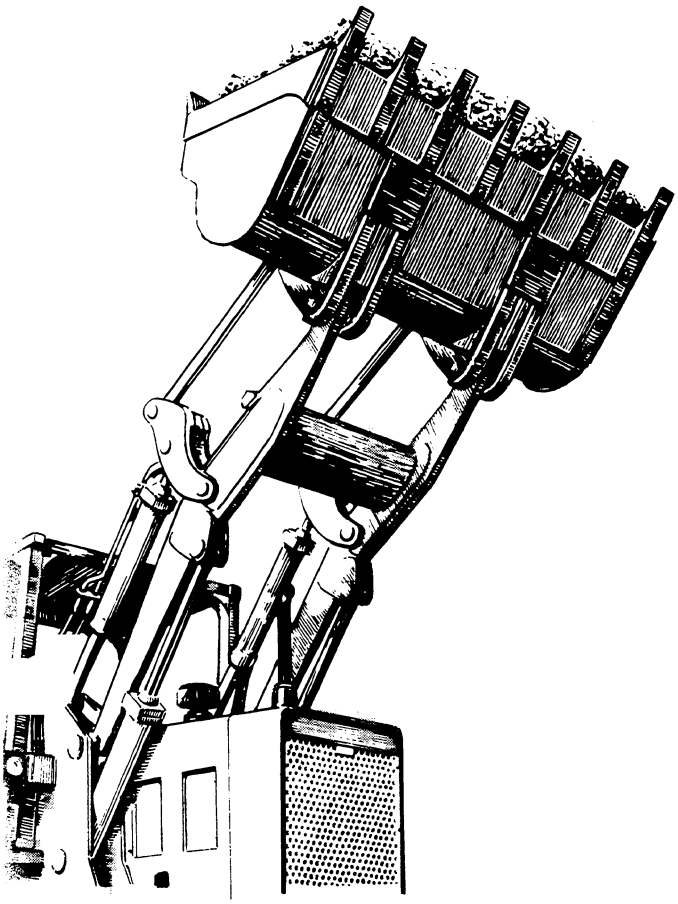
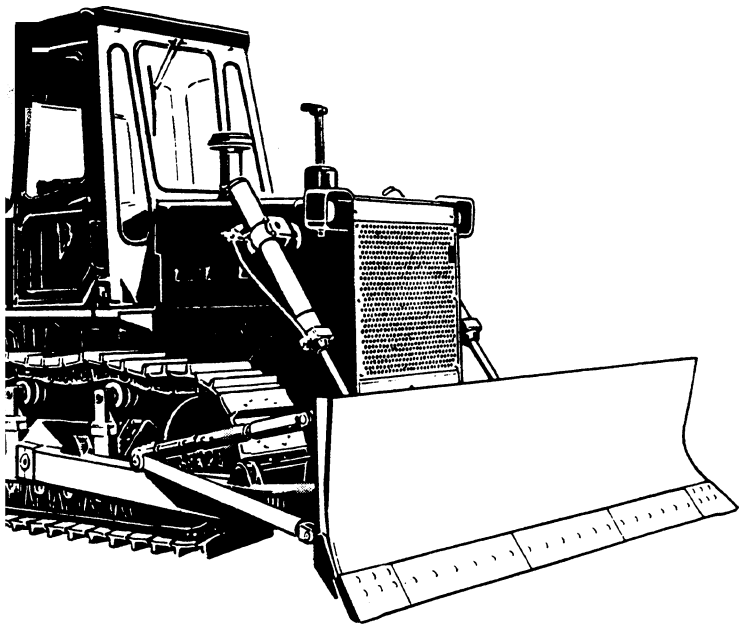


FL14 - FL14B
crawler loader

14 - 14B
dozer

150C
crawler tractor



Service manual

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FIAT-ALLIS

2nd edition

FL 14 - FL 14 B
crawler loader

14 - 14 B
dozer

150 C
crawler tractor

SERVICE MANUAL

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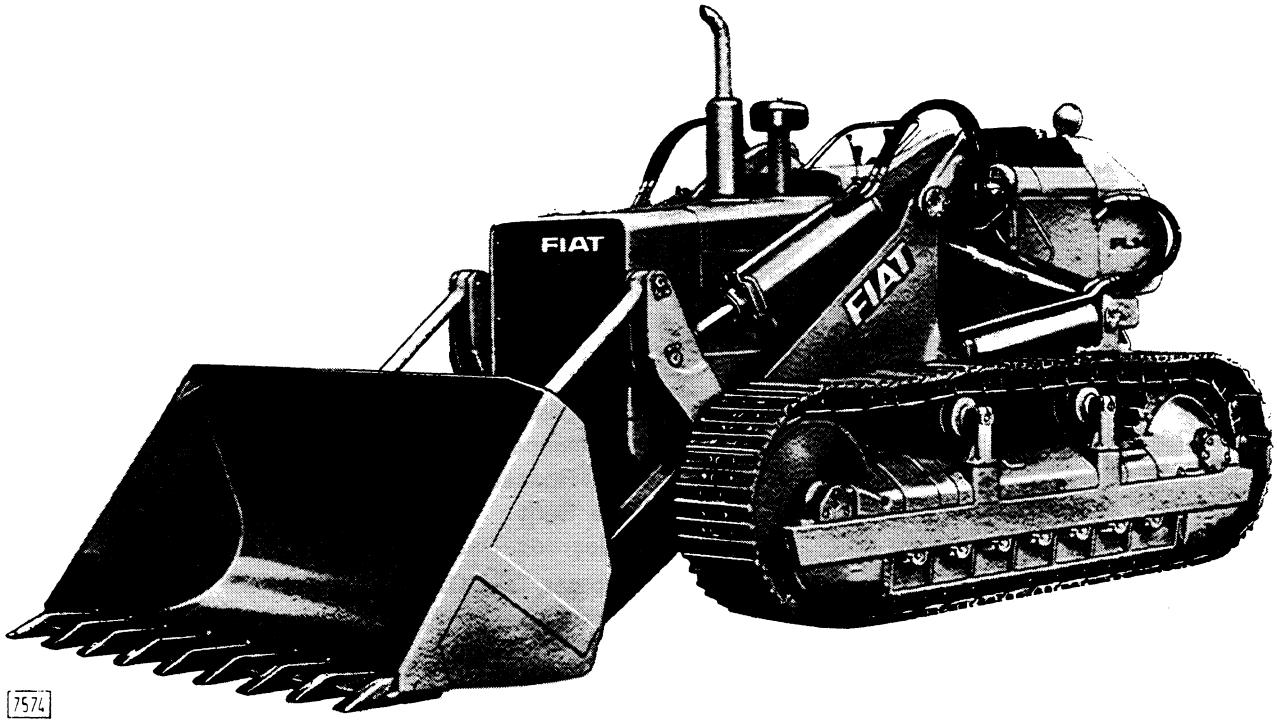
IMPORTANT

The Imperial weights and measures are given for operators' convenience and, though the closest approximation is sought, they are normally rounded off for practical reasons. In case of discrepancies only the metric units should be considered.
The wear allowances indicated for some items are given for guidance only.
Any reference made in the manual to "front", "rear", "right-hand" and "left-hand" is as viewed facing the direction of forward travel from the driver' s seat.
A. M. = Ante-modification — P. M. = Post-modification.

NEW MODEL DESIGNATION SYMBOLS

The commercial designation of the FIAT-ALLIS models was changed recently for standardization reasons. For the dozers, letters AD or BD forming the first part of the designation have been suppressed, the second part remaining unchanged. The designation symbols written on the machines and in the technical literature are being progressively updated.

LOADER
Model FL 14



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GENERAL

FOREWORD

**The descriptions, data and instructions given in this section apply to Loader Model FL 14.
Items applicable to Angledozer AD 14, Bulldozer BD 14 and Crawler Tractor 150 C are described in the subsequent sections.**

SPECIFICATION

IDENTIFICATION DATA

Chassis type	
— Engineering code	625.500
— Marketing code	150 CA
Engine type	8205.02.500
Machine type	FL 14

ENGINE

Cycle	Diesel, naturally-aspirated
Strokes	Four
Injection	Direct
No. of cylinders	Six
Bore	122 mm. (4.80 in.)
Stroke	140 mm. (5.51 in.)
Capacity	9,820 c.c. (599.2 cu.in.)
Compression ratio	16.7 to 1
Main bearings	Seven
Crankshaft rotation (as seen from fan side)	Clockwise
Output (fan, air cleaner and exhaust silencer removed)	150 H.P.
At	2,000 r.p.m.
Max. no-load speed	2,150 r.p.m.
Min. no-load speed (idling)	500 r.p.m.

Valvegear

Pushrod-operated overhead valves

Hourmeter rating	1,400 r.p.m.

Fuel System

Dry air cleaner including centrifugal pre-cleaner and two pairs of in-line paper cartridge elements with associated warning light on the dashboard. Optional oil-bath air cleaner.

Twin, in-line cloth/paper cartridge element fuel filters inserted in the fuel pump outlet line.

FIAT (BOSCH licence) fuel injection pump of the in-line type featuring six pumping elements, L.H. helix plungers and fuel recirculation system.

Fuel injection spill timing	22° B.T.D.C.
Firing order	1-5-3-6-2-4
Injector nozzles	Four spray orifices Spray angle = 160°

Lubrication System

Forced-feed system featuring gear type feed and scavenge oil pumps.

Pump drive ratio	.880 to 1

Steel gauze suction filters on each oil pump and twin-paper cartridges fitted side-by-side on the pump outlet line.

Tube type oil cooling heat exchanger branched off the engine cooling system.

Cooling System

Vane type centrifugal water pump and twin side-by-side wax type thermostats.

Pump drive ratio	1.377 to 1

Six-deep vertical tube radiator core and six-bladed blower type radiator fan.

TORQUE CONVERTER

Hydraulic, 13 in. dia., single-stage, single-phase.

Torque multiplication ratio	2.37 to 1

Double universal joint shaft between converter and gearbox.

GEARBOX

Constant-mesh spur-tooth gearbox and reverser, with five hydraulically-operated oil-bath multi-plate power-shift clutches.

Three forward and 3 reverse ratios.

Hydraulic powershift gear selector lever on the left of the driver's seat.

Power Take-off

Splined shaft on rear end of reverse clutch shaft.

Shaft speed range

— Ante-modification . . . 0 to 1,969 r.p.m.
— Post-modification . . . 0 to 2,164 r.p.m.

Shaft direction of rotation (as seen from the rear) . . Clockwise

CONVERTER/GEARBOX HYDRAULIC SYSTEM

Double gear-type hydraulic pump (feed and scavenge) operated through a pair of gears driven off the flywheel.

Pump drive ratio . . . . . 1.326 to 1

Feed pump rated output (at max. r.p.m.) . . . . . 66 litre/min. (14½ gall./min.)

Feed pump rated pressure

– Ante-modification . . . 13 kg/cm² (185 p.s.i.)
— Post-modification . . . 15 kg/cm² (213 p.s.i.)

Scavenge pump rated pressure . . . . . 1 kg/cm² (14.2 p.s.i.)

Steel wool replaceable element oil filters on feed pump inlet and outlet, and steel mesh gauze filter on scavenge pump inlet.

Main powershift valve block assembly including a number of shuttle valves.

Gearbox clutch pressure regulating valve:

— Max. pressure setting
  — Ante-modification . . 12 to 13 kg/cm² (171 to 185 p.s.i.)
  — Post-modification . . 14.5 to 15 kg/cm² (206 to 213 p.s.i.)

Retarder valve for progressive gearbox clutch engagement.

Torque converter pressure regulating valve

— Pressure setting . . . . .9 to 1.1 kg/cm² (13 to 16 p.s.i.)

Torque converter safety valve

— Pressure setting . . . . 6.7 to 8.3 kg/cm² (95 to 118 p.s.i.)

Lubricating oil pressure relief valve

— Pressure setting . . . . 2 kg/cm² (28.4 p.s.i.)

Shell-and-tube oil cooling heat exchanger branched off the engine cooling system.

BEVEL DRIVE

Centre spiral bevel reduction with bolted-on ring gear

— Reduction ratio . . . . 3.231 to 1 (13/42)

STEERING CLUTCHES

Hydraulically-operated oil-bath multi-plate 11 inch side clutches.

— Number of plates to each clutch 15

Individual control pedals

— Initial pedal travel = Clutch with drawl.
— Final pedal travel = Brake application.

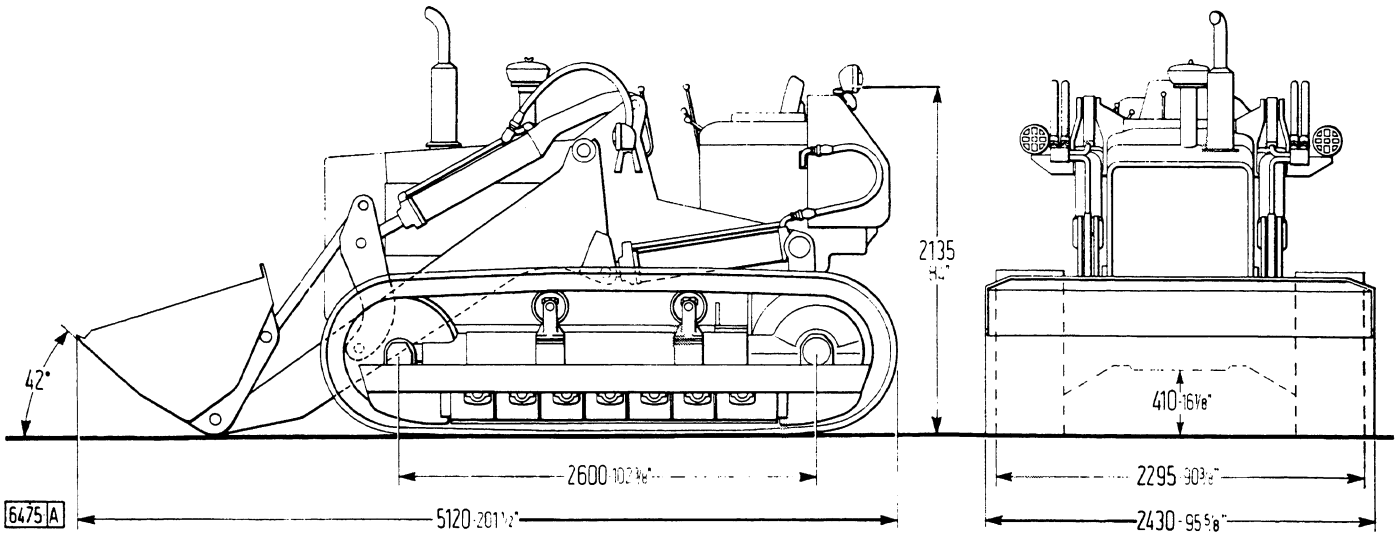


Fig. 1 - FL 14 Loader Overall Dimensions
Note: For equipment dimensions see Fig. 270.

BRAKES

Service

Hydraulic power-assisted oil-bath bands self-wrapping on steering clutch outer drums and actuated through two independent pedals lockable together by means of a bridge plate, or two combined steering/clutch brake pedals.

— Drum dia. . . . . 340 mm. (13 3/8 in.)
— Band width . . . . . 90 mm. (3 1/2 in.)

Parking

Service brakes mechanically applied through independent pedals and held in position by a locking lever.

Emergency

Quick reversing through the gear selector lever.

STEERING CLUTCH/BRAKE HYDRAULIC SYSTEM

Flywheel-driven gear type hydraulic pump
— Pump drive ratio . . . 1.326 to 1
— Rated output (at max. r.p.m.) . . . . 50.5 litre/min. (11 gall./min.)
— Max. pressure setting:
  — Ante-modification . . 29 kg/cm² (412 p.s.i.)
  — Post-modification . . 31 kg/cm² (441 p.s.i.)

Steel wool cartridge oil filter on pump inlet and paper cartridge filter on oil exhaust to transmission case.

Hydraulic control valve assembly including servo-valve, shuttle and interlock valves for brake power cylinder and steering clutch control.

— Steering clutch control valve pressure setting . . . 19.5 to 20.5 kg/cm² (277 to 291 p.s.i.)
— Brake overload/safety valve pressure setting
  — Ante-modification . . 25 to 29 kg/cm² (356 to 412 p.s.i.)
  — Post-modification . . 27 to 31 kg/cm² (384 to 441 p.s.i.)

Independent brake servo cylinders . . . . . One to each brake

HUB-REDUCTION FINAL DRIVE

Spur gear double-reduction
— Ratio
  — Ante-modification . . 10.911 to 1
  — Post-modification . . 12.286 to 1

SPROCKETS

Bolted-on split ring gear and long-life floating ring seals.

— No. of teeth 27
— Pitch circle diameter . . 824 mm. (32.44 in.)
— Face width . . . . . 78 to 80 mm. (3.07 to 3.15 in.)

UNDERCARRIAGE

Box frame track carriage assemblies anchored to tractor frame front and rear ends.

— No. of shoes to each chain 41
— Shoe width . . . . . 425 mm. (16.73 in.)
— Link pitch . . . . . 190 mm. (7.48 in.)
— Ground contact area . . 22,100 cm² (3,425 sq. in.)
— Ground pressure (specific) .70 kg/cm² (10 p.s.i.)
— No. of track rollers per track chain 7
— No. of top idler wheels per track chain 2

Hydraulically-actuated spring-type track tension assembly
— Overload valve pressure setting . . . . . 800 to 850 kg/cm² (11,378 to 12,089 p.s.i.)

Sealed-for-life track rollers, top idlers and front idler wheels, fitted with floating ring seals.

FRONT SUSPENSION

High strength beam bracing the track carriage assemblies.

REAR SUSPENSION

Two bars attached to the rear transmission case and resting on the track carriage assemblies.

Two support arms incorporated in the track carriage frames.

EQUIPMENT

Hydraulic system consisting of gear-type hydraulic pump driven off the flywheel through a pair of gears
— Pump drive ratio . . . .956 to 1
— Rated output at max. r.p.m. 287 litre/min. (75.8 Gall./min.)
— Rated pressure . . . . 122 kg/cm² (1,735 p.s.i.)

Steel wool cartridge oil filter on pump inlet and paper artridge filter branched off the oil exhaust to tank.

Hydraulic valve block assembly incorporating three shuttle valve spools, pressure relief valve, safety valves, reverse flow control valves and non-return valves in each circuit.

— Relief valve pressure setting	118 to 122 kg/cm² (1,678 to 1,735 p.s.i.)
— Safety valve pressure setting (arm raising, bucket withdrawal and scarifier raising/lowering circuits)	148 to 152 kg/cm² (2,105 to 2,162 p.s.i.)
— Bucket tipping safety setting	93 to 97 kg/cm² (1,323 to 1,380 p.s.i.)

Bucket arm double-acting cylinders (2 off)

— Bore	160 mm. (6.30 in.)
— Stroke	860 mm. (33.86 in.)

Bucket raise control release device.

Bucket roll double-acting cylinders (2 off)

— Bore	140 mm. (5.51 in.)
— Stroke	755 mm. (29.72 in.)

Bucket positioner.

SC 14 scarifier double-acting cylinders (2 off, optional)

— Bore	120 mm. (4.72 in.)
— Stroke	360 mm. (14.17 in.)

ELECTRICAL SYSTEM (24 Volts)

Two series-connected batteries	
— Capacity at 20 hour rate	136 Amp-hour
Three-phase self-rectifying alternator	FIAT A 12 M 124/24/26/B
— Maximum rating	32 Amps (approx.)
Voltage regulator	FIAT RC 2/24
Alternator warning relay	SIPEA TS 10-24
Starter	MARELLI MT 16 PC
— Output	6 HP
— Drive	Solenoid and clutch

WEIGHTS

Dry engine (without lubricant, coolant and air cleaner)	960 kg. (2,117 lb.)
Standard machine (fully operational, including driver)	15,400 kg. (33,957 lb.)

TRANSMISSION RATIOS AND TRAVEL SPEEDS

GEAR		Gearbox/Reverser Ratios		Engine-to Sprocket Ratios		Max. Travel Speed (at 2,000 engine r.p.m.)			
						A.M. (*)		P.M. (°)	
		A.M. (*)	P.M. (°)	A.M. (*)	P.M. (°)	K.P.H.	M.P.H.	K.P.H.	M.P.H.
Low	Forward	2.804 to 1	2.543 to 1	98.852 to 1	100.932 to 1	3.6	2.2	3.5	2.1
	Reverse	2.332 to 1	2.108 to 1	82.189 to 1	83.663 to 1	4.2	2.6	4.1	2.5
Intermediate	Forward	1.782 to 1	1.616 to 1	62.817 to 1	64.138 to 1	5.4	3.3	5.3	3.2
	Reverse	1.482 to 1	1.339 to 1	52.227 to 1	53.165 to 1	6.3	3.9	6.3	3.9
High	Forward	1.066 to 1	0.967 to 1	37.592 to 1	38.383 to 1	8.4	5.2	8.5	5.3
	Reverse	0.887 to 1	0.802 to 1	31.255 to 1	31.816 to 1	9.8	6.1	9.9	6.2

Bevel drive ratio (13/42)		3.231 to 1
Hub-reduction final drive ratio	A.M. (*)	10.911 to 1
	P.M. (°)	12.286 to 1
Overall ratio (bevel and hub)	A.M. (*)	35.250 to 1
	P.M. (°)	39.692 to 1

(*) Up to chassis No. 005099. - (°) As from chassis No. 005100.

CAPACITIES

ITEMS	QUANTITY					REFILL AND VISCOSITY
	Kg	lb	lt	Imp. gall.	U.S. gall.	
Cooling system	—	—	46	10 1/8	12 1/8	Water
Fuel tank	—	—	248	54 1/2	65 1/2	Diesel fuel, decanted and filtered
Engine sump, filters, lines, injection pump and governor	26	57 3/8	28,6	6 1/4	7 1/2	FIAT AGERTER OIL (*)
Engine sump only	19	41 7/8	21	4 5/8	5 1/2	
Oil bath air cleaner (opt.)	3,3	7 1/4	3,6	3/4	61/64	
Prop-shaft (2 nipples)						FIAT G9 grease
Converter gearbox (1)	25	55 1/8	27,5	6	7 1/4	Above 0 °C (32 °F) FIAT AGERTER 30 oil (SAE 30)
Rear transmission casing	24	53	26,4	5 3/4	7	below 0 °C (32 °F) FIAT AGERTER 10W (SAE 10W)
Final drives (each)	14	30 7/8	15,4	3 3/8	4	FIAT AW 90M oil
Idlers and rollers	8	17 5/8	8,8	2	2 3/8	FIAT AGERTER 30 (SAE 30)
Grease nipples	—	—	—	—	—	FIAT G9 grease
Loader hydraulic system (3)	80	176 3/8	88	19 3/8	23 1/4	AP51 fluid above 0°C (32°F); for lower temperatures use AP31, having viscosity corresponding to SAE 10W
Ripper hydraulic system (3)	11	24 1/4	12,1	2 5/8	3 1/4	

(*) Use to following oils depending on climatic conditions:

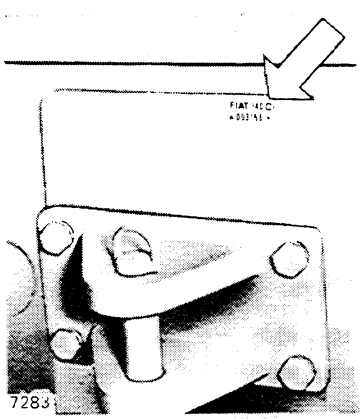
AGERTER 10 W (SAE 10 W)	Minimum below —15 °C (5 °F)	
AGERTER 20 W (SAE 20 W)	Minimum between —15 °C and 0 °C (5 °F and 32 °F)	
AGERTER 30 (SAE 30)	Max. up to 35 °C (95 °F)	Minimum above 0 °C (32 °F)
AGERTER 40 (SAE 40)	Max. over 35 °C (95 °F)	

LUBRICANT DATA

ITEM	FIAT PRODUCT	
	Name	International specification
ENGINE-GEARBOX-BEVEL GEAR-STEERING CLUTCHES	AGERTER	MIL-L-2104C; Serv. API-CD
TRACK ROLLERS - IDLERS	AGERTER 30	SAE 30
SIDE FINAL DRIVES	AW 90/M	SAE 90 EP; MIL-L-2105B
EQUIPMENT HYDRAULIC SYSTEM	AP 31	SAE 10 W oil for hydraulic control circuits. Contains oiliness, antioxidizing and anti-wear additives.
	AP 51	Same - SAE 20 W
GREASE SYSTEMS	G9	Lithium - Calcium base grease, water/high load/temperature resistant N.L.G.I. N. 2 consistency.

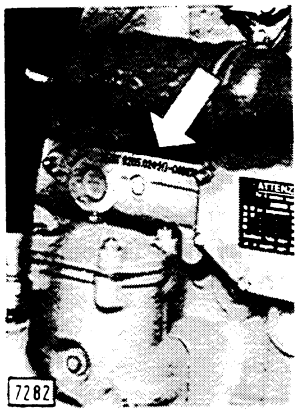
(1) If fuel sulphur content is more than 1% change oil every 150 hours in order to avoid fast engine wear.
(2) Change oil in the cleaner as soon as dust or dirt on the bottom is 1 cm (3/8 in) thick.
(3) The quantities shown refer to normal refilling.

IDENTIFICATION DATA

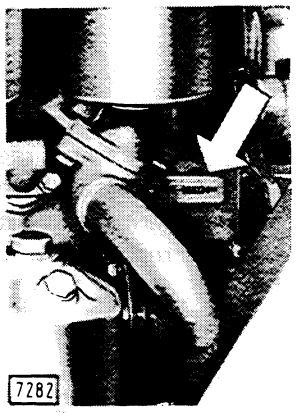


Chassis number

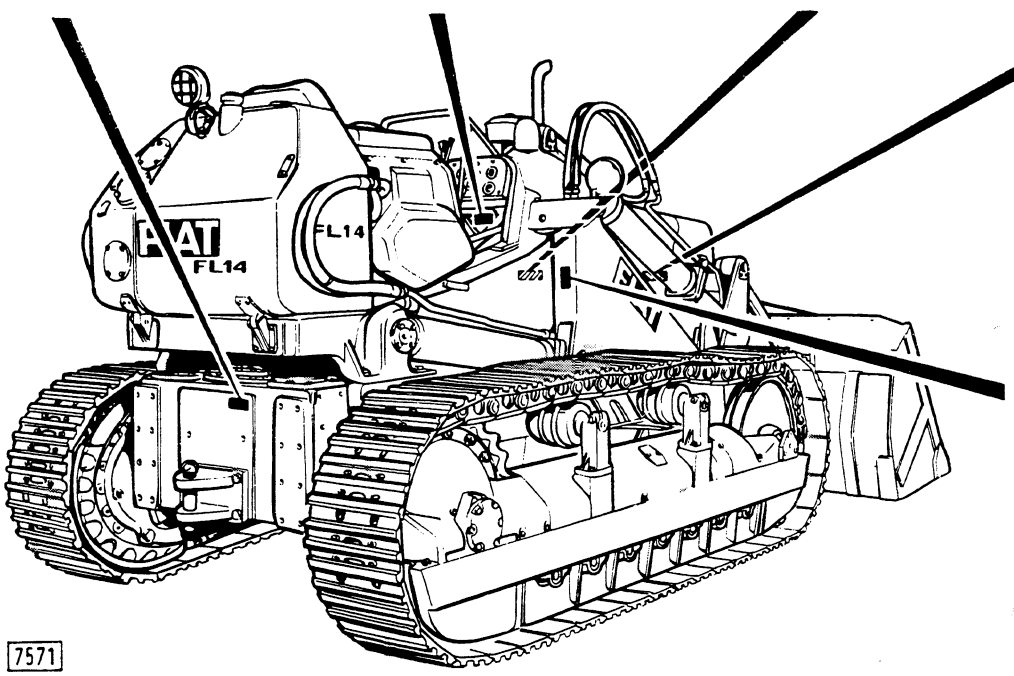
Data plate



Engine number (P.M. location)



Engine number (A.M. location)



Equipment number

Fig. 2 - Location of identification data on the machine

SPARE PARTS

Whenever replacement parts are required it is essential that only genuine spares should be fitted to ensure efficient running.

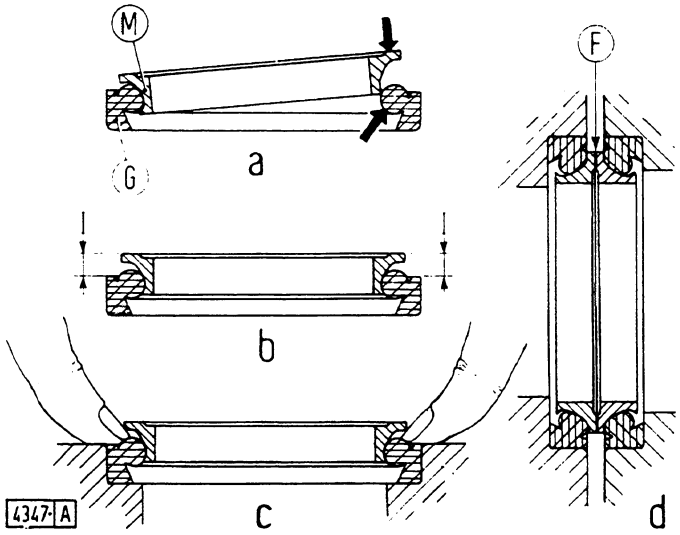
When ordering, please state:

— Tractor model (marketing code) and chassis number (see Fig. 2).
— Engine type and number (see Fig. 2).
— Spare part number (see the Spare Parts Catalogue).

GENERAL FITTING NOTES

FLOATING RING SEALS

Carefully examine metal rings (M) ensuring that their sealing surfaces are free from score marks, dents or wear due to misalignment or flatness errors.
Both metal rings, together with rubber seals (G), should be renewed even if only one is found to be defective.



Do not pair new and worn metal rings together, nor used rings of different pairs.

If necessary, rubber seals (G) can be renewed without changing the metal rings.

To fit a seal proceed as follows:

— Remove all sharp corners and burrs, and carefully clean the rubber seal housings.

— Thoroughly clean the rubber seals.

— Couple each metal ring to the associated rubber seal as shown in (a), pushing and pressing as indicated by the arrows.

— Ensure that each metal ring is properly seated - dimension I (see detail b) should be equal all round.

— Place each seal assembly in position by depressing the rubber ring as shown in detail (c).

— Before pairing the seal assemblies (see detail d) clean sealing faces (F) using a lint-free cloth and smear a light coat of highly fluid oil over the contact surfaces.

ROTARY SHAFT SEALS

To fit rotary shaft seals proceed as follows:

— Prior to fitting, soak the seals for at least half an hour in the fluid to be retained.

— Carefully clean the shaft and ensure that the contact surface is free from damage.

— Turn the end of the sealing lip towards the fluid to be retained. If of the thrower lip type, turn the grooves so that during shaft rotation the fluid tends to be thrown back.

— Smear the sealing lip with a very thin coat of lubricant (oil is better than grease) and pack the space between sealing lip and dust shield with grease (applicable to double lip seals).

— Fit the seals into their housing using a flat-ended tool or ram. Under no circumstances fit with a drift and hammer.

— Avoid entry of the seal into the recess in a tilted position. Exert a firm and uniform pressure squarely on it and ensure that the seal is pressed fully home.

— To prevent sealing lip damage during fitting, it is advisable to use some sort of protection before sliding over the shaft.

"O" RINGS

Lubricate each ring prior to fitting and, on reassembly, slide over the part but do not twist, otherwise leakage will result.

FACE SEALING RINGS

To remove proceed as follows:

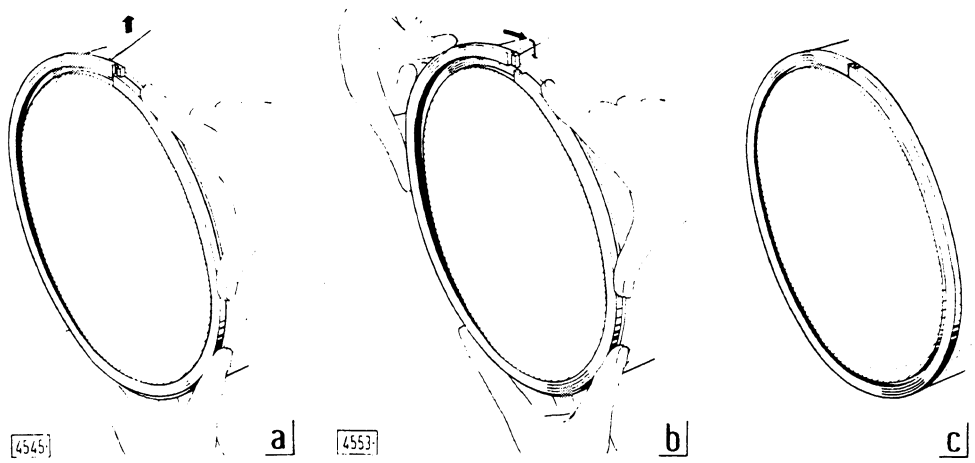
— Depress one end of the ring (see a).

— Hold in position and insert a scriber point beneath the other end to separate the interlocking ends as shown.

To refit adopt the following procedure:

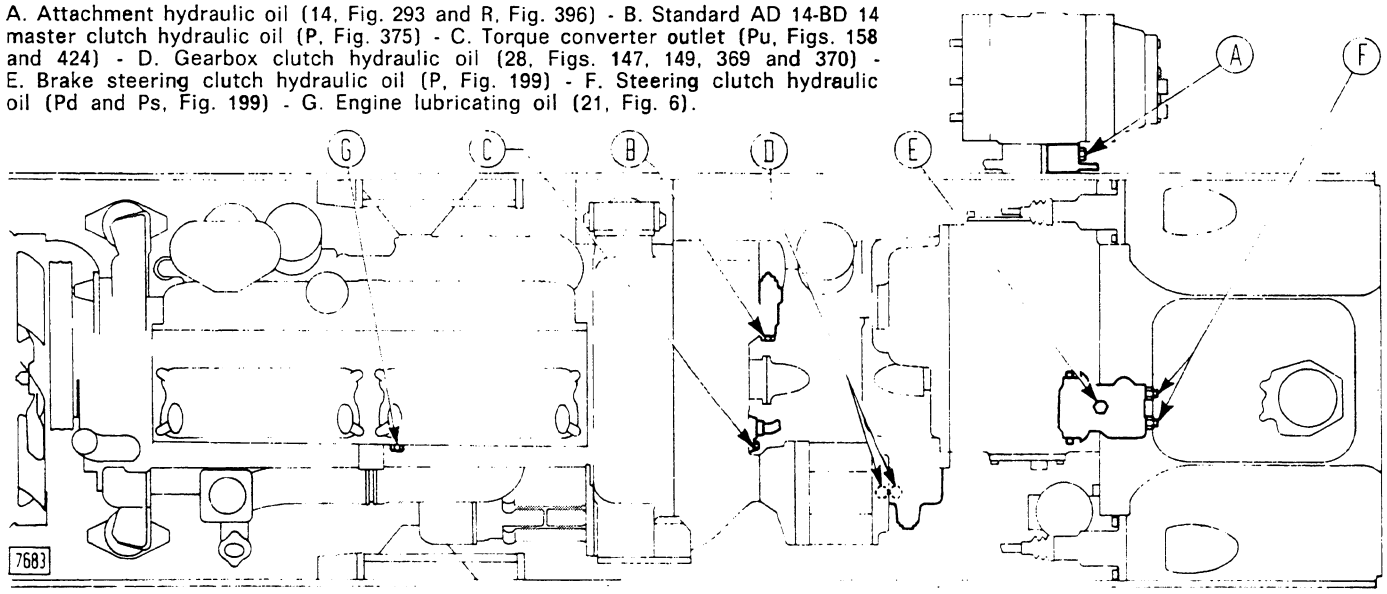
— Re-position the seal and depress one end of the ring (see b).

— Hold in position and lift the free end (see b) until the two ends lock together correctly (see c).



HYDRAULIC/LUBRICATION SYSTEM PRESSURE CHECK POINTS

A. Attachment hydraulic oil (14, Fig. 293 and R, Fig. 396) - B. Standard AD 14-BD 14 master clutch hydraulic oil (P, Fig. 375) - C. Torque converter outlet (Pu, Figs. 158 and 424) - D. Gearbox clutch hydraulic oil (28, Figs. 147, 149, 369 and 370) - E. Brake steering clutch hydraulic oil (P, Fig. 199) - F. Steering clutch hydraulic oil (Pd and Ps, Fig. 199) - G. Engine lubricating oil (21, Fig. 6).



ENGINE

DESCRIPTION

The FIAT engine (see Figs. 3 and 4) fitted to class 14 equipment is a high speed, 4 stroke, 6 in-line, naturally-aspirated Diesel unit.

The **engine block** is a single casting with machined bores, main bearing housings, camshaft bearing housings and valve tappet bores.

The dry type cast iron **cylinder liners** are cold-fitted into the engine block.

Two **cylinder heads** are fitted, one to each group of three cylinders, incorporating steel valve seat inserts and fuel injector sleeves.

The **crankshaft** runs on seven main bearings.

The light alloy **pistons** carry two compression rings and two oil scaper rings.

The **valve timing gear train** consists of helical gears, pushrod operated camshaft, overhead valves with double springs and valve guides inserted in the cylinder heads.

Air is drawn into the engine through a replaceable paper element dry cleaner.

Fuel injection is direct into the high-turbulence combustion chambers machined into the piston crowns, through in-line plunger injection pump unit incorporating 4-orifice fuel injectors.

The forced-feed **lubrication system** includes a double gear pump (feed and scavenge) and pressure relief valve, twin paper element full flow oil filter and heat exchanger branched off the engine cooling circuit. Up to engine No. 001869, the lubrication system also includes both the fuel injection pump and the speed governor.

The **cooling system** comprises a centrifugal water pump, radiator and blower fan.
Water temperature regulation is effected by two side-by-side wax element thermostats.

Engine starting is by means of a 24 Volt electromagnetically operated starter motor.

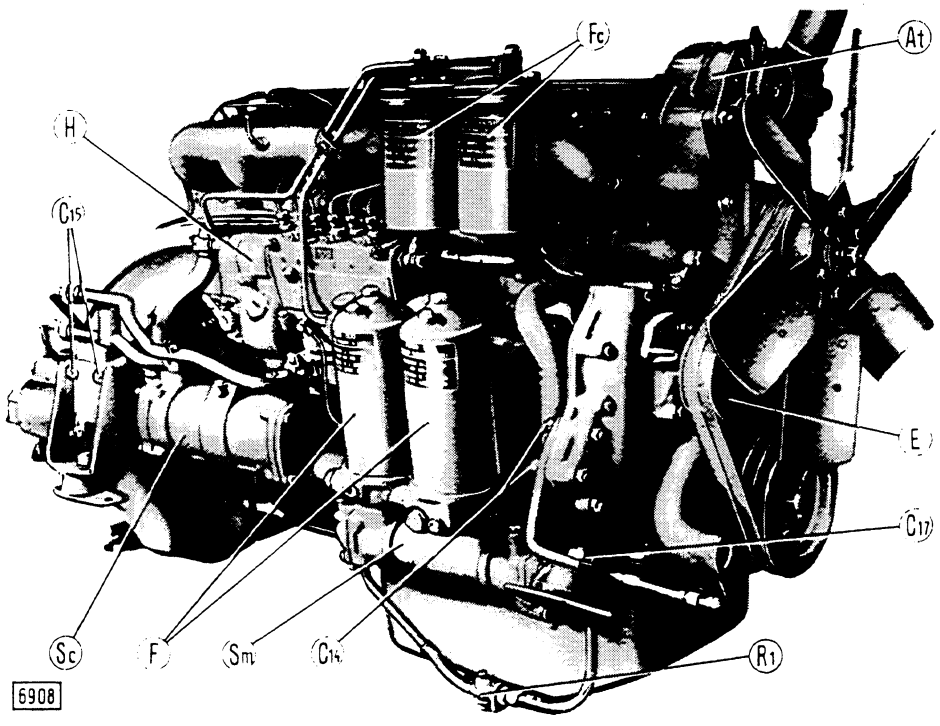


Fig. 3 - Front Right-hand Side View of the Engine

At. Alternator - C_{14}. Front bracket retaining nuts - C_{15}. Rear bracke self-locking screws - C_{17}. Cushion pad retaining nut - E. Tensioner pulley - F. Oil filters - Fc. A.M. fuel filters - H. Fuel injection pump - R_1. A.M. Water drain tap - Sc. Converter/gearbox oil heat exchanger - Fm. Engine oil heat exchanger.

BENCH TEST DATA

TEST CONDITIONS

— Engine on bench with fan, air cleaner and exhaust silencer removed.
— Atmospheric pressure 740 ± 5 mm. Hg.
— Ambient temperature 20 ± 3 °C.
— Relative humidity 70% ± 5.
— Fuel density 830 ± 10 gram/litre.
— Spill cut-off setting 22 ± 1° B.T.D.C., cylinder No. 1 in compression stroke.

Throttle lever position	Engine R.P.M.	Corresponding H.P. after running-in		Time required to burn 500 c.c. (30.5 cu.in.) of fuel
		2 Hours	50 Hours	
Maximum (full load)	2000	142 (Min.)	147 (Min.)	57.5 (Min.)
Maximum (maximum torque approx.)	1400	107 (Min.)	111 (Min.)	79 (Min.)
Maximum (no-load)	Up to 2150	—	—	—
Minimum (no-load)	500 to 550	—	—	—

COMPRESSION TEST

If engine performance is found to be unsatisfactory, check the injection system (using master nozzles and test injection pump) and the compression in each cylinder.
To check engine compression use tester **291310** proceeding as follows:

— Remove the injector from each of the six cylinders.
— Fit master injector **292632 (682 N2)** in place of the injector of the cylinder under test, and ensure positive sealing by applying a copper washer on the bottom of the fuel injector sleeve.

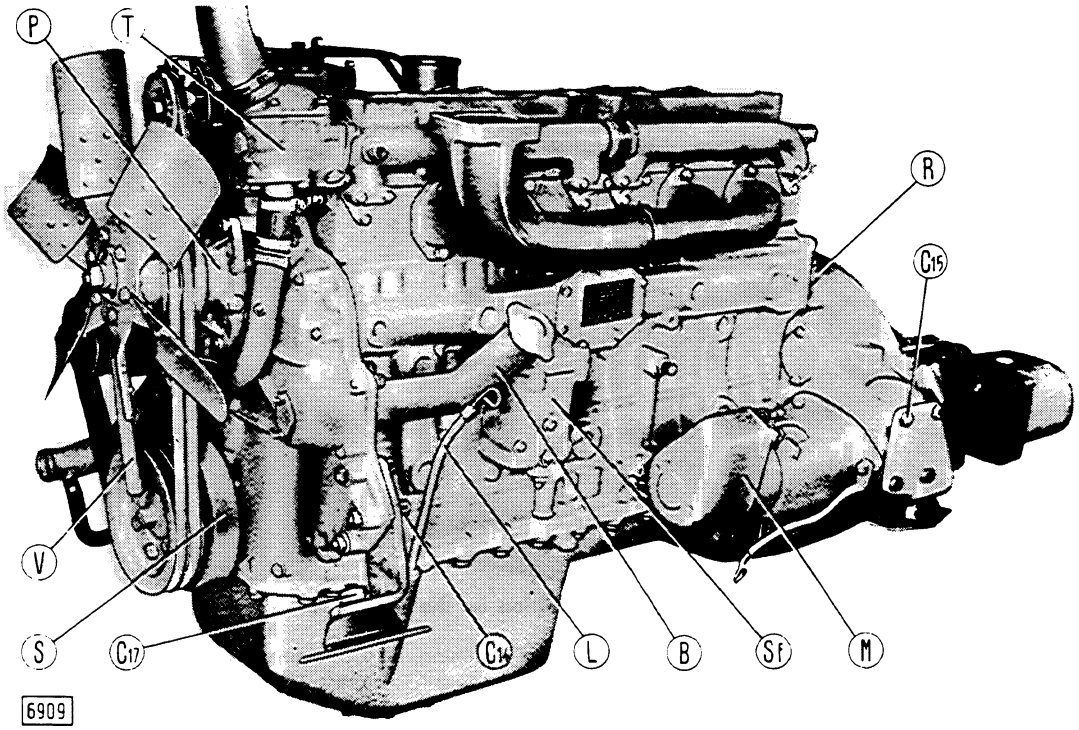


Fig. 4 - Front Left-hand Side View of the Engine
B. Oil filler - C_{14}. Front bracket self-locking nuts - C_{15}. Rear bracket self-locking screws - C_{17}. Cushion pad retaining nut - L. Oil dipstick - M. Starter - P. Water pump - R. Tachohourmeter angle drive - S. Vibration damper - Sf. Breather - T. Thermostats - V. Blower fan.

— Hold the injection pump in engine stop condition and take the necessary readings driving the engine through the starter.

In normal operating conditions, compression should be 26 to 28 kg/cm² (370 to 398 p.s.i.) as recorded at 40 °C sump oil temperature, 760 mm. Hg (sea level) atmospheric pressure with the engine running at 180 to 200 r.p.m.

The minimum compression which is acceptable for a worn engine is 22 kg/cm² (313 p.s.i.).

In this connection it should be noted that every 100 metres (328 ft.) altitude increase from sea level results in a 1% (approx.) decrease in compression.

The maximum compression differential between cylinders is not to exceed 3 kg/cm² (42.7 p.s.i.).

Insufficient compression may be due to faulty valves and seats, pistons and associated rings, cylinder liners or cylinder head gaskets.

Note: The purpose of the compression test is to assess the consistency of compression in the cylinders and to obtain an indication of the degree of wear affecting the parts which help to seal the combustion chambers. Therefore, the test results should not be interpreted as giving an absolute indication of engine efficiency.

TO REMOVE

1 Raise the bucket. Remove both fixed and pivoting engine side guards, the torque converter/gearbox side guards, rear and centre transmission covers and the footboards.

2 Drain the cooling system, drain the torque converter/gearbox oil and slacken the equipment hydraulic oil tank filter vent plugs.

3 Tip the driver's seat, turn off the fuel tank tap and disconnect the battery earth lead.

4 To remove the radiator assembly with attached air ducting, proceed as follows:
— Remove the exhaust silencer, the top panelling and the front grille.
— Withdraw the cowl from the top.
— Remove the air ducting grille and disconnect both water inlet and outlet sleeves.

5 Remove the pre-cleaner and air cleaner assembly with attached elbow connectors.

6 Disconnect the electrical cables, the piping, and the linkage to the instrumentation on the dashboard, fuel tank and to the accelerator contr (see Figs. 5 and 6).

7 Disconnect the pipes running from torque converter/gearbox hydraulic pumps to the other transmission units (see Figs. 7 and 8).

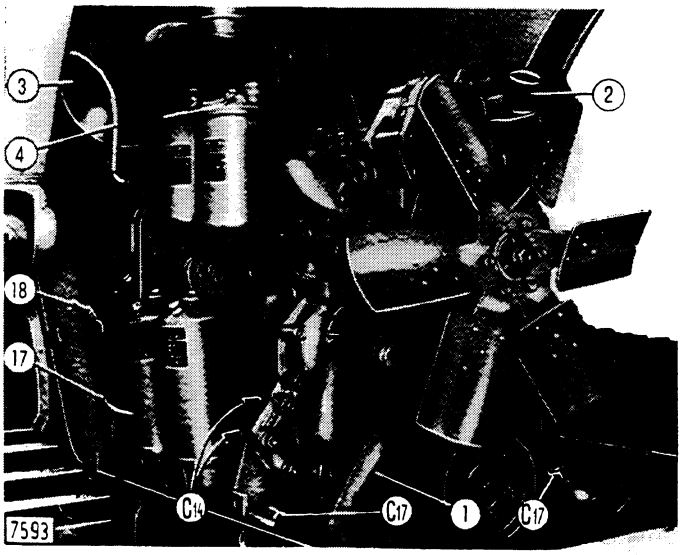


Fig. 5 - Right-hand Side View of the Engine in Position on the Machine

C_{14}. Front bracket self-locking nuts - C_{17}. Cushion pad retaining nut - 1. Radiator outlet pipe - 2. Radiator inlet pipe - 3. Air cleaner - 4. Air cleaner warning transmitter tube - 17. Fuel line - 18. Accelerator linkage.

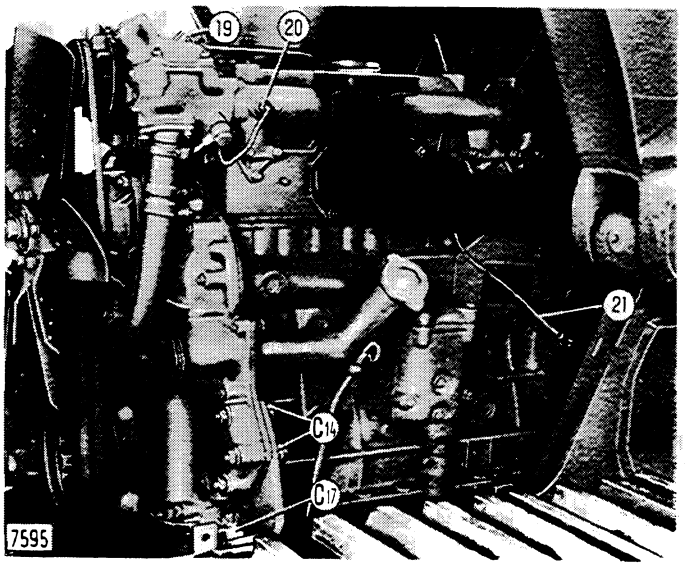


Fig. 6 - Left-hand Side View of the Engine in Position on the Machine

C_{14}. Front bracket self-locking nuts - C_{17}. Cushion pad retaining nut - 19. Alternator leads - 20. Water temperature transmitter - 21. Engine oil pressure gauge transmitter tube (pressure point thread size = M 14 × 1.5).

- Place lifting hook **291493** on the engine, hoist to take up the weight of the engine, remove the rear left-hand mounting bracket, take off the rear right-hand mounting bracket with attached cushion pads, separate the front cushion pads from the machine frame and withdraw the complete power unit with attached torque converter assembly and drive shaft (see Fig. 9).

TO OVERHAUL

Place the engine on rotary stand **290090** using two front brackets **291489** and two rear brackets **291490**, and follow the instructions given under the appropriate headings.

TO REFIT

Refitting is a reversal of the removal procedure. Moreover:

— Reinstall the front mounting brackets with attached cushion pads onto the engine and the rear left-hand mounting bracket with attached cushion pad to the machine frame.

— Ensure that the rear drive shaft universal joint incorporates its cork gasket (86, Fig. 136) and that the associated end spline is smeared with NEVER-SEEZ (supplied by ANGST-PFISTER).

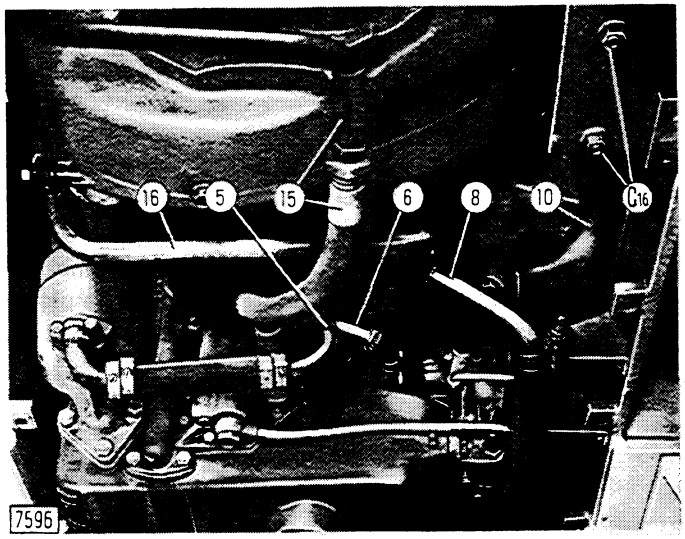


Fig. 8 - Bottom View of the Torque Converter/Gearbox Assembly
C_{16}. Engine mount cushion pad retaining nuts - 5. Converter/gearbox feed pump inlet pipe - 6. Scavenge pump outlet pipe - 8. Steering clutch/brake pump inlet pipe - 10. Equipment pump outlet line - 15. Heat exchanger return line (gearbox lubrication) - 16. Converter/gearbox scavenge pump inlet pipe.

— Hook up using lifting hook **291493** and offer up the engine onto the machine (see Fig. 9).

— Refit the rear right-hand mounting bracket with attached cushion pad and bolt the engine onto the frame.

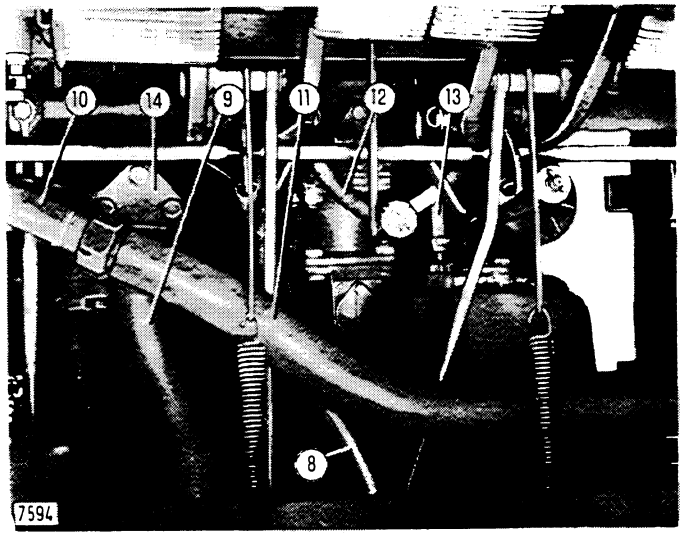


Fig. 7 - Top View of the Torque Converter/Gearbox Assembly
8. Steering clutch/brake pump outlet line - 9. Equipment pump inlet pipe - 10 and 11. Equipment pump outlet pipe and tube - 12. Line to gearbox clutch oil pressure check valve - 13. Torque converter/gearbox air connection pipe - 14. Pipe retaining bracket.

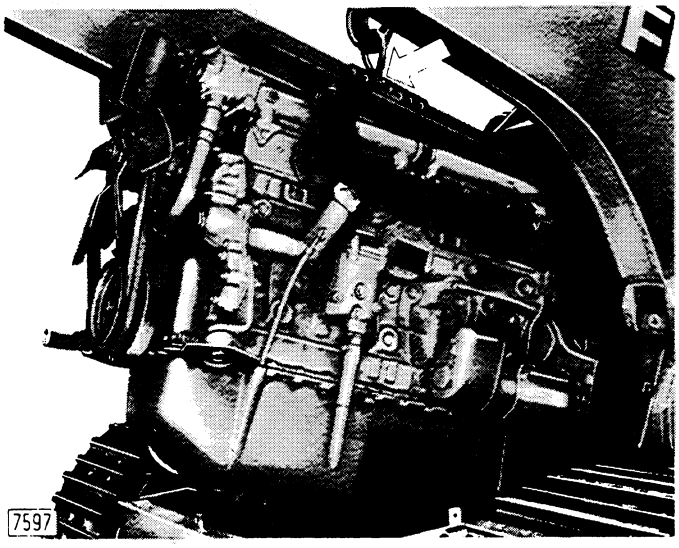


Fig. 9 - Removing (or Refitting) the Power Unit Using Lifting Hook No. 291493
Note: The arrow points to the fixing hole to be used for lifting.

ENGINE BLOCK AND CYLINDER HEADS

CYLINDER BLOCK AND LINERS

The finish machined cylinder liners are heat-treated before press-fitting into the block. Their selection according to grades A and B (see Fig. 10) takes place after press-fitting, without any need for further processing.
The grade identification letters are stamped in the top of the block adjacent to the liners (see detail e).

BLOCK CLEANING AND INSPECTION

In the course of overhaul carry out the following:

— Wash the casting in hot water and soda, subsequently rinsing in cold water.
— Clean the internal oilways using petrol and blow dry with compressed air.
— Ensure that both core plugs and threaded plugs are efficient.
— Before refitting any seal or gasket ensure that the associated contact surfaces are perfectly clean.

LINER RENEWAL

Inspect the liners for wear as follows:

— Check the liner bore over the working length (X, Fig. 10) swept by the piston rings.
— The diameter reading should be taken in both the upper and lower part of the working length in plane (c) parallel to the crankshaft and in plane (d) at right angles to it.
— Compare the readings to establish the amount of liner out-of-roundness and taper.

To assess the piston working clearance check the liner bore diameter in lower part (Z) in plane (d) only.
If out-of-roundness or taper in excess of .15 mm. (.006 in.) is detected, renew the cylinder liners as oversize pistons are not available.
Using plate **291510**, withdraw the cylinder liners from the bottom of the crankcase.
When fitting replacement liners proceed as follows:

— Thoroughly clean both the liners and the associated block bores.
— Apply a thin coat of oil to the block bore.

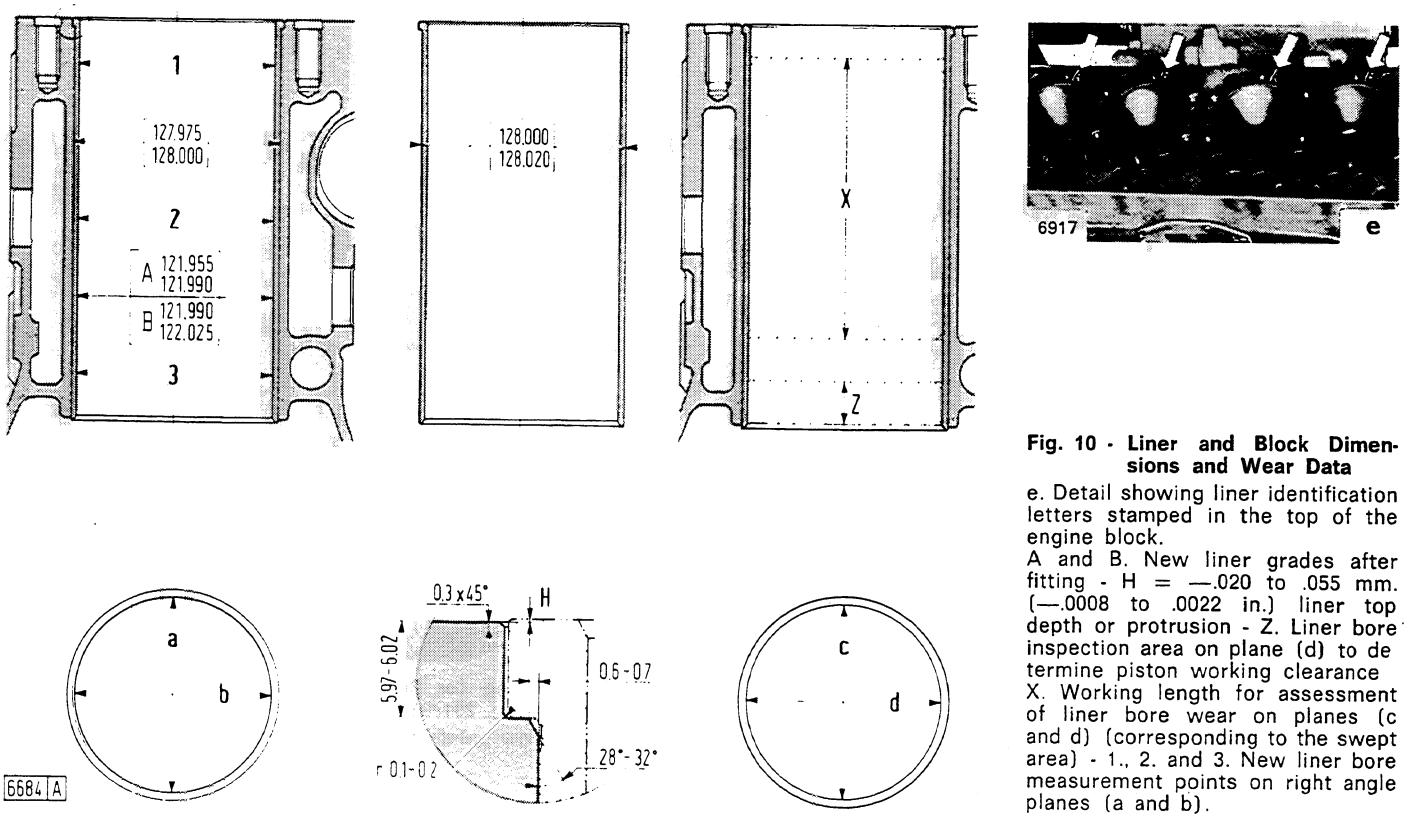


Fig. 10 - Liner and Block Dimensions and Wear Data

e. Detail showing liner identification letters stamped in the top of the engine block.
A and B. New liner grades after fitting - H = —.020 to .055 mm. (—.0008 to .0022 in.) liner top depth or protrusion - Z. Liner bore inspection area on plane (d) to determine piston working clearance
X. Working length for assessment of liner bore wear on planes (c and d) (corresponding to the swept area) - 1., 2. and 3. New liner bore measurement points on right angle planes (a and b).

- Drive each liner into the crankcase from cold using a suitable press and plate **291501**.

— When the liner is 80 to 100 mm. (3 to 4 in.) in (see L, Fig. 11), the load (P) required to drive the liners fully home is 350 to 3,500 Kg. (770 to 7,700 lb.).

— As a load lower than 350 Kg. (770 lb.) indicates insufficient interference, whilst one higher than 3,500 Kg. (7,700 lb.) means excessive interference, the replacement liners should be selected so that fitting load (P) is within the stated range.

— With the liner fully home, check the liner bore by placing a suitable dial gauge set to zero on planes (a and b, Fig. 10), subsequently repeating the readings in three points (1, 2 and 3) at different heights.

— Also check that top depth or liner protrusion (H) is — .020 to .055 mm. (— .0008 to .0022 in.).

— Where necessary, re-apply the grade identification letters (see e).

If in the course of overhaul block bore out-of-roundness is found to be in excess of .1 mm. (.004 in.) the bores should be opened out by .25 mm. (.010 in.) (see Engine Data).

After opening out the block it will be necessary to recut the lead-in chamfer according to the dimensions given in the appropriate detail of Fig. 10.

If the block top needs skimming (which should be done with the liners removed) it will also be necessary to restore the original depth of counterbore and lead-in chamfer according to the dimensions shown in the appropriate detail of Fig. 10, to obtain fitted liner dimension (H) as prescribed.

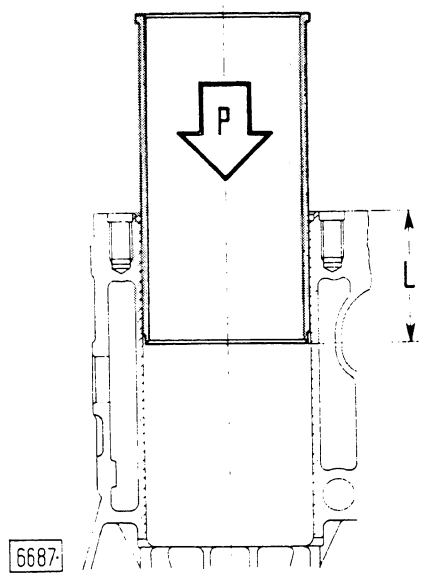


Fig. 11 - Pressing the Liners in the Engine Block

L = 80 to 100 mm. (3.15 to 3.93 in.) lead-in depth prior to controlled load application - P = 350 to 3,500 Kg. (770 to 7,700 lb.) liner fitting load (see text).

Note: The liner bore is surface-hardened and must not be ground, honed or dressed at all after fitting. Owing to their low interference, these liners can be removed and refitted several times without any adverse effect.

OIL SUMP

During overhaul, wash the oil sump in hot water and soda and rinse in cold water.

Removal and refitting of the oil sump with the engine on the overhaul stand will be facilitated by the use of hook **291494**.

With the engine fitted on the machine oil sump removal necessitates front lower cover removal, engine oil draining and removal of the bolts retaining the machine frame to front cross member (5, Fig. 12) and track carriage rear supports.

Hoist the frame until the oil sump comes off the cross member and place the wood blocks as shown in Fig. 12. Subsequently, remove the retaining screws and lift off the sump.

To refit the oil sump proceed as follows:

— Always renew the complete gasket.

— Using jointing compound, apply the gasket assembly onto the sump ensuring that the holes are

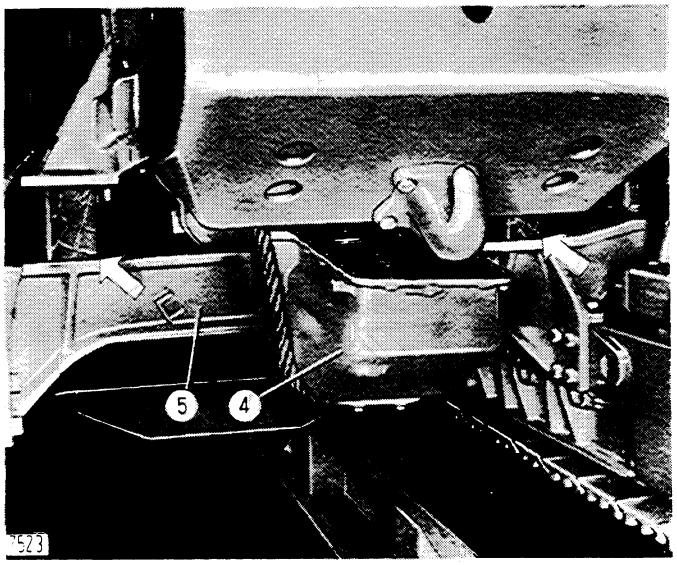


Fig. 12 - Removing (or Refitting) the Oil Sump with the Engine in Position on the Machine

Note: The arrows point to the wood blocks.

4. Oil Sump - 5. Front cross member.

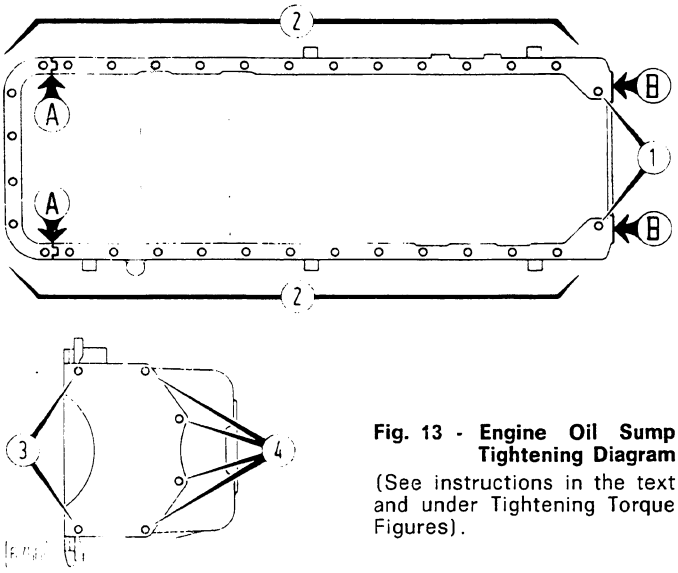


Fig. 13 - Engine Oil Sump Tightening Diagram
(See instructions in the text and under Tightening Torque Figures).

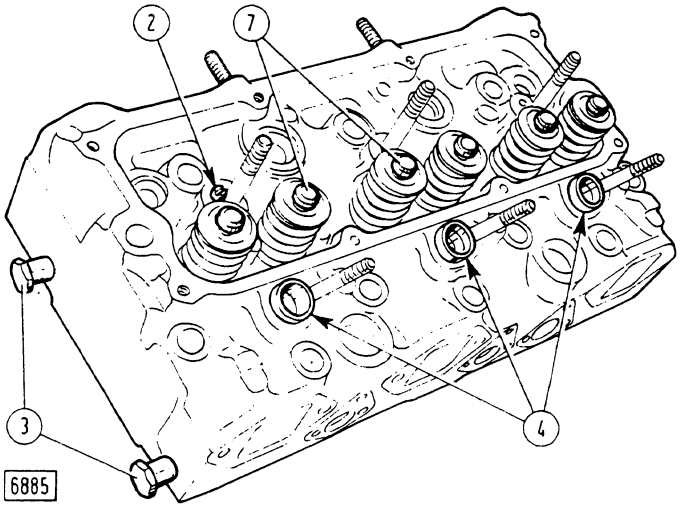


Fig. 15 - Rear Cylinder Head
2. Rocker oil restrictor plug - 3. Rear engine lifting bolts - 4. Fuel injector sleeves - 7. Valve stem caps.

correctly aligned and the rear end of the gasket protrudes by 1 to 1.5 mm. (.04 to .06 in.). If necessary, cut off the excess material.
— Coat gasket seams (A, Fig. 13) and ends (B) with jointing compound. Also smear the threads of screws (3).
— Place the sump in position and reinstall retaining screws (2) through a few turns only.
— Fully tighten screws (1) and refit screws (3 and 4) to 3/4 of their full depth.
— Slightly slacken screws (1) and fully tighten screws (3 and 4).
— Fully tighten screws (2) in a staggered sequence.
— Check that screws (3 and 4) are adequately tight and tighten screws (1).

CYLINDER HEADS

The cylinder heads should not be removed when the engine is hot, otherwise distortion may result.
Check head flatness by placing each cylinder head on a surface plate smeared with carbon black and,

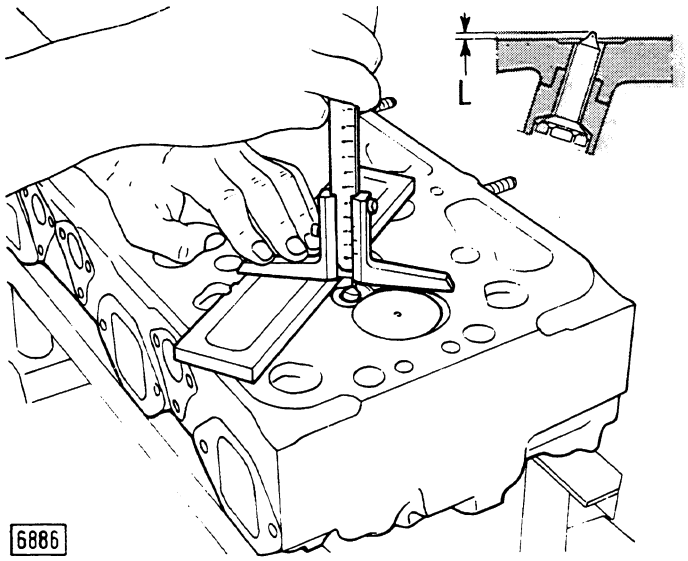


Fig. 14 - Checking Injector Protrusion from Cylinder Head
L = 5 to 6 mm. (.196 to .236 in.) spray nozzle protrusion.

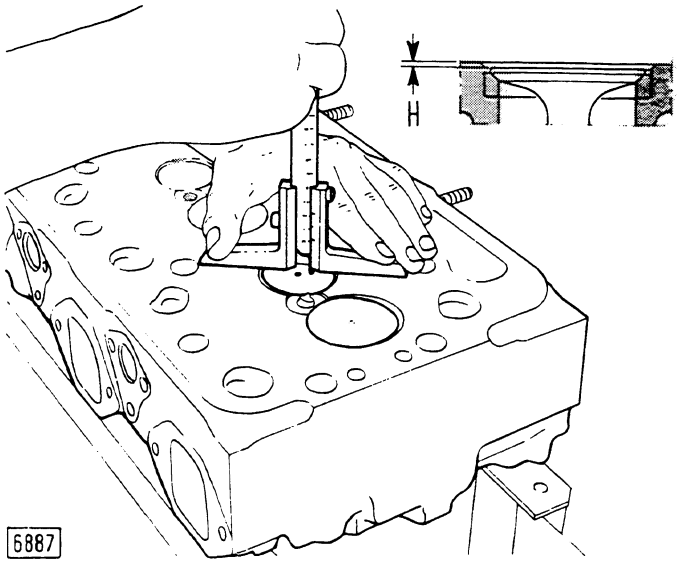


Fig. 16 - Checking Valve Depth in Cylinder Head
H = .8 to 1.2 mm. (.031 to .047 in.) valve depth.

If necessary, re-dress by scraping, or grinding if the amount of distortion is in excess of .15 mm. (.006 in.). When grinding, the maximum amount of material which can be removed should not exceed .5 mm. (.02 in.).

Remember that new cylinder head thickness should be 124.75 to 125.00 mm. (4.9114 to 4.9213 in.).

After refitting the fuel injectors and the valves, ensure that:

— Fuel injector protrusion (L) is as shown in Fig. 14.

— Valve depth (H) is as shown in Fig. 16.

If protrusion (L) is found to be less than the minimum indicated value, re-skim the injector taper seat in the sleeve using cutter **291339** (F, Fig. 22). If the protrusion is greater, the sleeve should be renewed.

To renew the fuel injector sleeves, tap using set **A. 90424/1** and remove from the cylinder heads by means of extractor **A. 42110.**

Install the new injector sleeves into the cylinder heads using the hand press and expand their top end using punch **291350** (P_2, Fig. 22).

Check for leaking core plugs and fuel injector sleeves. In case of doubt it is advisable to renew the parts which are suspected of being unreliable. Injector sleeve leakage can often be obviated by using punch **291350** (P_2).

To obtain a proper seal between injector and sleeve bottom, dress the taper seat using cutter **291339** (F).

Ensure that the orifices in rocker lubricant restrictor plugs (2, Fig. 15) are not clogged.

Subsequently, the cylinder heads should be throughly washed to eliminate any abrasive particle.

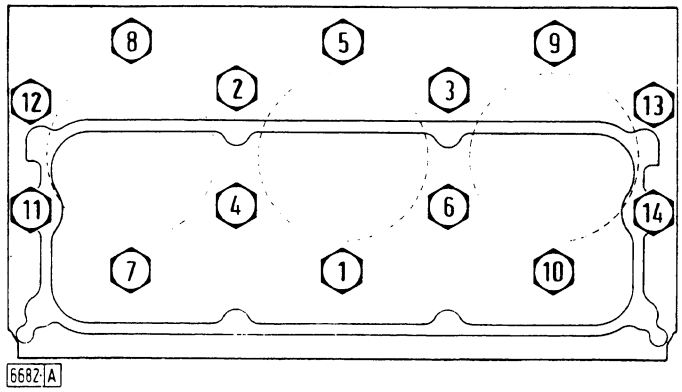


Fig. 17 - Cylinder Head Tightening Sequence

Note: The prescribed tightening torque should be reached in at least 3 successive stages adopting the sequence indicated above.

When refitting the head gaskets ensure that the side marked « ALTO » lies uppermost; before refitting, smear the gasket surfaces with carbon dust.

Remember that the two cylinder heads are not interchangeable, as they incorporate differently positioned rocker lubrication ways and engine lifting points.

VALVE SEAT RE-CUTTING

Use tool **291113** to rest the cylinder heads on, and support **291112** to position the valves.

For valve re-cutting, use universal hand cutter **A. 60419**, or set of cutters and handles **292264.**

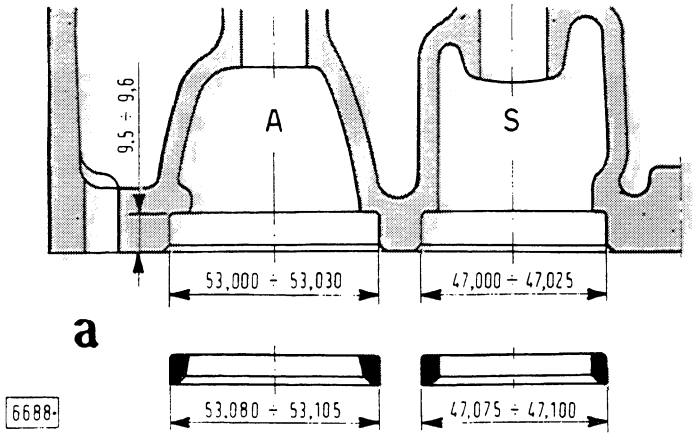
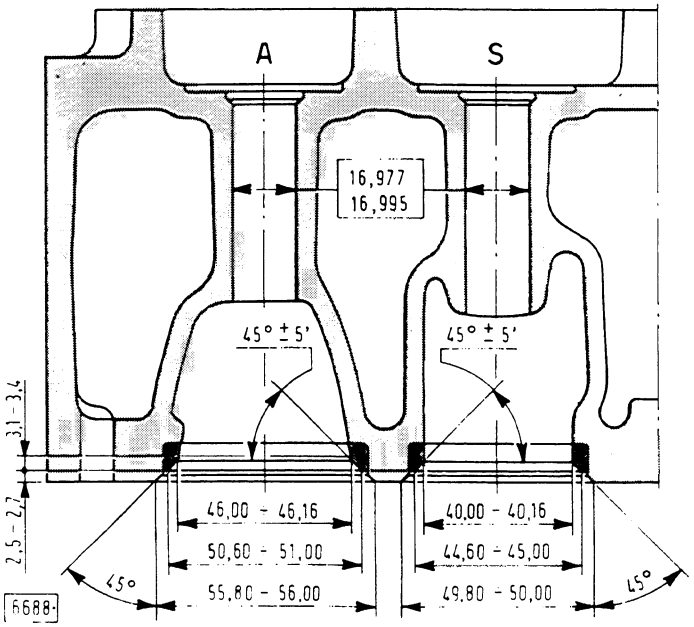


Fig. 18 - Valve Seat and Guide Bore Dimensions

a. Detail of standard valve seat inserts - A. Inlet - S. Exhaust. **Note:** .20 mm. (.008 in.) oversize seat inserts are available for overhaul purposes (see Data Table).



VALVEGEAR

CAMSHAFT

Crankcase mounted camshaft (1, Fig. 20) runs in four white-metal-lined steel bearings and is retained in position by a front thrust plate (6).

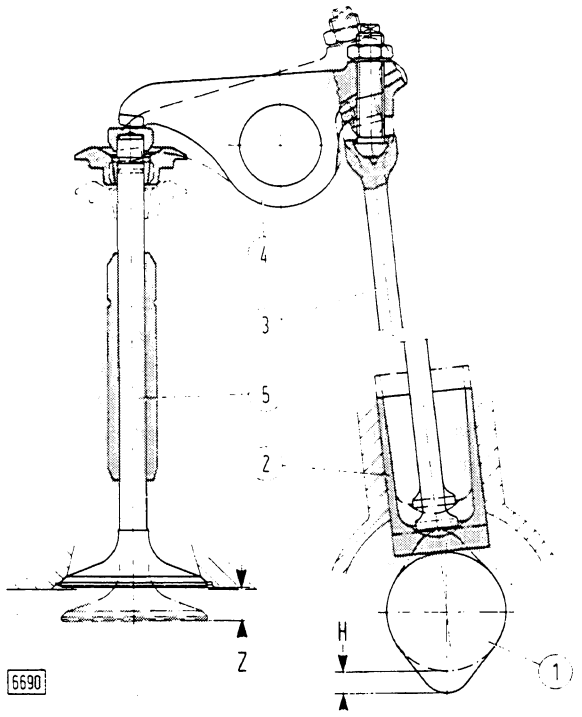


Fig. 19 - Valve Train

H = 7.621 mm. (.3000 in.) cam lift (effective lift = 7.3 mm. - .2874 in.) - Z = 12.2 mm. (.4803 in.) maximum valve lift - 1. Valve control cam (inlet and exhaust) - 2. Tappet - 3. Pushrod - 4. Rocker - 5. Valve.

The bearings are press-fitted into the engine block and retained in position by screws (27).

In case of replacement, remove retaining screws (27) and withdraw the bearings using:

— Universal extractor **292909** for front and rear bushes, after removing the rear engine mounting.

— Drift **292797** for intermediate bushes, which can be retrieved through the centre opening (28, Fig. 20).

Camshaft removal is possible with the engine fitted on the machine only on Model FL 14, after taking off the radiator, the cylinder heads, the timing cover and the sump. Therefore, it is advisable to remove the engine assembly (see page 16), which is in any case always necessary to be able to remove the camshaft bearings.

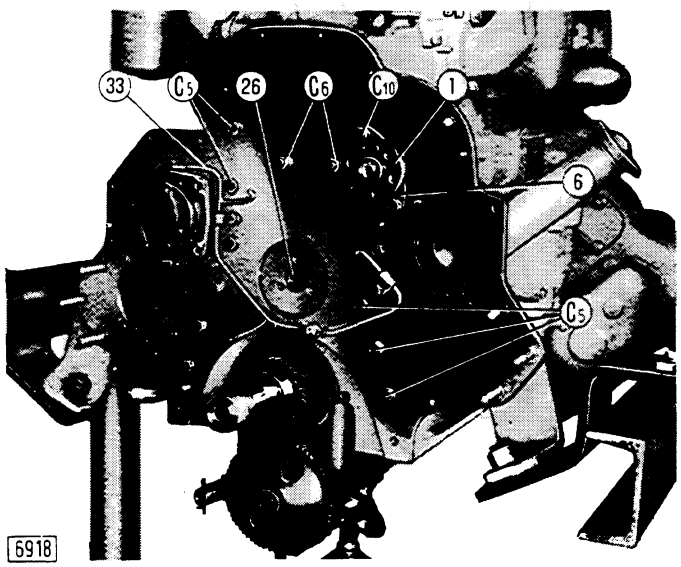
To reinstall the camshaft bearings proceed as follows:

— Turn the bushes so that the associated retainin screws (27, Fig. 20) line-up with the relevant holes, and holes (B and G, Fig. 21) line-up with crankcase lubricating ways (b and g) respectively.

— First refit the two intermediate bushes acting from the front end of the crankcase and using drift **292797.**

— For front and rear bushes, use drift **292796.**

— After refitting, the bushes do not need reaming.



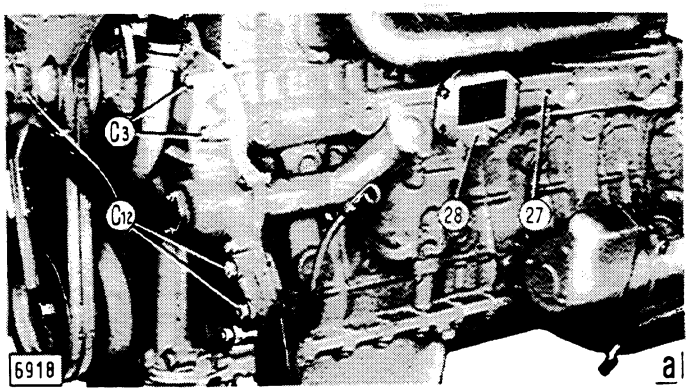


Fig. 20 - Scrap View of Engine Showing Camshaft Positic

a. Detail of crankcase left-hand side view - C_3. Plate retaining screw - C_1 and C_{12}. Timing cover retaining screws and nuts - C_5. Plate self-locking nuts - C_{10}. Camshaft thrust plate retaining screws - 1. Camshaft - 6. Camshaft thrust plate - 26. Idler gear stub shaft lubricating hole - 27. Camshaft bearing retaining screws - 28. Camshaft side cover - 33. Valve gear oilways.

When refitting the camshaft, ensure that the rear cover with attached angle drive is disconnected, and turn the thrust plate as shown in Fig. 20.

Note: Prior to starting the engine after camshaft or engine overhaul, lubricate the shaft by introducing 1 Kg. (1¾ pt.) of oil through each cylinder head.

TO INSPECT CAMSHAFT AND BEARINGS

Check both camshaft journals and associated bearings (see Fig. 21) for wear and excessive running clearance (see Data Table).

The bearings are not supplied with undersize inside diameter. If the running clearance is found to exceed .20 mm. (.008 in.) the bearings should be renewed, if necessary together with the camshaft itself.

Scored cam surfaces can be redressed using a very fine abrasive stone; however, if the results obtained are not satisfactory, it is advisable to renew the camshaft.

Check the driven gear flange for run-out as follows:

— Place the camshaft with the two end journals over V-blocks and rest the stylus of a dial guage on the flange face at approximately 37 mm. (1.456 in.) from the centreline (C, Fig. 21).

— Rotate the shaft and check that over one revolution the recorded run-out does not exceed .01 mm. (.0004 in.).

— Place the stylus over spigot surface (D) and check that over one complete revolution the amount of out-of-round does not exceed .01 mm. (.004 in.).

Finally, check for shaft distortion by placing the stylus of the dial gauge over the two centre journals to ensure that the maximum eccentricity does not exceed .10 mm. (.004 in.) over one complete revolution. If a greater amount of distortion is found to be present, the camshaft will have to be straightened on a suitable press.

VALVES AND VALVE GUIDES

To remove the valves take off the cylinder heads, compress the valve springs using tool **291050** (E, Fig. 22) and withdraw spring cones (8).

If after thorough cleaning the valves show signs of damage or defective sealing, re-grind and re-hone together with the associated seats. Subsequently, the parts involved will have to be carefully washed to eliminate all abrasive matter.

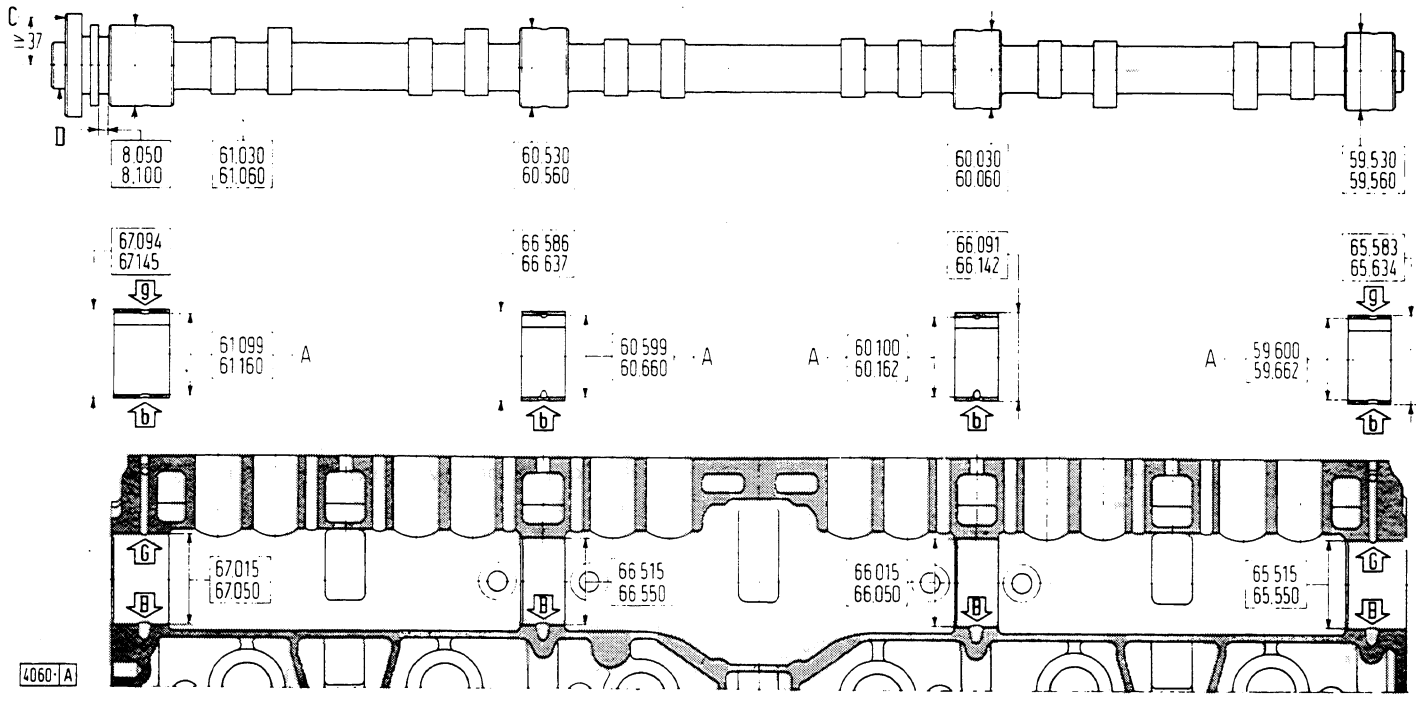


Fig. 21 - Camshaft, Bearing and Housing Dimensions

A. Bearing fitted diameter - C. and D. Flange run-out stylus position - b-g and BG. Lubricating holes and ways for camshaft journals and bearings.

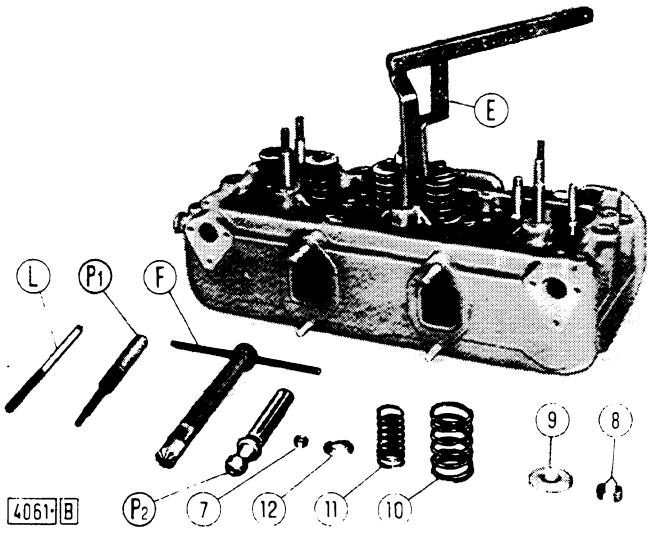


Fig. 22 - Removing (or Refitting) the Valves
E. Tool 291050 - F. Injector sleeve cutter 291339 - L. Valve guide reamer 291499 - P_1. Valve guide drift 294196 - P_2. Injector sleeve punch 291350 - 7. Valve stem caps - 8. Cones - 9. Top cup - 10. Outer spring - 11. Inner spring - 12. Lower cup.

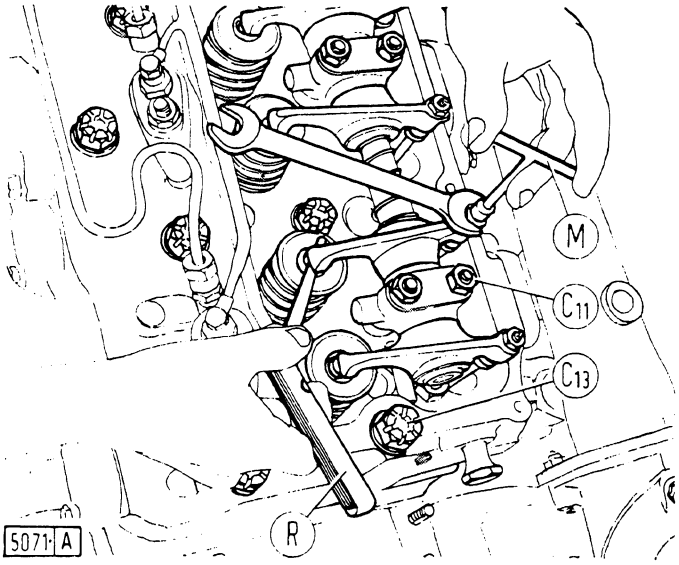


Fig. 24 - Adjusting the Valve Clearance
C_{11}. Rocker bracket retaining nuts - C_{13}. Cylinder head self-locking screws - M. T-spanner 290886 - R. Feeler gauge.

Maximum valve stem working clearance in the associated guides is .20 mm. (.008 in.).

Check valve stems and valve guides for size using a micrometer and kit **A. 95723** respectively. If the clearance recorded is excessive, renew the valves in question. If following valve replacement the clearance still exceeds the specified value, also renew the valve guides.

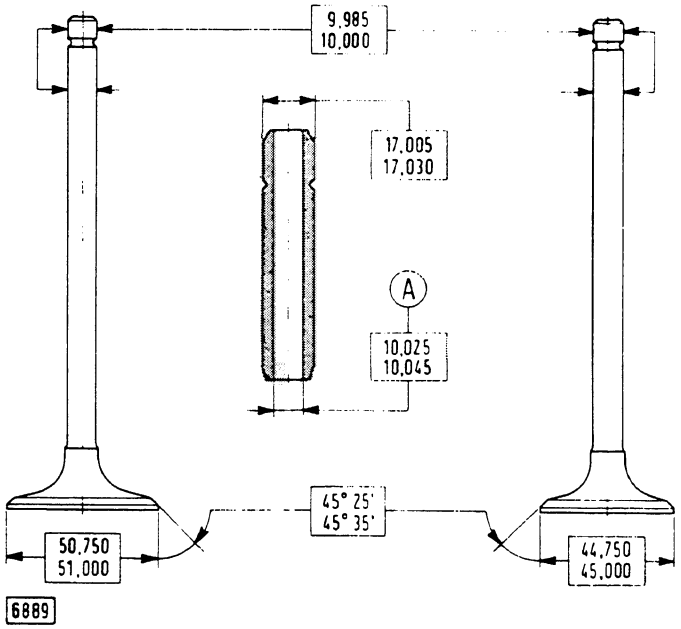


Fig. 23 - Valve and Standard Valve Guide Dimensions
A. Fitted dimension to be obtained after reaming.

To renew the valve guides use drift **291496** (P_1, Fig. 22) together with a suitable press, acting from the underside of the heads to remove, and from the top to refit.

When checking the valve guides bear in mind that:

— The bore surface should be perfectly smooth and free from score marks and evidence of pick-up or deposits of any kind.

— Each guide should be equipped with the associated locating circlip.

— The guides should be tight in their seats in the heads, otherwise renew using oversize guides (see Data Table).

— After refitting, each guide should be reamed again using reamer **291499** (L, Fig. 22).

Exhaust guides are shorter than inlet valve guides by some 10 mm. (.394 in.).

On completion of the refitting operation, ensure that:

— Valve depth below cylinder head is as prescribed in Fig. 16.

— Cup retaining cones (8, Fig. 22) are correctly seated. In case of any doubt the cones should be renewed.

— Valve stem end caps (7) do not show any sign of upsetting on the sides in contact with the rockers. If damaged or excessively worn, the caps should be renewed.

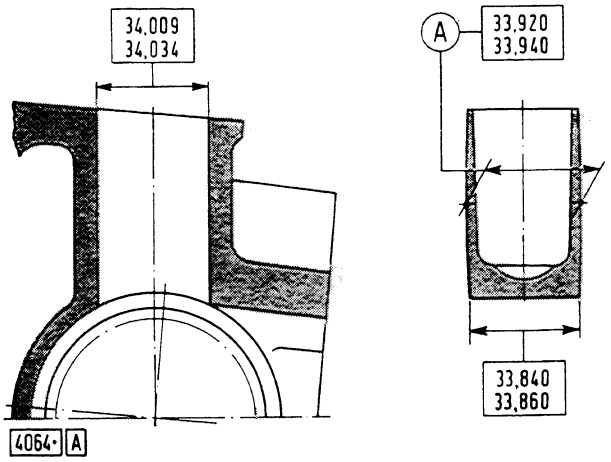


Fig. 25 - Standard Tappet and Bore Dimensions
A. Maximum outside diameter as measured at mid-height.

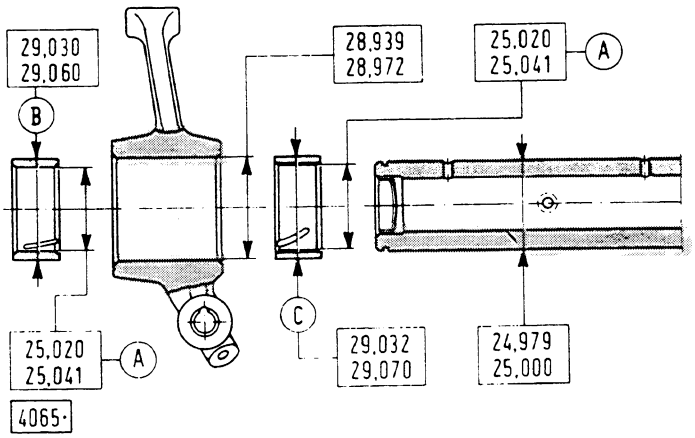


Fig. 26 - Rocker, Sleeve Bearing and Rocker Shaft Dimensions
A. Fitted diameter after reaming - B. Bronze bush - C. White-metal-lined steel shell.

TO ADJUST VALVE CLEARANCE

For valve clearance adjustment, use spanner **290886** (M, Fig. 24) and feeler gauge (R). The correct clearance is .30 mm. (.012 in.) for inlet valves and .40 mm. (.016 in.) for exhaust valves.

Cylinder matching for valve clearance adjustment is 1-6, 2-5, 3-4. Thus, bring the valves of the first cylinder of each pair in a condition of balance to adjust the valves of the second cylinder of the same pair and viceversa.

TAPPETS AND ROCKERS

Fitted to two separate rocker shafts (one to each cylinder head), the rockers differ in shape according to whether they are situated ahead (13, Fig. 28) or after (14) brackets (17).

Tappet withdrawal necessitates cylinder head removal. For tappet inspection proceed as follows:

— Check that the surface in contact with the cam is in good condition. Any score mark can be remedied using a very fine abrasive stone.

— Check the fitted clearance. If greater than .20 mm. (.008 in.) renew using oversize tappets and open out the associated bores in the engine block (see Data Table).

When refitting the tappets, apply a liberal amount of engine oil.

Check both the rocker shafts and rocker bushes for wear and excessive play.

If necessary, renew the bushes remembering the following points:

— Only bronze replacement bushes (C, Fig. 26) are available, whereas the bearings originally fitted in production may consist of white-metal-lined steel shells (B).

— When fitting the new bushes, position the lubricating grooves as directed in Fig. 27.

— When fitted in position, the bushes should lie flush with the rocker sides as shown by the arrows in Fig. 27.

— After fitting, the bushes should be reamed by means of expanding blade reamer **290001**.

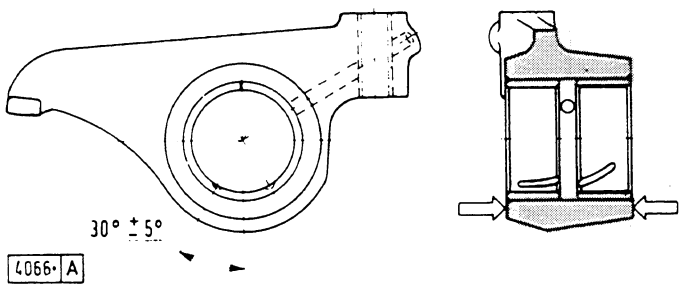


Fig. 27 - Rocker Bushes in Position
Note: The arrows indicate the rocker faces with which the bushes should be perfectly flush.

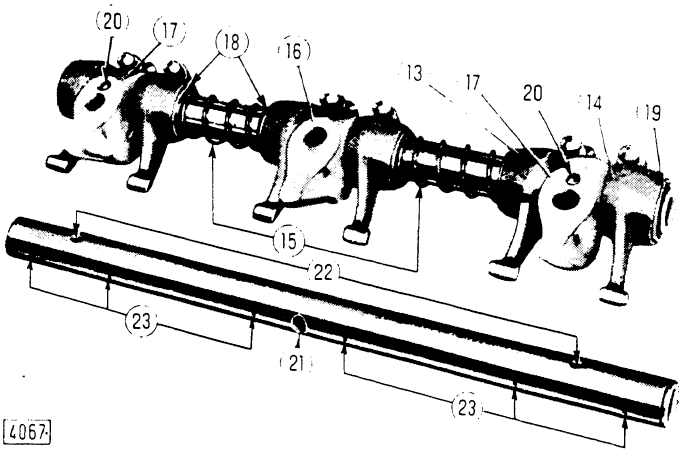


Fig. 28 - Refitting Rocker Assemblies
13. Front rocker - 14. Rear rocker - 15. Spacer spring - 16. Centre bracket - 17. Side brackets - 18. Spring thrust washers - 19. End washers - 20. Lubricating ways - 21. Shaft positioning dimple - 22. and 23. Lubricating ways.

Inspect the rocker toes. When re-grinding becomes necessary, remember that the depth of case (hardened layer) is 1.2 to 2 mm. (.047 to .079 in.) in the centre of the toe.

Reinstall the rocker shafts as indicated in Fig. 28, bearing in mind the following points:

— Lubricating holes and ways (20, 22 and 23) should be clear.

— Position the shafts so that dimple (21) lines-up with the centre bracket stud hole to obtain correct lubricating hole alignment.

— The thickness of spring thrust washers (18) should be 1.5 mm. (.59 in.).

— End washers (19) are available in three different thicknesses (1.5, 2 and 2.5 mm. - .059, .078 and .098 in.). Use a washer of suitable thickness in order to reduce end rocker play to a minimum.

VALVE TIMING

To refit the valve gear proceed as follows:

— Provisionally adjust the valve clearance (on both inlet and exhaust valves) to .5 mm. (.020 in.) on cylinders 1 and 6.

— Slacken the injectors and rotate the crankshaft until reference mark P.M.S. 1-6 (stamped on flywheel periphery) lines-up with the associated fixed timing pointer (see Fig. 30).

— Re-position the gears over the associated shafts taking care to align reference marks 1-1, 2-2 and 3-3, as shown in Fig. 31, fitting the idler gear last. This is necessary because the other two timing gears have their assembly position restricted by dowel (24 and 25).

— Tighten retaining screws (C_2, C_8 and C_9).

— Turn the crankshaft through a few degrees in either direction to ensure that cylinder No. 1 is actually downward in the firing stroke; consequently, the valves should be closed, whilst the valves of cylinder No. 6 should be open and in a condition of balance within the angular values given.

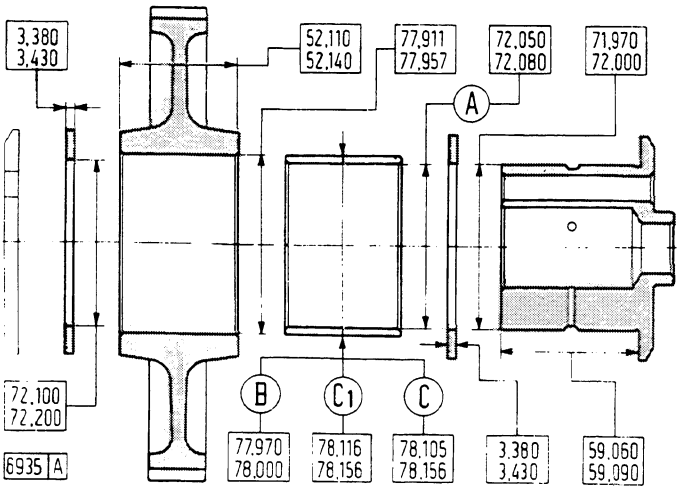


Fig. 29 - Valve Train Idler Gear and Stub Shaft Dimensions
A. Bush fitted diameter - B. Bronze bearing - C. White-metal-lined steel shell bearing (Vandervell type) - C_1. White-metal-lined steel shell bearing (Clevite type).

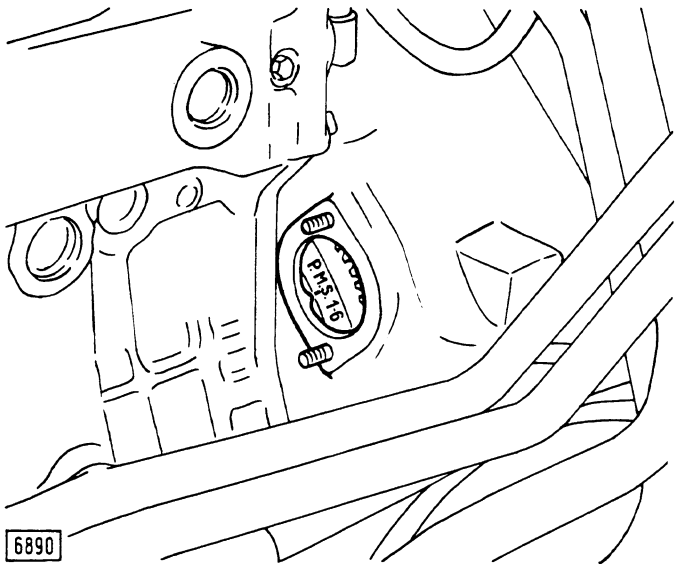


Fig. 30 - Flywheel Reference Marks Indicating T.D.C. Position of Cylinders 1 and 6

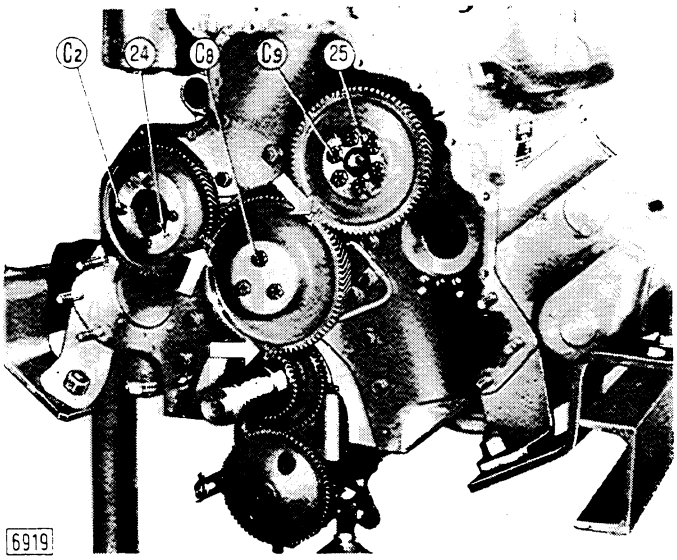


Fig. 31 - Refitting the Valve Timing Gear

Note: Arrows point to reference marks 1-1, 2-2, and 3-3 which should line-up for correct valve timing.
C2. Injection pump drive gear self-locking screws - C8. Idler stub shaft self-locking screws - C9. Camshaft gear self-locking screws - 24. Injection pump gear dowel - 25. Camshaft gear dowel.

TACHO-HOURMETER

The tacho-hourmeter situated on the instrument panel is driven directly from the rear end of the camshaft through an angle drive (1, Fig. 32) and associated flexible shaft (2).

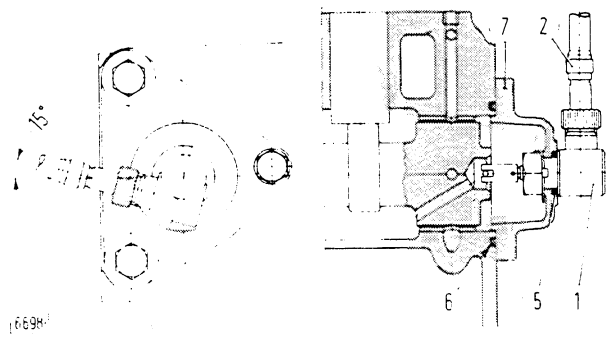


Fig. 32 - Refitting the Tacho-hourmeter Angle Drive
1. Angle drive - 2. Flexible drive - 5 and 6. O-rings - 7. Cover.

The hourmeter section of the instrument is geared to a constant 1,400 engine r.p.m. and records 1 hour to every 42,000 camshaft revolutions (700 r.p.m.).

The relavent transmission ratios are as follows:

— Angle drive	1 to 1
— Flexible drive	1 to 1
— Instrument	2 to 1

CRANKGEAR

CRANKSHAFT

To remove the crankshaft (see Fig. 36) withdraw the engine from the machine as directed on page 16, and bear in mind the following points:

— Remove the crankshaft vibration damper (see Fig. 33) using extractor **291504**.

— Before removing the rear engine support, connect the engine block to the rotary stand by means of bracket **291492** which should be positioned as shown in Fig. 34.

Note: The bracket retaining screw on both the engine and the stand should be tightened after slackening the retaining screws on brackets **291490**.

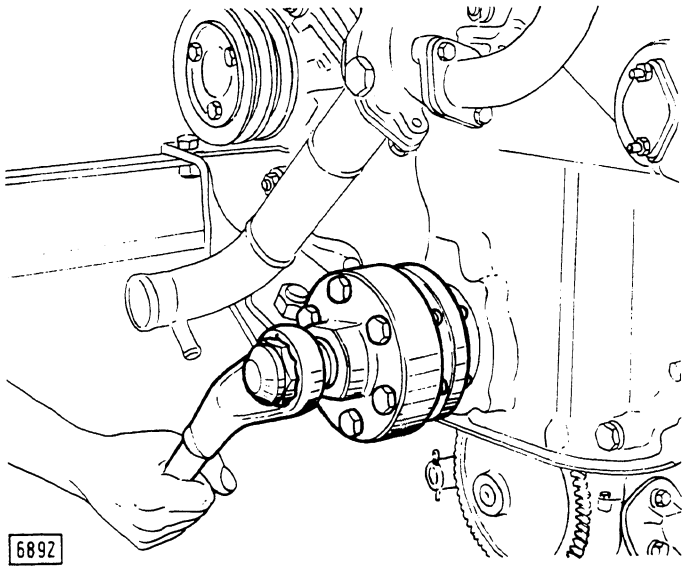


Fig. 33 - Removing Crankshaft Vibration Damper Using Extractor 291504

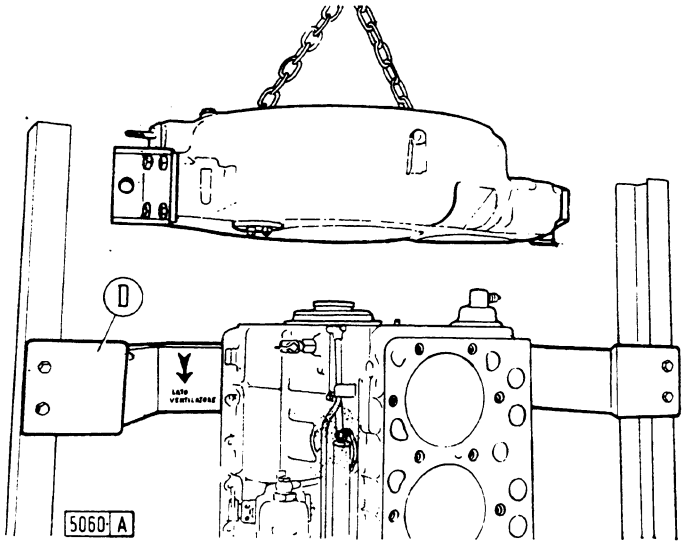


Fig. 34 - Removing (or Refitting) Rear Engine Support
Note: The arrow points to the correct bracket position.
D. Bracket 291492.

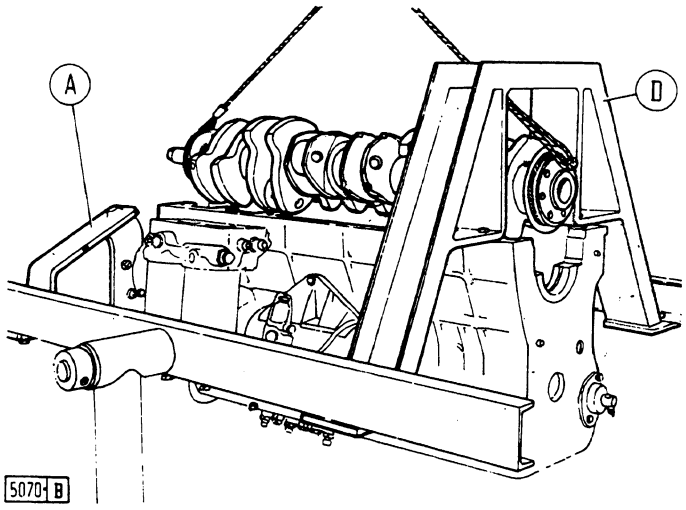


Fig. 36 - Removing (or Refitting) the Crankshaft
A. Bracket 291489 - D. Bracket 291492 to be fitted before removing the engine rear support.

Wash the shaft and inspect carefully. Even the slightest cracks necessitate crankshaft renewal.
Check both main journals and crankpins; any sign of pick-up or scratching can be eliminated by means of extra-fine emery cloth.

Score marks or ovality or taper errors in excess of .05 mm. (.002 in.) necessitate journal re-skimming to the nearest oversize dimension (see Data Table).
After re-grinding, blend the journal fillets and cu. the lubricating hole chamfers as shown in Fig. 35.

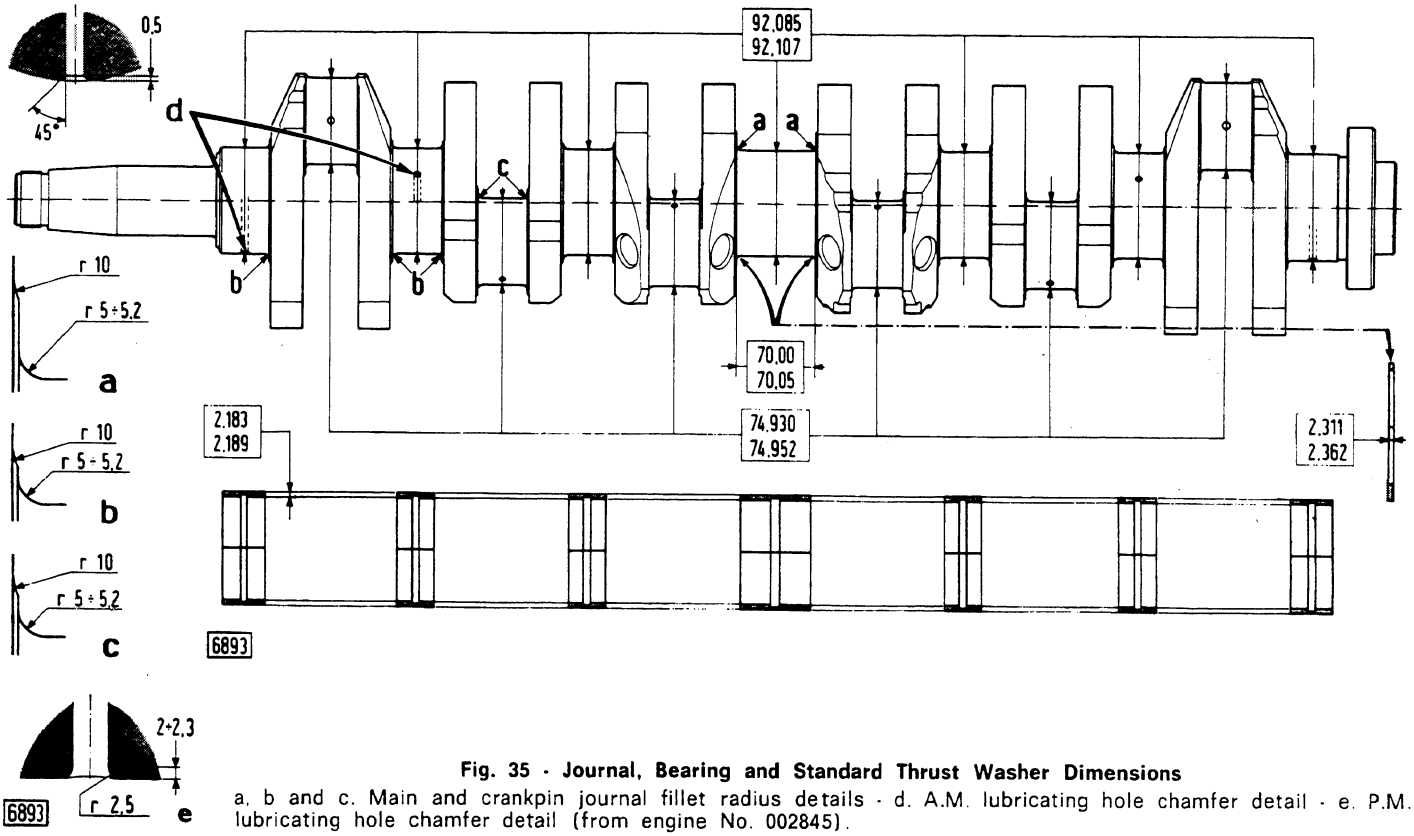


Fig. 35 - Journal, Bearing and Standard Thrust Washer Dimensions
a, b and c. Main and crankpin journal fillet radius details - d. A.M. lubricating hole chamfer detail - e. P.M. lubricating hole chamfer detail (from engine No. 002845).

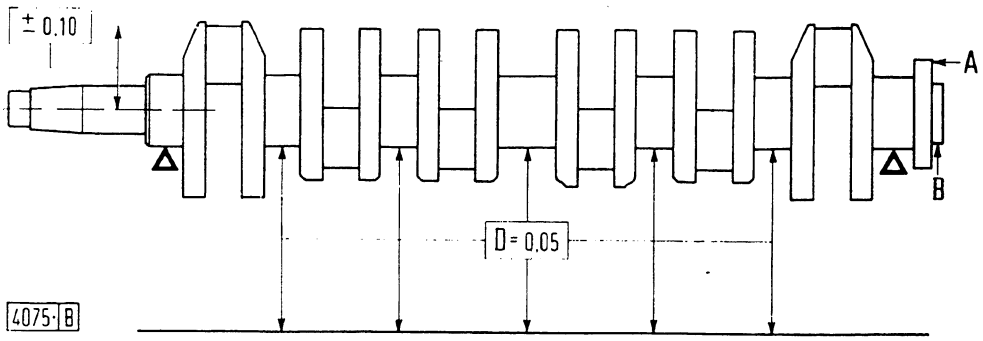


Fig. 37 - Checking Main Journal and Crankpin Alignment
A and B. Flange run-out stylus positions - D. Maximum main journal misalignment.

Subsequently, check the crankshaft bearing in mind that:

— Ovality of the journals should not exceed .008 mm. (.0003 in.).

— Taper of each journal should be lower than .012 mm. (.0004 in.).

— Maximum misalignment with the shaft over V-blocks and cranks of pistons 1 and 6 situated vertically at the top, should be .05 mm. (.002 in.) (see D, Fig. 37).

— Maximum misalignment of each pair of crankpins with respect to main journals should not exceed ± .25 mm. (± .010 in.) when measured as shown in Fig. 38.

— The distance from top of crankpin to crankshaft rotational axis should not exceed ± .10 mm. (± .004 in.) (see Fig. 37).

— Run-out, as measured with the dial gauge stylus in (A) over a diameter slightly smaller than the crankshaft flange outside diameter, should not exceed .02 mm. (.0008 in.). Moreover, eccentricity in (B) should not exceed .04 mm. (.0001 in.).

Check the core plugs for leakage using oil at 10 Kg/cm² (142 p.s.i.). In case of replacement, press the new plugs fully home and stake in position; subsequently, re-check the circuit with oil under pressure.

MAIN AND BIG END BEARINGS

The white-metal-lined thin-shell bearings do not need any fitting operation and should be renewed whenever their contact surfaces are found to be scored or excessively worn.

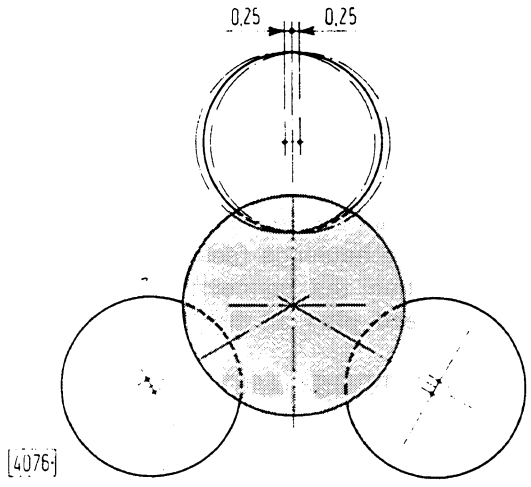


Fig. 38 - Checking Crankpin Axis Alignment

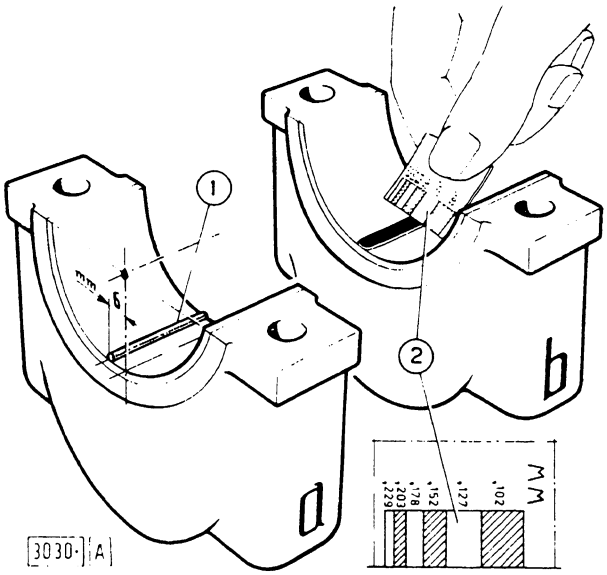


Fig. 39 - Checking Crankshaft Main Bearing Running Clearance
a. Calibrated wire in position in main bearing cap - b. Comparing width of compressed calibrated wire with reference scale - Reference is Plastigage type PR-1. 1. Calibrated wire - 2. Graduated scale printed on wire container.