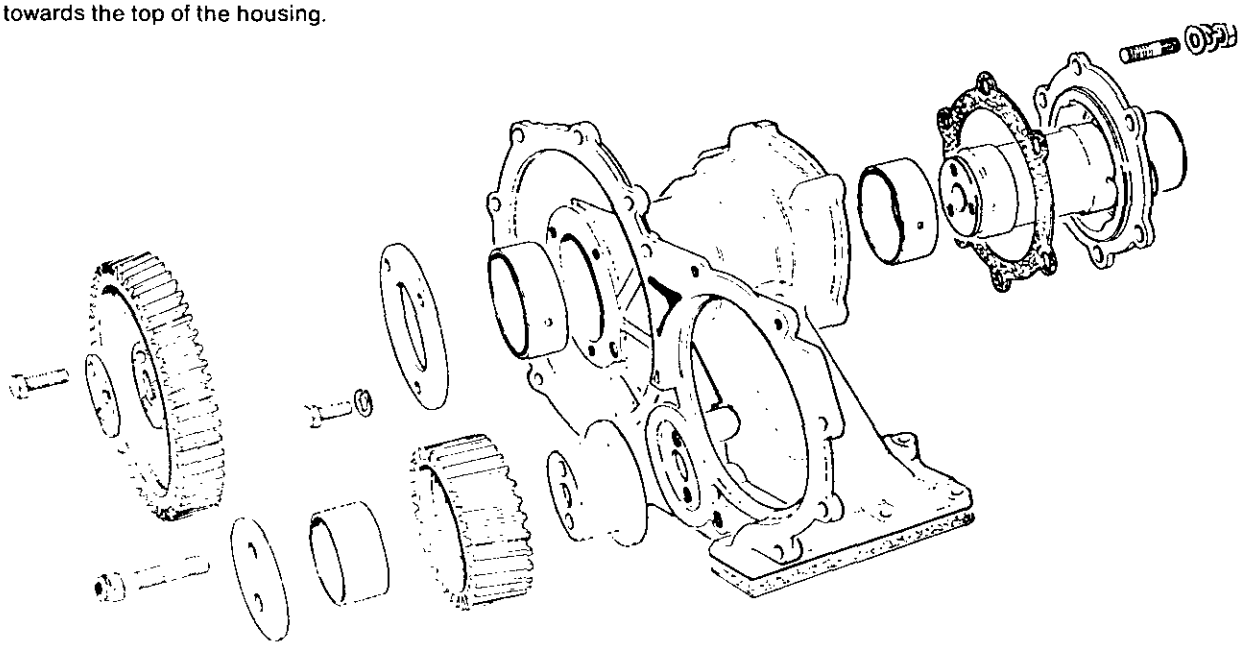
Certain engines incorporate a different fuel pump driving arrangement to the standard engine. An idler gear is fitted to the front of the auxiliary drive housing which transmits the drive from the camshaft to the fuel pump drive gear and the compressor gear, where fitted. The alternative drive for CAV in-line pumps is shown in Fig. J.13, for DP15 fuel pumps in Fig. J.14 and for Bosch MW in-line pumps in Fig. J.15.

The fuel pump drive shaft runs in two bushes for CAV in line pumps or a single bush for DP15 pumps. The smaller DP15 pump drive shaft (A, Fig. J.14) incorporates an eccentric drive (B, Fig. J.14) that operates the fuel lift pump by means of a push rod. The lift pump is mounted towards the top of the housing.

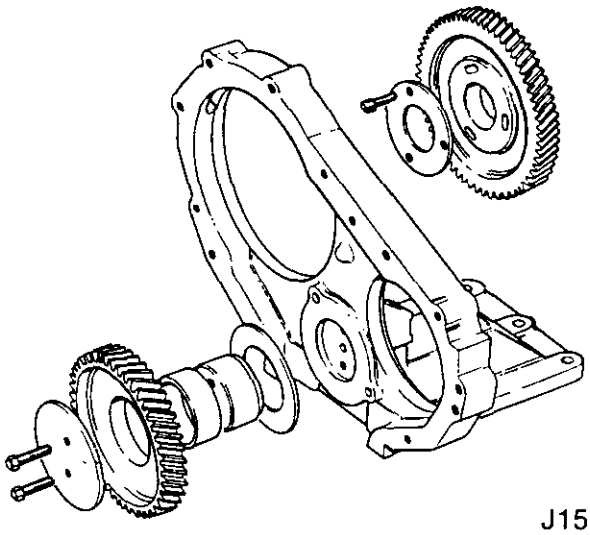
With the Bosch MW in-line fuel pump, the drive gear is mounted directly on the fuel pump drive hub (see Fig. J.15).

A lubricating oil feed is taken from the side of the housing to the in line pump and compressor, where fitted

If the bushes are to be renewed, they should be pressed in with the oil hole in the bush corresponding with the oil drilling in the housing. The split in the single bush (C, Fig. J.14) should be in the 12 o'clock position. After fitting, the bushes should be machined concentric with the internal diameter for the fuel pump adaptor plate and square to the adaptor plate mounting face to the dimensions given in Section B.



J13



J15

To Remove and Fit Camshaft/Fuel Pump Idler Gear and Hub — Alternative Drives

Remove timing case, as detailed previously.

Release setscrews and remove end plate, idler gear and hub or hub and thrust washer.

If the gear bush is renewed, ensure that the bush is fitted centrally and does not protrude beyond the gear. The bush is pre-finished.

To fit gear and hub, proceed as follows :—

Ensure that camshaft gear dowel is in 12 o'clock position and turn fuel pump gear to bring fuel pump to static timing position (Section K).

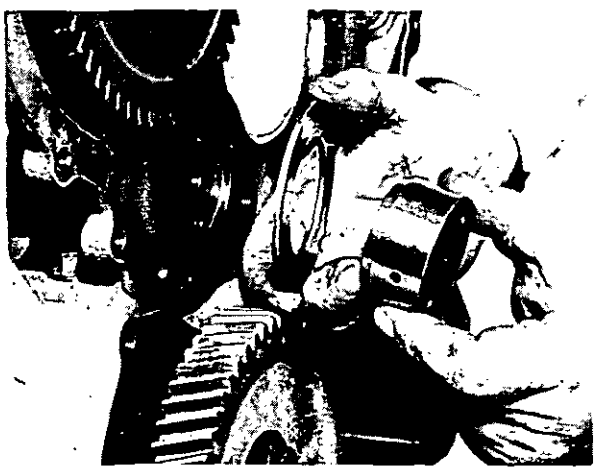
Position hub or thrust washer and hub (Fig. J.16). The holes for the securing setscrews are slightly off-centre and when fitting the hub, ensure that oil hole is towards fuel pump side of housing. Fit gear and end plate ensuring that fuel pump timing marks remain in line and tighten securing setscrews to torque given on Page B.3.

Check gear end float, in a similar manner to that shown in Fig. J.9, to the limits in Section B.

Check that backlash is at least 0.003 in (0,08 mm).

Refit timing case, as detailed previously.

Check fuel injection timing (Section K).



J16

To Remove and Fit Fuel Pump Drive Gear — Alternative Drives

Remove timing case, as detailed previously.

Unscrew fuel pump drive gear securing capscrews or setscrews and remove gear (Fig. J.17).

To fit fuel pump drive gear, proceed as follows :—

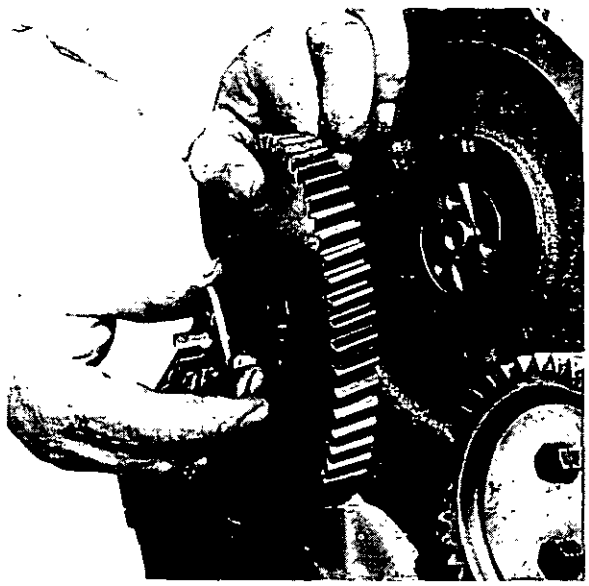
Ensure that camshaft gear dowel is in 12 o'clock position. Remove fuel pump timing inspection plug (see Section K). Turn fuel pump shaft to position pump timing marks to the static timing position (see Page K2 or K.3). Keeping timing marks in line, position fuel pump gear and holding gear against backlash (anti-clockwise from front), tighten gear securing capscrews to torque given on Page B.3.

Where applicable check fuel pump drive shaft end float to limits given in Section B. Where necessary, renew thrust plate, tightening thrust plate setscrews to 7 lbf ft (9,5 Nm) 0,97 kgf m.

Check that gear backlash is at least 0.003 in (0,08 mm).

Refit timing case, as detailed previously.

Check timing of fuel injection pump (Section K).



J17

To Remove and Fit Fuel Pump Drive Shaft *(where applicable)* – *Alternative Drives*

With timing case fitted – CAV In Line and DP15 fuel pumps:—

Position No. 1 piston to T.D.C. compression stroke (Section K).

Remove fuel injection pump and adaptor plate and fuel lift pump and push rod for DP15 pump (Section N).

Remove tachometer, if fitted, and fuel pump gear cover plate.

Remove fuel pump gear capscrews or setscrews and withdraw shaft (Fig. J.18).

Refit in reverse order, fitting gear as detailed previously.

Check fuel injection timing (Section K).

With timing case removed — DP15 pump :—

Remove fuel lift pump and push rod (Section N).

Remove fuel pump gear.

Remove thrust plate and withdraw shaft (Fig. J.19).

Refit in reverse order, fitting gear as detailed previously.

Check fuel injection timing (Section K).

To Remove and Fit Auxiliary Drive Housing — Alternative Drives

Remove timing case, as detailed previously.

Remove compressor, if fitted.

Disconnect fuel pipes and controls from fuel injection pump and fuel lift pump.

Remove lubricating oil supply and drain pipes, where fitted.

Where required, remove fuel injection pump and fuel lift pump and push rod for DP15 pump (Section N).

Where required, remove fuel pump gear, thrust plate and pump drive shaft and camshaft/fuel pump idler gear.

Remove auxiliary drive housing from cylinder block.

Fit auxiliary drive housing as follows :—

Position No. 1 piston to T.D.C. compression stroke (Section K).

Fit a new housing joint, suitably coated with Perkins "Hylomar" jointing compound, ensuring that oil hole is not obstructed. Joint may have to be trimmed at front edges.

If fuel pump drive has not been disturbed, position housing on block so that pump timing pin is aligned with timing mark on shaft (Section K).

Ensure that front face of housing is flush with front face of block and secure housing to block.

Where necessary, refit fuel pump drive shaft, thrust plate and gear and camshaft/fuel pump idler gear, as detailed previously.

Check that gear backlash is at least 0.003 in (0,08 mm).

Where necessary, refit lubricating oil supply and drain pipes.

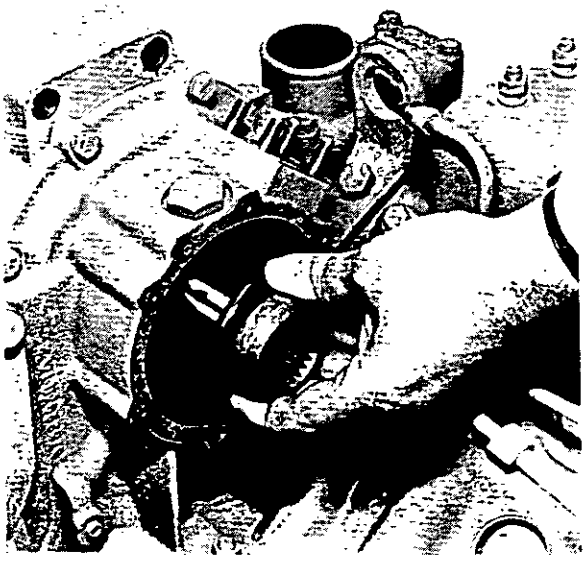
Where necessary refit fuel injection pump and fuel lift pump and push rod (Section N).

Reconnect fuel pipes and controls.

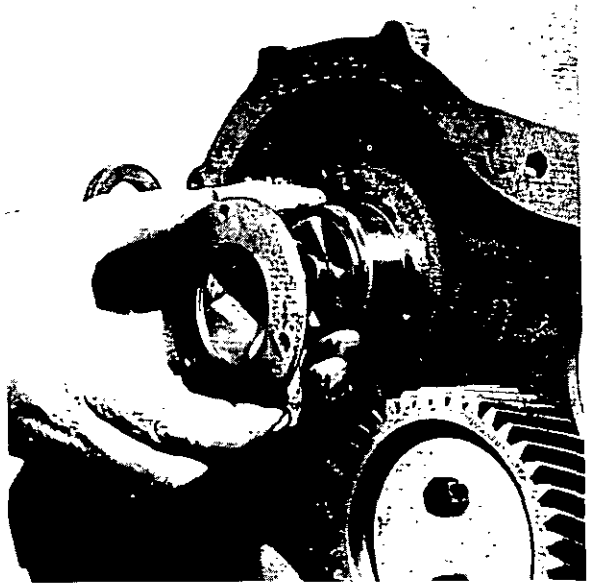
Refit timing case, as detailed previously.

Refit compressor and reconnect compressor oil pipe.

Check fuel injection timing (Section K).



J18



J19

SECTION K
Timing

Gear Timing Marks

On production, timing marks are stamped on the mating teeth of all relevant gears with No. 1 piston at T.D.C. compression stroke (Fig. K.1).

Due to the differing speeds of rotation, the marked teeth of the compressor/auxiliary drive gear and the crankshaft/camshaft idler gear will not necessarily mesh with their respective marked teeth in this position after the initial setting.

As the compressor/auxiliary drive shaft runs at three-quarters engine speed the meshing of the compressor/auxiliary drive gear timing marks does not necessarily indicate correct positioning of fuel injection pump timing and this should be checked as detailed later in this section.

For fitting of timing gears see Section J.

Crankshaft Timing Arrangement

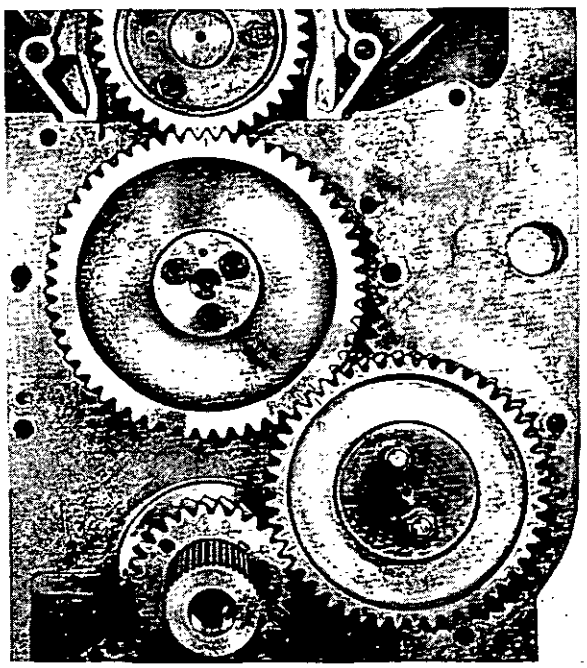
The basic crankshaft timing arrangement consists of a timing pin (1, Fig. K.2), screwed to the front of the lower half timing case. When unscrewed, with No. 1 piston at T.D.C., this pin will enter a drilling in the rear face of the crankshaft pulley (2, Fig. K.2).

Some applications have a timing pointer attached to the lower half timing case which aligns with a groove machined on the periphery and front face of the crankshaft pulley, when No. 1 piston is in the T.D.C. position.

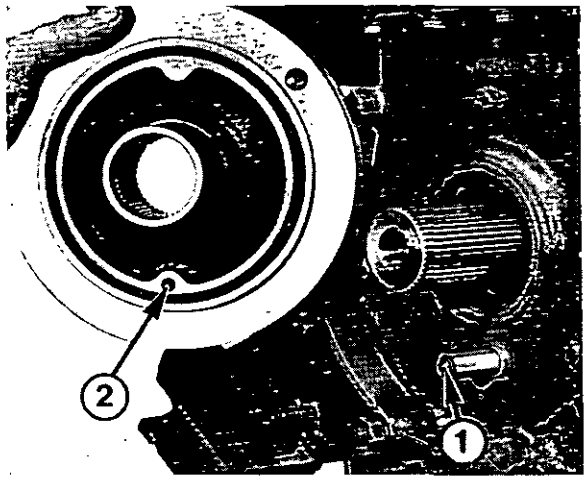
To Position No. 1 Piston to T.D.C. Compression Stroke

Remove rocker cover from front of right bank.

Turn crankshaft, in normal direction of rotation, until exhaust valve of No. 4 cylinder is open. Continue turning in the same direction until timing pin enters drilling in rear of crankshaft pulley or timing groove of pulley



K1



K2

aligns with timing pointer. In this position, valves of No. 4 cylinder should be rocking, i.e. inlet valve opening and exhaust valve closing.

If timing pointer has been damaged or if a more accurate T.D.C. position is required, this can be found by positioning No. 1 piston as detailed above, releasing a valve of No. 1 cylinder to rest on top of piston and positioning a dial test indicator on top of valve to determine T.D.C. When carrying out this procedure, ensure that valve does not drop completely into cylinder by fitting a suitable collar to valve and that final position is achieved in normal direction of rotation. As the piston comes to the top of its travel, a small crankshaft movement occurs without any vertical movement of piston and, if possible, crankshaft should be positioned at the centre point of this "lost" movement.

Checking Valve Timing

Remove front rocker cover of each bank.

Turn crankshaft until inlet valve of No. 4 cylinder is fully open and set valve tip clearance of inlet valve of No. 1 cylinder to 0.039 in (1,0 mm).

Turn crankshaft, in normal direction of rotation, until push rod of No. 1 inlet valve just tightens.

In this position, No. 1 piston should be at T.D.C. $\pm 2\frac{1}{2}°$ which can be checked by crankshaft timing arrangement as shown above.

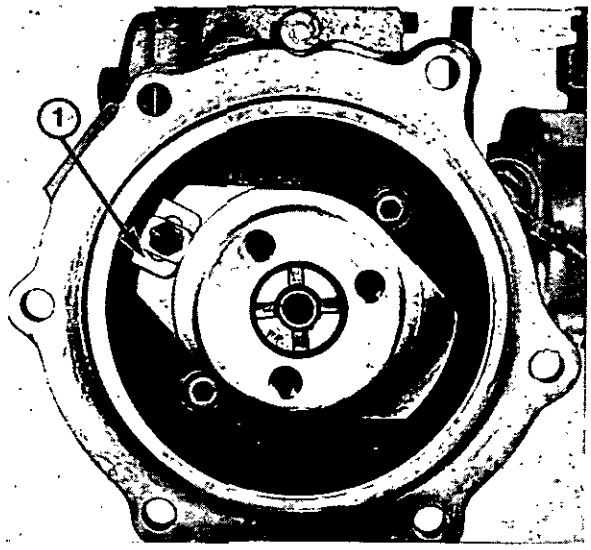
There is no adjustment for valve timing. If timing is incorrect, gears are probably not in correct mesh.

When timing is found to be correct, reset valve tip clearance of No. 1 inlet valve to 0.012 in (0,30 mm).

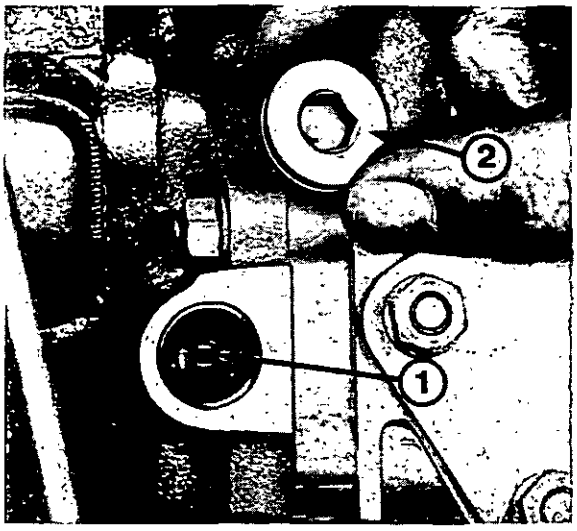
CAV In Line Fuel Injection Pump Basic Timing Arrangement

Two types of pump basic timing arrangement can be found, both utilising timing tabs fitted to the pump drive shaft adaptor. These timing arrangements can be used to position the pump during fitment, but the pump should be timed finally using the spill timing method as detailed later. It is advisable, when fitting a pump to the engine, to only tighten one of the gear securing setscrews or nuts prior to spill timing. The setscrew or nut tightened should be one that will be accessible through the gear access aperture of the timing case when the pump is fitted.

The small tab (1, Fig. K.3 and Fig. K.4) incorporates a



K3

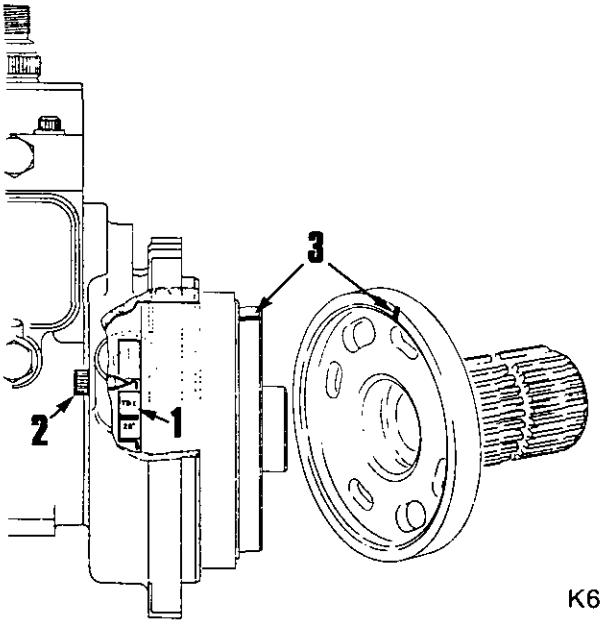


K5

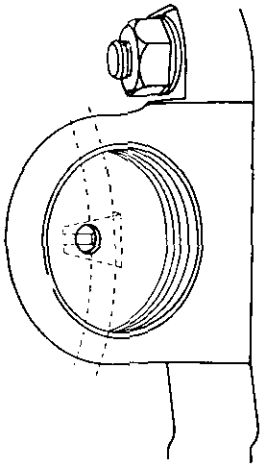
slot that, when central in the timing aperture in the pump adaptor housing (1, Fig. K.5), indicates that the pump is positioned relative to No. 1 piston at T.D.C. compression stroke. This can be checked after the timing inspection plug (2, Fig. K.5) has been removed.

The timing arrangement shown in Figs. K.6 and K.7 incorporates a larger tab (1) and also a timing indicator screw (2) fitted in the rear face of the pump adaptor housing. This tab has a groove and a slot and the groove is marked T.D.C. with the static timing angle. The pump is positioned relative to No. 1 piston at T.D.C. compression stroke when the groove on the tab is in line with the point of the indicator screw, as shown in Fig. K.7. This can be checked by viewing through the timing aperture in the pump adaptor housing after the timing inspection plug (3, Fig. K.7) has been removed. The slot in the tab is central in the timing aperture at the No. 1 element spill timing position and is used for timing tab setting.

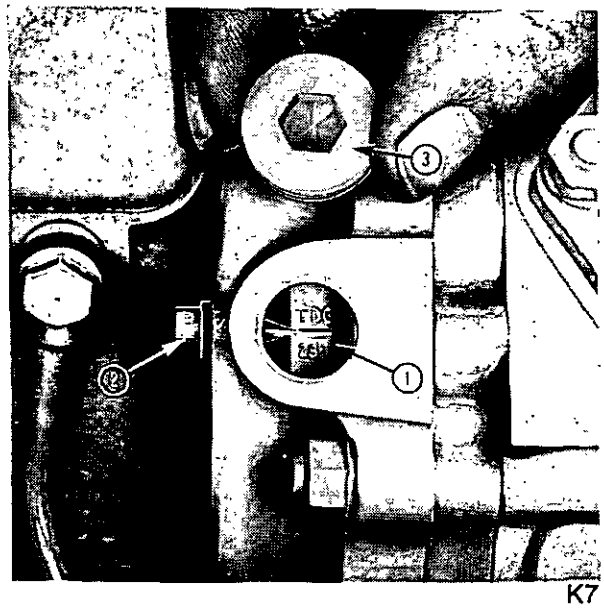
The adaptor drive shaft shown in Fig. K.6 is used with the alternative pump drive arrangement (Fig. J.12) and this has a timing mark which should be aligned with the timing mark on the pump drive adaptor (3, Fig. K.6). The drillings for the adaptor shaft securing studs or setscrews are offset, allowing the shaft to be fitted in one position only. If there is no mark on the pump drive adaptor, the adaptor shaft should be fitted with the studs or setscrews central in their slots.



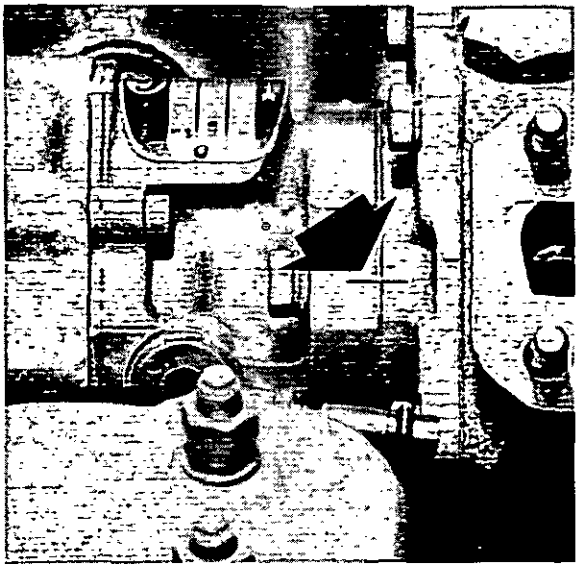
K6



K4



K7

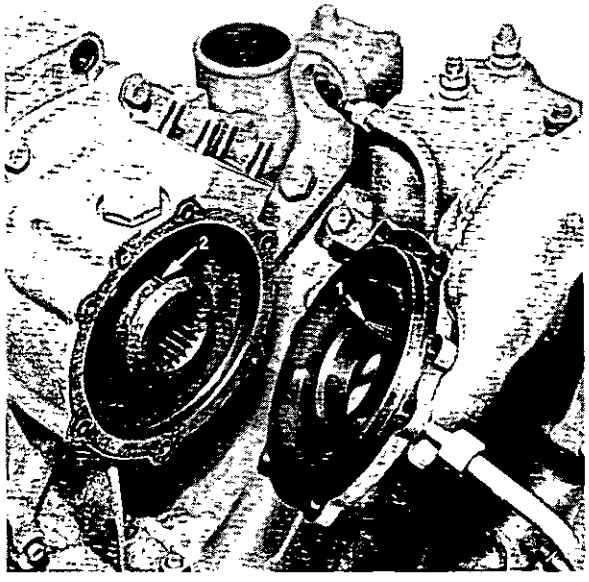


K8

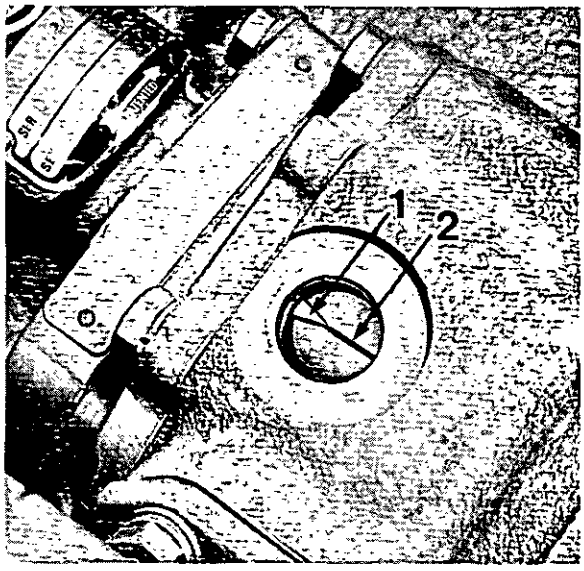
DP15 Fuel Injection Pump Timing Arrangement

Fuel pump drive shaft is fixed in relation to engine by means of a master spline on pump drive shaft. Correct pump body position is achieved by aligning a scribed line on pump mounting flange with a corresponding line on pump adaptor plate (Fig. K.8).

Drive to fuel pump can be checked by means of a timing pointer fitted to pump adaptor plate (1, Fig. K.9) which should align with a timing mark on fuel pump shaft (2, Fig. K.9) when No. 1 piston is at T.D.C. compression stroke. Timing pointer (1) and drive shaft timing mark (2) can be seen after timing inspection plug has been removed from fuel pump drive housing (Fig. K.10). Alternatively drive timing can be checked using tool MS67B as detailed later.



K9



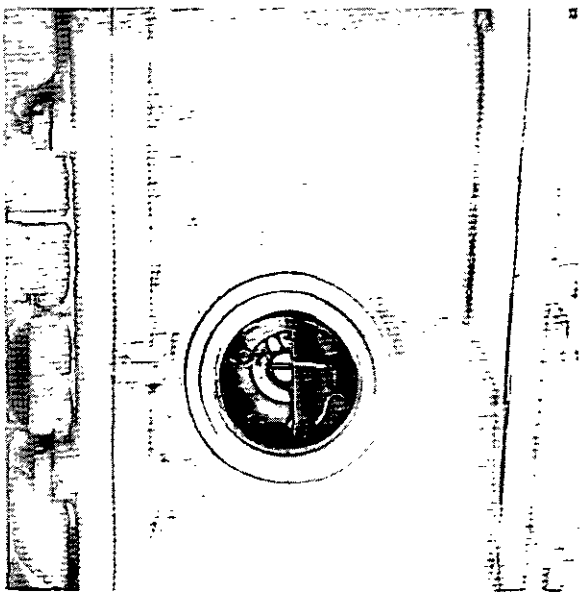
K10

Bosch In-Line Fuel Injection Pump Timing Arrangement

A *timing circlip is fitted in right hand side of pump* governor housing. When groove in one end of governor spring shaft is in line with timing mark on circlip (see Fig. K.11), fuel pump shaft is correctly positioned in relation to No. 1 piston at TDC compression stroke. The timing circlip can be seen after timing inspection plug has been removed from right hand side of pump governor housing.

Checking CAV In Line Fuel Pump Spill Timing

Fuel pump timing can be carried out by spill timing No. 1 outlet of the fuel injection pump to No. 1 piston at the spill timing position on its compression stroke. The spill timing position can be determined by reference to the service setting code stamped on the fuel pump data plate (Fig. N.20) and the table given on Page B.15. Later pumps may have a small tab on the



K11

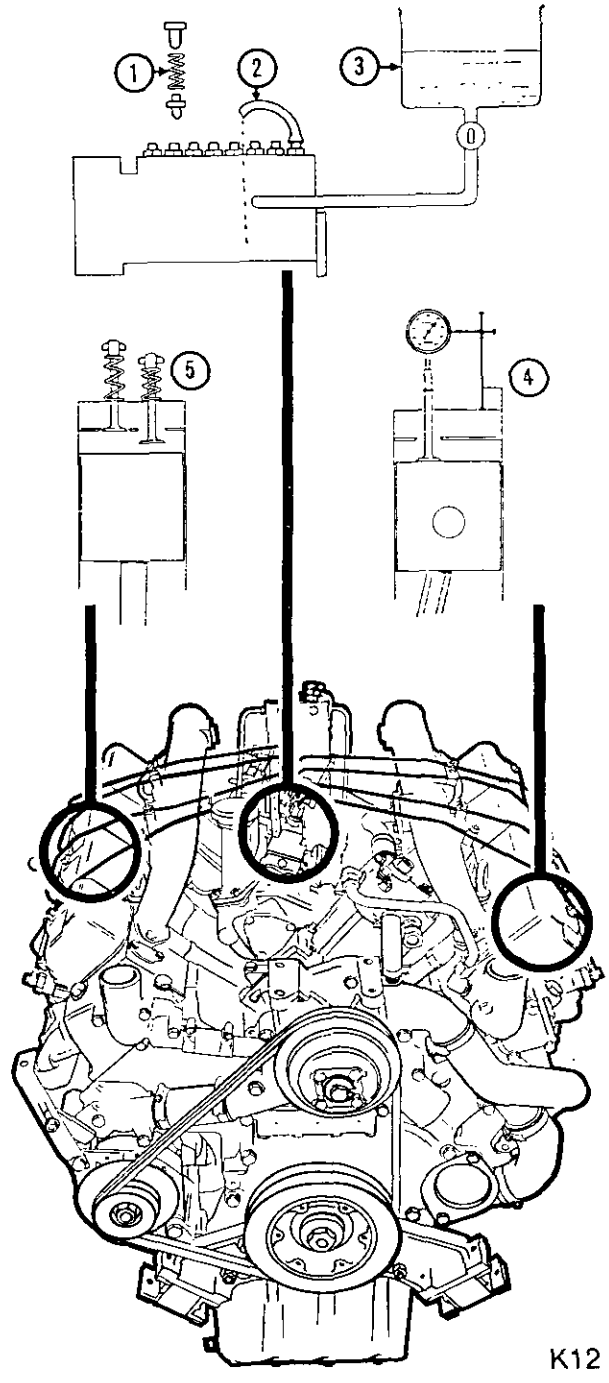
right hand side of the pump giving the static timing angle.

Spill time the pump (Fig. K12) as follows:–

With No. 1 piston at T.D.C. compression stroke (Page K.2), release a valve of No. 1 cylinder to rest on top of piston. Fit a suitable collar to valve to prevent it dropping into cylinder.

Position a dial test indicator with plunger resting on top of valve stem, determine exact T.D.C. position and zero the indicator.

Remove volume reducer, delivery valve and spring (1) from No. 1 fuel pump outlet, using delivery valve wrench CT9054. While No. 1 pump outlet connection is removed, check that pump plunger is on correct stroke to ensure that correct spill cut-off is obtained. Pump plunger must be coming up bore as No. 1 piston approaches TDC compression stroke. This can be checked by turning the crankshaft back through 45° and then forward in the normal direction of rotation and watching No. 1 pump plunger. Fit overflow pipe (2) to fuel pump outlet and connect a small tank (3) to fuel pump inlet to give a gravity feed of fuel.



K12

Turn crankshaft back through 90° and then forward, in normal direction of rotation, until fuel just ceases to flow from overflow pipe (fuel flow reduced to single drips at approximately 10 second intervals). In this position, check that position of No. 1 piston, as shown by dial test indicator (4), is in the correct position as shown on Page B.15 and that exhaust valve of No. 4 cylinder (5) is open, i.e. No. 1 piston on compression stroke.

Adjust timing, if necessary, by releasing the four nuts or setscrews (Fig. K13) or the three fuel pump gear securing capscrews or setscrews and turning fuel pump shaft in required direction by means of the studs or screws.

Tighten nuts or screws to torque given on Page B.3.

After any adjustment, turn engine through two revolutions, in normal direction of rotation, and recheck timing When timing is correct, re-assemble fuel pump components and tighten delivery valve holder to 30/35 lbf ft (41/47 Nm) 4,1/4,8 kgf m if a nylon sealing washer is fitted around valve guide or 42 lbf ft (57 Nm) 5,9 kgf m where a metal washer is fitted on top of valve guide.

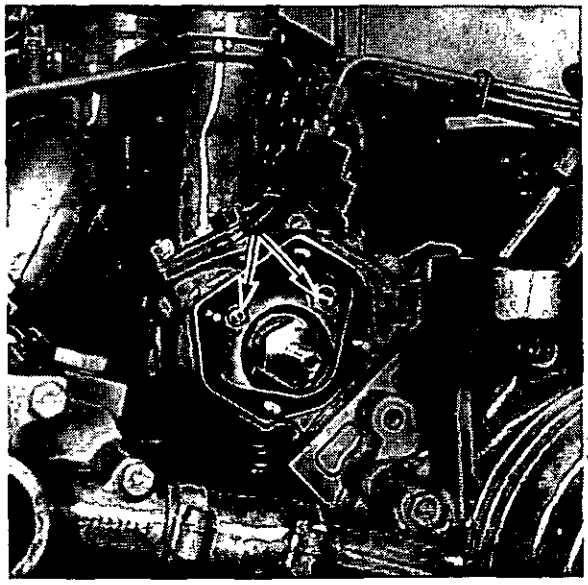
Note : Where a metal washer is fitted on top of delivery valve guide, this washer should be renewed and thread of valve holder lightly greased before final assembly of fuel pump components.

Refit valve springs and rocker lever of No. 1 cylinder.

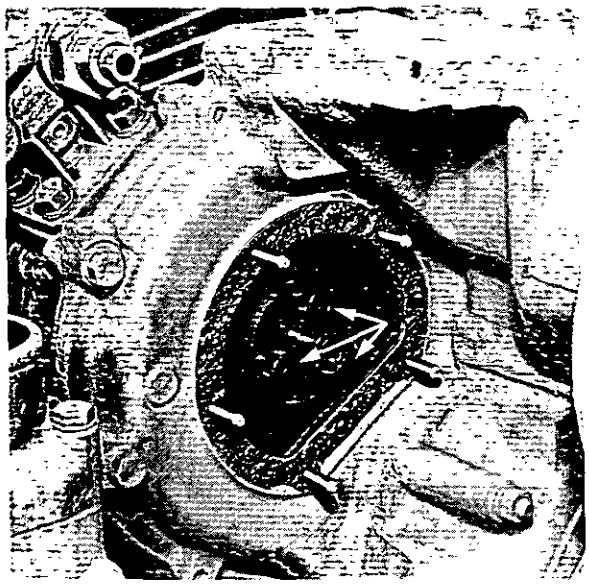
Refit rocker covers and fuel pipes (Page E.3) and bleed fuel pump (Page N.8).

To Check DP15 Fuel Injection Pump Timing Using Timing Marks

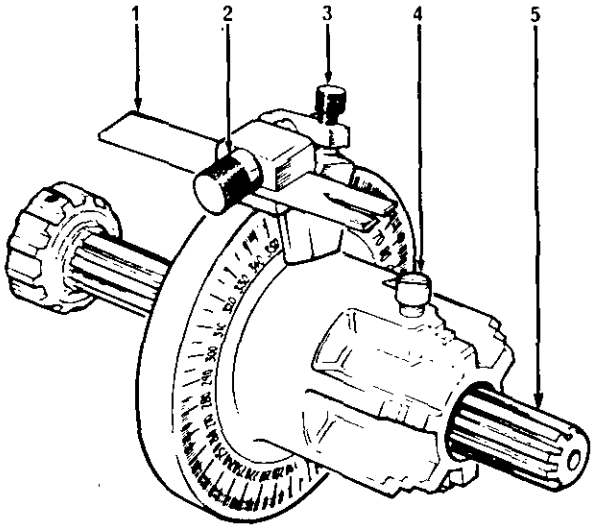
Ensure that scribed line on fuel pump mounting flange



K13



K14



K15

is in line with corresponding line on pump adaptor plate (Fig. K.8).

Position No. 1 piston to T.D.C. compression stroke, as detailed previously.

Remove timing inspection plug from fuel pump drive housing and fuel pump gear cover plate from upper half timing case.

Holding gear against backlash, anti-clockwise from front, check that timing mark on pump drive shaft is in line with tip of timing indicator pointer (Fig. K.10).

If mark is not in line, release fuel pump gear capscrews (Fig. K14) and reposition shaft. Holding gear against backlash and keeping timing mark in line with pointer, tighten gear capscrews to 35 lbf ft (47 Nm) 4,8 kgf m. Where necessary, release crankshaft timing pin from pulley, turn crankshaft through two revolutions, in normal direction of rotation and recheck timing.

When timing is correct, screw timing pin securely back on timing case, if necessary, and refit timing inspection plug, fuel pump gear cover and rocker cover.

To Check DP15 Fuel Injection Pump Timing Using Timing Tool

Where timing tool MS67B (Fig. K.15) is available timing can be checked as follows:–

Turn crankshaft, in normal direction of rotation, to position No. 1 piston at T.D.C. compression stroke, as detailed previously.

Remove fuel injection pump (Section N).

Release screw (4, Fig. K15) and position shaft (5) so that large splined end is at front end of tool, i.e. same end as screw (4). Ascertain checking angle given in Section B. Release screw (3) and set chamfered edge of bracket to this angle.

Release screw (2) and position slotted pointer (1) so that slot is towards front of tool and chamfered side of slot uppermost. At this stage keep end of pointer well back from front of body. Enter splined shaft fully into fuel pump drive shaft ensuring that master splines engage, locate register of tool in fuel pump location aperture and lock splined shaft in position. Move slotted pointer forward so that slot is half way over adaptor plate.

Take up backlash in gears by turning tool clockwise as viewed from rear and check that timing mark on adaptor flange is central in slot of pointer.

If timing is incorrect, remove fuel pump gear cover from timing case, release gear capscrews and holding gear against backlash, anti-clockwise from front, re-position shaft so that timing mark is central in slot of pointer and tighten gear capscrews to 35 lbf ft (47 Nm) 4,8 kgf m. Remove timing tool and, if necessary, release pulley timing pin, turn crankshaft two revolutions in normal direction of rotation and recheck timing.

When timing is correct, remove timing tool and refit fuel pump, where necessary, refit gear cover, rocker cover, and tachometer and screw timing pin back into timing case.

To Check Bosch In-Line Fuel Injection Pump Timing

Position No. 1 piston at TDC compression stroke as detailed on Page K.2.

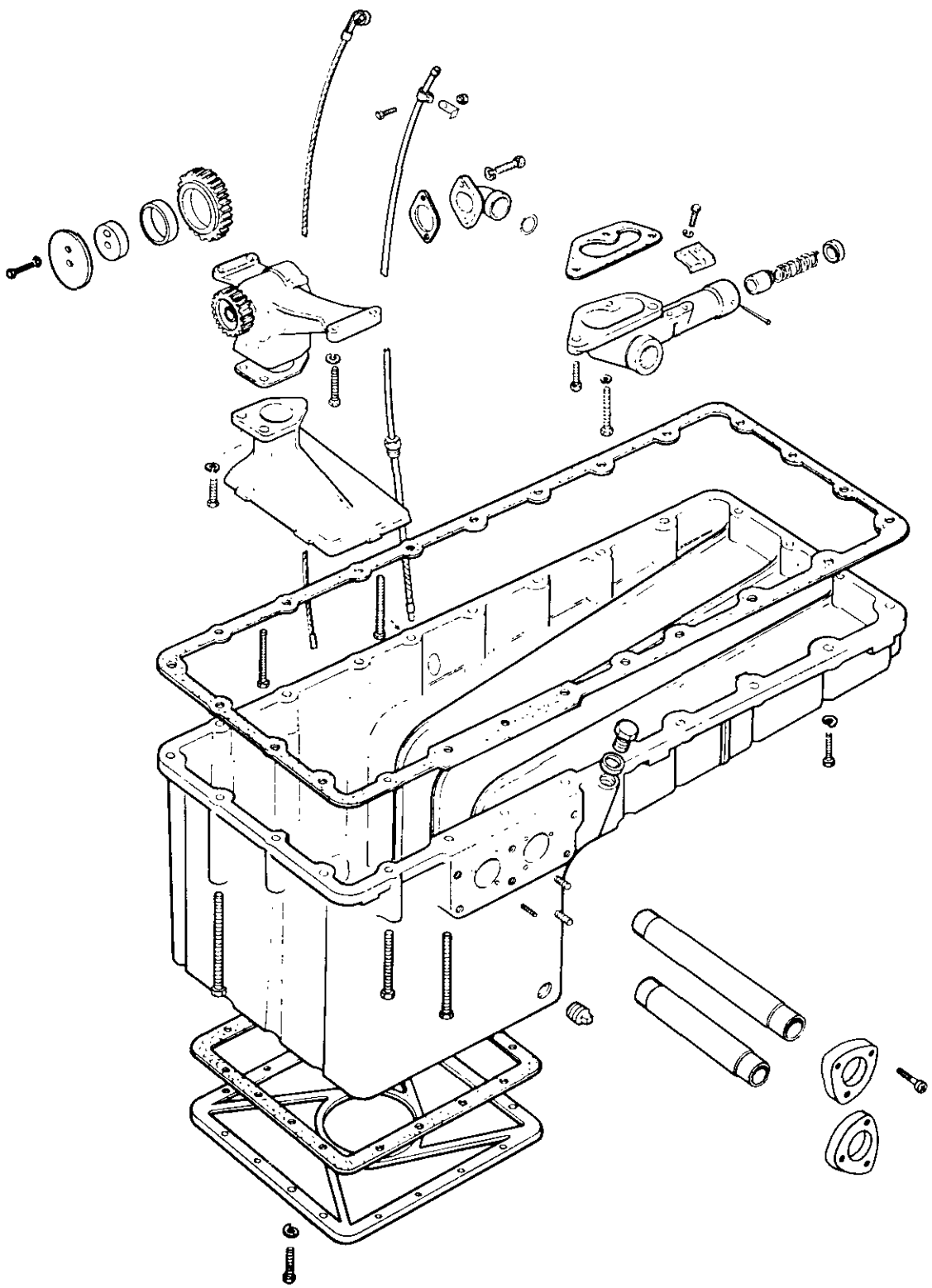
Remove timing plug from right hand side of pump governor housing and fuel pump gear cover plate from upper half timing case.

Holding gear against backlash (anti-clockwise from front), check that groove in end of governor spring is in line with mark on timing circlip (Fig. K.11).

If timing marks are not in line, release fuel pump gear capscrews, and reposition pump shaft. Holding gear against backlash and keeping timing marks in line, tighten gear capscrews to 37 lbf ft (5,1 kgf m) 50 Nm. Turn crankshaft through two revolutions in normal direction of rotation and recheck timing.

When timing is correct, refit timing inspection plug, fuel pump gear cover and rocker cover.

SECTION L
Lubricating System



General

Lubricating oil is circulated by a gear type pump that is driven, through an idler gear, by the crankshaft gear.

Oil is drawn up by the pump through a strainer in the sump and passed through a cooler and twin element filter to a gallery in the cylinder block.

From the gallery, oil is fed to each crankshaft main bearing and to the auxiliary drive shaft, through drillings in the block.

The big end bearings are fed by internal drillings in the crankshaft from the main bearings and each camshaft bearing is supplied with oil through drillings in the cylinder block from the main bearing housings.

The compressor/auxiliary drive shaft bearings are supplied with oil, through drillings in the cylinder block, from the main oil gallery.

The idler gear hubs are supplied with oil through drillings that connect to the oil passages to and from the front main bearing.

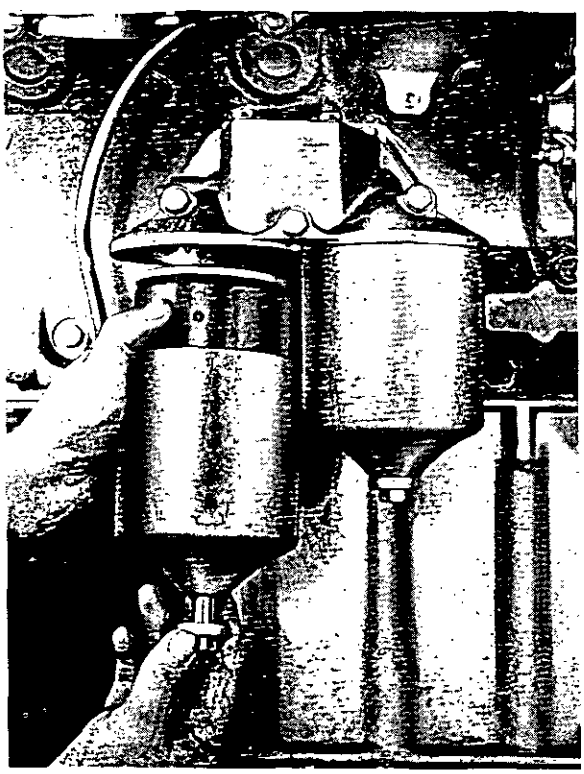
A reduced oil flow is taken from the centre camshaft bearing, through drillings in the cylinder block and external pipes to the cylinder heads, to lubricate the rocker assemblies and fuel injection pump.

The pistons, liners and small ends are splash lubricated.

Maximum oil pressure is controlled by a relief valve that returns excess oil to the sump.

Oil Strainer

The strainer may be mounted directly on to the oil pump or may be attached to the end of a suction pipe. There is no periodic servicing on this strainer but the gauze should be cleaned whenever the sump is removed.



L1

Oil Filter

The twin element, full flow, filter is situated on the forward right hand side of the cylinder block.

*The standard filter arrangement consists of two re*placeable paper elements fitted into separate bowls or a long single bowl. Some applications utilise two replaceable canisters where the element is an integral *part of the bowl.*

If the filter headcasting is removed from the engine ensure, when refitting, that the joint is fitted with the larger oil transfer hole towards the front of the engine.

To Renew Standard Lubricating Oil Filter Elements

Release centre bowl securing setscrews and lower *bowls clear (Fig. L.1).*

Discard elements and clean bowls with a suitable cleaning fluid.

Fit new joints of correct type in filter headcasting.

Refit bowls with new elements ensuring that elements fit centrally on their seats and bowls seat correctly on headcasting joints. Tighten securing setscrews.

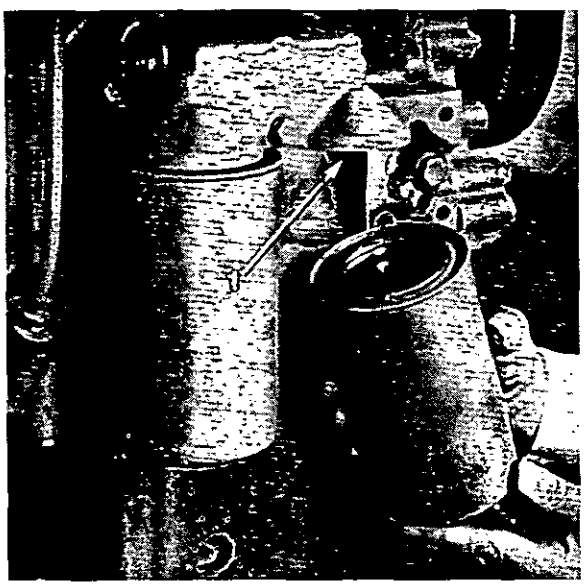
Filter elements will normally be changed at same time as lubricating oil and after refilling sump with oil, run engine and check for leaks.

Recheck oil level after running engine and top up as necessary.

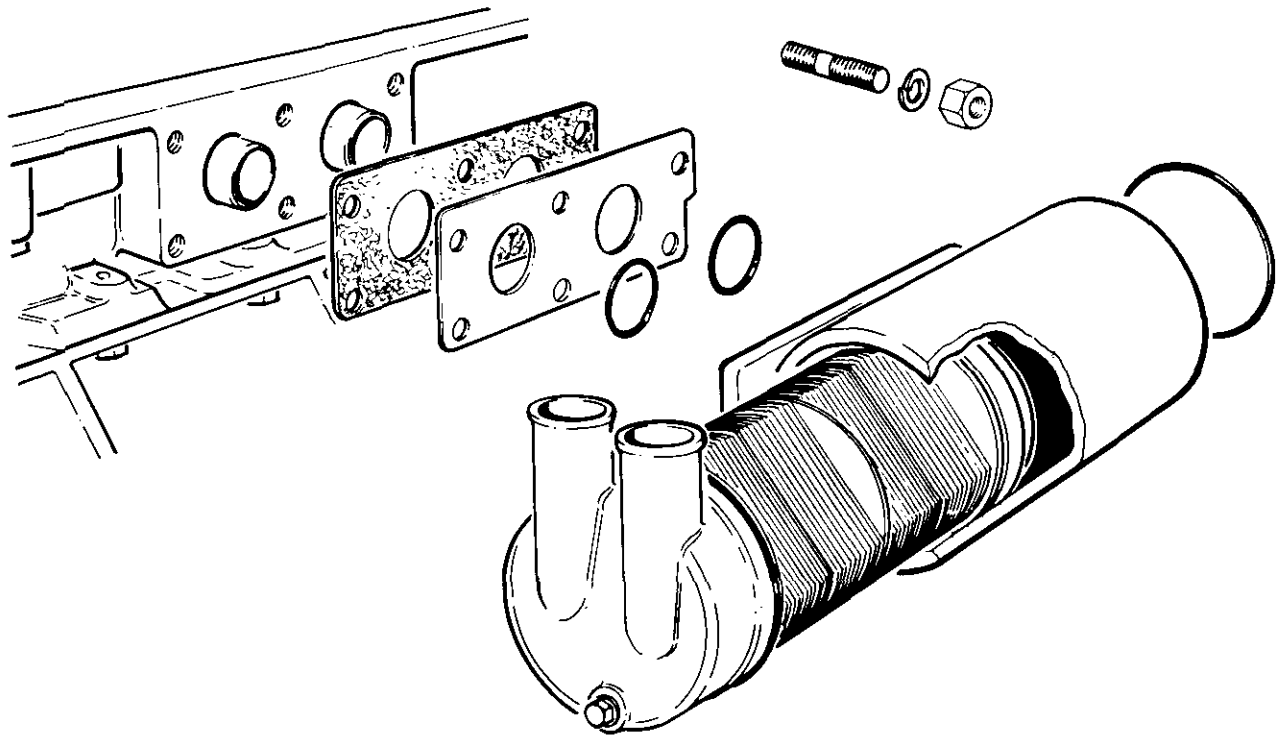
Note: Filter bowl securing setscrews should be checked for tightness after first 1,000 miles (1,500 km) or 50 hours running.

To Renew Disposable Canister Oil Filter Elements

1. Unscrew filter canisters from filter head (Fig. L.2).
2. Ensure that threaded adaptors (1) are secure in the filter head casting.
3. Discard old canisters.
4. Clean filter head.
5. Pour clean lubricating oil slowly in the centre threaded orifice allowing time for the oil to fill the bowls through the filter elements.



L2



L3

6. Using clean engine oil, liberally oil top seals of replacement canisters.
7. Screw replacement canisters on to filter head until seal just touches head and then tighten by hand as per instructions on canister. Where a tool is available, tighten to 12/15 lbf ft (16/20 Nm) 1,66/2,07 kgf m.
8. Run engine and check for leaks.

Oil Cooler

The oil cooler is mounted on the forward left hand side of the sump.

V8.540 and later V8.510 engines are fitted with a horizontal cooler (Fig. L.3) which has replaced the vertical cooler (Fig. L.5), fitted to earlier V8.510 engines.

Water passes through the tubes and cools the oil passing around the tubes in the horizontal cooler whereas the oil passes through the tubes of the vertical cooler.

The vertical cooler has a valve in the base which allows oil to by-pass the tube stack when the pressure difference between the oil inlet and outlet sides of the cooler exceeds 20 lbf/in² (138 kN/m²) 1,41 kgf/cm².

To Remove Oil Cooler

Drain cooling system and drain coolant from cooler by removing drain plug (1, Fig. L.4 or L.5).

Drain lubricating oil from cooler by removing the two oil drain plugs (2, Fig. L.4 or L.5).

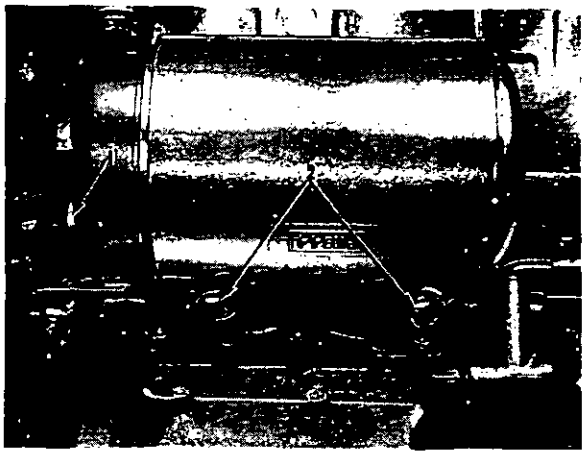
Disconnect coolant inlet and outlet connections.

Remove the two setscrews securing vertical cooler to cylinder block, noting any distance pieces fitted between cooler mounting lugs and block.

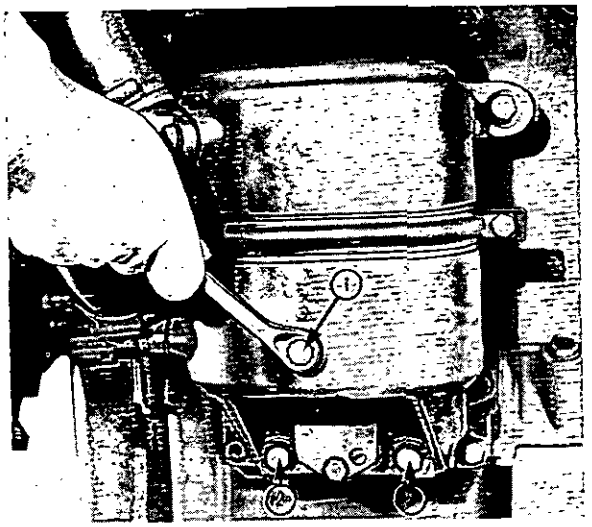
Remove the six setscrews or nuts securing cooler to sump and remove cooler (Fig. L.6 or L.7).

To Fit Oil Cooler

With horizontal coolers, ensure that joint between plate and sump is serviceable, renew "O" rings on transverse oil pipes protruding from sump and secure cooler to sump.



L4



L5

With vertical coolers, fit new joint, suitably coated with jointing compound and secure cooler to sump. Fit set-screws and washers securing cooler mounting lugs to cylinder block positioning correct distance pieces, where necessary, between lugs and block.

Where necessary, fit cooler drain plugs (Fig. L.4 or L.5).

Connect coolant inlet and outlet connections.

Fill cooling system.

Run engine and check for leaks. Do not run engine at high speed until oil has had time to fill cooler and build up pressure.

After running engine, check oil level and top us as necessary.

To Dismantle Oil Cooler

No attempt should be made to service the cooler unless facilities are available to test the re-assembled cooler, as detailed later in this section and new seals are also available.

Horizontal Cooler :—

Mark cooler body to indicate end at which connection end of tube stack is fitted.

Remove screws and washers locating tube stack in body.

Slide closed end of stack out of body until "O" ring is just clear. This can be achieved by supporting stack, with connections uppermost and knocking mounting flange gently on a soft but firm surface (e.g. a stout wooden bench). Do not knock on the end caps.

Remove "O" ring from groove.

Remove stack through other end of body in a similar manner to that described above and remove remaining "O" ring.

Vertical Cooler :—

Release clamping ring and separate upper and lower casings.

Remove tube stack and seals.

Remove by-pass valve cover, spring and relief valve.

To Assemble Oil Cooler

Horizontal Cooler :—

Renew "O" rings.

Oil or lightly grease "O" rings, ring grooves and seal tracks in body.

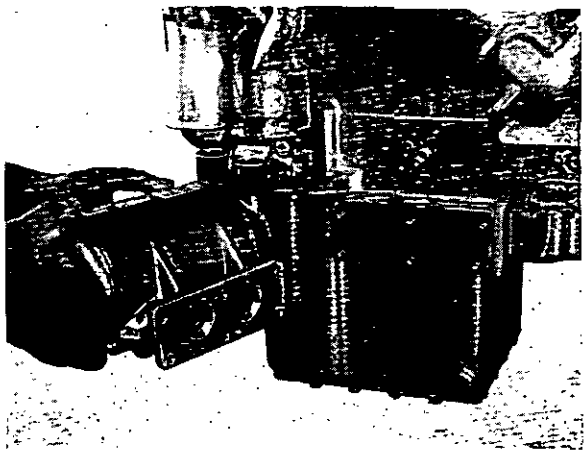
Fit "O" ring in groove at connection end of tube stack.

Enter closed end of stack into marked end of body and slide stack through body until "O" ring groove at closed end of stack just protrudes through other end of body.

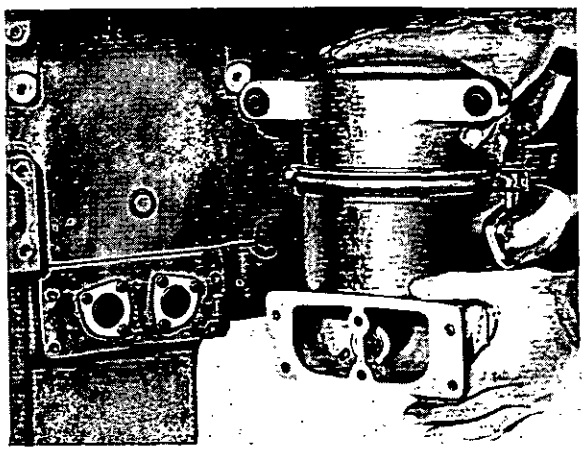
Fit remaining "O" ring in its groove, ensure that locating recesses in stack align with locating screw holes in body and slide stack back into body until it is centralised.

Fit stack locating screws and washers.

Test cooler as detailed later.



L6



L7

Vertical Cooler :—

Renew all seals and joints

Fit sealing strip over dividing rib in lower half casing. In later coolers, the base of this strip is fitted inside a groove in the dividing rib.

Lightly grease sealing rings and mating surfaces.

Position tube stack sealing rings on end flanges of tube stack.

Fit tube stack in lower half casing with locating tongue (1, Fig. L.8) fitting in recess in casing (2, Fig. L.8) and the tubes that are not encompassed by the baffle plate to the opposite side to the water connection.

Some tube stacks have two seal retainers fitted to their bottom faces and these should be fitted over the sealing strip.

Ensure, by viewing through oil ports, that sealing strip is still correctly fitted and that seal retainers, where fitted, fit over ends of sealing strip.

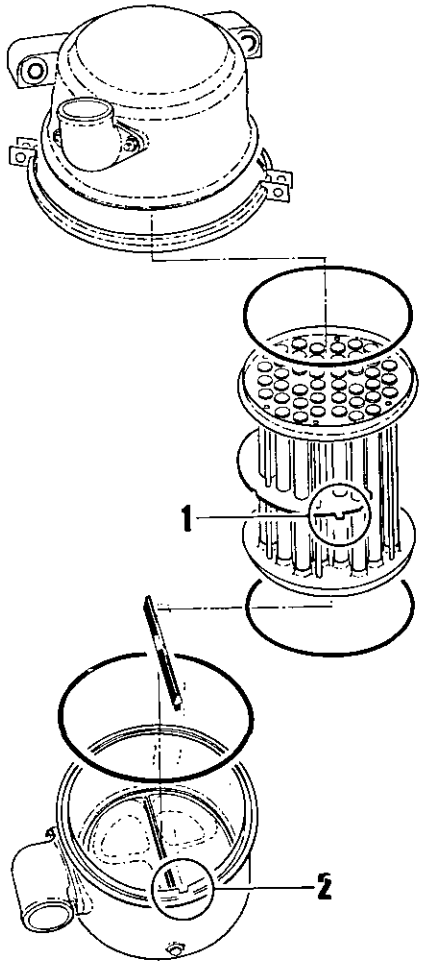
Fit casing sealing ring in its recess in lower half casing.

Position top half casing with mounting lugs on same side as and parallel to cooler mounting flange.

Fit body clamps with ends at approximately 30° to mounting flange (Fig. L.9). Where distance pieces are supplied with clamps, these should be clipped to the clamping bolts and fitted to the outside of the bolts.

Lightly oil by-pass valve and fit valve, spring and end cover with a new seal fitted to the cover.

Test cooler as detailed below.



L8

To Test Oil Cooler

Horizontal Cooler :—

Fabricate a suitable adaptor to blank off oil ports, making provision for a pressure connection.

Fill water side with water and immerse cooler in water, ensuring absence of trapped air.

Pressurise oil side with air to a pressure of 90/150 lbf/in² (620/1030 kN/m²) 6,33/10,55 kgf/cm², depending upon maximum air line pressure available.

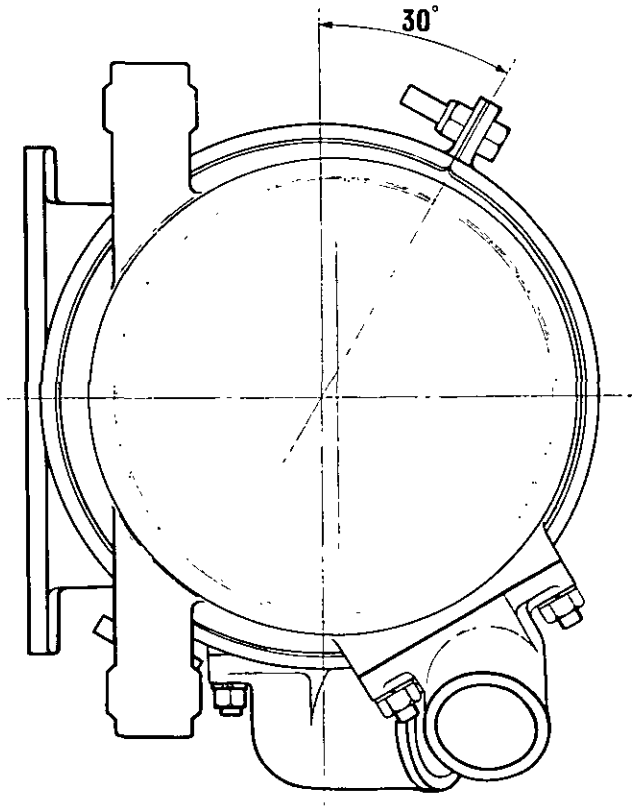
Tube stack should be rejected if air bubbles persist from water inlet or outlet connection.

If air bubbles escape past "O" rings at either end of cooler, fit new rings, as described previously.

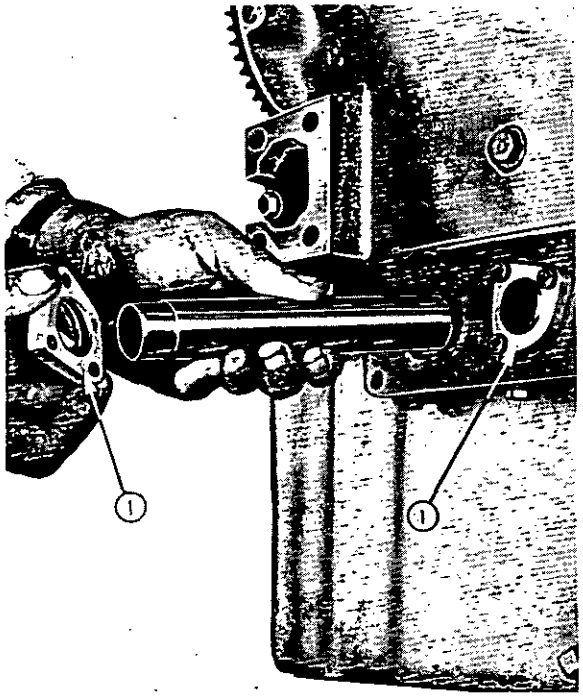
Vertical Cooler :—

Suitable adaptors, incorporating pressure connections, must be fabricated to blank off oil ports and water connections.

It is important that cooler is tested in the following sequence after assembly. If any leaks occur during any part of the test they should be rectified before



L9



L10

test is continued.

1. Fill water side with water and shake cooler to remove trapped air. Whilst watching for bubbles, pressurise oil side with air in the following sequence :—

   1½ minutes at 7 lbf/in² (48 kN/m²) 0,49 kgf/cm².

   1½ minutes at 50 lbf/in² (345 kN/m²) 3,52 kgf/cm².

   2 minutes at 80/150 lbf/in² (550/1030 kN/m²) 5,62/10,55 kgf/cm².*

2. Fill oil side with a thin oil, i.e. Risella 17, and shake cooler to remove trapped air. Whilst watching for bubbles, pressurise water side with air in the following sequence :—

   2 minutes at 30 lbf/in² (207 kN/m²) 2,11 kgf/cm².

   1½ minutes at 10 lbf/in² (69 kN/m²) 0.7 kgf/cm².

   2 minutes at 3 lbf/in² (21 kN/m²) 0,21 kgf/cm².

*Depending upon maximum air line pressure available.

To Remove Oil Sump

Drain lubricating oil by removing sump drain plug.

Drain cooling system and remove oil cooler (Page L.3).

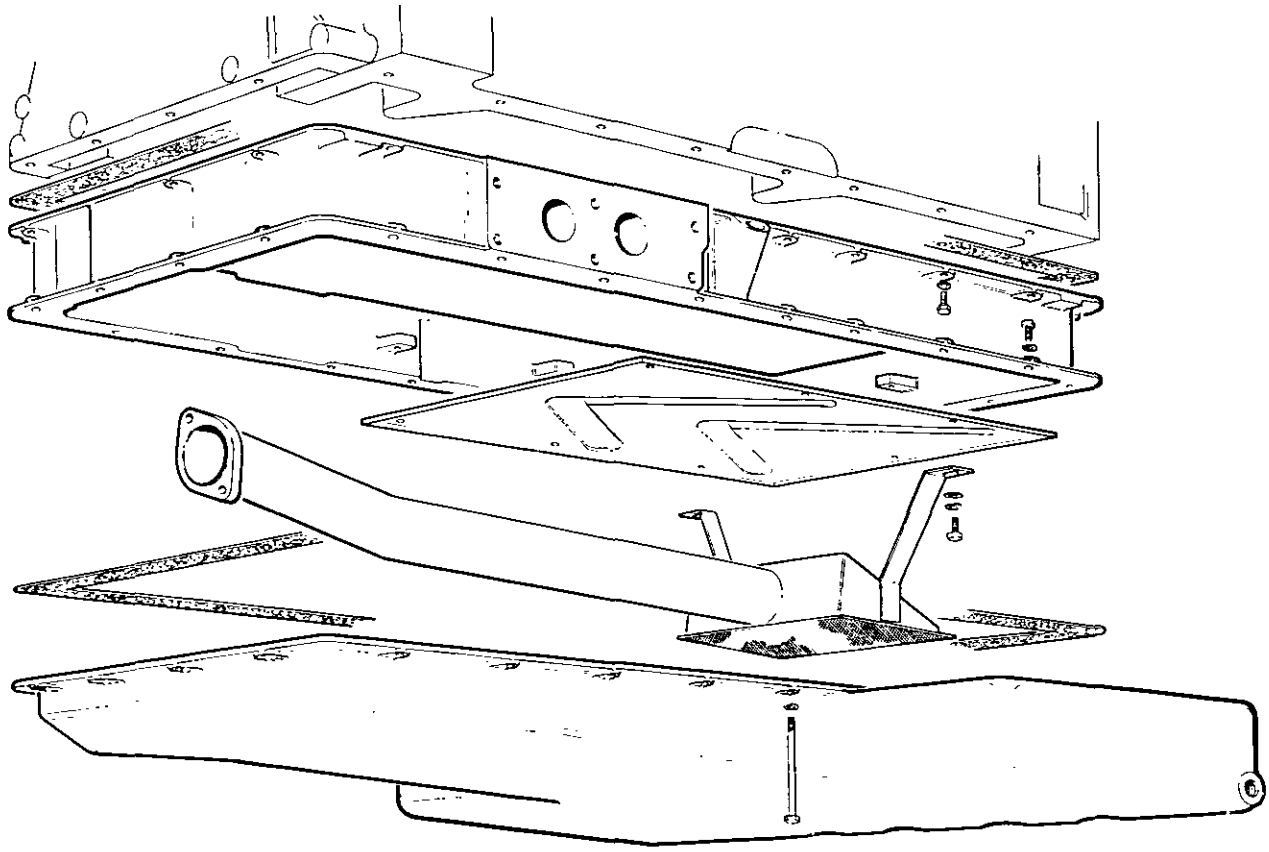
Remove dipstick and tube.

Where horizontal cooler is used, remove transfer pipe "O" rings, retaining plate and joint and withdraw pipes through side of sump.

Where vertical cooler is used, remove oil transfer pipe locating flanges (1, Fig. L.10) and remove pipes.

Release sump securing setscrews and lower sump.

On some V8.510 engines, a skirt is fitted between the sump and the cylinder block, as shown in Fig. L.11.



L11

With this arrangement, it is not necessary to remove the oil cooler and oil transfer pipes when lowering the sump but care should be taken that the joint between the skirt and the cylinder block is not disturbed.

If the skirt is to be lowered, the oil cooler and oil transfer pipes will have to be removed. With the arrangement shown in Fig. L.11 which has a baffle plate fitted to the skirt, the oil pump suction pipe and strainer will have to be removed before the skirt can be lowered.

To Fit Oil Sump

Where a skirt is fitted between the sump and cylinder block, as shown in Fig. L.11, the following instructions regarding fitting cooler and oil transfer pipes will not apply unless the skirt has been removed.

Renew "O" rings in oil pump outlet (7, Fig. L.19) and relief valve inlet (2, Fig. L.13 or L.14).

Where timing case has been removed, refit it before fitting sump.

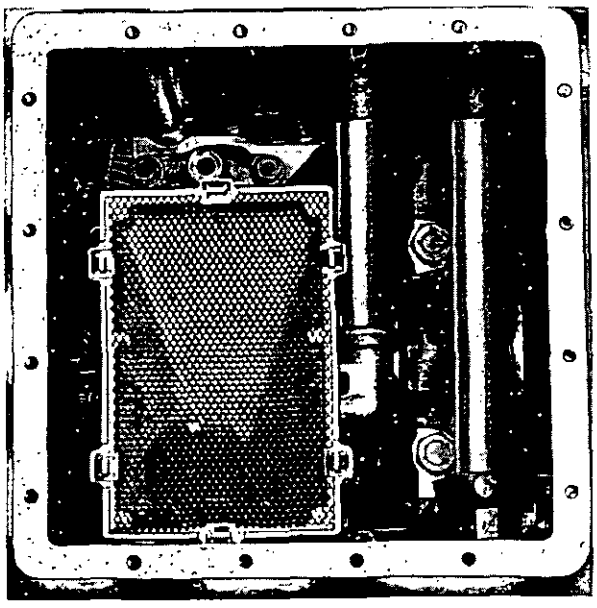
Ensure mounting faces of sump and block are clean.

Position sump gasket suitably coated with jointing compound.

Place sump in position and tighten sump securing setscrews evenly.

Position oil transfer pipes. The shorter pipe fits through the aperture in the sump nearer to the timing case (Fig. L.10) and locates in the oil pump outlet as shown in Fig. L.12 and the longer pipe locates in the relief valve housing. Ensure that pipes are correctly located in oil pump and relief valve housing.

Where horizontal cooler is used, position pipe retaining plate joint, suitably coated with jointing compound, retaining plate and new "O" rings over ends of transfer pipes.



L12

Where vertical cooler is used, fit pipe retaining flanges (1, Fig. L.10) complete with new "O" rings. These flanges are identical but are reversed on each pipe and can only be fitted in one position.

Fit oil cooler (Page L.4).

Fill cooling system.

Fill oil sump to correct level with an approved grade of oil.

Run engine and check for leaks. Do not run engine at high speed until oil pressure has had time to build up.

Check oil level and top us as necessary

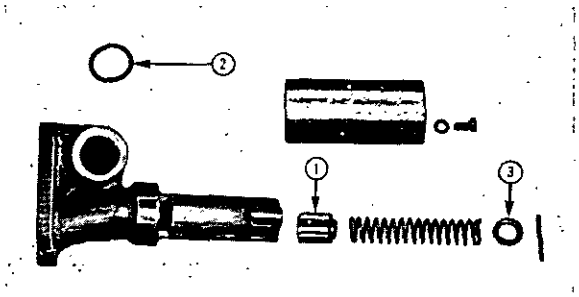
Oil Pressure Relief Valve

This is fitted to the underside of the forward right hand side of the cylinder block and the valve housing also forms the main oil delivery elbow from the oil cooler to the filter, etc.

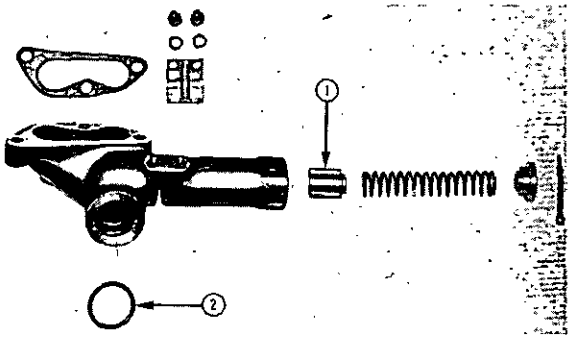
Two types of valve are used, as shown in Figs. L.13 and L.14, the type fitted depending upon the application. The valve is preset to 60/65 lbf/in² (414/448 kN/m²) 4,2/4,6 kgf/cm² and no attempt should be made to adjust the pressure other than by the renewal of parts to restore the original pressure setting.

The valve assembly can be dismantled after removal of the shroud, where fitted, and the split-pin from the end of the housing.

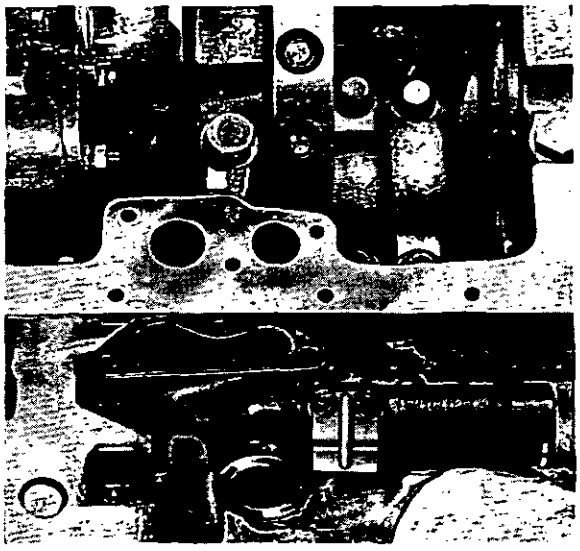
When assembling, the piston (1) should be fitted with the hollow end towards the seat. The cup washer (3) of the vertical type relief valve should be fitted with the spring seating inside the cup.



L13



L14



L15

To Remove and Fit Oil Pressure Relief Valve

Remove sump (Page L.6).

Release setscrews and remove relief valve (Fig. L.15).

Ensure that mounting faces on block and valve housing are clean.

Fit relief valve, using a new joint suitably coated with jointing compound and secure with setscrews and spring washers.

Ensure that a new "O" ring (2, Figs. L.13 and L.14). is fitted.

Replace sump (Page L.7).

To Remove and Fit Crankshaft/Oil Pump Idler Gear and Hub

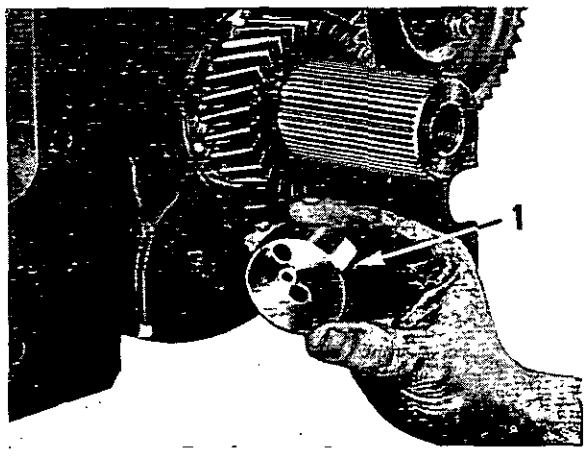
Remove timing case (Page J.2).

Release idler gear hub securing setscrews and spring washers and remove end plate. These setscrews were locked by a tabwasher on early V8.510 engines.

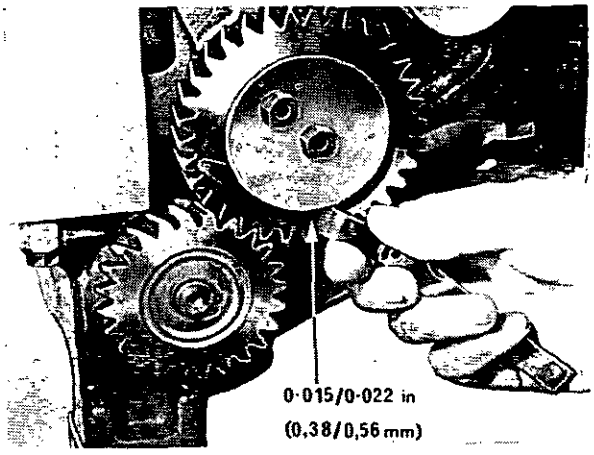
Remove idler gear and hub.

Position hub with dowel correctly located and oil drilling (1, Fig. L.16) positioned away from crankshaft.

Note : Two types of hub may be found. The earlier type has two fixing holes and setscrews as shown in Fig. L.16. The later type has three fixing holes although only two setscrews are used, the third hole being unused. With the later type hub, ensure that the oil hole is plugged at the outer end.



L16



L17

Fit gear, end plate, spring washers and setscrews. Tighten setscrews to 17/19 lbf/ft (23/26 Nm) 2,4/2,6 kgf/m.

Check end float of gear on hub (Fig. L.17). On production, end float is 0.015/0.022 in (0,38/0,56 mm) and maximum permissible worn end float, in service, is 0.030 in (0,76 mm).

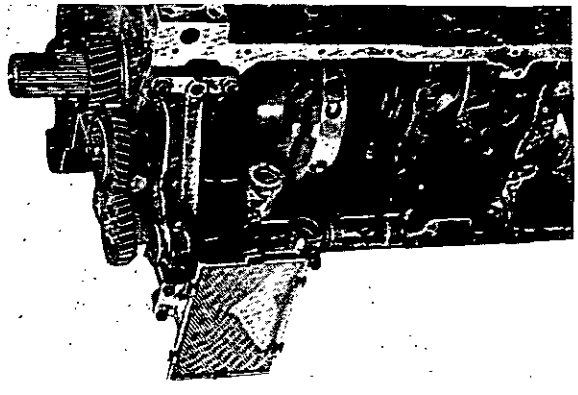
Check that at least 0.003 in (0,08 mm) backlash exists *between idler gear and oil pump and crankshaft gears.*

Refit timing case (Page J.2).

Oil Pump

The gear type oil pump is fitted to the bottom of the forward end of the cylinder block (Fig. L.18) and is gear driven, through an idler gear, from the crankshaft gear.

There are two types of lubricating oil pump. The earlier type had 9 tooth internal gears and the drive gear was a keyed fit on the drive shaft being secured with a circlip. The current pump has 10 tooth internal gears and the drive gear is solely an interference fit on the shaft with no key or circlip. With the 10 tooth oil pump, it should be noted that if the pump is dismantled, then it will be necessary to renew both the shaft and drive gear as having been assembled once, the interference fit will be destroyed. With the current pump, under no circumstances should a new drive shaft be fitted with an old drive gear or a new drive gear be fitted to an old shaft. Both type pumps are interchangeable as assemblies.



L18

To Remove Oil Pump

Remove lubricating oil sump (Page L.6).

Where necessary, remove strainer support bracket setscrews and remove strainer and pipe.

Remove setscrews securing pump to cylinder block and remove pump.

To Fit Oil Pump

Before fitting, prime pump by injecting clean engine lubricating oil into pump body.

Position oil pump with drive gear in mesh and in line with idler gear and secure with setscrews and spring washers.

Check that at least 0.003 in (0,08 mm) backlash exists between oil pump drive gear and idler gear.

Where necessary, fit suction pipe and strainer using a new joint suitably coated with jointing compound.

Ensure that new "O" rings are fitted in oil pump outlet and relief valve housing inlet.

Fit sump (Page L.7) and oil cooler and fill sump to correct level with oil of an approved grade.

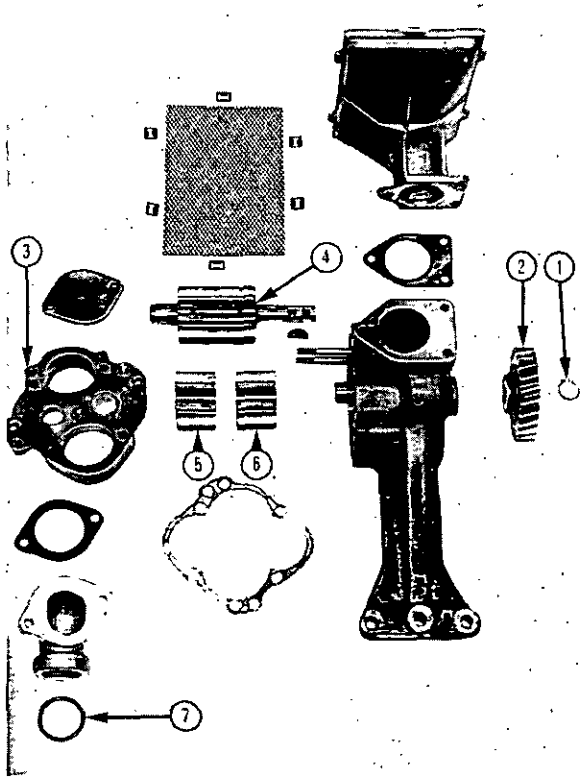
To Dismantle Oil Pump (Fig. L.19)

Where necessary, remove strainer.

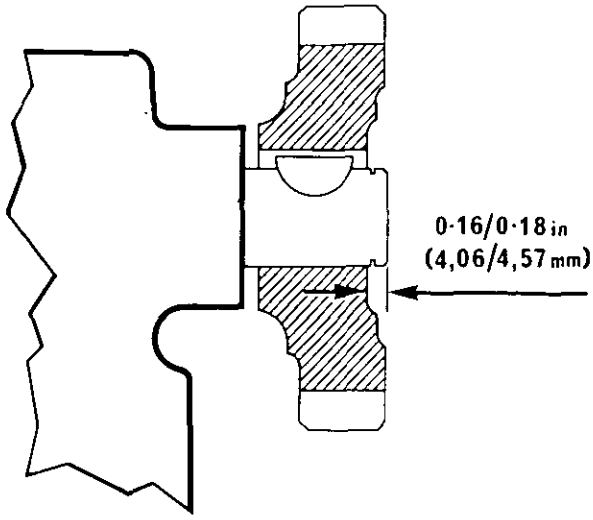
Remove drive gear circlip (1) — where fitted.

Using a suitable puller, remove drive gear (2). If gear is removed from 10 tooth pump, interference fit between gear and shaft will be reduced and a new gear and driver shaft assembly must be fitted.

Remove drive gear key — where fitted.



L19



L20

Remove end cover (3).

Withdraw driver gear and shaft (4). Do not remove gear from shaft.

Remove driven gears (5 and 6).

To Assemble Oil Pump

Fit drive gear key (where applicable) and supporting end of shaft, press on drive gear (Fig. L.20), with gear shoulder towards pump body, until inner front face of gear is 0.16/0.18 in (4,06/4,57 mm) from front end of shaft for 9 tooth pumps.

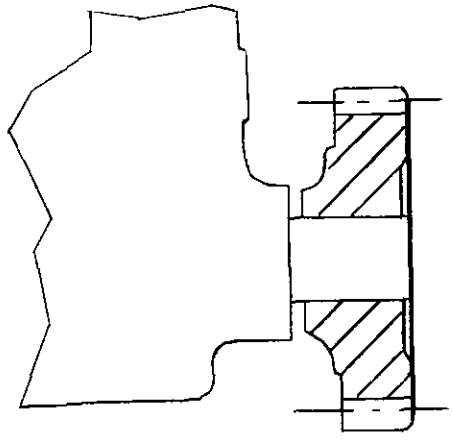
With 10 tooth pumps the drive gear should be pressed on until it is flush with end of the shaft (Fig. L.21).

Fit drive gear circlip in its groove (where applicable).

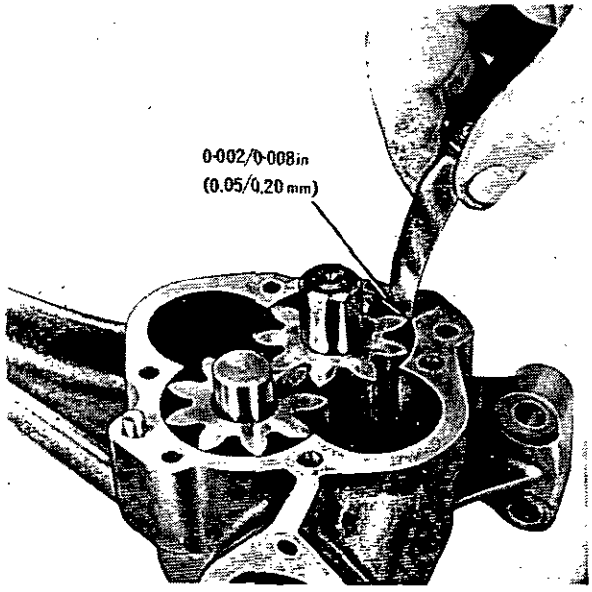
Assemble driven gears with shouldered ends outermost and oil holes in line as in Fig. L.23.

Fit end cover with new joint, ensuring dowels are correctly fitted.

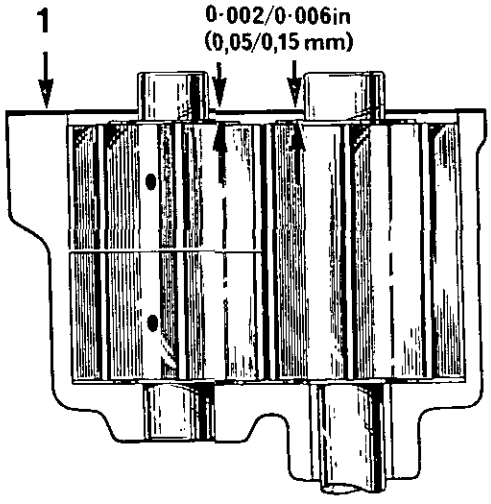
Where necessary, fit pump outlet elbow and blanking plate with new joints.



L21



L22



L23

Oil Pump Overhaul

Clean all parts thoroughly and check for damage.

Refit gears in body and check radial clearance of gears in body (Fig. L.22). On production this clearance is 0.002/0.008 in (0.05/0.20 mm) and maximum permissible worn clearance, in service, is 0.010 in (0,25 mm).

Check backlash between driver and driven gears. On production, backlash is 0.014/0.018 in (0,36/0.46 mm) for 9 tooth pumps and 0.024/0.039 in (0,61/0.99 mm) for 10 tooth pumps.

Check end float of gears in body (Fig. L.23), using a straight edge and feeler gauges, with joint (1) in position or making a suitable allowance for joint. If any wear has taken place in end cover, this will increase the overall end float but the cover can be machined to eliminate slight wear at this point.

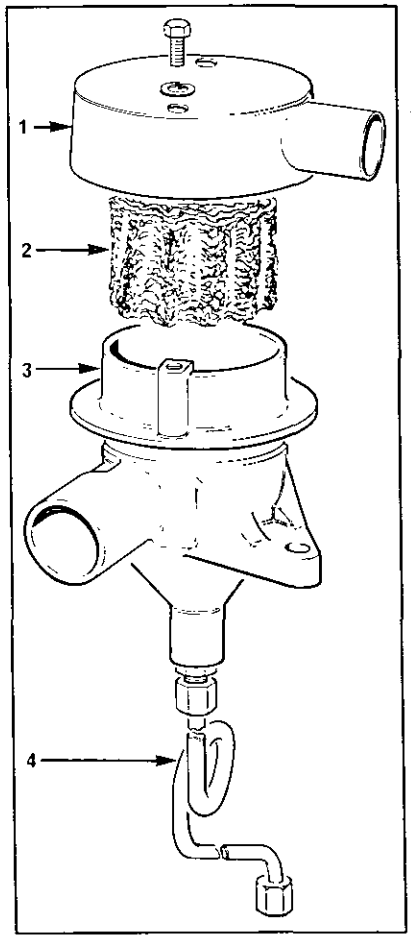
Production end float is 0.002/0.006 in (0,05/0,15 mm) and maximum permissible worn end float, in service, is 0.010 in (0,25 mm).

To Clean Standard Type Engine Breather (Fig. L.24)

Remove top cover (1) and withdraw breather gauze (2). Wash gauze and dry thoroughly.

If sludge is present in breather body (3), remove body and drain pipe (4), clean body and blow through pipe with high pressure air. Refit breather and drain pipe to engine.

Replace gauze and top cover, using a jointing compound between rim of body and top cover and secure



L24

cover with setscrews and spring washers. Refit breather outlet pipe, where necessary.

On some early V8.510 engines, a gauze was fitted in the hose between the rocker cover and breather. This has been found to be no longer necessary and may be discarded.

To Clean Integral Type Engine Breather (Fig. L.25)

This breather assembly is normally fitted to cylinder block top cover between the cylinder banks.

Disconnect breather pipe and remove assembly from engine. Mark top cover (1) and body (7) to facilitate reassembly.

Release grub screw and remove top cover, top gauze (3), deflector (4), lower gauze (5) and funnel assembly (6). Later breathers have funnel assembly fixed in body.

Wash gauzes and component parts and dry thoroughly.

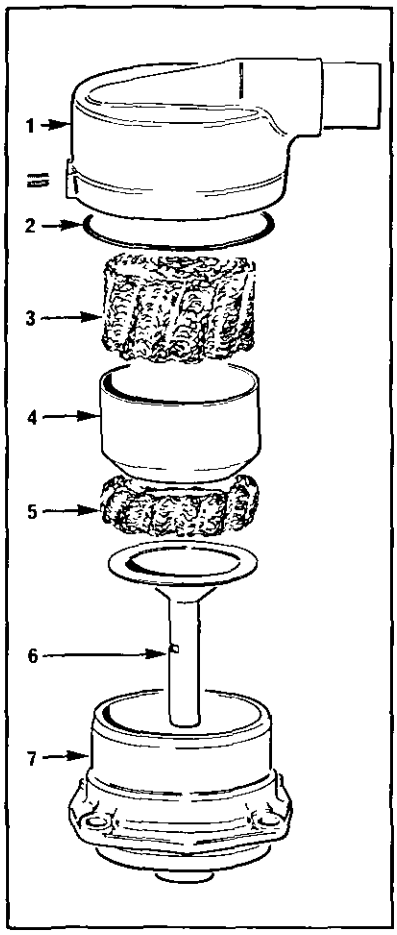
Where necessary, position funnel in base.

Place lower gauze around inside of body on top of funnel and position deflector on top of gauze. If a deep deflector is fitted, top of deflector should be level with top of body.

Fit top gauze inside deflector and ,where necessary, position plate on top of gauze.

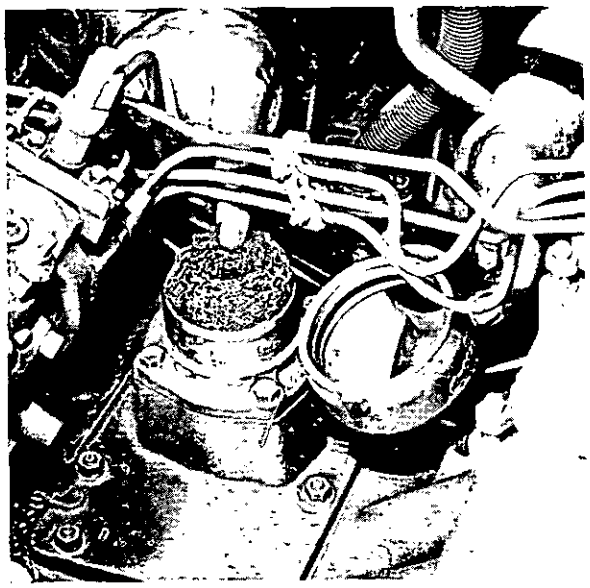
Check that sealing ring (2) is serviceable and fit in top cover. Fit top cover to body with marks in line and secure with grub screw.

Refit to block cover with new joint and reconnect breather pipe.

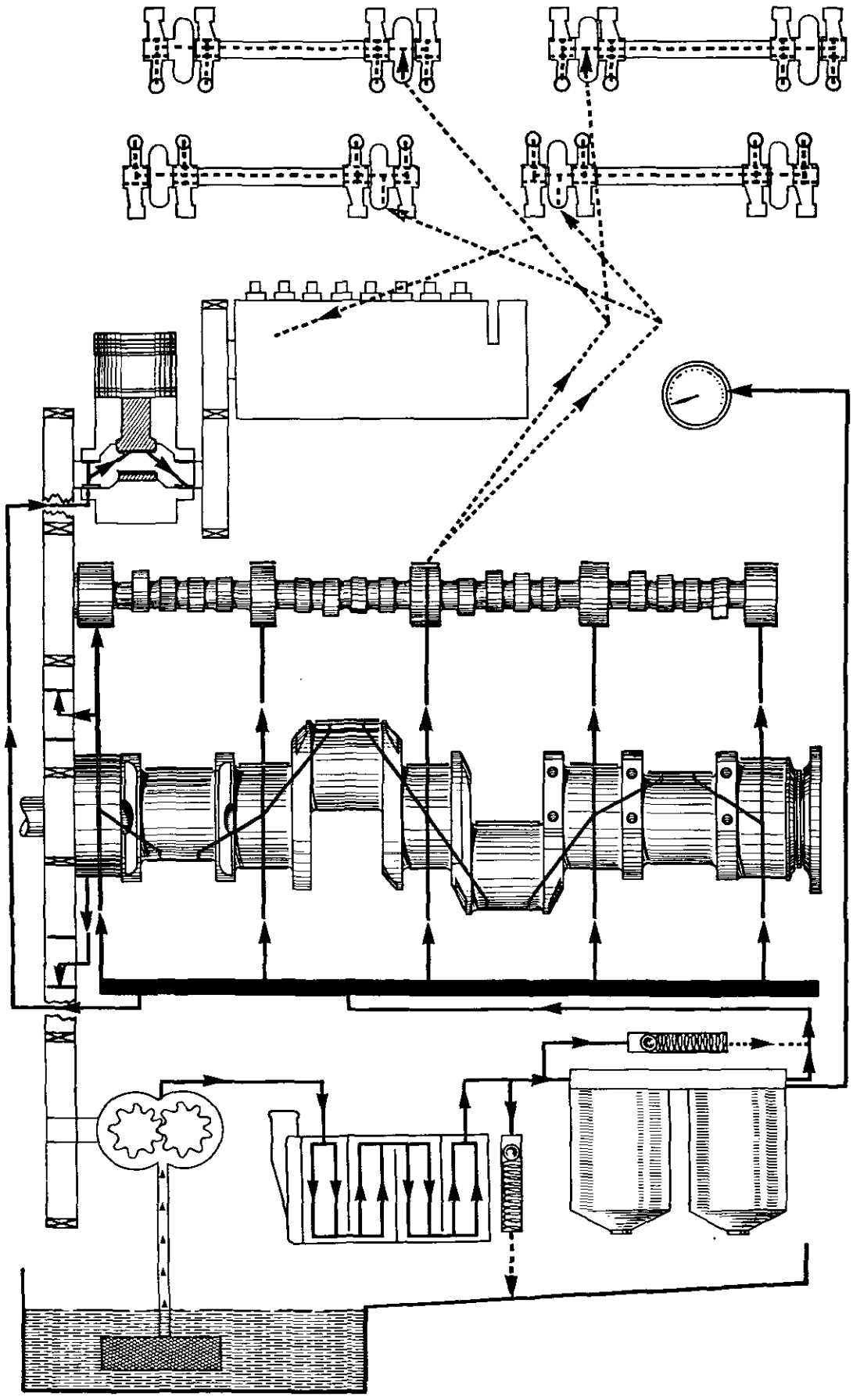


L25

Where engine is operating or standing in dusty conditions, it is advisable to remove and clean top gauze only at a more frequent interval than that given in "Preventive Maintenance" for cleaning gauzes. It is only necessary to remove breather top cover to gain access to gauze (Fig. L.26).

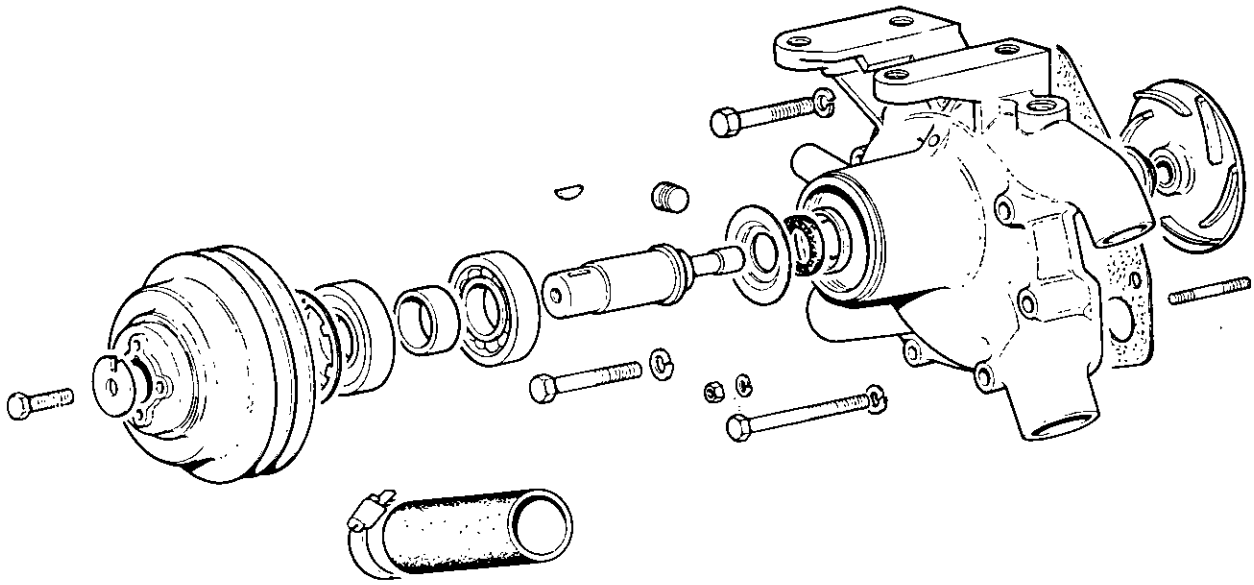


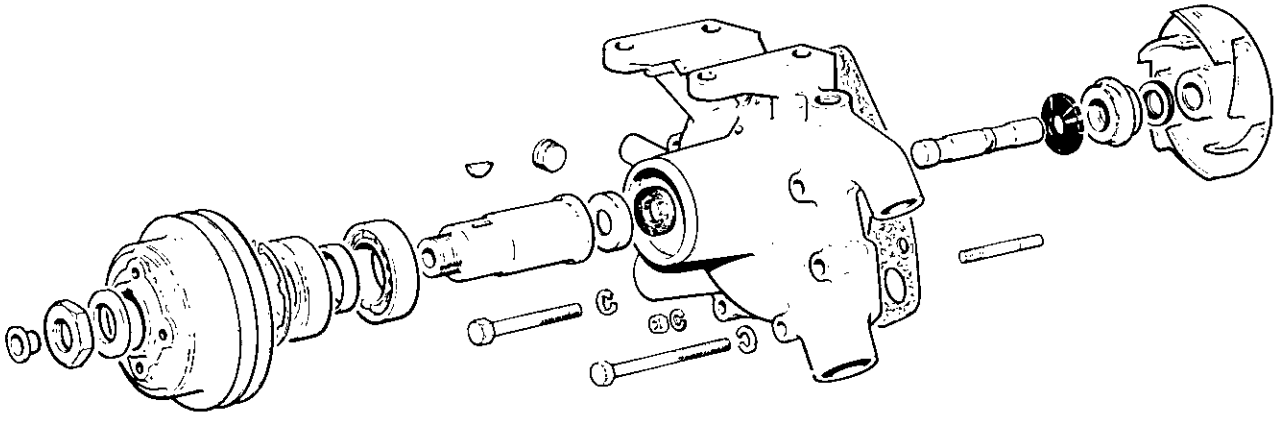
L26



Lubricating Oil Flow Diagram

SECTION M
Cooling System





General

The flow of coolant through the cooling system is assisted by a centrifugal water pump that is mounted on the front of the upper half timing case and is belt driven from the crankshaft pulley.

From the water pump, coolant is directed to each cylinder bank independently. Before the coolant enters the left hand bank, it is circulated around or through the tubes of an oil cooler that is mounted on the side of the engine.

After passing around the cylinder banks, coolant enters the cylinder heads and is returned to the radiator through outlets at the front of the cylinder heads.

Coolant is also directed, from the water pump, to the head of the compressor, returning to the left bank thermostat housing.

A thermostat is fitted to each cylinder head coolant outlet to assist in quick warming up of the engine to its operating temperature.

Fan Belts

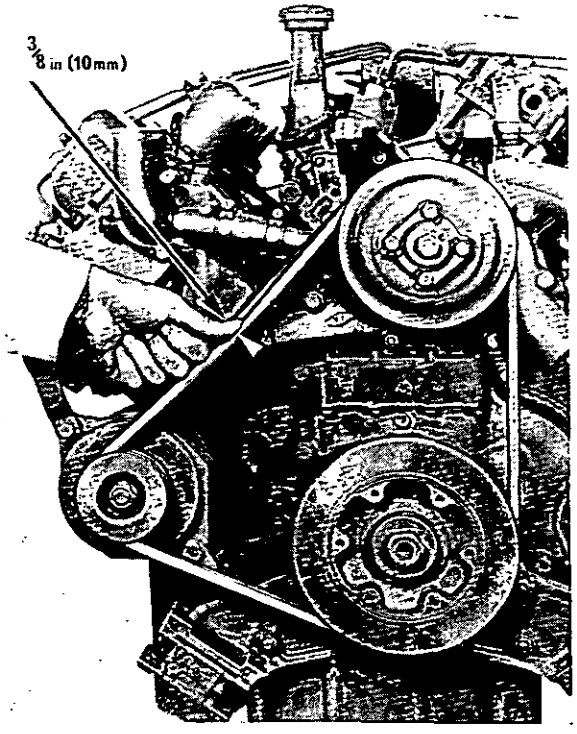
Twin belts are used to drive the alternator and water pump.

The fan is normally fitted to the water pump pulley but on certain applications it is mounted on the crankshaft pulley.

Belt tension should be adjusted so that, without undue pressure, the belt can be depressed approximately $\frac{3}{8}$ in (10 mm) with the thumb applying pressure at a point midway along the longest unsupported length of the belt (Fig. M.1). Adjustment of belt tension is achieved by loosening the alternator mounting bolts and altering the position of the alternator on its mounting link. On some applications a belt tensioner may be fitted which should be adjusted, where necessary, to give the correct tension. Depending upon the engine application, this is done by either altering position of a quadrant type pulley mounting bracket or by moving pulley along a fixed bracket by means of an adjusting screw after locking nut on rear of pulley shaft has been released. After adjusting tensioner pulley, secure pulley mounting bracket or pulley locking nut and recheck belt tension. With this arrangement, the alternator drive belt tension is adjusted separately, as detailed previously.

Twin drive belts should be changed in pairs.

When a new belt is fitted, tension should be rechecked after a short period of running to allow for initial stretch and bedding in which is common to new belts.



M1

Tensioner Pulley — Screw Adjustment Type (Fig. M.2)

Release drive belts.

Remove nut, washer and plate (1) from rear of pulley shaft (2) and remove pin and collar (3) from end of adjustment screw (4). Release pulley assembly from bracket (5) by screwing out adjustment screw.

Dismantle pulley assembly as follows :—

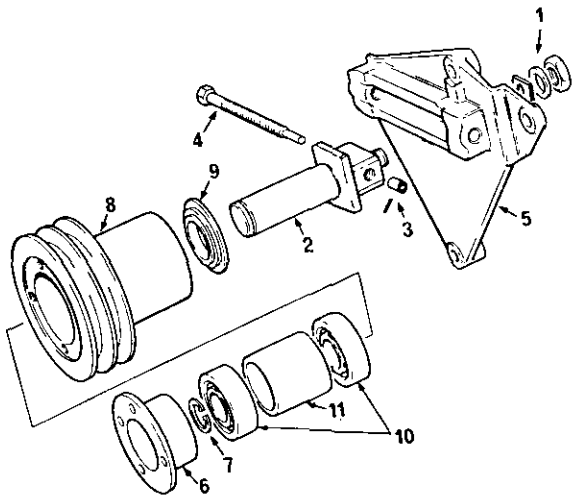
Remove bearing retainer cover (6) and bearing circlip (7).

Supporting rear end of pulley (8), press out shaft together with abutment collar (9). Remove collar from shaft.

Press out bearings (10) and spacer (11) through front end of pulley.

Assemble as follows :—

Press bearing in with closed end towards rear of pulley. Position spacer and press in remaining bearing with closed end towards front of pulley. Half fill bearings and space between bearings with high melting



M2

point grease e.g. Shell Alvania 2.

Temporarily fit bearing retaining cover.

Fit abutment collar on shaft with bosses towards front of shaft and press shaft through bearings.

Remove bearing retainer cover, fit bearing circlip and secure cover.

Position pulley assembly in bracket, screw adjustment screw through shaft and retain screw with collar and pin.

Fit plate, washer and nut to rear of pulley shaft, fit belts and adjust belt tension.

Tensioner Pulley — Quadrant Type (Fig. M.3)

Release bracket fixings and remove drive belts.

Release pulley assembly from bracket by removing setscrew (1) and washer (2).

Remove circlip (3) and press bearings (4) spacer (5) and sleeve (6) through front end of pulley (7).

Press bearings and spacer off sleeve.

Assemble as follows :—

Half fill bearings with a high melting point grease e.g. Shell Alvania 2.

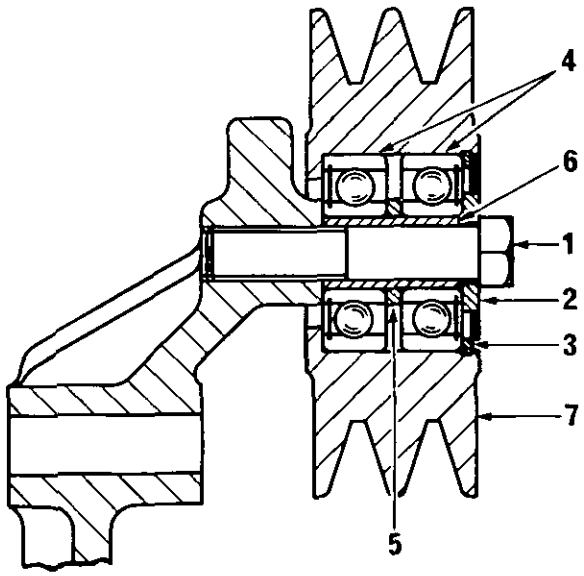
Press sleeve (6) into bearing (4) so that closed side of bearing is at end of sleeve, fit spacer (5) and fit other bearing with open side of bearing next to spacer. Half fill space between bearings with hight melting point grease.

Press bearing and sleeve assembly into pulley (7) and fit circlip (3).

Clean threads of setscrew (1) and bracket and apply Loctite "Screw Lock" to setscrew threads.

Secure pulley assembly to bracket with setscrew and washer and tighten setscrew to 45 lbf ft (61 Nm) 6,2 kgf m.

Fit belts and adjust belt tension.



M3

Thermostats

A thermostat is fitted in each cylinder head coolant outlet.

When the engine is cold, the thermostat causes coolant to by-pass the radiator.

Certain engines are fitted with by-pass blanking thermostats. As the coolant warms up, in addition to the opening of the top valve to allow coolant to the radiator a plate valve at the bottom of the thermostat closes the by-pass port.

Thermostats can be removed after coolant outlet elbows and joints have been removed. Before refitting, check jiggle pin (1, Fig. M.4) is free to move.

Testing Thermostats

Suspend thermostat in water and heat gradually.

With a thermometer, check that thermostat operates within the limits given on Page B.13. The start of opening temperature is normally marked on the top of the thermostat.

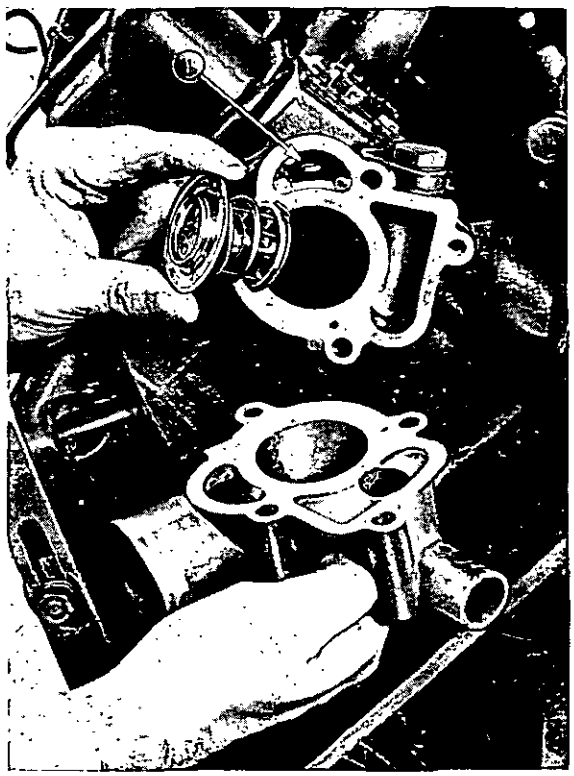
Water Pump

The water pumps fitted to early V8.510 engines have a single shaft, as shown in Fig. M.5, whereas the water pumps fitted to V8.540 and later V8.510 engines incorporate a two-piece shaft, as shown in Fig. M.7. The later, two-piece shaft, pump can be identified by the pulley securing nut as the earlier pulley is secured by a setscrew.

To remove pump, drain cooling system, loosen alternator mounting or belt tensioner and remove fan belts, disconnect hoses and remove securing nuts and setscrews.

Fit pump to timing case with new joint, connect hoses, fit fan belts and adjust tension (Page M.2) and fit fan.

Fill cooling system, run engine and check for leaks.



M4

To Dismantle Single Shaft Water Pump (Fig. M.5)

Remove pulley securing setscrew.

Using a suitable puller, remove pulley (1) and key

Tool PD155 with adaptors PD155-1 may be used (Fig. M.6).

Remove bearing retaining circlip (2).

Supporting pump on rim of pulley end and using a suitable adaptor that will pass through bore of impeller, press out shaft (5) through impeller, complete with bearings (3) and spacer (4).

Remove impeller (10), dished flange (6) and felt seal (7).

Press out rear seal (9) towards impeller end and felt seal retainer (8) towards pulley end.

Press shaft from bearings and spacer.

To Assemble Single Shaft Water Pump (Fig. M.5)

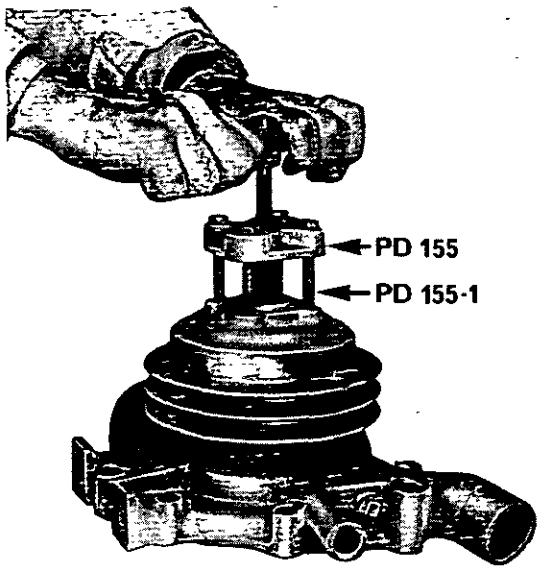
Lightly coat outside of brass cage of rear seal (9) with suitable jointing compound and press seal into position on body flange. Ensure that carbon face of seal is clean.

Press in felt seal retainer (8) until rim is flush with machined face in body.

Fit felt seal (7) in retainer.

Press bearings (3) on shaft (5) with shielded faces of bearings outwards towards front and rear of shaft and spacer (4) positioned centrally to shaft between bearings.

Half fill bearings and space between with high melting point grease.



M6

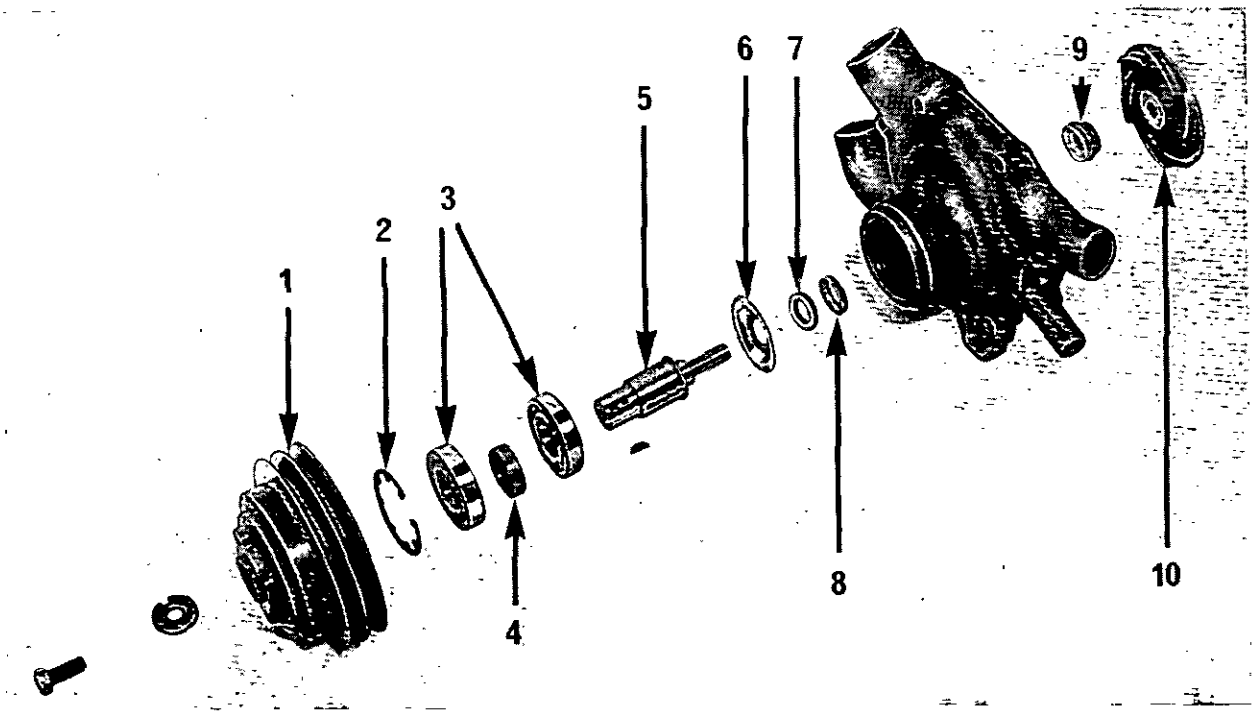
Position dished flange (6) with central protrusion towards felt seal.

Press shaft and bearing assembly into body and fit bearing retaining circlip (2).

Fit pulley key and with impeller end of shaft supported, press on pulley.

With pulley end of shaft supported and water pump body unsupported, press on impeller until rear face of impeller boss protrudes 0.021/0.026 in (0,53/0,66 mm) above rear face of body (Fig. M.7).

Fit pulley retaining setscrew and washer, after cleaning threads and applying "Loctite Nut Lock" and tighten to 40 lbf ft (54 Nm) 5,5 kgf m.



M5

To Dismantle Two-Piece Shaft Water Pump (Fig. M.8)

Remove blanking plug (1) from pulley end of main shaft (2).

Insert suitable round bar into pulley end of main shaft bore and press out impeller shaft (3) complete with impeller (4).

Remove ceramic counterfaced seal (5) from impeller shaft.

Supporting impeller on its central boss, press out shaft.

Remove water pump seal (6) and flinger (7) from impeller end of body. On later pumps, the flinger has been deleted.

Remove pulley nut (8) and washer (9).

Using a suitable puller, with end of shaft blanked off, draw off pulley (10).

Remove pulley key (11) from main shaft

Remove bearing retaining circlip (12).

Using a suitable round bar, 0.600/0.620 in (15,24/15.75 mm) diameter with end chamfered 1/64 in (0,40 mm) maximum, in impeller end of main shaft, press out main shaft, complete with bearings (13) through pulley end.

Where necessary, remove felt seal (14) and retaining cup (15) through pulley end. These may not be fitted on later pumps and can also be discarded on earlier pumps.

Press out main shaft from bearings and spacer (16)

To Assemble Two-Piece Shaft Water Pump (Fig. M.8)

It is not necessary to refit items 14 and 15.

Press one bearing (13) onto main shaft (2), with shielded face towards bearing retaining flange of shaft. Fit spacer (16) and press other bearing onto shaft with shielded face away from first bearing.

Half fill bearings and space between bearings with high melting point grease.

Applying pressure to inner race of outer bearing, press main shaft and bearing assembly into body. Fit bearing retaining circlip (12) in its recess.

Supporting pulley end of main shaft, press in impeller shaft (3) with the shorter machined diameter towards pulley end, as shown in Fig. M.7.

Fit pulley key (11) and supporting impeller end of shaft, press on pulley (10).

Clean threads of pulley nut (8) and shaft and fit nut and washer (9) using "Loctite Retaining Compound", tightening nut to a torque of 70 lbf ft (95 Nm) 9,7 kgf m.

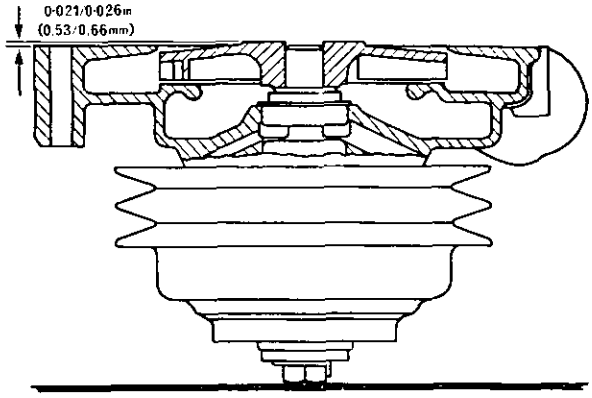
Fit flinger (7), where applicable, to impeller shaft with convex face towards pulley end and locate flinger in its groove on shaft.

Fit water pump seal (6) with cup of cage entering body aperture and lip registering on machined face.

Fit ceramic counterfaced seal (5) to impeller shaft with ceramic insert towards water pump seal.

With main shaft supported and pump body unsupported, press on impeller (4), with vanes inwards, until the machined centre portion of impeller protrudes 0.015/0.020 in (0,38/0.51 mm) beyond rear face of pump body.

Fit blanking plug (1) to pulley end of main shaft.

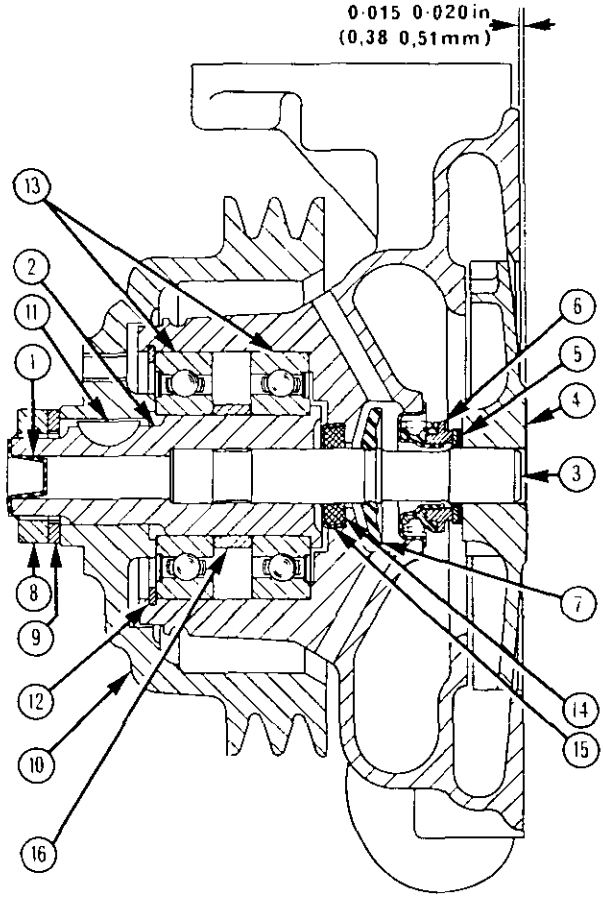


M7

Ceramic Seals

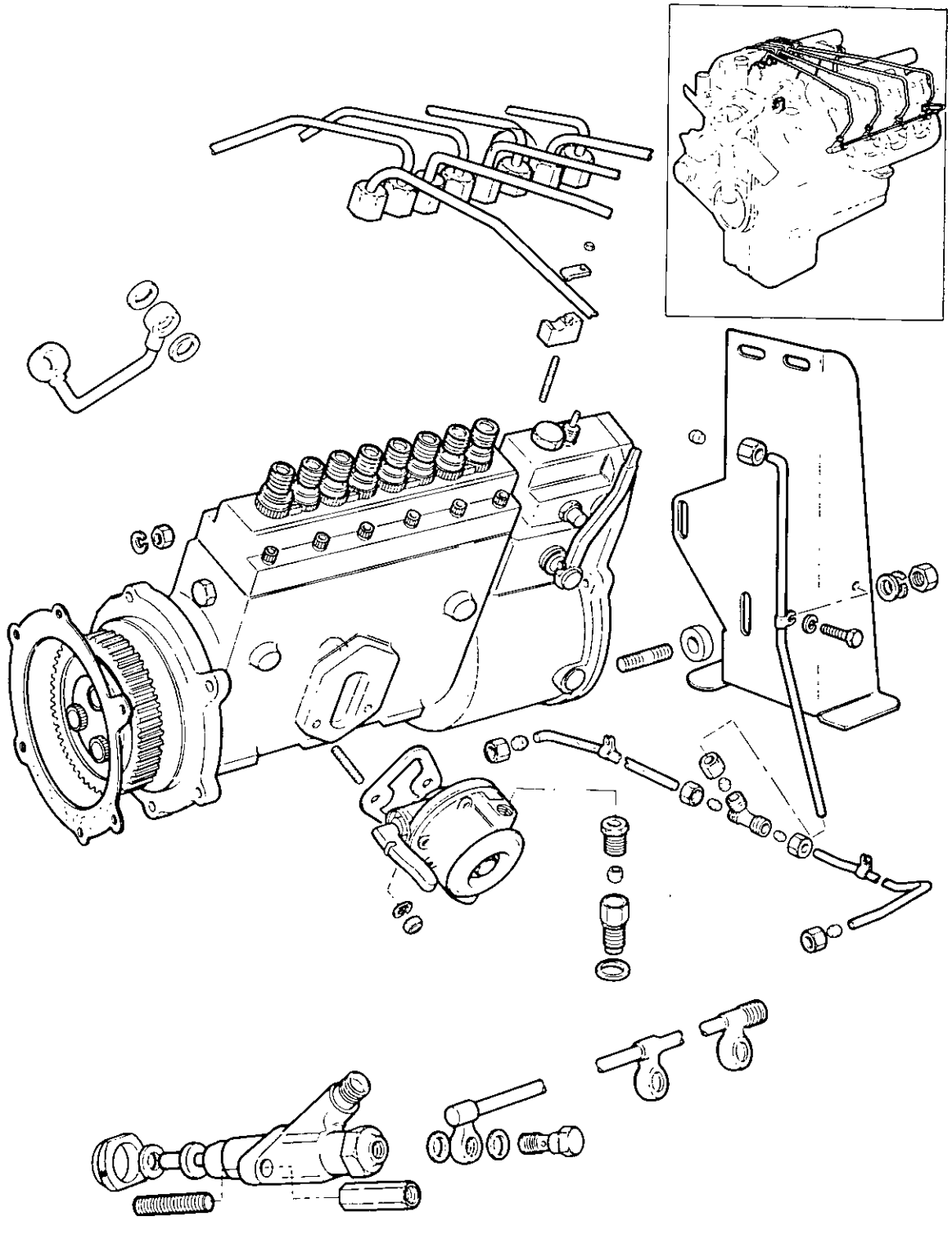
If an engine is run without coolant in the water pump, the heat build-up between the carbon seal and the ceramic counter face is very rapid, resulting in the cracking of the ceramic.

This can cause a misunderstanding that the leakage of water from the pump is due to the incorrect assembly of the sealing arrangement in the water pump.



M8

SECTION N
Fuel System



FUEL SYSTEM—N.2

Fuel Filter

The final fuel filter may be either a single element type (Fig. N.1), a twin element, parallel flow filter (Fig. N.2) or a twin element, parallel flow filter with screw-on canisters (Fig. N.3).

Both elements of twin element filters must be renewed together at the appropriate time.

To Renew Single Fuel Filter Element

Thoroughly clean exterior of fuel filter assembly.

Supporting base of filter, unscrew setscrew (2, Fig. N.1) in centre of filter head.

Lower filter base plate and discard element (1, Fig. N.1).

Thoroughly clean filter head and base in a suitable cleaning fluid.

Inspect sealing rings and renew if damaged in any way.

Place base squarely on bottom of new element and offer up assembly squarely to filter head so that top rim of element locates centrally against sealing ring in filter head. Hold in this position whilst securing setscrew is located and screwed home.

After fuel filter has been re-assembled, the fuel system should be bled as detailed on Page N.10.

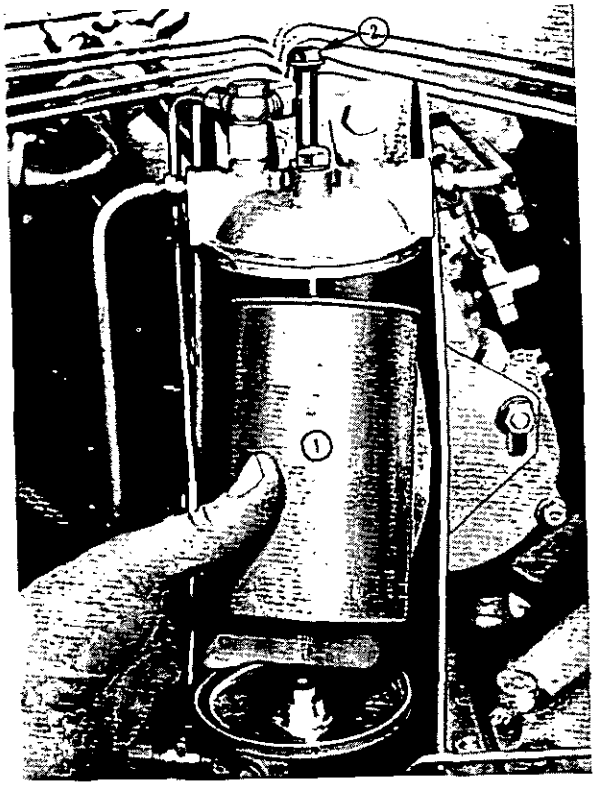
To Renew Twin Fuel Filter Elements (Fig. N2)

Thoroughly clean the exterior of the filter assembly. Where drain taps (4) are fitted, drain fuel from the filter.

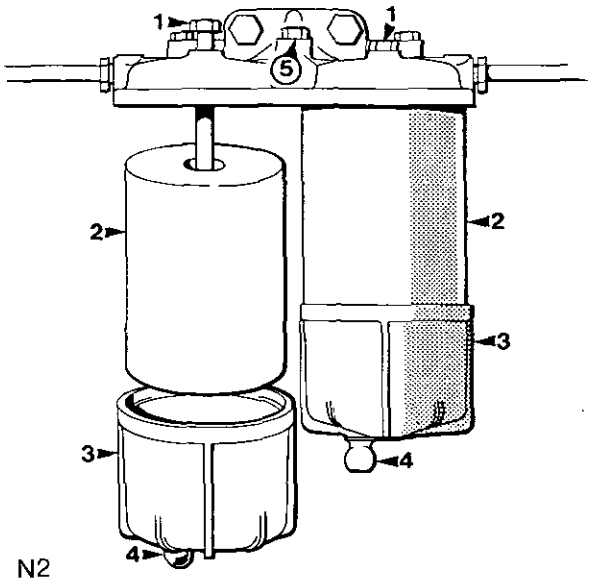
Holding each filter bowl (3) in turn, unscrew setscrews (1) and remove elements (2) and bowls.

Clean the inside of the filter head and bowls. Inspect the sealing rings and renew where necessary.

Place the bowls squarely in the bottom of the new filter elements and offer up each assembly squarely to



N1



N2

the filter head so that the top rim of the element locates centrally against the sealing ring in the head. Hold in this position whilst the securing setscrew is located and screwed home.

After the filter has been reassembled, it is necessary to remove air using the bleed plug (5) as detailed on Page N.10.

To Renew Screw-on Canister Fuel Filter Elements (Fig. N.3).

Thoroughly clean exterior of filter assembly.

Using a strap wrench or similar tool, unscrew filter elements from filter head and discard.

Ensure that threaded adaptors are secure in filter head.

Clean inside of filter head.

Lightly lubricate top seal of new canisters using clean fuel.

Screw new canisters to filter head until canister seals just touch filter head and then tighten by hand a further quarter of a turn.

Bleed the filter as detailed later in this Section.

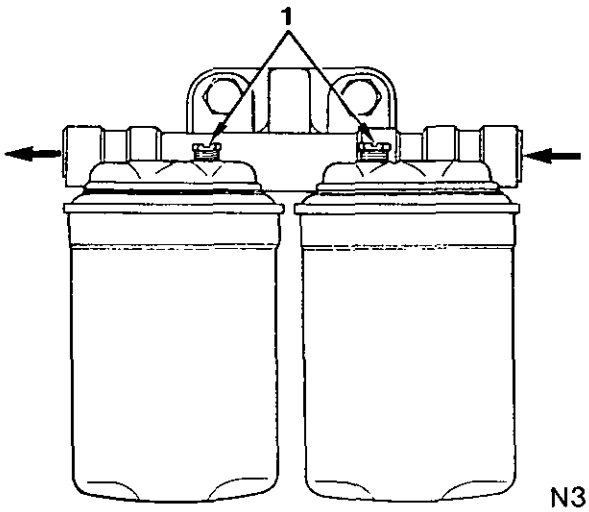
Fuel Lift Pump

The fuel lift pump used with the CAV in line fuel injection pump is a "VP" type pump.

This is a mechanically driven diaphragm type pump mounted on the left hand side of the fuel injection pump and driven by an eccentric on the injection pump shaft.

The fuel lift pump used with the DP15 fuel injection pump is a "Z" type pump.

This is a plunger type pump mounted in the fuel injection pump drive housing and driven, by means of a push rod, by an eccentric on the driveshaft to the fuel injection pump. A manually operated, plunger type, priming pump is usually incorporated in the pump assembly but on some applications a separate priming pump is fitted above the fuel filter.



N3

The fuel lift pump used with the Bosch in-line fuel injection pump is an MW24 type pump.

This is a plunger type pump mounted on the left hand side of the fuel injection pump and is driven by an eccentric on the injection pump shaft. If this pump is faulty, the complete pump must be renewed.

To Clean VP Fuel Pump Sediment Chamber

Release centre setscrew and remove cap and pulsator diaphragm (Fig. N.4).

Clean sediment chamber and check diaphragm. Renew diaphragm if necessary.

Refit diaphragm and cover and secure with setscrew.

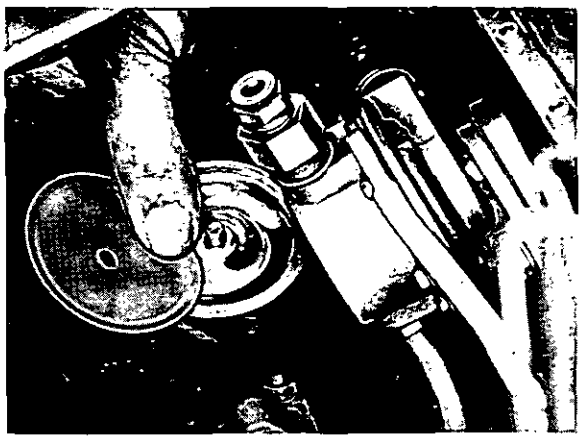
Bleed fuel system (Page N.10).

To Remove and Fit Fuel Lift Pump

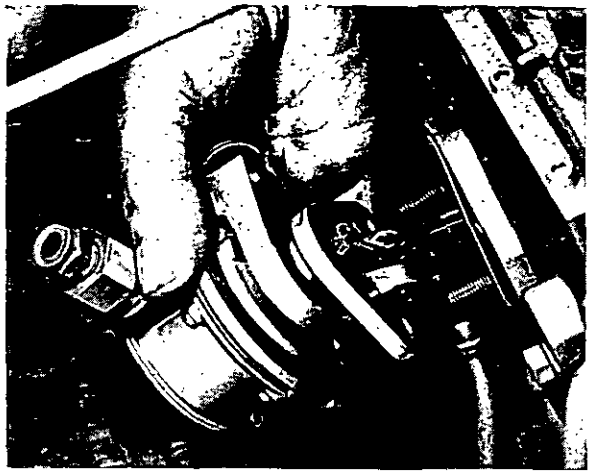
Disconnect inlet and outlet pipes at pump.

Remove securing nuts and washers and remove pump and joint (Fig. N.5 or N.6).

Where necessary, remove the push rod (Fig. N.7), the fuel injection pump driveshaft may have to be turned to make the push rod accessible.



N4



N5

Where necessary, oil the push rod and position it in its bore in the fuel injection pump drive housing. Turn the fuel injection pump driveshaft so that the push rod is in its lowest position.

Fit pump using a new joint, ensuring that mating faces of fuel injection and lift pumps are clean.

Re-connect pump inlet and outlet pipes.

Bleed fuel system (Page N.10).

To Dismantle "VP" Fuel Lift Pump (Fig. N.8)

Clean exterior and mark flanges of top and bottom bodies to ensure correct repositioning.

Remove end cover (1) and pulsator diaphragm (2).

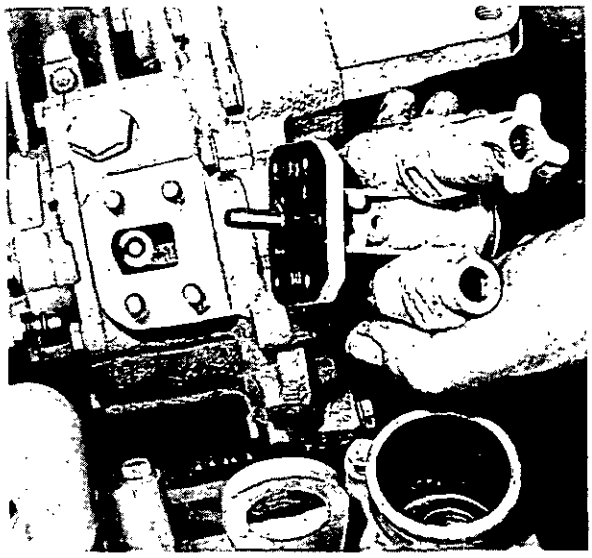
Separate two halves of pump.

Remove diaphragm (4) by unhooking from rocker arm link (6) and remove diaphragm spring (5). Remove diaphragm rod seal, if fitted.

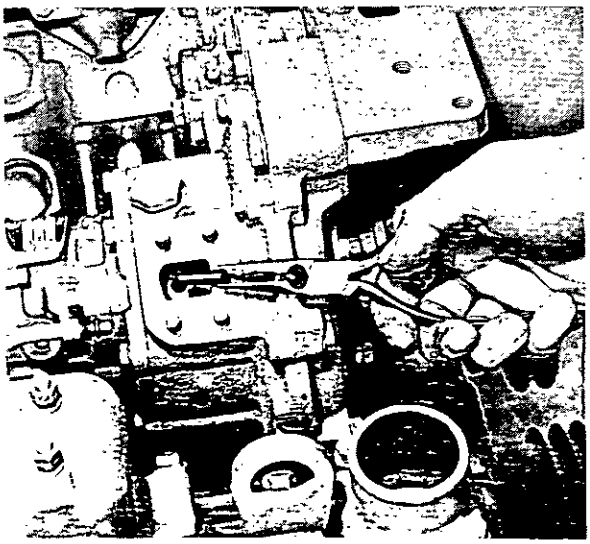
Drive out rocker arm pivot pin (7) and remove rocker arm (8), spring (9) and link.

Remove priming lever retaining pin (10) and withdraw priming lever (11) and spring.

Remove valves (3) by carefully levering from housings and remove valve joints.



N6



N7

To Assemble "VP" Fuel Lift Pump (Fig. N.8)

Place valve joints in position in upper half body.

Position valves (3) and retain by staking housing in six places for each valve. Inlet valve must be fitted with spring protruding into pump chamber and outlet valve in reverse position

Fit pulsator diaphragm (2) and top cover (1) and secure with setscrew and washer.

Position rocker arm (8), link (6) and spring (9) in body and insert rocker arm pin (7). Tap in pin until flush with body and retain by staking body in three places at each end of pin. Ensure that spring is correctly positioned.

Fit new diaphragm rod seal, if one was originally fitted, with small diameter of seal protruding through into operating link chamber.

Position diaphragm spring (5) and place diaphragm assembly (4) on spring with pull rod downwards and primer tag of spring retainer plate in line with primer lever recess.

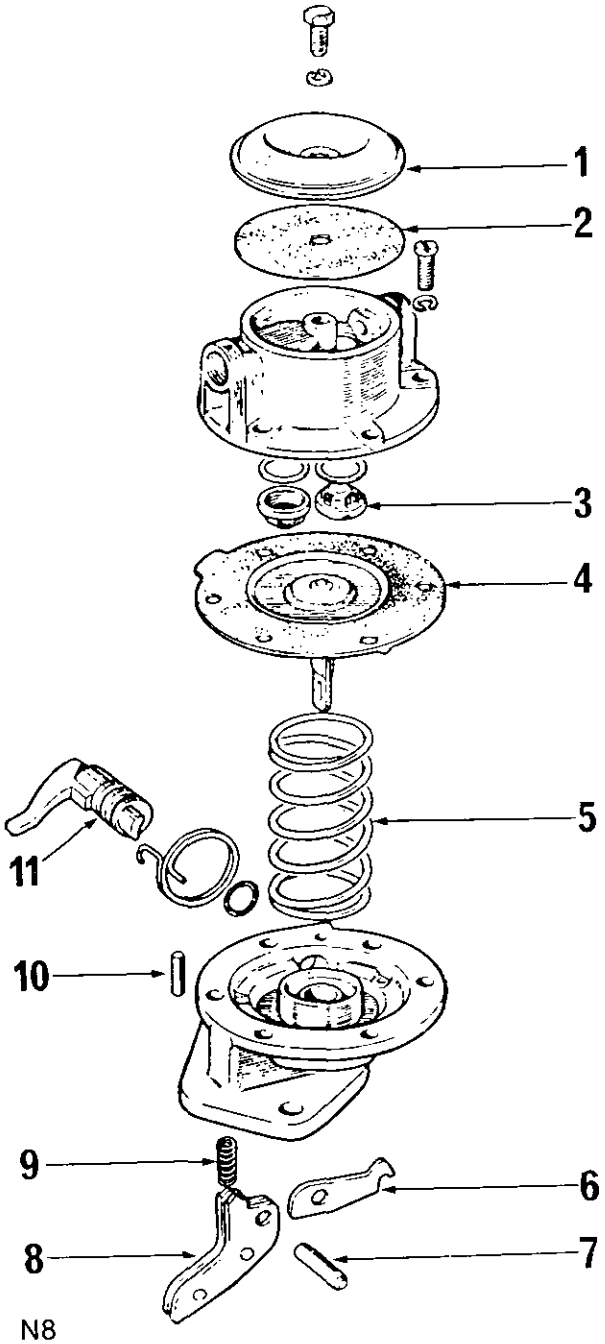
If a new diaphragm spring is being fitted, ensure that it is the same colour as the spring that has been removed.

Press diaphragm downwards and engage pull rod on rocker lever link. Line up screw holes of diaphragm and body.

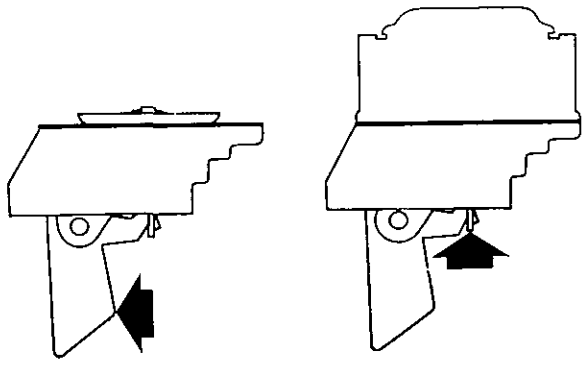
Press rocker lever away from pump (Fig. N.9) until diaphragm is level, position top half body with location marks in line and locate securing screws and washers — do not tighten.

Release rocker lever, press upwards on pull rod (Fig. N.10) and tighten screws diagonally and evenly. After assembly, edge of diaphragm should be about flush with edge of flanges. Any appreciable protrusion indicates incorrect fitting and should be corrected by refitting.

Fit primer (11) with seal and spring and retain with pin (10).



N8



N9

N10

To Dismantle 'Z' Type Fuel Lift Pump (Fig. N.11)

Remove the capscrew from the top of the body, bearing in mind that it is under spring pressure. Withdraw the spring and remove the piston complete with push rod. Release the push rod and remove its sealing ring. The push rod main seal is staked into position in the pump body. Unscrew the priming pump assembly from the body. If necessary, pull the handle off the plunger shaft, press the plunger and sleeve out of the barrel and remove the sealing rings.

Unscrew the outlet connection and remove the spring, valve and valve seating washer — note the position of the other valve in the connection. Unscrew the inlet connection, noting the position of the valve inside the connection.

To Assemble 'Z' Type Fuel Lift Pump (Fig. N.11)

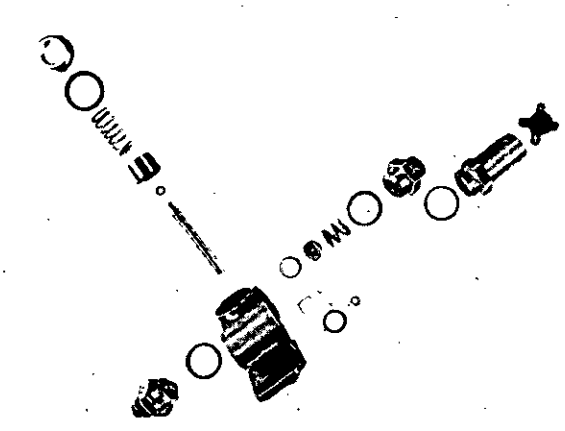
Where necessary, fit a new push rod seal in the pump body and retain it in position by staking the body in four places.

Fit a new sealing ring to the push rod and insert the rod into the base of the piston. Lubricate the rod with clean engine oil and the piston with clean fuel oil and position the assembly in the pump body. Fit the spring and secure the assembly with the capscrew and new washer.

Where necessary, fit a new valve and seating washer into the outlet connection with the spring cage inside the connection. Place a new valve seating washer into the outlet part of the body, position the inner valve on the washer with the spring cage towards the outlet and place the spring over the valve. Fit the outlet connection and new sealing washer.

Fit new sealing rings to the priming plunger, position the plunger and sleeve in the pump barrel and press on the priming pump handle. Fit the assembly to the pump body using a new sealing washer. Screw or clip the priming handle into the body.

Where necessary, fit a new valve and seating washer into the inlet connection with the spring cage protruding from the connection and fit assembly to the pump body using a new sealing washer.



N11

Fuel Injection Pump

All V8.510 and the majority of V8.540 engines are fitted with a CAV in line-plunger type pump (Fig. N12) but certain V8.540 engines are fitted with a DP15 distributor type pump (Fig. N.13) or a Bosch in-line fuel injection pump (see Fig. N.14).

The CAV in-line and DP15 pumps are fitted at the rear of an auxiliary drive housing between the cylinder banks. The standard drive for the CAV in-line pump is through straight spur gears from the rear of the compressor/auxiliary drive shaft but some CAV in-line pumps and all DP15 pumps are driven through a shaft directly from the front timing gears.

The Bosch in-line pump is mounted at the forward end of the auxiliary drive housing and is driven by a gear mounted directly on the pump shaft. This gear engages with the camshaft/fuel pump idler gear.

To Remove CAV In-Line Fuel Injection Pump

Remove high pressure fuel pipes, marking pipes with respective cylinder numbers to simplify refitting.

Disconnect excess fuel, stop and speed controls from fuel injection pump.

Remove low pressure pipes to fuel lift pump and fuel injection pump.

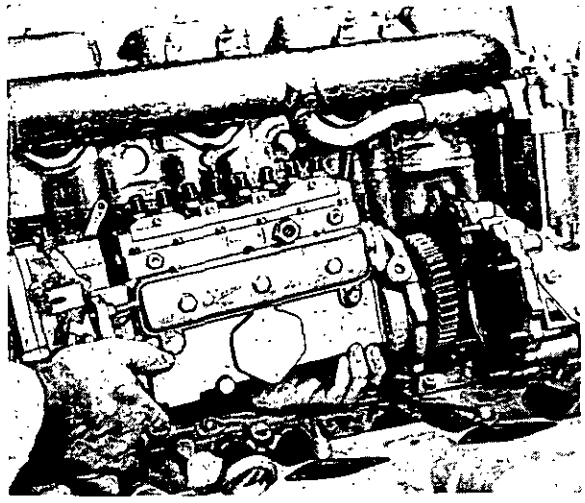
Where necessary, remove return pipe from fuel injection pump to filter.

Remove fuel filter assembly and support bracket.

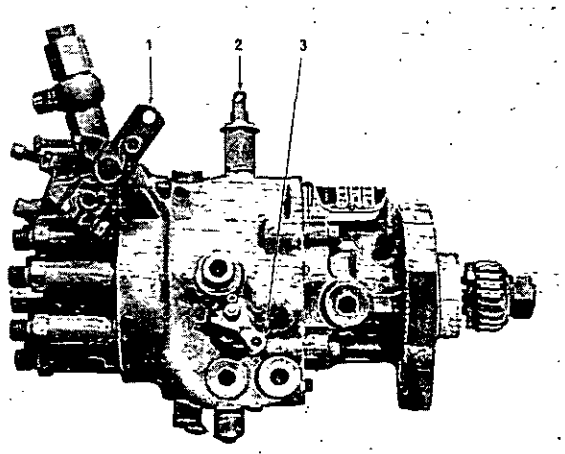
Disconnect lubricating oil feed pipe from right bank rocker feed to fuel injection pump.

Where necessary, remove tachometer adaptor from front of auxiliary drive housing.

Remove securing nuts and washers and withdraw fuel injection pump (Fig. N.12).



N12



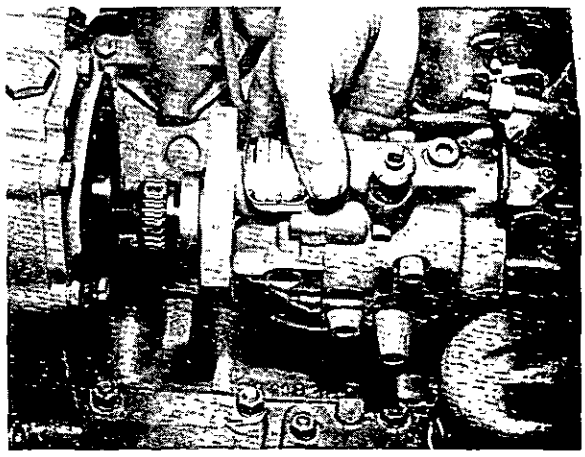
N13

To Remove DP15 Fuel Injection Pump

Disconnect the control rods from the engine speed control lever (1, Fig. N13), stop control lever (2) and excess fuel control lever (3). On some pumps the stop control lever is replaced by an electrically operated stop control.

Disconnect the low pressure fuel pipes at the pump. Remove the high pressure fuel pipes, marking each pipe to facilitate refitment.

Remove the setscrews securing the pump to the adaptor plate and remove the pump (Fig. N.15).



N15

To Remove Bosch In-Line Fuel Injection Pump

Remove the high pressure pipes, marking each pipe to facilitate correct replacement.

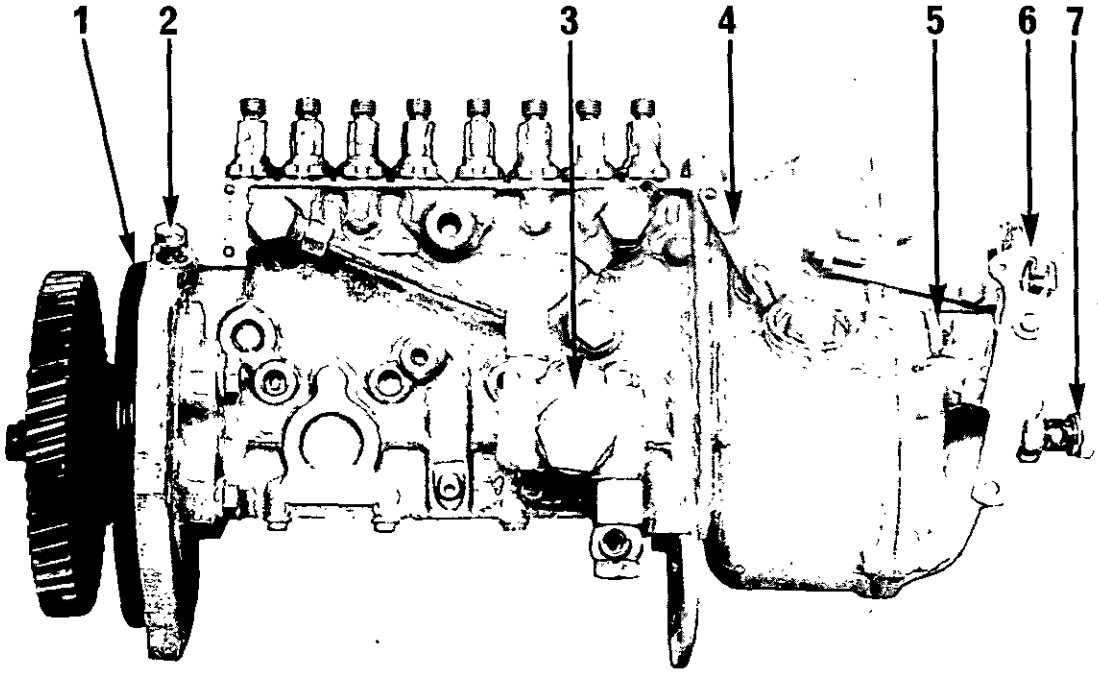
Disconnect the stop and speed controls from the pump.

Disconnect the low pressure fuel pipes from the fuel lift pump and fuel injection pump.

Remove the lubricating oil supply pipe from the drive housing to the pump adaptor plate and the oil drain pipe from the rear of the pump governor housing to the cylinder block top cover plate.

Release the pump support bracket fitted at the bottom of the pump just forward of the governor housing.

Remove the nuts and setscrews securing the pump adaptor plate to the drive housing and remove the pump.



N14

1. 'O' Ring.
2. Lubricating Oil Supply Connection.
3. Fuel Lift Pump.
4. Stop Lever.
5. Maximum Speed Adjustment Screw.
6. Engine Speed Control Lever.
7. Lubricating Oil Drain Connection.

To Fit CAV In-Line Fuel Injection Pump with Standard Drive Arrangement

Where an anti-stall device (1, Fig. N.14) is fitted, before fitting pump, remove device from governor cover and then screw back in by four complete turns. This is to ensure that the device does not interfere with the slow running speed on initial start but it will have to be re-set, as described later, after slow running speed has been checked.

Remove timing inspection plug from pump adaptor housing and check type of timing tab used, see "Fuel Injection Pump Basic Timing Arrangement" on Page K.2. If the larger timing tab is used, ensure that timing indicator screw (2, Fig. K.7) is fitted, if necessary remove it from old pump and fit it in replacement pump, securing it with "Loctite Stud Lock"

Remove front rocker cover of right hand bank and where necessary, remove tachometer adaptor plate or cover plate from auxiliary drive housing directly in front of fuel pump mounting position.

Position No. 1 piston to T.D.C. compression stroke (Page K.2).

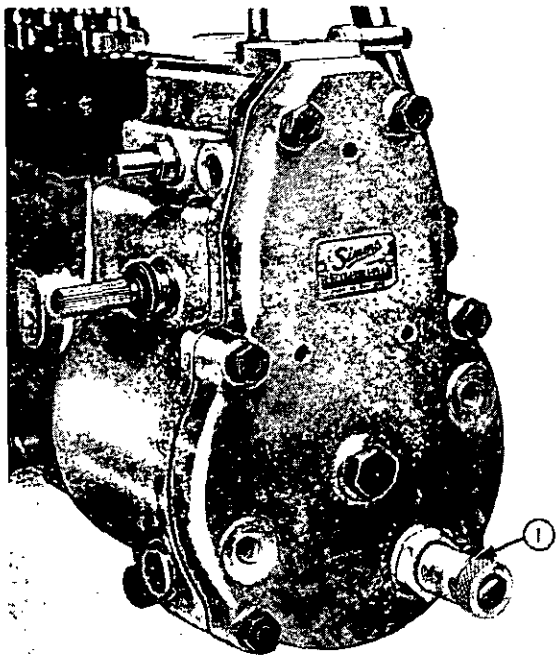
Loosely fit pump drive gear with securing capscrews or studs central in slots of gear and tighten one capscrew or nut which will be accessible through front gear cover aperture, when pump is fitted to engine. Early capscrews were fitted with washers but these capscrews were changed and the later capscrews have a hardened plate in place of the washers.

Fit fuel pump to engine, ensuring that timing points remain in line and secure with nuts and washers.

Spill time the pump as detailed on Page K.4 and when correct, tighten gear retaining capscrews or nuts to torque given on Page B.3.

Refit fuel pump lubricating oil supply pipe

Refit fuel filter bracket, fuel filter and low pressure fuel pipes.



Where necessary, refit fuel return pipe from pump to filter.

Refit rocker cover and high pressure fuel pipes (Page E.3).

Refit excess fuel, stop and speed controls to pump, ensuring that full movement of controls is possible at pump.

Bleed fuel system (Page N.10).

Remove filler plug (3, Fig. N.17) and insert one pint (0,6 litre) of clean engine lubricating oil. Replace plug.

Check and adjust slow running speed and reset anti-stall device, if fitted, as detailed later.

To Fit CAV In-Line Fuel Injection Pump with Alternative Drive Arrangement

Set the anti-stall device, where fitted, as detailed for the standard drive arrangement.

As this alternative drive arrangement utilises a master spline location between the fuel pump drive shaft and the pump adaptor shaft, it is not necessary to position the engine before fitting the pump.

Fit adaptor shaft to pump ensuring that timing marks (3, Fig. K.6) are in line. The drillings for the adaptor shaft securing studs or setscrews are offset allowing shaft to be fitted in one position only. If there is no timing mark on the pump, shaft should be fitted with studs or setscrews central in their slots. Tighten adaptor shaft securing nuts to 21 lbf ft (28 Nm) 2,9 kgf m or, if setscrews are used, tighten setscrews to 15 lbf ft (20 Nm) 2,1 kgf m.

Ensure that a timing indicator screw is fitted in rear face of pump adaptor housing, if necessary remove screw from old pump and fit it to replacement pump, securing it with Loctite "Stud Lock"

Turn adaptor shaft until double spline space corresponds with master spline of fuel pump drive shaft and fit pump to its drive housing, securing it with nuts and washers

Check fuel pump spill timing, as detailed on Page K.4, making any necessary adjustment at fuel pump drive gear.

Refit pipes, etc., bleed and prime pump and check speed adjustments as detailed for the standard drive arrangement.

To Fit DP15 Fuel Injection Pump

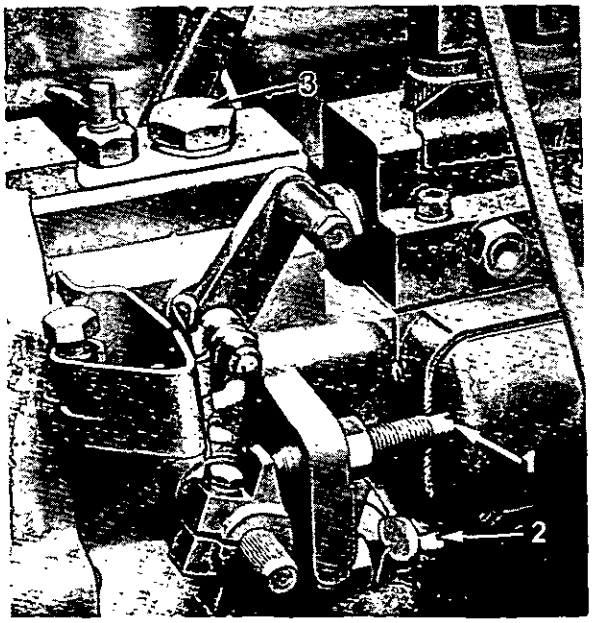
Where necessary, check that the drive to the pump is correctly timed as detailed in Section K.

Turn the pump shaft until the master groove of the pump drive shaft adaptor corresponds with the master spline of the pump drive shaft. Using a new joint, fit the pump to the adaptor plate with the timing marks on the fuel pump flange and adaptor plate in line (Fig. K.8).

Reconnect the high pressure fuel pipes (Fig. E.9).

Reconnect the low pressure fuel pipes.

Reconnect the engine speed, excess fuel and stop controls at the pump ensuring that the pump levers can move through their full travel and that the stop lever, where fitted, is positioned vertical to the pump.



N17

Bleed the pump as detailed later.

Run engine and check for leaks and check slow running speed as detailed below.

If a new pump has been fitted, check maximum no load speed, as detailed later.

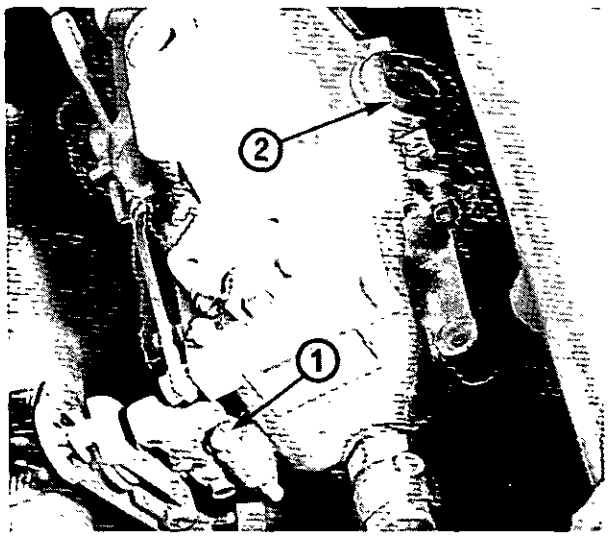
To Fit Bosch In-Line Fuel Injection Pump

Turning the crankshaft in the normal direction of rotation, position No. 1 piston at TDC compression stroke as detailed on Page K.2.

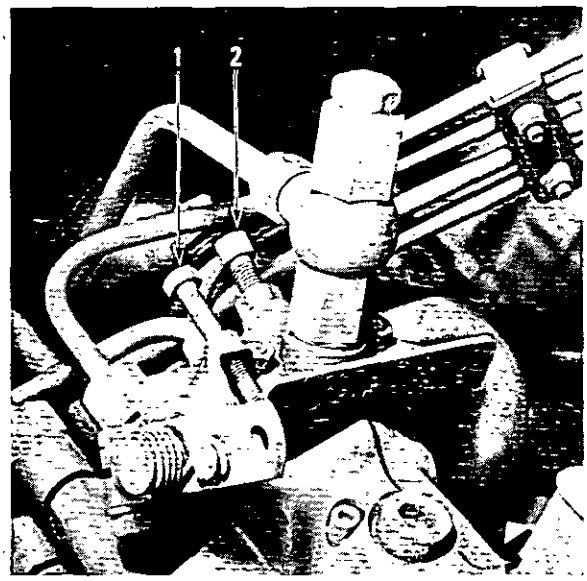
Remove the fuel pump gear cover from upper half timing case.

Ensure that a serviceable 'O' ring is fitted to the pump adaptor plate. Lubricate the 'O' ring with clean engine lubricating oil.

Remove the timing inspection plug (2, Fig. N.18) from the right hand side of the pump and turn the pump shaft until the groove in the end of the governor spring shaft is in line with the timing line on the circlip as shown in Fig. K.11.



N18



N19

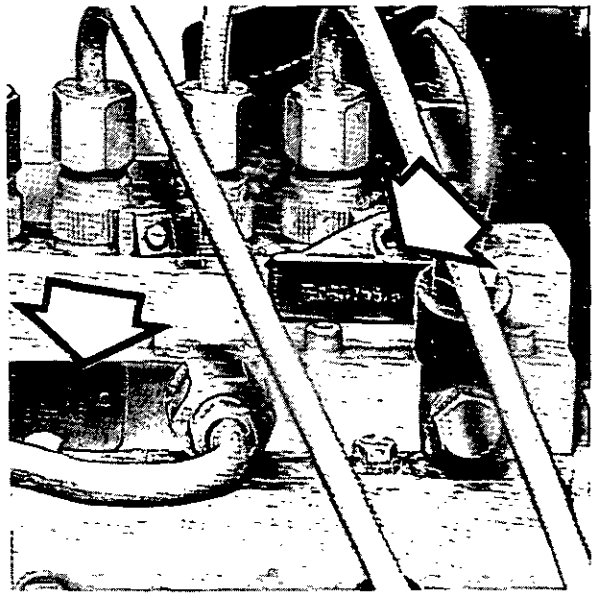
If the original pump is being fitted and the fuel pump gear and engine timing have not been disturbed, position the pump on the engine as follows:—

Turn the pump gear and shaft half a gear tooth anti-clockwise from the front and offer up the pump to the engine ensuring that the 'O' ring is not damaged when entering the drive housing.

Check that the pump timing marks are in line, if necessary remove the pump and re-engage the gear. When the correct engagement is obtained, secure the pump to the drive housing.

If fitting a new pump or if the timing has been disturbed, position the pump on the engine as follows:—

Position the gear on the pump hub, screw in the gear capscrews and release them sufficiently to allow movement of the gear.



N20

Keeping the pump timing marks in line, move the gear anti-clockwise from the front to the limits of the gear slots.

Offer up the pump to the engine, moving the gear clockwise from the front to engage with the idler gear ensuring that the 'O' ring is not damaged when entering the drive housing. Check that the timing marks will still align, if not, remove the pump and re-engage the gear.

Secure the pump to the drive housing.

Keeping the pump timing marks in line, take up the gear backlash by turning the gear anti-clockwise from the front and tighten the gear capscrews to 37 lbf ft (5,1 kgf m) – 50 Nm.

Check the pump timing as detailed in Section K.

Refit the pump gear cover plate and the rocker cover.

Refit the pump support bracket.

Refit the pump lubricating oil supply and drain pipes.

Insert 1 pint (0,6 litre) of clean lubricating oil into the pump. A filler plug is provided on either side of the governor housing.

Reconnect the low pressure fuel pipes to the lift pump and injection pump.

Refit the high pressure fuel pipes.

Reconnect the stop and speed controls at the pump, ensuring that the levers can move through their full travel.

Bleed the fuel system as detailed later.

Run the engine and check for leaks.

Check the slow running speed as detailed below and, if a new pump has been fitted, check the maximum no load speed.

Slow Running Speed Adjustment

Check that anti-stall device of CAV in-line pumps is inoperative, as detailed in "To Fit CAV In-Line Fuel Injection Pump".

With the engine warmed up to its normal operating temperature, check the slow running speed making any adjustment by turning the setting screw (1, Fig. N.17, 18 or 19) clockwise to increase the speed or anti-clockwise to decrease for CAV in-line and DP15 fuel pumps and the reverse procedure for Bosch in-line pumps. Slow running speeds may vary according to the application and will normally be given in the application manufacturer's handbook. If in doubt, apply to the nearest Perkins Distributor or to Technical Services Department, Perkins Engines Ltd., Peterborough, England. On CAV in-line pumps with GM Governor, the adjustment screw is the front screw of the two screws on the top rear of the governor housing.

Anti-Stall Device Adjustment – CAV In-Line Pumps

With engine at normal working temperature and idling speed set, as detailed above, screw in anti-stall device (1, Fig. N.16) until it just affects idling speed, screw it out 1/4 of a turn and lock with locknut.

Operate speed control lever and check that anti-stall device is not influencing idling speed setting.

Carry out a check, with engine warm, to ensure that engine does not stall-out under heavy braking conditions.

Maximum No Load Speed Adjustment

The maximum speed adjusting screw (2, Fig. N.17 or N.19 or 5, Fig. N14) on original fuel pumps is sealed at the factory and should not be interfered with. On CAV in-line pumps with GM Governor, the adjustment screw is the rear screw of the two screws on the top rear of the governor housing.

When fitting a replacement pump, however, the maximum no load speed should be checked and reset, if necessary, with engine warmed up.

The speed is indicated by the last four figures of the setting code on the fuel pump data plate, e.g. Setting Code LB 60/800/11A/3130 — Maximum No Load Speed is 3130 rev/min, Setting Code AB60E500/0/2860 — Maximum No Load Speed is 2860 rev/min. On CAV in-line pumps the data plate is fitted in one of the positions shown in Fig. N.20.

Turn screw anti-clockwise to increase engine speed and clockwise to decrease speed.

Atomisers

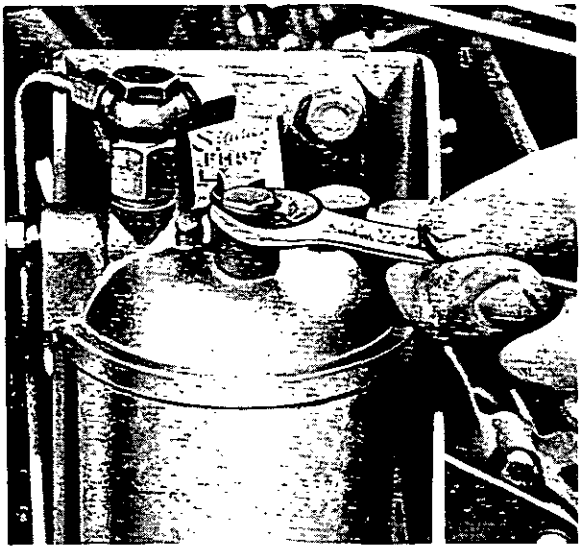
The data for the atomisers can be found on Page B.16 The "Setting Pressure" is the pressure at which a new atomiser is set and is slightly high to allow for the initial fall off of pressure that occurs in the first few hours of operation. The "Working Pressure" is the pressure at which a used atomiser can be checked. After reconditioning, the atomiser should be set to the "Setting Pressure" if a new spring has been fitted or to the "Working Pressure" if the existing parts have been refitted.

No attempt should be made to service or reset the pressure of an atomiser unless the proper equipment is available.

When fitting atomisers, fit a new joint washer and a serviceable dust seal. Ensure that atomiser is seated centrally and tighten securing nuts down evenly to a torque of 12 lbf ft (16 Nm) 1,7 kgf m.

Testing Atomisers on Engine

If it is suspected that an atomiser is faulty, the defective atomiser or atomisers may be determined by releasing the pipe union nut of each atomiser in turn, with the engine running at fast "tick-over. If, after slackening a pipe union nut, the engine revolutions remain constant, this denotes a faulty atomiser.



N21

Bleeding the Fuel System

Although the fuel system is self bleeding during normal running, it should be bled manually, as detailed below, when a large quantity of air has entered the system. The procedure for bleeding depends upon the type of fuel injection pump fitted.

Before bleeding, clean the area around the vent points.

If, after bleeding the fuel system, the engine starts, runs satisfactorily for a few moments and then loses power, misfires or stops and when checked the system is found to be full of air, then a leak on the suction side is indicated.

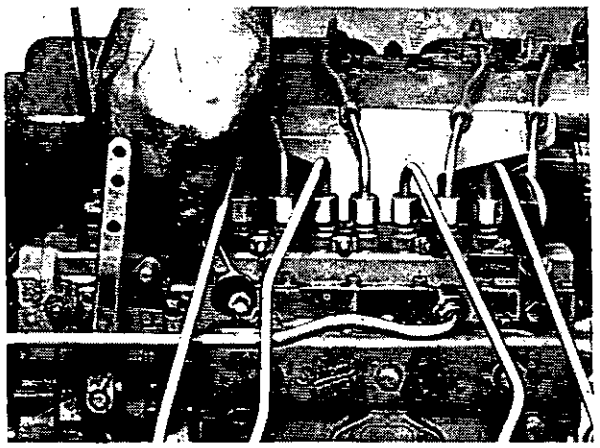
CAV In-Line Pumps:—

Unscrew the vent plug on the top of the fuel filter (Fig. N.21) and one of the two vent plugs fitted on the right hand side at each end of the fuel injection pump (Fig. N.22).

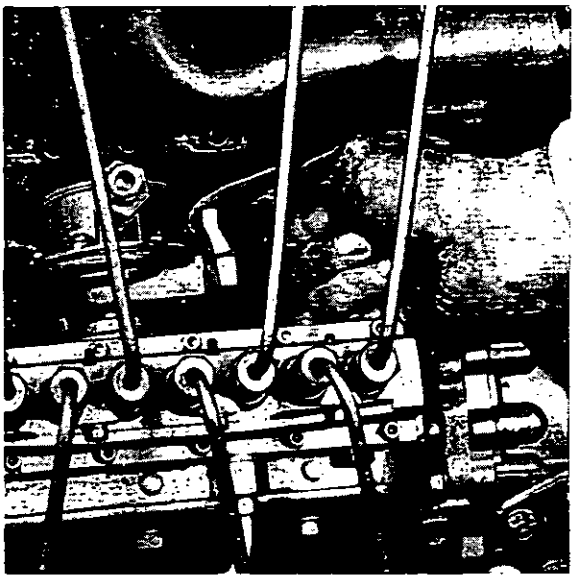
Operate the priming lever of the fuel lift pump (Fig. N.23) until fuel, free from air bubbles, issues from each venting point. If the fuel lift pump is on maximum lift, it will not be possible to operate the hand primer.

If so, turn the crankshaft half a turn.

Tighten the fuel filter vent plug and then the fuel pump vent plug.



N22



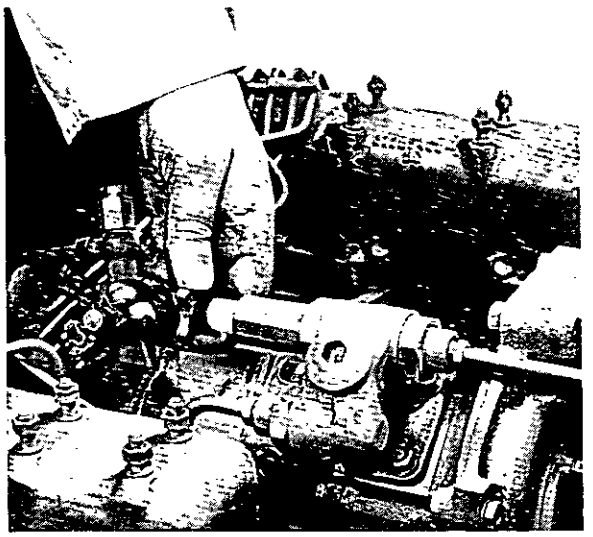
N23

Note : On some engines a non-return valve is fitted to the fuel injection pump in place of the forward vent plug, as shown in Fig N.22, with a pipe fitted between this valve and the fuel filter. This arrangement makes the system self-bleeding as it provides a continuous flow through the pump. It may be advisable, however, where a large amount of air has entered the system, to bleed the system manually, as detailed above, using the rear vent plug of the fuel injection pump.

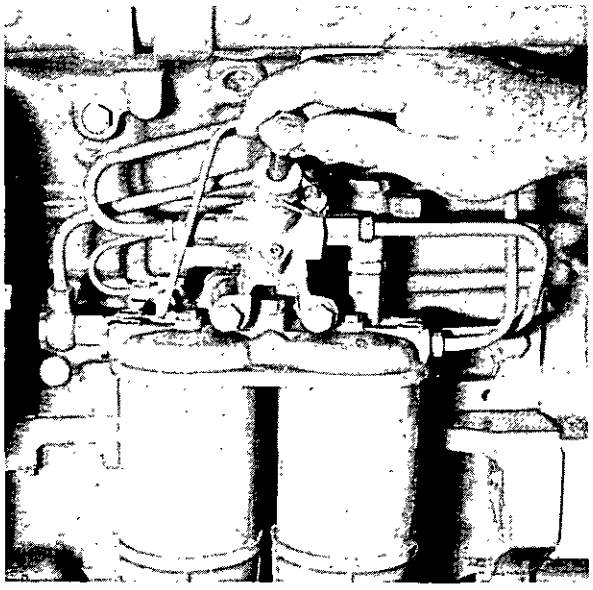
DP15 Pumps :—

Unscrew the vent plug on the top of the fuel filter (5, Fig. N.2 by two or three turns.

Unclamp or unscrew the plunger of the priming pump. The priming pump is either incorporated in the fuel lift pump (Fig. N.24) or a separate pump is fitted above the fuel filter (Fig. N.25). Operate the priming plunger until air free fuel flows from the filter vent point and then tighten the filter vent plug.



N24

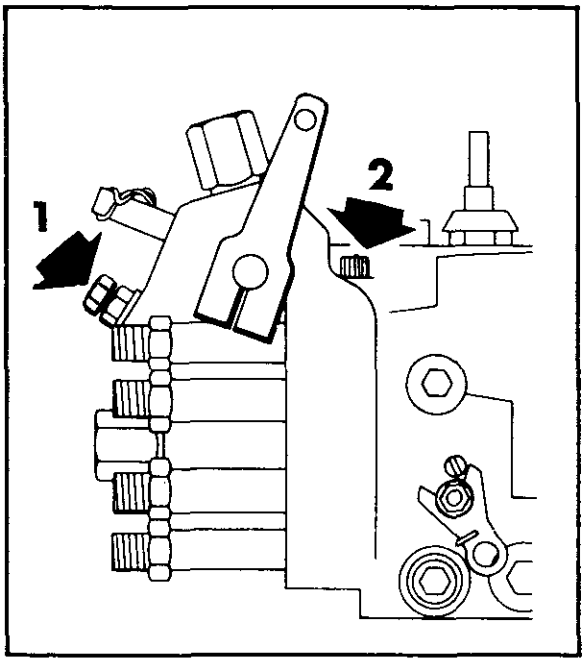


N25

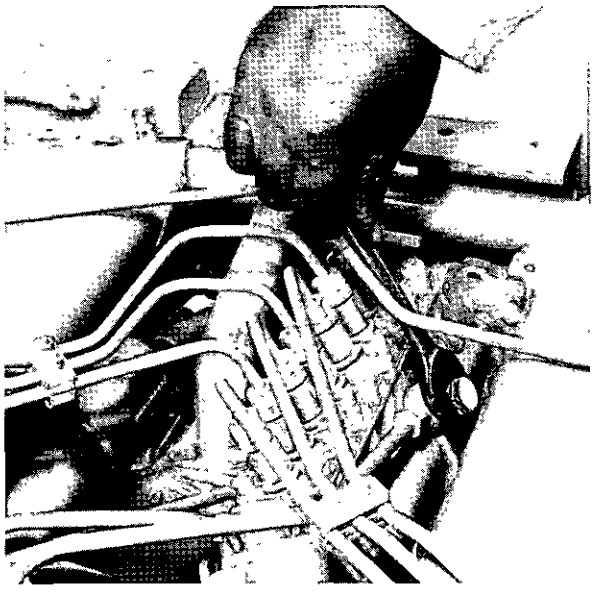
Unscrew the vent screw at the rear of the fuel injection pump (1, Fig. N.26) by two or three turns. Operate the priming plunger until air free fuel flows from the vent point and then tighten the vent screw. Secure the priming plunger to the pump.

Unscrew the vent plug and washer from the top right hand side of the fuel injection pump (2, Fig. N.26). Crank the engine over on the starter motor until air free fuel flows from the vent point and refit the vent plug and washer.

Slacken the unions at the atomiser end of two of the high pressure pipes. Set the speed control to fully open, ensure that the stop control is in the "run" position and crank the engine until air free fuel issues from both pipes. Tighten the two high pressure fuel pipe connections and the engine is ready for starting.



N26



N27

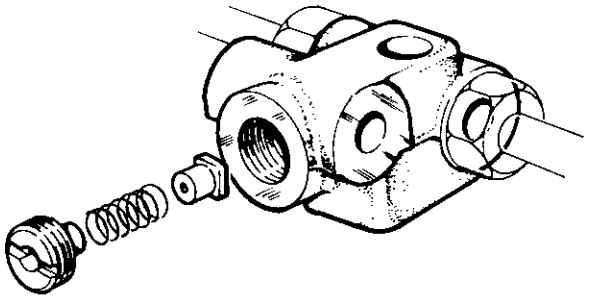
Bosch In-Line Pumps:—

Unscrew the bleed screws (1) on the top of the filter head (Fig. N.3) by two or three turns. Operate the priming pump until air free fuel issues from both the bleed points and then tighten the bleed screws.

Slacken the return connection banjo bolt of the injection pump (Fig. N.27). Operate the priming pump until air free fuel issues from around the threads and then tighten the banjo bolt. The plug fitted in the banjo bolt retains a pressurising valve spring and, if this plug is removed, ensure that the valve is refitted correctly with the flat plate towards the pump and the spring around the valve stem.

Fuel Leak-Off Relief Valve Assembly

A terminal block/relief valve assembly (Fig. N.28) is incorporated in the fuel leak-off system of some V8.540 engines. If this assembly is dismantled, ensure that the valve is refitted correctly with the long stem of the valve inside the spring. If the valve is incorrectly fitted, excessive pressure in the low pressure system will result which may cause loss of power or dilution of the oil by fuel.



N28

SECTION P
Flywheel and Flywheel Housing

Flywheel

It is advisable, when removing or fitting the flywheel, to fit suitable guide studs in the crank palm.

A timing arrow is stamped on the palm of some crankshafts for applications where flywheel timing marks are used and this arrow should be aligned with the corresponding arrow on the flywheel.

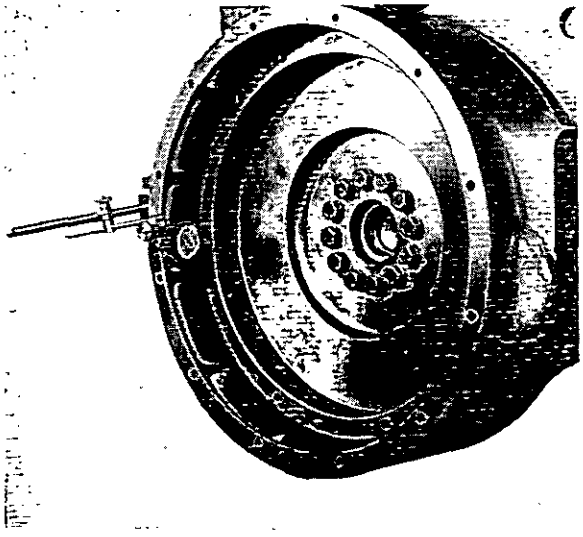
Tighten flywheel securing setscrews to 80 lbf ft (108 Nm) 11,1 kgf m.

To check alignment of flywheel face, position a suitable dial test indicator with its base on flywheel housing and plunger resting on flywheel face (Fig. P.1). Turn crankshaft and check that alignment is within limit of 0.001 in (0,025 mm) total indicator reading, per inch (25,4 mm) of flywheel radius from crankshaft axis to clock gauge plunger. When carrying out this check, press crankshaft to front or rear to take up end float whilst turning flywheel.

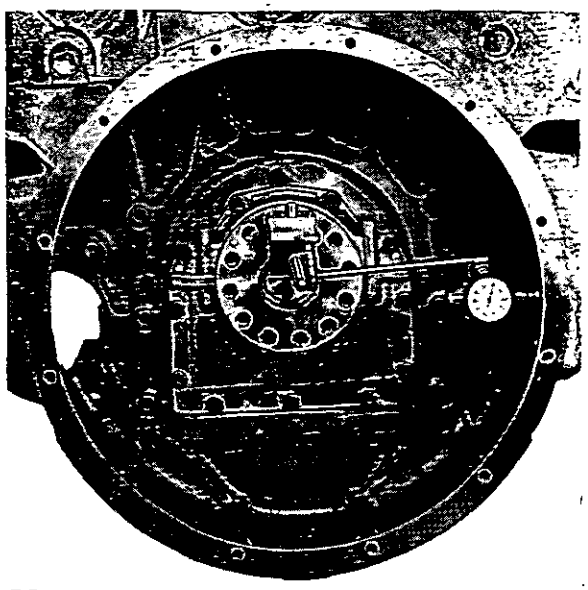
Where possible, position plunger of gauge on machined periphery of flywheel and check flywheel runout which should not exceed 0.012 in (0,30 mm).

Flywheel Ring Gear

The ring gear can be removed by suspending the flywheel assembly, by the ring gear, in cold water with the gear approximately ¼ in (6,5 mm) above the water and heating the ring gear evenly around its circumference. The gear can be fitted by heating it to a temperature not exceeding 480°F (250°C). The lead-in of the gear should be fitted towards the front face of the flywheel, i.e. that face which is towards the engine when the flywheel is fitted to the crankshaft.



P1



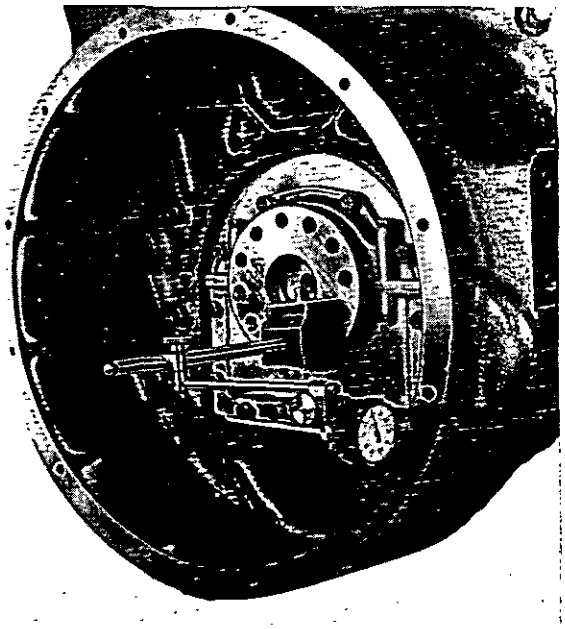
P2

Flywheel Housing

When fitting housing, check that alignment of bore (Fig. P.2) and face (Fig. P.3) are within applicable limits listed below :—

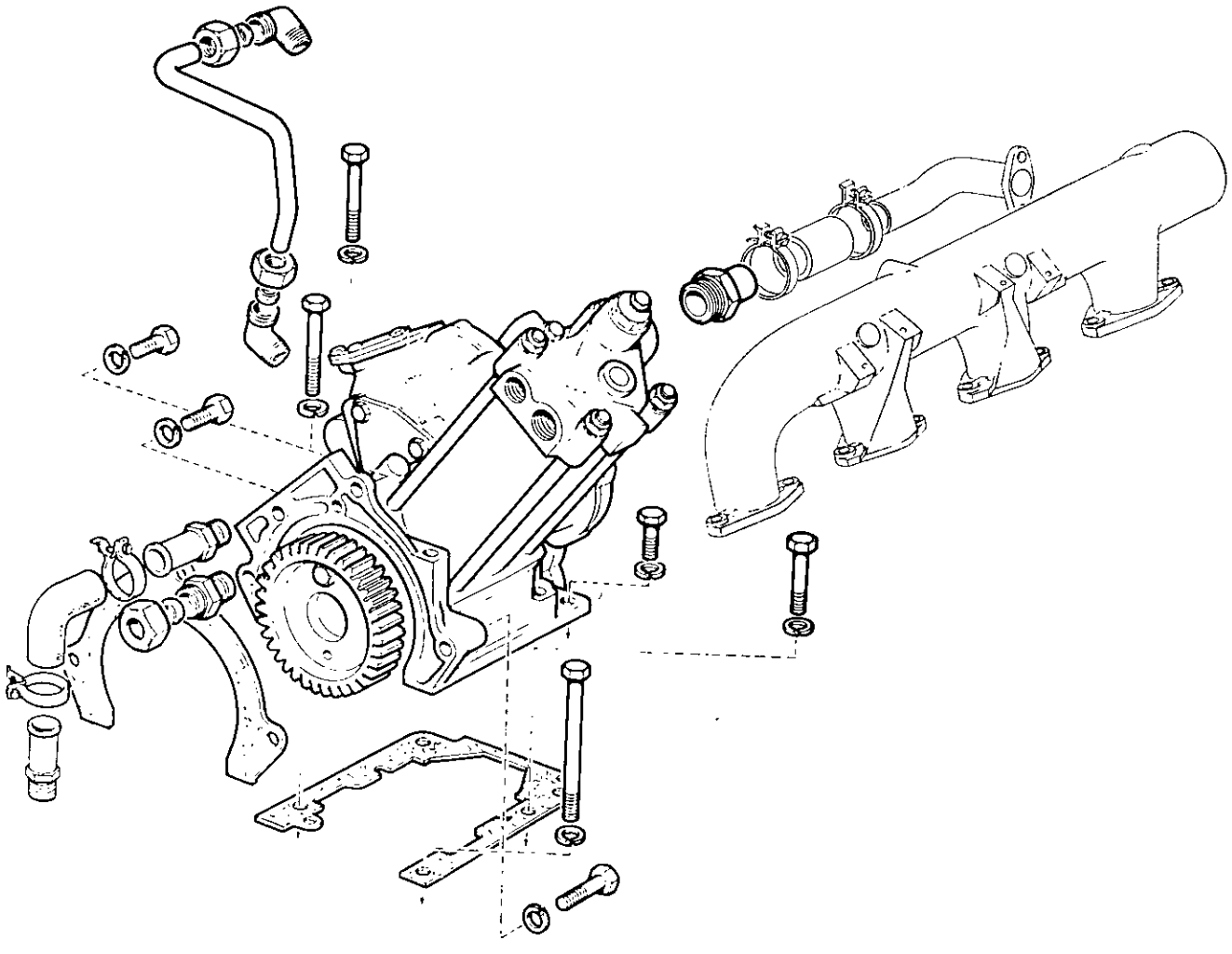
Diameter of Housing	Limit (Total Indicator Reading)
Up to 14.25 in (362 mm)	0.006 in (0,15 mm)
14.25 to 20.125 in (362 to 511 mm)	0.008 in (0,20 mm)
20.125 to 25.5 in (511 to 648 mm)	0.010 in (0,25 mm)
25.5 to 31.0 in (648 to 787 mm)	0.012 in (0,30 mm)

All adjustments to bring housing within these limits must be carried out on the housing and not on the cylinder block.



P3

SECTION Q
SCI2 Compressor/Auxiliary Drive



SC12 COMPRESSOR/AUXILIARY DRIVE—Q.2

SC 12 Compressor

The compressor is fitted between the cylinder banks at the front of the engine and is driven from the camshaft gear.

The crankcase of the compressor is an integral part of the auxiliary drive housing and the fuel injection pump drive is taken, through straight spur gears, from the rear of the compressor crankshaft.

The compressor should be phased to the engine crankshaft and later compressors, type PCGA 625/5 onwards, have a rear position timing arrangement and smaller sump tray fitted in order that the compressor can be removed or fitted without removing the engine timing case.

The manufacturer's type number is stamped on the nameplate (1, Fig. Q.3), fitted under one of the cylinder head nuts.

To Remove Compressor

If necessary, the compressor cylinder head and barrel (Fig. Q.1) can be removed with the compressor fitted to the engine, to gain access to the valves, piston rings, etc. The barrel should be marked before removal to ensure that it is fitted to its original position.

Remove compressor as follows :—

Types PCGA 625 to 625/4 :

Release air pressure from system and disconnect air pipes from compressor.

Drain cooling system.

Remove compressor water pipes.

Remove water pump and upper half timing case (*Page J.2*).

Remove fuel injection pump (Page N.5).

Release setscrews securing compressor/auxiliary drive housing to cylinder block and remove compressor (Fig. Q.2), noting position of various sizes of setscrews.

Types PCGA 625/5 onwards :

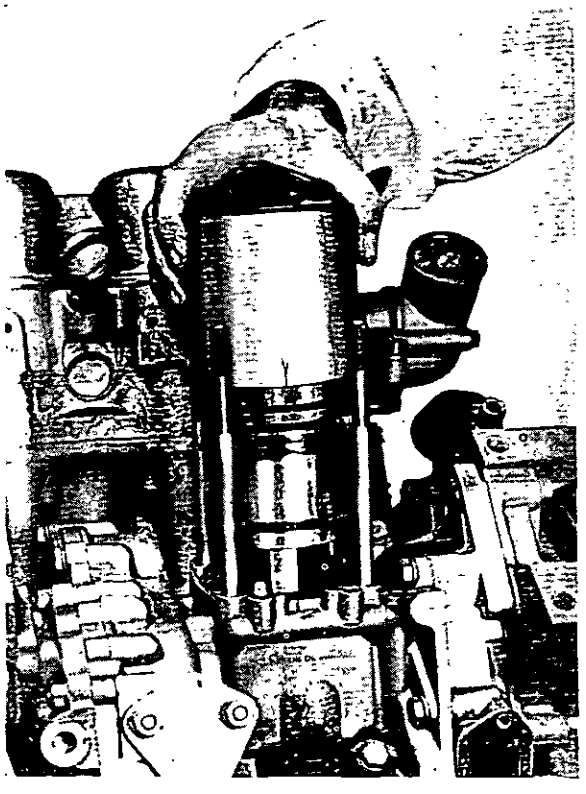
Release air pressure from system and disconnect air pipes from compressor.

Drain cooling system sufficiently to drain compressor cylinder head and water pipes.

Remove compressor water pipes.

Remove fuel injection pump (Page N.5).

Release setscrews securing compressor/auxiliary drive housing to cylinder block and timing case and remove compressor. Make a note of the positions of the various sizes of setscrews.



Q1

To Fit Compressor (Where timing case is removed)

Turn crankshaft until the single marked tooth of camshaft gear is in the 12 o'clock position.

Position a new auxiliary drive housing joint, suitably coated with jointing compound, ensuring that oil hole (1, Fig. Q.2) is not obstructed. The joint may have to be trimmed at the front edge.

Fit compressor and auxiliary drive housing with the two marked teeth of the compressor/auxiliary drive gear in mesh with the marked tooth of camshaft gear and front face of housing flush with front face of cylinder block.

Refit timing case and water pump.

Refit fuel injection pump (Page N.7) and check pump timing.

Refit fuel filter and bracket and all fuel pipes.

Connect compressor air and water pipes.

Refill engine cooling system.

Bleed fuel system (Page N.10).

Run engine, check for leaks and correct operation of compressor.

To Fit Compressor Types PCGA 625/5 onwards (Where timing case is fitted)

Turn crankshaft, in normal direction of rotation, to position No. 1 piston at T.D.C. compression stroke (Page K.2).

Fit new joints, suitably coated with jointing compound, to timing case and cylinder block ensuring that oil hole (1, Fig. Q.2) is not obstructed. The joints may have to be trimmed.

Position compressor crankshaft so that marked tooth of fuel pump drive gear (2, Fig. Q.3) is approximately half a tooth to the left of pointer (3, Fig. Q.3).

Position compressor assembly on engine. As compressor gear engages with camshaft gear, compressor shaft will turn and when assembly is fully home, the marked tooth of fuel pump drive gear should be nearest to pointer.

Secure assembly to timing case and cylinder block with setscrews and washers.

Fit fuel injection pump (Page N.7) and check pump timing.

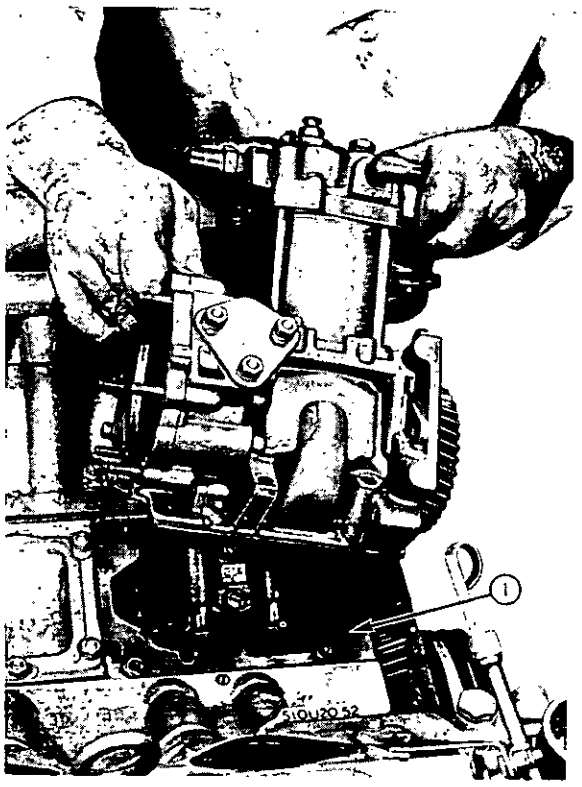
Refit fuel filter and bracket and all fuel pipes.

Reconnect compressor air and water pipes.

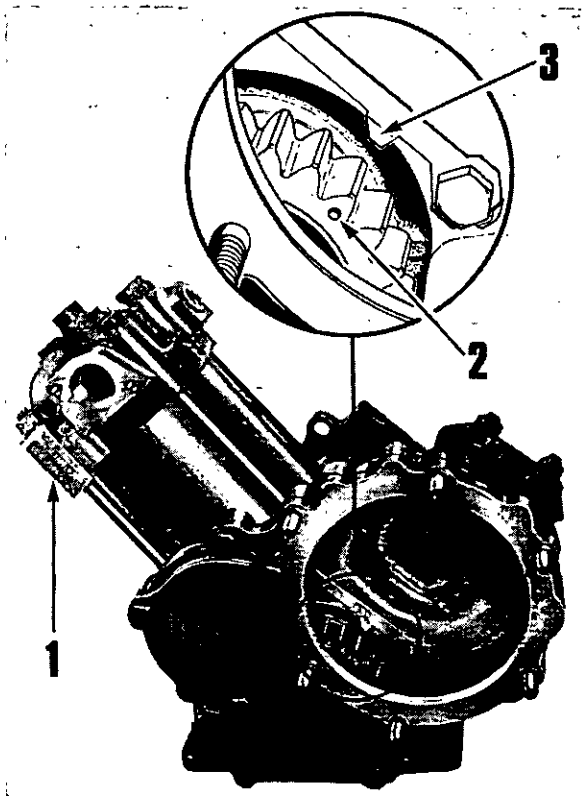
Refill engine cooling system.

Bleed fuel system (Page N.10).

Run engine, check for leaks and correct operation of compressor.



Q2



Q3

SC12 COMPRESSOR/AUXILIARY DRIVE—Q.4

To Dismantle Compressor and Auxiliary Drive

Clean exterior of compressor and auxiliary drive assembly.

Mark relative positions of cylinder head, barrel and auxiliary drive housing.

Release cylinder head nuts and remove cylinder head, gasket, barrel and barrel sealing ring.

Separate cylinder head manifold and base plate. Mark *inlet and exhaust springs to ensure correct re-*positioning on re-assembly.

Remove sump tray.

Unlock and remove connecting rod big end setscrews and remove piston and rod assembly. Remove piston rings and if necessary, remove gudgeon pin circlips and press out gudgeon pin.

Remove end cover (Fig. Q.4) and joint.

Disengage tabs of locking plate fitted inside fuel pump drive housing, remove setscrews securing housing to main body and remove housing (Fig. Q.5) and joint.

Release main bearing setscrews and remove main bearing caps, lower half bearings and thrust washers. Keep bearings and thrust washers with relevant caps.

Remove crankshaft and upper half bearings and thrust washers. Keep bearings and thrust washers with relevant caps.

Remove gears from crankshaft noting different securing arrangements.

Overhaul

Inlet and delivery valves may be lapped on very fine emery held on a flat surface. If the valves are grooved deeper than 0.003 in (0,08 mm) they should be renewed. The valve seats can be lapped with fine grinding paste and if necessary, a seating reamer can be used before lapping.

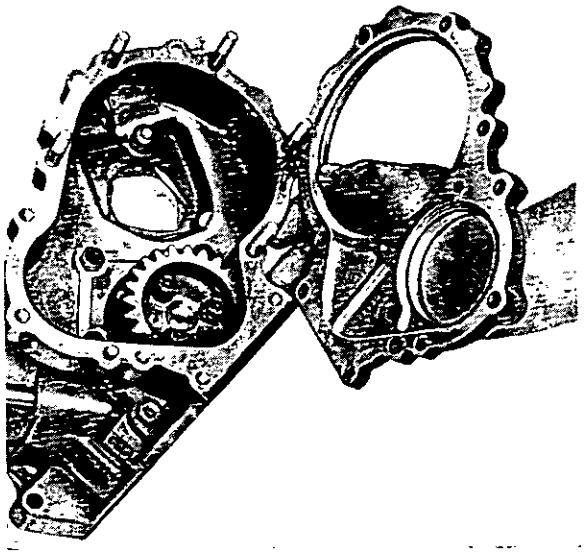
If the cylinder bore is scored or out of round more than 0.002 in (0,05 mm) or tapered more than 0.003 in (0,08 mm), renew the barrel. New rings may be fitted if the worn diameter of the cylinder does not exceed 3.3525 in (85,15 mm). If the cylinder diameter exceeds 3.3525 in (85,15 mm), renew the barrel, piston and rings.

The manufacturing clearances of the rings in the piston grooves are 0.0013/0.0033 in (0,03/0,08 mm) for the compression rings and 0.0005/0.0025 in (0,01/0,06 mm) for the scraper ring. The ring gap, when fitted in the cylinder, should be 0.003/0.007 in (0,08/0,18 mm) for compression rings and 0.010/0.015 in (0,25/0,38 mm) for the scraper ring.

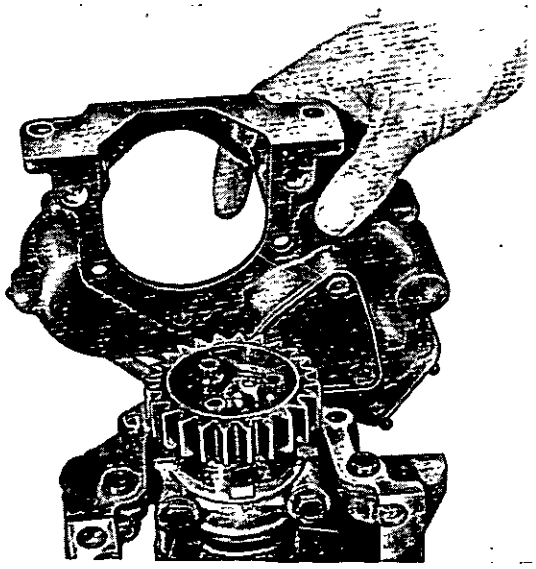
The clearance of the crankshaft in the main bearings and the crankpin in the big end bearings should not exceed 0.003 in (0,08 mm).

The gudgeon pin should be a finger push fit in the piston and have a clearance not exceeding 0.0015 in (0,038 mm) in the connecting rod bush.

Ensure all oilways are clear.



Q4



Q5

To Re-Assemble Compressor and Auxiliary Drive

Crankshaft and Main Bearings

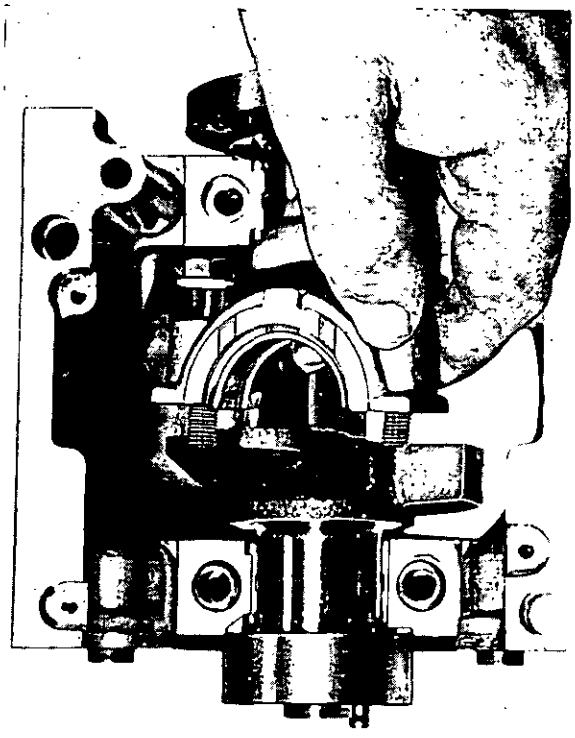
Early compressors, type PCGA 625, had oil passages in the crankcase to feed the rear main bearing whereas in later compressors, type PCGA 625-1, 625-2, etc., the oil for the rear main bearing is fed through drillings in the crankshaft. Although the later crankshaft can be fitted in the earlier crankcase the earlier crankshaft, with no drilling to the rear main journal, must not be fitted to the later crankcase. Latest compressors, type PCGA 625-8 onward, incorporate an oil supply drilling in the front main bearing cap. Ensure that the correct type bearings are used to suit the crankshaft and crankcase.

Clean all parts and lightly oil bearings, thrust washers and journals.

Fit compressor and fuel pump drive gears ensuring that dowels are fitted and gears are correctly located. Tighten gear securing setscrews to 16 lbf ft (2,2 kgf m).

Fit upper half bearings in position with locating tabs fitting in recesses in housings and place crankshaft in position with larger gear flange towards front of housing.

Position top half thrust washers between gear flanges and main bearing housing with grooved faces facing outwards towards gear.



Q6

Fit hollow dowels to main bearing housings.

Position bottom half thrust washers in main bearing caps with tabs fitting in locating grooves of caps and grooved faces facing outwards (Fig. Q.6).

Position lower half bearings in caps with locating tabs fitting in locating recesses in caps.

Fit main bearing caps, complete with lower half bearings and thrust washers, with numbers on caps coinciding with numbers on crankcase (Fig. Q.7).

Tighten main bearing cap securing setscrews to 20 lbf ft (2,8 kgf m).

Check that crankshaft end float is 0.001/0.011 in (0,03/0,28 mm).

Fuel Pump Drive Housing

Ensure all mounting faces are clean.

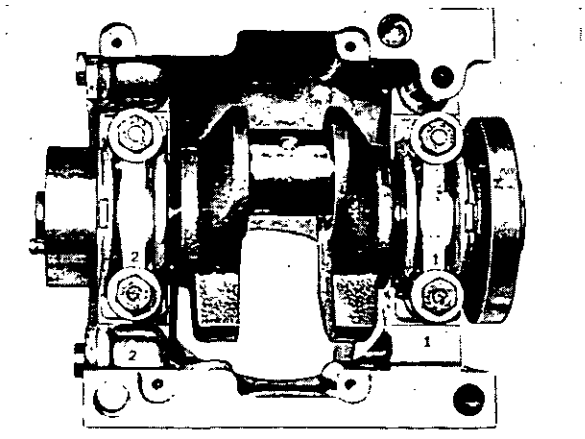
Fit hollow dowels to rear face of compressor crankcase.

Position new joint, suitably coated with jointing compound, to rear of crankcase.

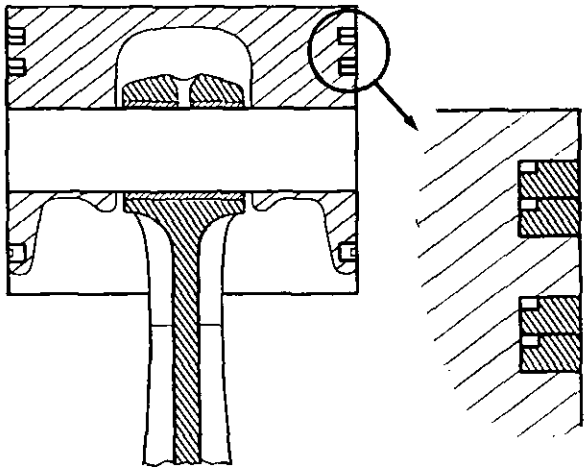
Position fuel pump drive housing and fit securing setscrews with locking plate to the three internal setscrews.

Tighten housing securing setscrews to 15/16 lbf ft (20/22 Nm) 2,1/2,2 kgf m and lock internal setscrews with locking tabs.

Ensure that dowels are fitted in rear face of housing and fit end cover with new joint, suitably coated with jointing compound.



Q7



Q8

Piston, Rings and Cylinder Barrel
Assemble piston to connecting rod and fit gudgeon pin *retaining circlips.*

Fit rings to piston with gaps equally spaced around piston. *The compression rings are fitted in pairs with* internal recesses towards piston crown (Fig. Q.8).

Lightly oil barrel and *fit in its original position with a* new sealing ring.

Fit piston and rod assembly with *tapped holes for big* end setscrews towards crankcase bottom face.

Locate bearings in connecting rod and cap with tabs fitting in their recesses.

Fit connecting rod cap with bearing tab recesses to same side as recesses in rod, tighten cap securing setscrews to 9/11 lbf ft (12/15 Nm) 1,2/1,5 kgf m and *lock with tabs of locking strap.*

Cylinder Head and Valves (Fig. Q.9).

Position valve assemblies in manifold and baseplate. *Ensure that shim washer (2) is fitted under weaker* inlet spring (3) in the recess in the baseplate (1).

Using a new joint, fit baseplate and manifold together and secure with setscrews. It is advisable to hold valves in their recesses with suitable dowels, when fitting baseplate and manifold. After fitting, check valves by lifting them off their seats several times.

Fit sealing ring (4) and retaining clip to unloader plunger (5). Smear plunger assembly and its bore with "Dow-Corning MS 200" fluid and assemble unloader spring, plunger, sealing washer and connection to cylinder head.

Fit cylinder head in its original position and tighten securing nuts down progressively to 15/16 lbf ft (20/22 Nm) 2,1/2,2 kgf m.

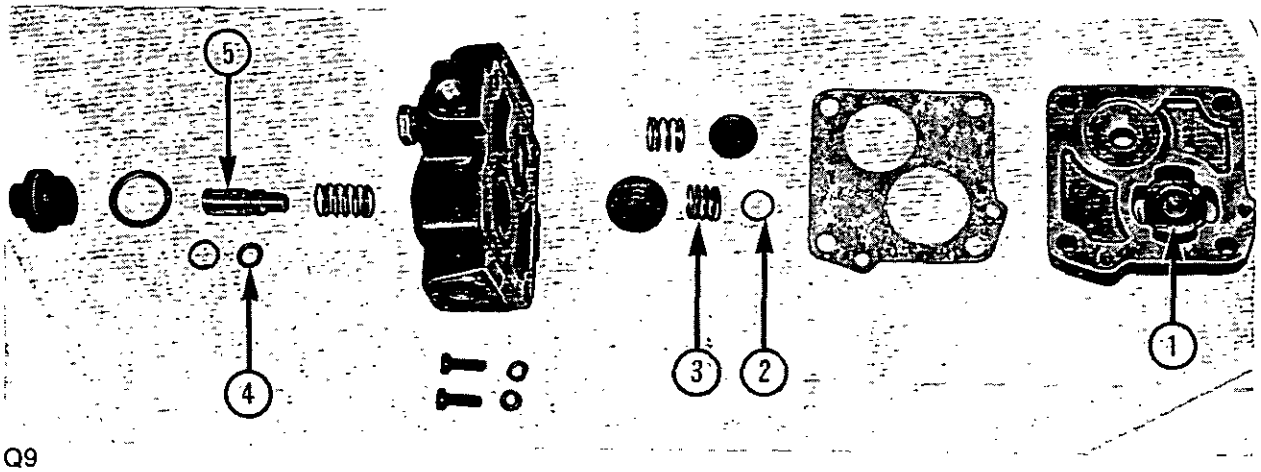
Compressor Operating Test

Reduce the pressure in the reservoir by operating the brakes and check, with the engine running, that the governor valve and unloader mechanism are functioning at the correct pressure (if possible, a master gauge should be used).

Compressor Leakage Tests

Excessive leakage past the delivery valve can be detected, with the engine stopped, by applying air *pressure at 100 lbf/in² (690 kN/m²) 7,03 kgf/cm²* to the delivery port and listening for escaping air.

If this test is satisfactory, charge the system to the normal maximum operating pressure and stop the engine. Check again for an audible air leak which, if present, indicates leakage at the unloader plunger.



Q9

Fault Finding

Compressor fails to maintain adequate pressure in the system

Dirty air cleaner or filter.

Excessive carbon in the compressor cylinder head or discharge line.

Delivery valve leaking.

Excessive wear in compressor.

Inlet valve or unloader plunger stuck open.

Excessive leakage at inlet valve.

Compressor passes excessive oil

Excessive wear

Dirty air cleaner or filter

Excessive oil pressure.

Back pressure from engine crankcase.

Piston rings incorrectly installed.

Noisy operation

Loose drive.

Excessive carbon in cylinder head or discharge line.

Excessive wear.

Compressor does not unload

Defective unloader plunger sealing ring.

Unloader plunger sticking or binding

AUXILIARY DRIVE

Where a compressor is not fitted with the standard drive arrangement, the auxiliary drive assembly is basically identical, the compressor crankshaft being replaced by a plain drive shaft.

The procedure for removing and fitting drive shaft, thrust washers, etc., is as detailed for compressor.

The bearings, etc., are identical and relevant dimensions given in "Data and Dimensions" are suitable for both applications.

To Remove and Fit Standard Auxiliary Drive

Remove fuel injection pump (Page N.5). .

Release setscrews securing auxiliary drive assembly to timing case and cylinder block and remove auxiliary drive assembly, making note of position of various sizes of setscrews.

Before fitting assembly, ensure that all mounting faces are clean.

Position new joints to cylinder block and timing case, suitably coated with jointing compound, ensuring that oil supply hole in block is not obstructed. The joints may have to be trimmed.

Position auxiliary drive assembly and secure to timing case and cylinder block with setscrews and washers.

Fit fuel injection pump (Page N.7) and check pump timing.

Refit fuel filter and bracket and all fuel pipes.

Bleed fuel system (Page N.10).

Run engine and check for leaks.

SECTION R
Electrical Equipment

ELECTRICAL EQUIPMENT—R.2

The following information is given as a general guide towards the servicing of the electrical equipment fitted to the engine, but this can vary on different applications, in which case, the procedures laid down by the manufacturer of the application may have to be followed.

This information is provided by and published by permission of C.A.V. Limited.

A typical charging system using a C.A.V. AC524 or AC7B Alternator is depicted in the schematic drawing R.1.

The various components are :—

1 Two 12V Batteries.

2 Starter Solenoid.

3 Starter Motor—C.A.V. type SL5.

4 Ammeter

5 Auxiliary Equipment and Starter Switch

6 Alternator C.A.V. type AC524.

7 Alternator C.A.V. type AC7B.

8 Alternator Warning Lamp 2.8W or 300 ohm 5 watt resistor.

9 Regulator type 440A.

10 Thermostart Relay (Optional).

11 Two 12V Thermostarts (Optional).

ALTERNATORS

General Precautions

The diodes in alternators function as one way valves and the transistors in the regulator operate as fast switches. Both are accurate and very sensitive. They do not wear and never need attention or adjustment, but, because they are sensitive to voltage changes and high temperatures, the following precautions are vital to prevent their destruction :—

1 **Never** disconnect the battery whilst the alternator is running. This will cause a voltage surge in the system, damaging diodes and transistors.

2 **Never** disconnect any electrical lead without first stopping the alternator and turning all switches to the "OFF" position.

3 **Always** identify a lead to its correct terminal before disconnection. A short circuit or reversed polarity will destroy diodes and transistors.

4 **Never** connect a battery into the system without checking for correct polarity **and** correct voltage.

5 **Never** "flash" connections to check for current flow. No matter how brief the "flash", the transistors may be destroyed.

6 **Never** experiment to try to adjust or repair the system unless you have had training on alternators and you have the correct test equipment and technical data.

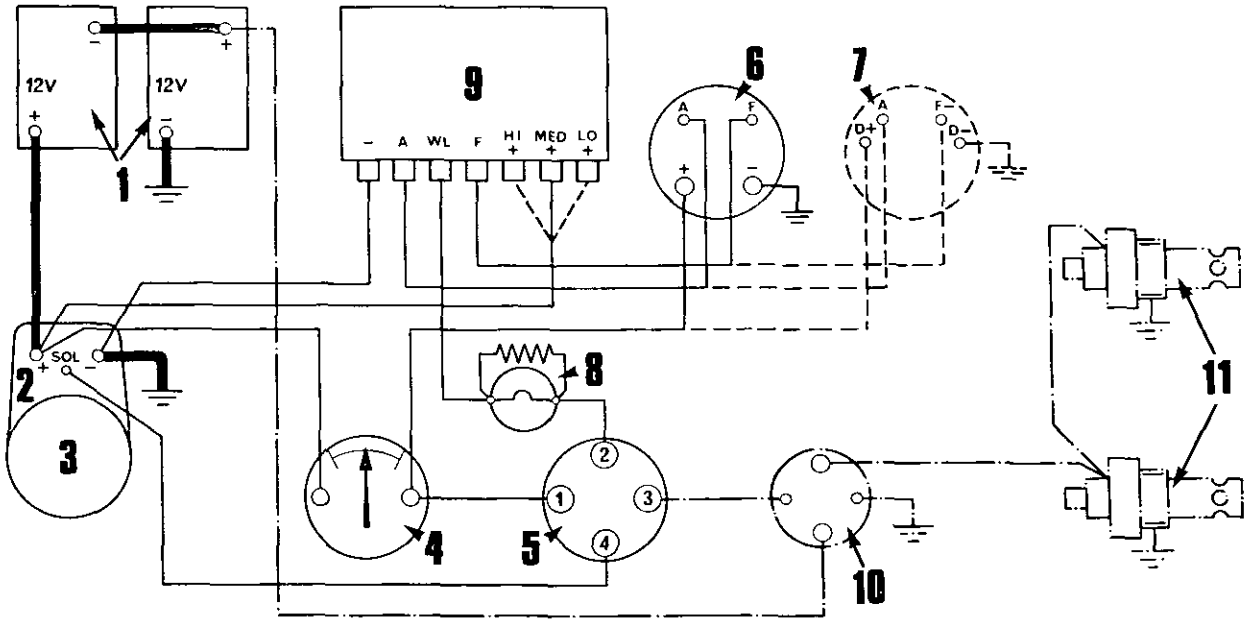
7 **Never** earth the field circuit.

8 **Never** run the alternator on an open circuit.

9 **Never** attempt to polarise an alternator.

10 **When** using a battery charger, disconnect the battery cables.

11 **Never** apply a battery voltage direct to the regulator or alternator field terminals as this will damage the transistors.



R1

12 Disconnect the alternator terminals before carrying out any electrical welding on the vehicle or machine as the intense magnetic field created by the "make" and "break" of the arc may cause damage to the diodes.

13 Do not check for continuity of the alternator or regulator with an insulation tester, such as a "Wee Megger", etc.

14 Ensure the regulator is mounted in such a position that the ambient temperature does not exceed 160°F (70°C).

15 **Never** mount the regulator directly or indirectly to the engine.

16 Always disconnect the battery before connecting test instruments (except voltmeter) or before replacing any unit or wiring.

General Maintenance

Maintenance is limited to eliminating the build up of dirt and corrosion.

1 To enhance cooling, keep the alternator clean with a cloth moistened in kerosene. Ensure that the ventilation slots or air spaces are clear and unobstructed.

2 Remove any dirt accumulated on the regulator/control box housing and ensure that cooling air can pass freely over the casing.

3 The drive belt on the alternator should be in good condition and at the correct tension (see Section M). A slack belt will slip, wear and may not drive the alternator at the correct speed, if at all. Too tight a belt will create a severe side thrust on the alternator bearings, considerably reducing their life.

4 Keep the battery fully charged.

Testing Procedures with AC5 or AC7B Alternator System fitted to Application

No open circuit, voltage or current output checks should be performed on the installation UNLESS :—

1 The warning light fails to illuminate when the alternator is stationary and the warning light switch is closed, or fails to extinguish when the alternator is running.

2 No charging current shows on an ammeter.

3 The battery is flat, indicating insufficient charging current.

4 The battery is boiling, indicating a loss of voltage control.

If any of the above conditions appear in the charging system, the procedure indicated in "FAULT FINDING" should be followed.

Unless a fault occurs, the voltage setting will remain constant throughout the life of the equipment.

Checking Operation of a Newly Wired System

All terminal connections must be made according to the application manufacturers wiring diagram.
Observe the following :—

1 Check POLARITY. Check correct connections to the regulator.

2 Disconnect the regulator if it is necessary to make wire insulation tests.

3 Tests for "EARTH" may be made using a 24 volt supply providing a series resistor is used to limit the maximum current to 0.5 AMPERES.

Test Equipment Required

1 A good quality moving coil voltmeter, 0-50 volts range.

2 A good quality moving coil ammeter, 0-100 amperes range.

Test Procedure

Connect the voltmeter across the battery. Disconnect the alternator output lead at the alternator and connect the ammeter in series with the alternator terminal and the output lead.

The battery should be in a charged condition.

The system is in correct working order when the following is observed :—

1 Close the warning light switch (switch on the application master electric switch on the dash board) when the warning light should light up.

2 Switch on a 10-15 amperes load such as lights, fans, etc. and leave on for 10-15 minutes.

3 Start engine and run at fast idle speed when :
(a) The warning light should go out.
(b) The ammeter records a small charge current dependent on the engine speed.

4 Momentarily increase the engine speed to near maximum when the charging current should be about 30 amperes for an AC524 alternator or at least 40A for an AC7B alternator.

5 Run the alternator at approximately 3,000 rev/min (engine speed about 1,500 rev/min) and switch off the electrical load as detailed in paragraph 2. Dependent upon the connection selected at the regulator for the positive sensing lead (H, M or L) see Fig. R.1, the voltage should rise to between 26 and 28 volts and then remain constant. At the same time the current reading on the ammeter should drop appreciably.

Any variance in the above data could indicate a fault and the "Fault Finding" procedure should be adopted before disconnecting any components.

The regulator is a non-repairable sealed unit and if suspected of being faulty, it must be renewed.

On some applications, the regulator is incorporated in a suppression box and if the box is suspected of being

faulty, your local C.A.V. agent should be contacted. The testing of the regulator in this arrangement is covered under the normal fault finding procedure.

Fault Finding

For any particular fault, the checking procedure should be carried out in the sequence given.

Warning light does not appear when switched "ON"

Check the bulb.

No fault.

Check all wiring connections at regulator, alternator and battery.

No fault.

Switch off, disconnect "F" lead at regulator and connect it to the regulator negative terminal. Switch on. If warning light appears, the regulator is faulty. If warning light does not illuminate, the alternator is faulty.

Warning light does not go out and ammeter shows no output with engine running.

Check all wiring connections at regulator, alternator and battery.

No fault.

Switch off, disconnect "F" lead at regulator and connect to regulator negative terminal. Switch on. Run engine at fast idle.

No Output — Alternator faulty.

Output appears — Regulator faulty.

Warning light does not go out when engine is running and ammeter shows reduced output. Full output only at maximum speed.

or

Warning light goes out but alternator gives reduced output. Full output only at maximum speeds.

Alternator Faulty, probably open circuit diode.

Warning light flashes intermittently, ammeter needle flickers with battery fully charged and no load switched on.

Excessive resistance or poor connections in Regulator negative sensing lead see fig. R.1.

No fault.

Faulty Regulator

Batteries overcharging, ammeter indicates high of full output all the time.

Check connections of Regulator positive sensing lead, see fig. R.1.

No fault.

Faulty Regulator.

STARTER MOTOR

Maintenance

Very little maintenance is necessary between overhauls beyond occasionally checking the brushes for wear and the commutator for cleanliness.

Brushgear

The brush leads should be effectiveiy insulated and clear of any obstruction. The brushes should be free and any sticking brushes rectified by cleaning the brush holders. Ensure the brushes are bedded in to at least 80% of their contact area and are refitted in their original positions. With the SL5 24 and CA45F starters, the brushes should be changed if their length has been reduced to 0.5 in (12,7 mm) or less.

Replacement brushes must be of the correct grade and be bedded in before use. Brushes must only be replaced in complete sets.

When replacing the CA45F commutator cover, ensure that the windows are fully covered and that the cover fixing screw is at the bottom when the starter is mounted on the engine. This is important as water may enter the starter if the cover is not correctly positioned.

Commutator

The surface of the commutator should be clean. If it is dirty or badly discoloured and cannot be cleaned in situ, remove the complete armature assembly in accordance with the manufacturers instructions and clean the commutator, using very fine glass paper. Ensure that all traces of dust and abrasive are blown off before reassembly.

"On Engine" Fault Finding

If the starter does not function correctly, check that the battery is fully charged and that all connections are clean and tight. A defective starter switch or badly worn starter brushes can also cause malfunctioning.

Difficulty in obtaining a smooth engagement between pinion and flywheel may be due to incorrect flywheel to pinion clearance. This should be 0.125 in ±0.031 in (3,18 mm ±0,79 mm) between the face of the flywheel and the engaging face of the pinion.

Fitting Starter Motor to Engine

When fitting a starter motor, check that there is at least 0.010 in (0,25 mm) clearance between the starter motor and cylinder block at all points.

The starter motor securing setscrews should be tightened to a torque of 50 lbf ft (69 Nm) 6.9 kgf m. The starter motors on earlier V8.510 engines were secured by socket headed capscrews and if difficulty is experienced in tightening these capscrews to the required torque, the capscrews should be replaced by twelve point headed setscrews as used on V8.540 and later V8.510 engines.

LUBRICATING OILS

Lubricating oils should meet the requirements of the U.S. Ordnance Specifications MIL-L-46152 or MIL-L-2104C. Engines installed in Heavy Duty Earthmoving Equipment should meet the U.S. Ordnance Specification MIL-L-2104C. The lubricating oils for use in Perkins Diesel engines should have a **minimum** Viscosity Index of 80.

Note: Operators are advised not to use a lubricating oil to the MIL-L-2104C specification for the first 500/1,000 miles (800/1,600 km) or 25/50 hours of operation in engines other than those installed in Heavy Duty Earthmoving Equipment.

Some of these oils are listed below and over page. Any other oils which meet these specifications are also suitable.

MIL-L-46152 OILS

Company	Brand	S.A.E. Designation		
		0°F (-18°C) to 30°F (-1°C)	30°F (-1°C) to 80°F (27°C)	Over 80°F (27°C)
B.P. Ltd.	Vanellus M	10W	20W	30
	Vanellus M		20W/50	20W/50
Castrol Ltd.	Castrol Deusol CRX	10W	20	30
	Castrol Deusol CRX	10W/30	10W/30	10W/30
	Castrol Deusol CRX		20W/50	20W/50
	Deusol RX Super		20W/40	20W/40
A. Duckham & Co. Ltd.	Fleetol HDX	10	20	30
	Fleetol Multi V		20W/50	20W/50
	Fleetol Multilite	10W/30	10W/30	10W/30
	Farmadcol HDX		20	30
	Hypergrade	—	15W/50	15W/50
	Fleetmaster	—	15W/40	15W/40
Esso Petroleum Co. Ltd.	Essolube XD-3	10W	20W	30
			15W/40	15W/40
Mobil Oil Co. Ltd.	Delvac 1200 Series	1210	1220	1230
	Delvac Special	10W/30	10W/30	10W/30
Shell	Rotella TX	10W	20W/20	30
	Rotella TX		20W/40	20W/40
	Rimula X	10W	20W/20	30
		10W/30	10W/30	10W/30
			15W/40	15W/40
			20W/40	20W/40
Total Oil Co. Ltd	Total Super HD		20W/20	30
	Total HD2-M	10W/30	20W/40	20W/50
	Total HD3-C (Rubia S)	10W	20W/20	30
	Total HD3-C (Rubia TM)		15W/40	15W/40
	Total Universal Tractor Oil (Multagri)		20W/30	20W/30
	Total Super Universal Tractor Oil (Multagri TM)		20W/30	20W/30

MIL-L-2104C OILS

Company	Brand	S.A.E. Designation		
		0°F (-18°C) to 30°F (-1°C)	30°F (-1°C) to 80°F (27°C)	Over 80°F (27°C)
B.P. Ltd.	Vanellus C3	10W	20W/20	30
Castrol Ltd.	Castrol/Deusol CRD	10W	20	30
	Deusol RX Super		20W/40	20W/40
	Agricastrol HDD	10W	20	30
	Agricastrol MP		20W30	20W/30
	Agricastrol MP		20W/40	20W/40
A. Duckham & Co. Ltd.	Fleetol 3	3/10	3/20	3/30
	Farmadcol 3	3/10	3/20	3/30
	Hypergrade	–	15W/50	15W/50
	Fleetmaster	–	15W/40	15W/40
Esso Petroleum Co. Ltd.	Essolube D-3HP	10W	20W	30
	Essolube XD-3	10W	20W	30
			15W/40	15W/40
Mobil Oil Co. Ltd.	Delvac 1300 Series	1310	1320	1330
Shell	Rimula CT	10W	20W/20	30
	Rotella TX	10W	20W/20	30
	Rotella TX		20W/40	20W/40
	Rimula X	10W	20W/20	30
		10W/30	10W/30	10W/30
			15W/40	15W/40
			20W/40	20W/40
Total Oil Co. Ltd.	Total HD3-C (Rubia S)	10W	20W/20	30
	Total HD3-C (Rubia TM)		15W/40	15W/40
	Total Super Universal Tractor Oil (Multagri TM)		20W/30	20W/30

Where oils to the MIL-L-46152 or MIL-L-2104C specification are not available, then oils to the previous specification MIL-L-2104B may continue to be used providing they give satisfactory service.

The above specifications are subject to alteration without notice.

EXAMPLES OF SERVICE FACILITIES

Service Publications

The following Service Literature may be purchased through your local Perkins Distributor

Workshop Manuals,
Operators Handbooks,
Crankshaft Regrinding,
Fault Finding Guide,
Engine Brake Testing Data
Installation and Maintenance Guide for Static Standby Engines
Etcetera.

USE ONLY GENUINE PERKINS PARTS

TO ENSURE YOU OBTAIN THE BEST RESULTS FROM YOUR ENGINE AND TO SAFEGUARD YOUR OWN GUARANTEE, FIT ONLY GENUINE PERKINS PARTS. THESE ARE READILY OBTAINABLE THROUGHOUT THE WORLD

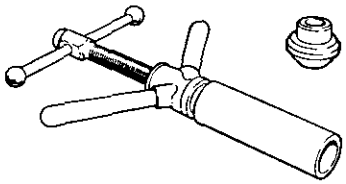
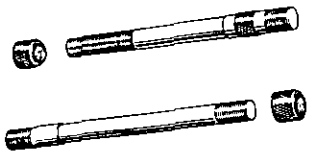
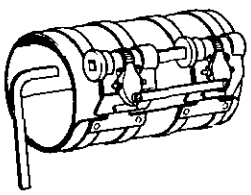
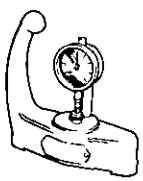
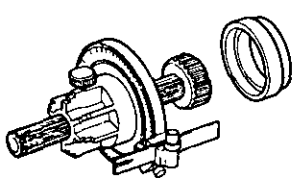
Service Instruction

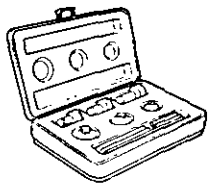
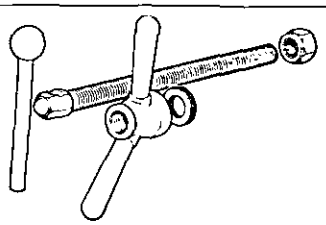
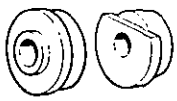
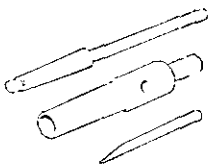
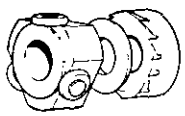
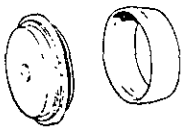
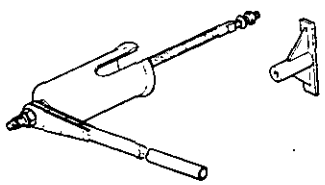
PETERBOROUGH

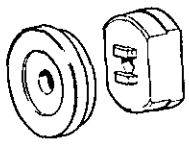
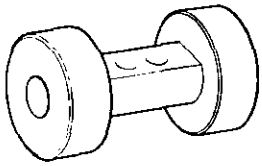
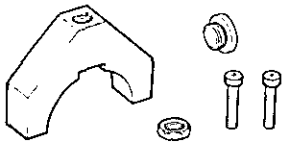
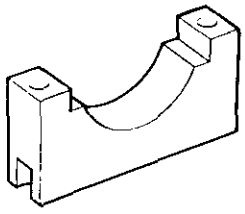
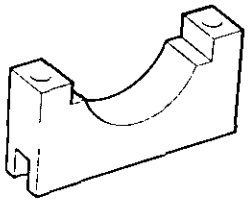
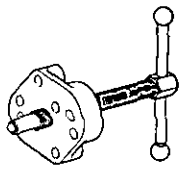
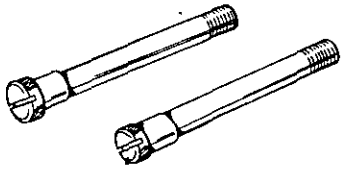
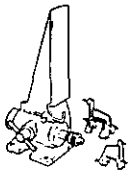
Apply to Product Education Department for details.

APPROVED SERVICE TOOLS

Available from V. L. Churchill & Co. Ltd., Daventry, Northamptonshire, NN11 4NF, England.

	Tool No.	Description
	PD.1D	VALVE GUIDE REMOVER AND REPLACER (MAIN TOOL)
	PD.1D-1A	ADAPTOR FOR PD.1D A pair of puller bars fitted with knurled nuts. Suitable for 5/16" and 3/8" guides. The necessary distance piece from the adaptors below should also be used.
	PD.1D-5	ADAPTOR FOR PD.1D A 22.5 mm (7/8") distance piece used to replace valve guides to a set height. For early V8.510.
	PD.1D-8	SHORT VALVE GUIDE REPLACER/ADAPTOR 20 mm (0.787") For V8.540 and later V8.510.
	No.8	PISTON RING SQUEEZER
	PD.41B	PISTON HEIGHT AND VALVE HEIGHT GAUGE A simple method of quickly checking piston and valve height.
	MS.67B	UNIVERSAL TIMING GAUGE (Not for in line pumps)

	Tool No.	Description
	MS.73	ADJUSTABLE VALVE SEAT CUTTERS
	PD.140	CAMSHAFT BUSH REMOVER/ REPLACER
	PD.140-1	ADAPTOR FOR PD.140
	PD.141	TIMING COVER OIL SEAL REPLACER For Standard V8.510.
	PD.143	VALVE SEAT RETAINING CUTTER AND ROLLER HANDLE Use with the appropriate valve seat cutter pilot.
	PD.143-1	ADAPTOR FOR PD.143
	PD 145B	CRANKSHAFT REAR OIL SEAL REPLACER ADAPTOR (LIP TYPE SEAL)
	PD.150A	CYLINDER LINER REMOVER/ REPLACER (MAIN TOOL) For Field Service replacement of single liners. Not advised for complete overhaul. For this work use adaptors with a hydraulic ram unit.

	Tool No.	Description
	PD.150-6A	ADAPTORS FOR PD.150 Used for removal and replacement.
	PD.150B-12	CYLINDER LINER REPLACER Used when crankshaft is not fitted.
	PD.150B-13	STIRRUP—CYLINDER LINER REPLACER Used when crankshaft is fitted.
	PD.150B-14	END CAP—CYLINDER LINER REPLACER Used with PD.150B-13 on V8.510 engines.
	PD.150B-15	END CAP—CYLINDER LINER REPLACER Used with PD.150B-13 on V8.540 engines.
	155B	BASIC PULLER The cruciform head with multiple holes at different centres is used with adaptors listed below.
	PD.155-1	ADAPTORS FOR PD.155A Used to remove water pump pulleys. Also suitable to remove Camshaft Gears.
	335	CON ROD JIG & 336 MASTER ARBOR

INDEX