360 SIDES.

INDUSTRIAL PRODUCTS
SERVICE MANUAL
FOR
2700 RANGE ENGINES

2701E – 4 cyl. – Diesel
2703E – 6 cyl. – Diesel
2704E – 6 cyl. – Diesel
2701C – 4 cyl. – Diesel
2703C – 6 cyl. – Diesel
2704E – 6 cyl. – Diesel

2711E – 4 cyl. – Diesel
2712E – 4 cyl. – Diesel
2713E – 6 cyl. – Diesel
2714E – 6 cyl. – Diesel
2715E – 6 cyl. – Diesel
2704ET – 6 cyl. – Diesel Turbo Charged
2704ET – 6 cyl. – Diesel Turbo Plus

This Manual is intended as a mechanics guide to the method of servicing the Ford 2700 Range of Diesel and Diesel Turbo Charged Engines.

It contains complete instructions for all service, repair and overhaul operations, and lists the special tools necessary for each operation.

For convenience the contents are divided into eight basic sections.

CONTENTS

JUNE 1979

Ford policy is one of continuous improvement and whilst every effort is made to ensure that this publication is up to date and correct in all respects, the right to change specifications and equipment at any time without notice is reserved and accordingly this publication is not to be regarded as a description of any individual engine.

SECTION 1
ENGINE COMPONENTS AND OVERHAUL PROCEDURE

CONTENTS

JUNE 1979

GENERAL DESCRIPTION

The 2700 Range of Ford Industrial Engines comprises the following models:–

2701E	4 cyl.	3.964 l.	(242 cu.in.)	Diesel
2703E	6 cyl.	5.416 l.	(330 cu.in.)	Diesel
2704E	6 cyl.	5.945 l.	(360 cu.in.)	Diesel
2704ET	6 cyl.	5.945 l.	(360 cu.in.)	Diesel Turbocharged
2701C	4 cyl.	4.150 l.	(254 cu.in.)	Diesel
2711E	4 cyl.	4.150 l.	(254 cu.in.)	Diesel
2712E	4 cyl.	4.150 l.	(254 cu.in.)	Diesel
2703C	6 cyl.	5.950 l.	(363 cu.in.)	Diesel
2713E	6 cyl.	5.950 l.	(363 cu.in.)	Diesel
2704C	6 cyl.	6.220 l.	(380 cu.in.)	Diesel
2714E	6 cyl.	6.220 l.	(380 cu.in.)	Diesel
2715E	6 cyl.	6.220 l.	(380 cu.in.)	Diesel

Refer to the relevant Engine Specifications for the bore, stroke and other details.

The terms 'Left' and 'Right' are applicable when engine is viewed from the rear.

The Diesel versions are of the direct injection type and operate on the four stroke cycle.

Overhead valves are mounted vertically in replaceable guides in the cast iron cylinder head and are operated by rockers, push rods and tappets from a camshaft located in the right-hand side of the cylinder block.

The camshaft is driven at half engine speed by a gear meshing directly with the crankshaft gear, steel backed bearing bushes are fitted to all six cylinder engines prior to April 1971. Engine No. S790085 camshaft bearings were only fitted to the four cylinder engines when the main bearing bores had been increased to 0.381 mm. (0.015 in.) o/s and/or Heavy Duty P.T.O. had been fitted. From April 1971, Engine No. S790085, all four cylinder engines are fitted with camshaft bearings.

The four cylinder engine has four bushes and the six cylinder engine has six. The front bush is of the bronze type while the remainder are white metal.

A skew gear, machined integral with the camshaft drives the oil pump. An eccentric for the fuel lift pump is also incorporated on the camshaft.

Camshaft thrust is taken by a thrust plate bolted inside the timing case to the cylinder block front face. This thrust plate is located between thrust washers adjacent to a detachable collar on the camshaft and the camshaft gear.

The forged crankshaft runs in five large diameter main bearings in four cylinder engines and seven in the sixes. These bearings and also the connecting rod big end bearings have detachable steel backed aluminium tin bearing liners. Crankshaft end-float is controlled by thrust washers fitted at each side of the centre main bearing. Main bearing bolts are 15·88 mm. (5/8 in.) diameter and are of the self-locking type. On six cylinder engines a damper is incorporated in the pulley assembly to damp out torsional oscillations in the crankshaft.

The connecting rods are H section forgings with the big end caps retained by self-locking bolts on all models with the exception of 2703E/C models, bolts and self locking nuts are fitted to these models. Two tension pins are fitted to each bearing cap for positive location on all models. The small end has a steel backed bronze bush.

JUNE 1979

Aluminium alloy solid skirt pistons with the combustion chamber machined in the piston crowns are used. The combustion chamber has a toroidal tip to promote efficient combustion. Each piston has three compression and one oil control ring above the piston pin. The upper compression ring is barrel faced, the second is internally stepped on the top face and the lower externally stepped on the lower face. These last two rings must be fitted the correct way round and are marked to facilitate assembly. The oil control ring is of the slotted channel type scraper with a coiled expander on the inside. Refer to individual model specifications for material finish. The piston pins are fully floating and are retained in position by circlips installed in grooves at each end of the piston pin bore.

The cylinder bores of 2701E, 2703E, 2704E and 2704ET Models have dry type liners which protrude to reduce the dead air space between the cylinder head and gasket. All other models are of the "Parent Bore" type i.e. the piston being in contact with the cylinder block. The cylinder block is cast iron and does not incorporate a tappet chamber, push rod tubes and drain holes being machined in the block.

The sumps are aluminium castings and are located by dowels on six cylinder engines to ensure positive alignment of the rear face.

The 2703E and 2704E engines were fitted with either the SIMMS "Minimec" or C.A.V. D.P.A. injection pump and all other engines are fitted with either the SIMMS "Minimec" injection pump or the Bosch injection pump.

There is provision for various combinations of power take off from the front and rear of the timing gear cover, as well as from the crankshaft front end.

SECTIONED ENGINE–PARTS IDENTIFICATION

Note:–The item numbers in the following columns refer to the corresponding numbers in the Sectioned Engine illustration on the opposite page.

1. Push Rod
2. Rocker Cover
3. Fuel Leak off Pipe
4. Rocker Arm
5. Valve Clearance Adjusting Screw
6. Crankcase Ventilation Breather Valve
7. Intake Manifold
8. Rocker Shaft
9. Valve Cap
10. Oil Filler Cap
11. Valve Spring Retainer
12. Valve Spring
13. Valve Guide
14. Valve
15. Thermostat
16. Fan
17. Front Lifting Eye
18. Cylinder Head
19. Fan Belt
20. Water Pump
21. Delivery Valve Holder
22. Stop Control Lever
23. Injection Pump
24. Drive Gear
25. Pulley and Damper Assy.
26. Cylinder Block
27. Crankshaft
28. Oil Filter
29. Oil Pump
30. Oil Pan
31. Connecting Rod
32. Fuel Pump Actuating Lever
33. Hand Priming Lever
34. Fuel Lift Pump
35. Camshaft
36. Flywheel
37. Flywheel Ring Gear
38. Piston
39. Fuel Filter
40. Injector
41. Rear Lifting Eye

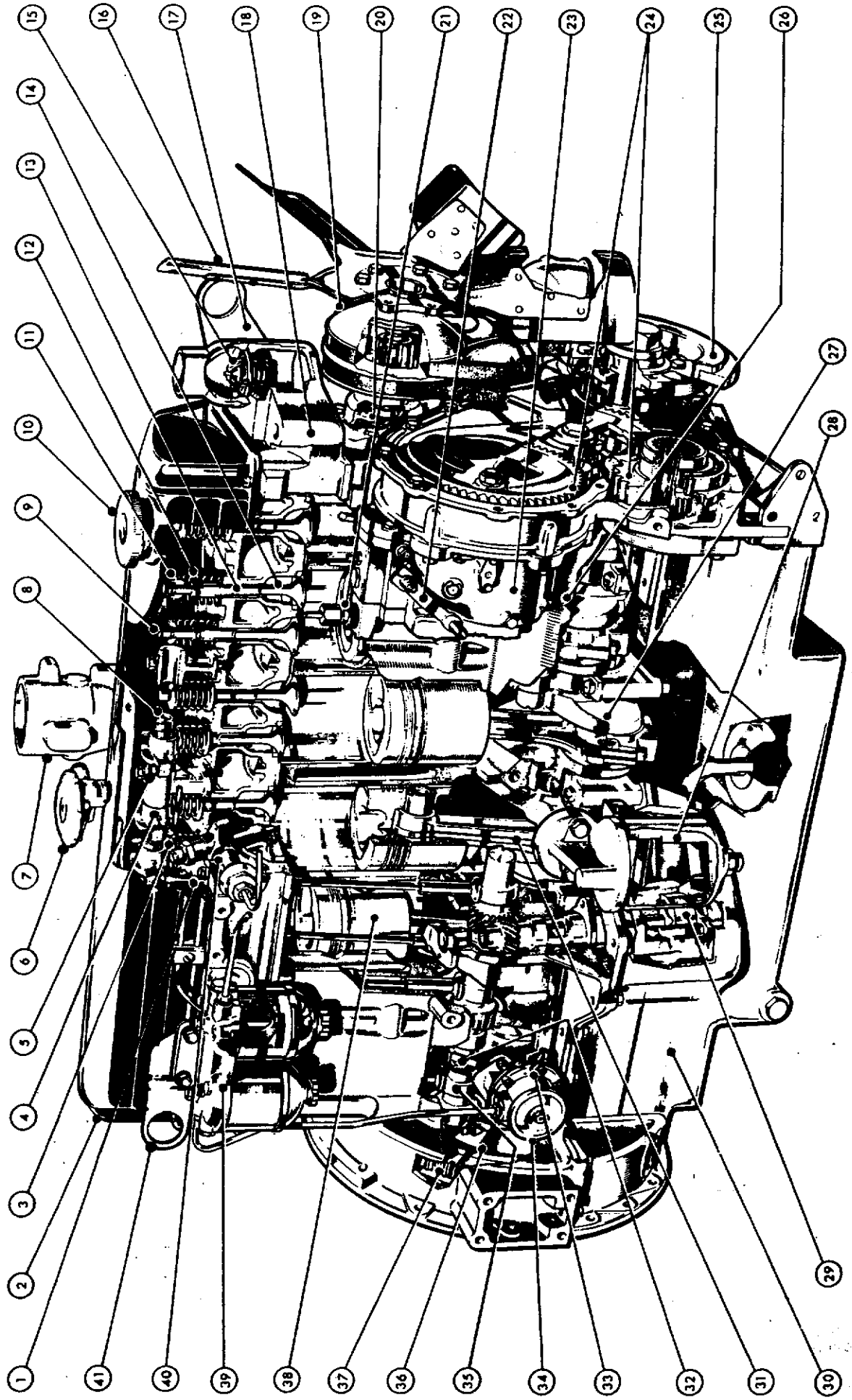


Fig. 1 – SECTIONAL VIEW OF 6 CYL. ENGINE

A list identifying the parts numbered is on the opposite page

JUNE 1979

ENGINE COMPONENTS

INLET AND EXHAUST MANIFOLDS (Normally Aspirated Engines)

The inlet and exhaust manifolds are separate and are retained on the left-hand side of the cylinder head by studs, with brass nuts, and bolts, all fitted with plain washers. The studs are located in the upper holes and retain both manifolds. Bolts are used in the lower holes only (See Fig. 2).

Inlet manifolds are aluminium castings providing an unrestricted passage to the inlet ports.

The exhaust manifolds are cast iron with separate ports for each cylinder and incorporate a flange for attaching the exhaust pipe. A pair of inlet/exhaust manifold gaskets are fitted.

Inlet and Exhaust Manifolds – (Turbocharged Industrial Engines) Fig. 2.

Retention of the manifold to the cylinder head is the same as for normally aspirated engines and a pair of gaskets are fitted.

The inlet manifold is an aluminium casting incorporating two separate passages, one directing air from the air cleaner to the turbocharger and the other from the turbocharger to the inlet ports. The two inner pairs of inlet ports are joined together.

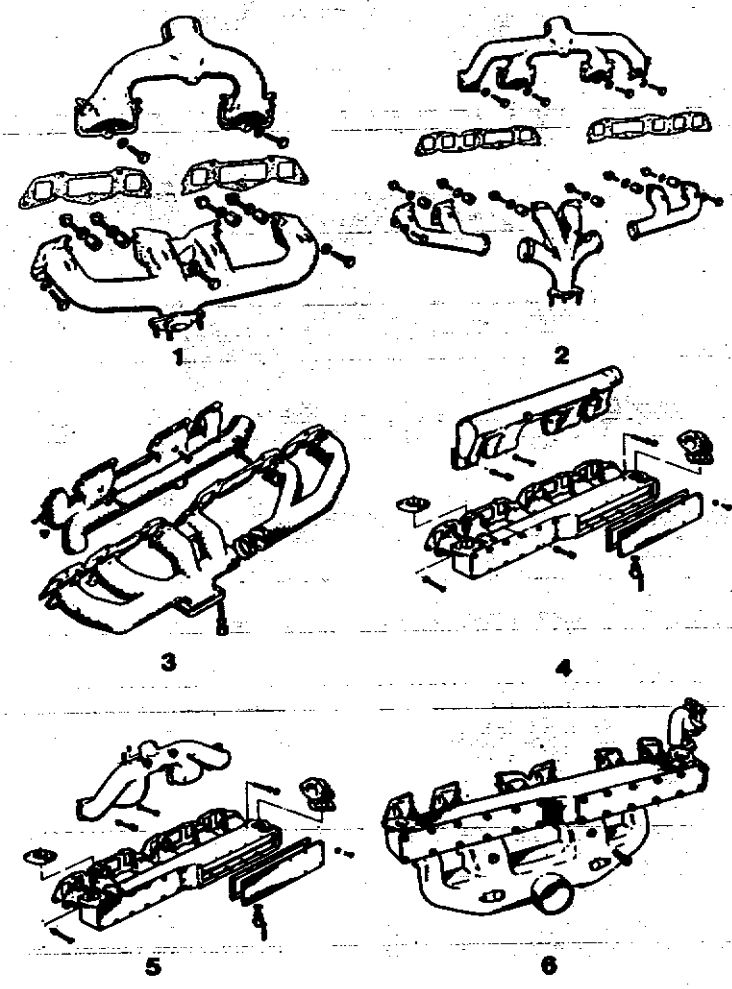


Fig. 2 A selection of manifolds used with 2700 Range Engines.

1. 4 cyl. Normally Aspirated Engine
2. 6 cyl. Normally Aspirated Engine
3. Industrial Turbocharged Engine
4. Standard Marine Engine
5. Intercooled Marine Engine
6. Turbo Plus Marine Engine

Inlet and Exhaust Manifolds — (Turbocharged Marine and Intercooled Engines) Fig. 2.

The inlet manifold is an aluminium casting, providing an unrestricted passage to the inlet ports. The inner pair of inlet ports are joined together. The water cooled exhaust manifold is cast iron and has removable covers to the water jacket, the rear end incorporates the mounting flange for the turbo-charger. Coolant connections are flange mounted on the top face of the water jacket housing, a drain cock is fitted on the lower face.

The manifolds are fitted with gaskets.

Where it is necessary to replace the exhaust manifold on 2704ET Marine engines, ensure only the latest type (Part No. 693F-9429-JAA), with drain cock (Part No. 723F-8115-JAA) is fitted.

ROCKER COVER

The rocker cover is normally a steel pressing retained by screws around the flanged edge.

A breather tube and baffle are incorporated in the rocker cover and an oil filler cap is also fitted at the front of the steel cover.

CYLINDER HEAD – Normally Aspirated Engines

The cylinder head is made of cast iron and incorporates replaceable valve guides and exhaust valve seat inserts. A composition type cylinder head gasket, with aluminium coated steel reinforcement around the cylinder bores is used, the head is retained by 9.525 mm. (3/8 in.) diameter bolts x 105.82 mm. (4 9/16 in.) long. These bolts have a letter X on the head for identification purposes. BOLTS MARKED 100, AS USED ON 590E/592E ENGINES MUST NOT BE USED.

From 1st May 1976, all turbocharged engines have been fitted with new type cylinder head bolts having integral washers. These new bolts are not interchangeable with the earlier types and can only be used on engines to which they were fitted as original equipment or on earlier cylinder heads modified as detailed in paragraph 24 on Page 17.

Note: Turbo Plus engines have two special cylinder head bolts for mounting the air charge cooler.

JUNE 1979

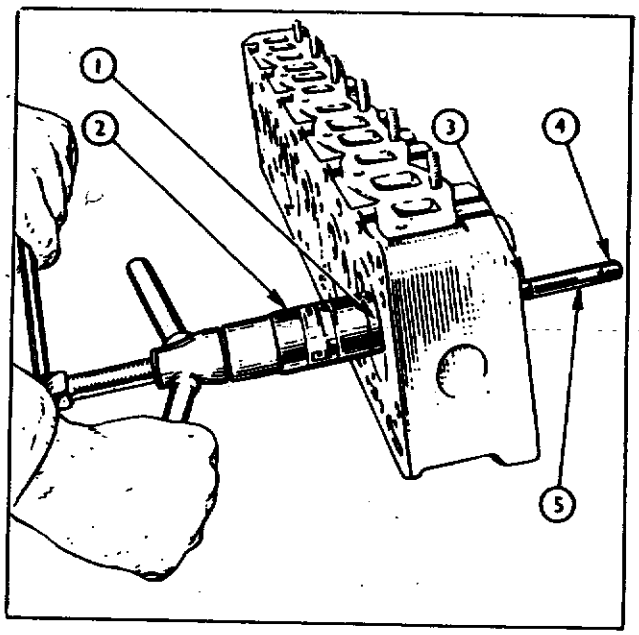


Fig. 3 – Valve Guide Removal

1 Conical Seat Detail "a"
2 Guide Remover and Replacer Tool No. CT.6073
3 Valve Guide
4 Nut Detail "d"
5 Spacer Detail "b"

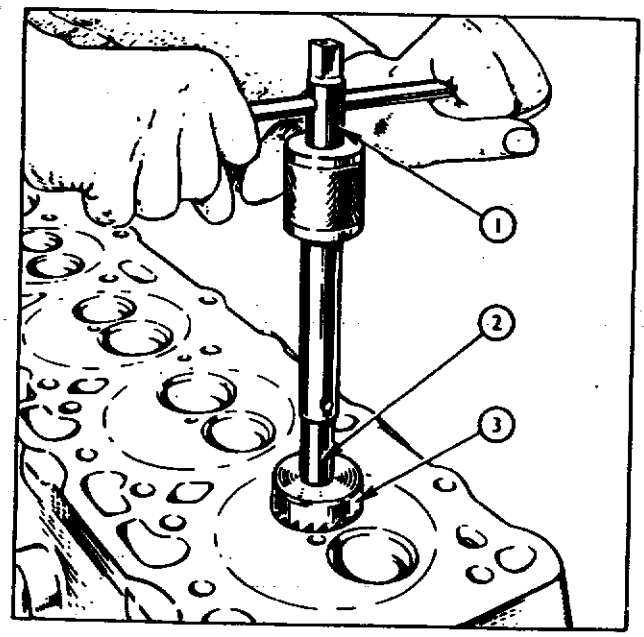
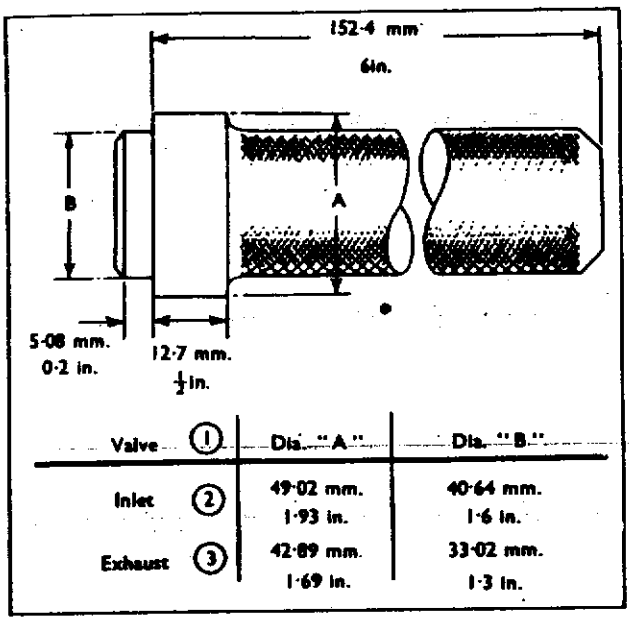


Fig. 4 – Recutting Valve Seats

1 Handle Tool No. 316X
2 Pilot Tool No. 316–12
3 Inlet Valve Seat Cutter Tool No. 317TT.30



Valve		Dia. "A"	Dia. "B"
Inlet	②	49·02 mm. 1·93 in.	40·64 mm. 1·6 in.
Exhaust	③	42·89 mm. 1·69 in.	33·02 mm. 1·3 in.

Fig. 5. – Valve Insert Replacer

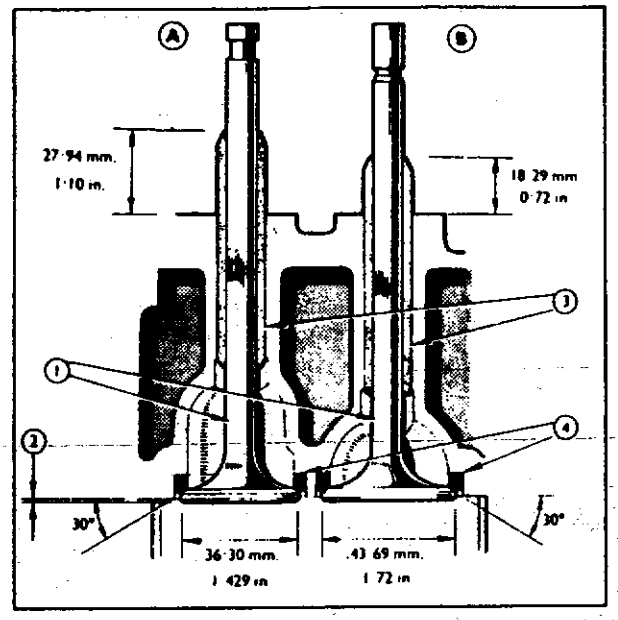


Fig. 6. – Valve Seats
1 Valves A Exhaust and B Inlet
2 Valve Protrusion 0.864 mm. (0.034 in.) Max.
3 Valve Guides
4 Valve Seat Inserts

Inlet and exhaust valve guides are identical and when excessively worn may be removed and new guides fitted using valve guide remover and replacer Tool No. CT.6073 and adaptors Tool No. CT. 6073–1A exhaust and CT. 6073–3 inlet. Screw the pull rod detail "e" into the tool centre screw and locate the conical seat detail "a" over the pull rod. Pass the pull rod through the valve guide, so that the conical seat locates in the valve seat, locate spacer detail "b" on the pull-rod and retain with the nut detail "d" (see Fig. 3). Remove the valve guide by turning the wing nut clockwise. Unscrew the nut and remove the spacer and valve guide. Pass the pull rod through the valve guide bore, again from the seat side, locate a new guide on the pull rod, tapered end away from the head, with replacer/adaptor Tool No. CT.6073–1A detail "n" (exhaust) or CT.6073–3 (inlet) over the tapered end. Screw the nut onto the pull rod and fit the guide by turning the wing nut. The respective replacer adaptors ensure that the guides are fitted to the correct depth and protrusion (see Fig. 6).

After fitting new valve guides the valve seats must be recut to ensure that the seat is concentric with the valve stem bore. Recut the seats with cutters Tool No. 317–TT–26 (exhaust) and 317–TT–30 (inlet) fitted to pilot Tool No. 316–12 in handle Tool No. 316X (Fig. 4). Where necessary seats may be narrowed with cutters Tool No. FMC.317–27 (exhaust) and FMC.317–29 (inlet). The valve seats should also be recut when they show signs of pitting or burning.

Replacement valve seat inserts are available and should be fitted where necessary. Where inserts have not been fitted previously it will be necessary to machine a recess in the cylinder head for the appropriate valve seat insert. If, for any reason, an existing insert has become loose or damaged, oversize inserts can be fitted. Use only the inserts specified for turbocharged engines for all engine ranges if it is necessary to replace the inserts.

The sizes for machining the recesses for standard and oversize valve seat inserts are tabulated in the section "General Specifications" at the end of this Chapter.

Valve seat inserts may be removed by inserting a suitable chisel under the insert and striking smartly when the insert will be forced out of its location. Care should be taken in this operation to avoid damage to the combustion chamber.

To fit a new insert, select the correct size and enter the insert with the chamfered edge away from the combustion chamber and press into place using insert replacer tools made to the dimensions shown in Fig. 5. After fitting the inserts, the seats must be cut with the appropriate cutter tools to the dimensions in Fig. 6 to give a maximum valve protrusion above the cylinder head face of 0.86 mm. (0.034 in.).

CYLINDER HEAD (Turbo Charged Engines)

The cylinder head is different in that it has valve seat inserts on the inlet and exhaust valves, also a "Scallop" machined between the two valves.

VALVES AND SPRINGS

The valves, which have 30° seats, are mounted vertically in the cylinder head, the inlet valve head diameter being larger than the exhausts. Their respective diameters are 45.24 mm. (1.78 in.) and 38.89 mm. (1.53 in.) and both valves have stems which are phosphate coated to improve durability The relative positions of the valves are inlets Nos. 2, 3, 6 and 7 (4–cylinder) and 2, 4, 5, 8, 9 and 11 (6–cylinder) and exhausts Nos. 1, 4, 5 and 8 (4–cylinder), and 1, 3, 6, 7, 10 and 12 (6–cylinder).

Identical valve springs are fitted to both valves and are close-coiled at one end. When fitting these springs ensure that the close coiled end is located in the pressed steel seat located around the valve guide. The inlet valve spring is retained by a hardened steel retainer and split tapered collets, while the exhaust has a hardened steel retainer with parallel collets, as the exhaust valve is of the rotator type. With this type of valve a small cap is fitted over the valve stem to locate in the retainer on top of the collets. Rocker arm pressure is then transmitted directly to the retainer and valve spring and, as there is a small clearance between the cap and the valve stem, the valve is free to rotate when open.

NOTE: Some exhaust valves on automotive engines do not have rotator caps and have the tapered collets.

Rotator cap clearance is 0.025 to 0.127 mm. (0.001 to 0.005 in.) and it is very important that this is maintained at all times. Insufficient clearance will prevent the valve rotating when open which will eventually result in the valves and valve seats burning. If the clearance is excessive, the valve will hammer on the collets and lead to excessive wear and possible valve failure.

The use of rotator caps has been discontinued for current production engines. If it is necessary to replace exhaust valve/s fitted with rotator caps, only the latest level of exhaust valve/s must be fitted, e.g. without rotator caps. The valves can be replaced in complete sets or individually. When the latest valve/s is fitted, the valve gap is to be set to 0.381 mm (0.015 in).

The inlet valve level has also been amended, current engines are now fitted with the same valve as used in the turbocharged engine. These valves can be identified by the letter 'T' stamped on the valve head.

Valve stem caps are fitted to the inlet valve to reduce wear on the rocker arm pads and valve stems. Each valve stem is fitted with an umbrella type seal below the valve spring retainer.

The valves may be re-ground if the face is unduly pitted or distorted providing the edge thickness is not reduced to 0.79 mm. (0.008 in.) or less. Hand lapping may be used but should be kept to a minimum or the angles may be altered and the seat width become too wide. A seat width of 1.59 mm. (0.063 in.) to 2.38 mm. (0.016 in.) is acceptable.

ROCKER SHAFT ASSEMBLY

The rocker arms, which are handed and fitted with self locking screws, are located on the rocker shaft between supports, each pair of rockers being spaced by a compression spring. The rocker shaft supports are retained on the cylinder head by bolts fitted with spring washers. (Fig. 7).

A two piece hollow rocker shaft is used on 6–cylinder engines, one piece on 4 cylinder engines, and is located in the correct position by bolts through the intermediate supports either side of the central support. The extreme ends of the rocker shafts are sealed with expansion plugs and as these do not retain the end supports it is advisable to attach a piece of cord between them, when removing the rocker shaft assembly, to prevent accidental disassembly.

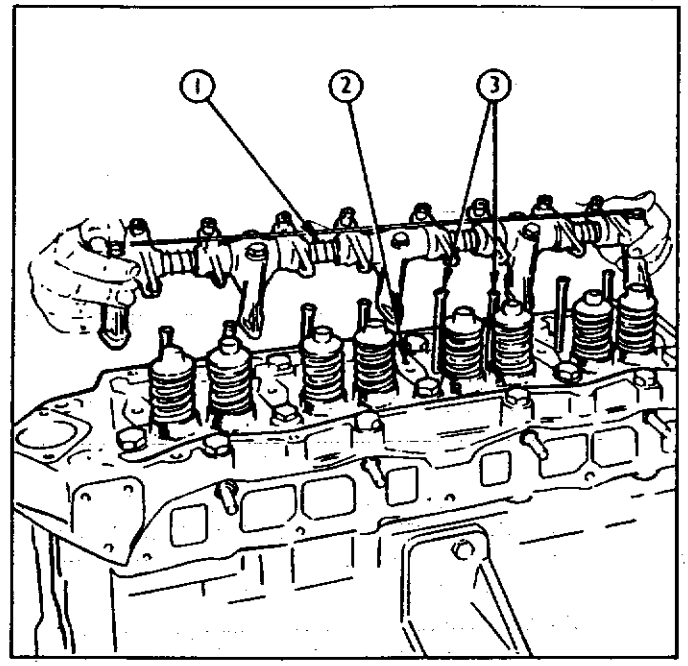


Fig. 7 Rocker Shaft Removal

1 Push Rods
2 Oil Feed Hole
3 Rocker Shaft

Self locking screws are fitted to the rocker arms and on initial assembly the installation torque, with the thread lubricated, must be 9.5 to 20.3 Nm (0.97 to 2.07 kgf m or 7 to 15 lbf ft) when the ball end is 9.53 mm (0.375 in) below the rocker shaft bore centre line. When turning these screws or when adjusting valve clearances a socket or ring spanner must be used.

CYLINDER BLOCK

The cylinder block is cast iron and is cast integral with the upper half of the crankcase. The cylinder bores have dry liners fitted to the turbocharged engines, also the normally aspirated engines built prior to November 1969. A full length water jacket is provided on all engines. Casting and machining pads cast on the top edge of the cylinder block on the right hand side are used for numbering the engine. The engine number is stamped on the front pad and the numbers stamped on the rear pad indicate the engine capacity.

On normally aspirated engines built prior to November 1969, the cylinder liners are pressed in to give a protrusion of 0.51 to 0.64 mm. (0.020 to 0.025 in.). Although occasionally in service it is permissible for the liners to drop to a maximum of 1.5 mm. (0.060 in.) below the block surface.

Cylinder blocks are now available for the 3964 c.c. (242 cu in) and 5950 c.c. (363 cu in) engines without liners, and are completely interchangeable with the linered assemblies. When using these assemblies ensure that the correct pistons and cylinder head gasket are used.

Reboring of these later level cylinder blocks may be carried out to suit the currently available oversize pistons.

To remove and replace the cylinder liners on normally aspirated engines Tool No. C.6136–8 should be used (see Fig. 8). Attach the protection strips to the cylinder block face, invert the cylinder block and stand on the bed of a suitable press. Locate the remover in the bottom of the liner (use large diameter spigot for larger bored engines and a small diameter spigot for the smaller bored engines) and press the liner out. To fit a new liner, stand the cylinder block with the sump face on the press bed and apply a 76 mm. (3 in.) band of Loctite to the Block bore. Locate the replacer ring over the end of the liner having the internal chamfer, insert the remover into the replacer ring and press and liner home. The replacer ring automatically sets the protrusion. After installation, bore and hone to give the correct piston fit.

To remove and replace the cylinder liners on the turbocharged engines Tool EPCO Flexi-Force cylinder liner press FF138 should be used.

CYLINDER BLOCK (continued)

To Remove

1. Screw the four support legs in the cylinder pressure plate, place the ram pressure plate onto the opposite end of the legs and retain with flat washers and nuts. Mount the assembly onto the cylinder block and fit the locating bolt (See Fig. 9).

2. Insert the long pull-rod through the cylinder bore and assemble the remover plate, flat washer and nut to the end of the pull-rod.

3. Position the ram assembly, ram uppermost, over the pull-rod and onto the pressure plate, fit a flat washer and nut to the pull-rod. Ensure that the remover plate is correctly located in the lower end of the liner.

4. Connect the hydraulic pump hose to the ram assembly. Tighten the pressure release screw then operate the pump. When the ram reaches the end of its stroke, loosen the pressure release screw, adjust the pull-rod by tightening the nut down onto the ram. Tighten the pressure release screw and operate the pump. Successive operation of the ram and adjustment of the pull-rod length will withdraw the liner.

To Replace

Before installing the liners, remove all foreign matter from the cylinder block bores by lightly brushing with a wire brush.

Remove all traces of dust and oil from the bores by using a suitable degreasing agent, e.g. trico or petrol.

1. Apply a 76 mm. (3 in.) band of "Loctite" retaining compound No. 75 (EM4G64) to the top of the cylinder block bore using a clean, oil and grease free brush. Completely clean and degrease the cylinder liners. Coat the outside diameter with Locquic T (SM4G-4647-A) ensuring that the whole surface is covered, and allow the primer to dry. With the internal chamfer upwards, enter the liner into the bore, square the liner to the bore by using a hide mallet.

2. Using the pull-rod coupler, join the two pull-rods together, assemble the cross-beam, flat washer and nut to the lower end of the pull-rod. Insert the pull-rod into the liner so that the cross beam locates on the sump face of the cylinder block (Figs. 10 and 11).

3. Slide the replacer plate over the pull-rod and locate the machined groove onto the liner. Place the ram assembly, ram uppermost over the pull-rod and onto the replacer plate, fit a flat washer and nut to the pull-rod and tighten the nut onto the ram.

4. Connect the hydraulic pump hose to the ram, tighten the pump pressure release screw and operate the pump. When the ram has reached the end of its stroke, loosen the pressure release screw and adjust the pull-rod by tightening the nut down onto the ram. Tighten the pump release screw and operate the pump. Repeated operation of the ram and adjustment of the pull-rod will replace the liner.

   The replacer plate is machined to set the correct liner protrusion.

5. Bore the liner within 0.127 mm. (0.005 in.) undersize, then hone to obtain the correct piston fit. This honing operation is applicable to the centrifugally cast iron liner only. CROMARD LINERS ARE 'REFINISHED'.

JUNE 1979

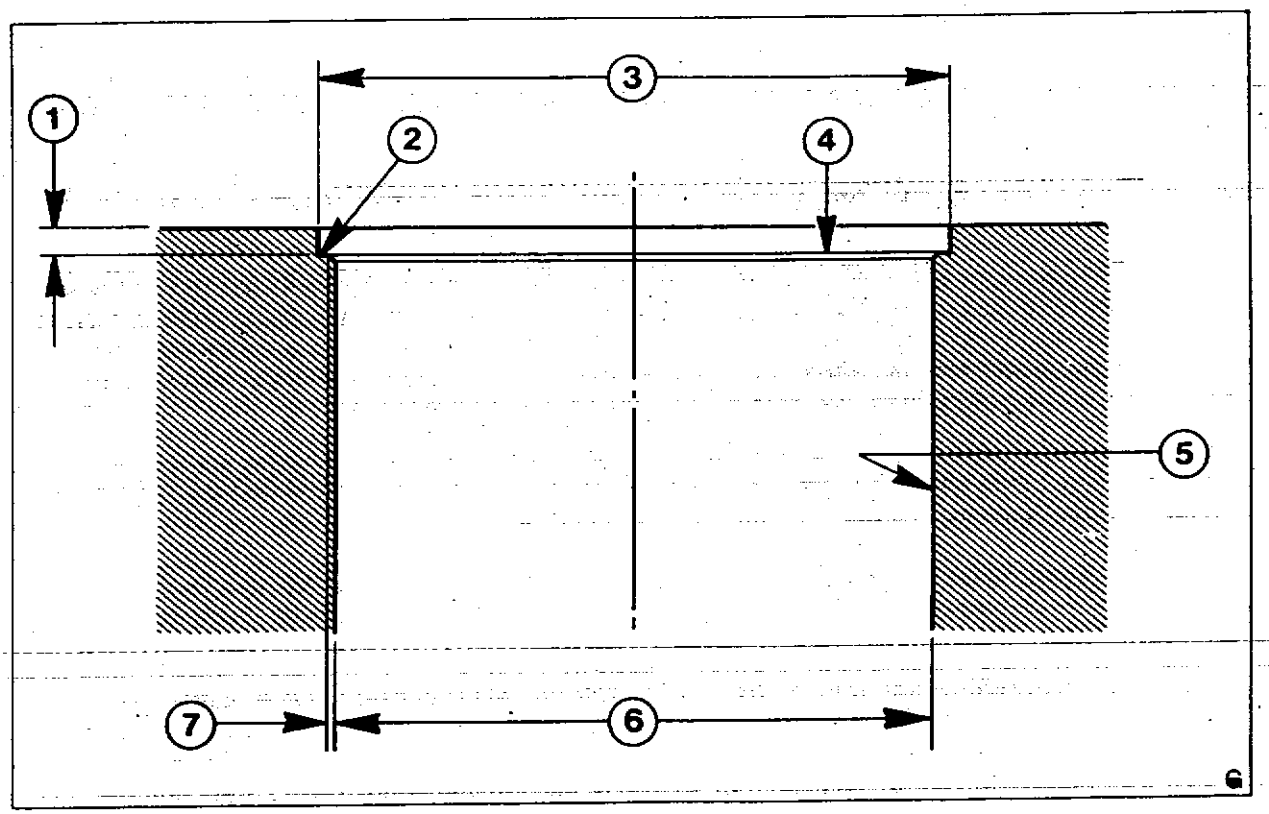
REPLACEMENT OF CROMARD CYLINDER LINERS WITH CAST IRON LINERS (TURBO-CHARGED ENGINES)

Engines built between August 1969 and December 1972, fitted with Cromard liners may be reworked to the latest design level by machining the existing cylinder block and fitting lipped cast iron liners, new pistons and rings, connecting rods and big end bearing liners.

NOTE: Engines built after engine number S844447, will not require the later type connecting rods, as these are fitted in production.

PROCEDURE FOR MACHINING THE EXISTING CYLINDER BLOCK

1. Remove the engine from the equipment or vehicle.
2. Strip the engine down to the basic block level.
3. Remove the Cromard cylinder liners.
4. Machine all the block bores to accept the cast iron cylinder liners (part number 733F-6055-GAB) in accordance with the dimensions shown below.



1. 4.7625 to 4.8641 mm (0.1875 to 0.1915 in.)
2. 0.5080 mm (0.02 in.) radius maximum
3. 113.1443 to 113.2713 mm (4.4545 to 4.4595 in.) diameter, to be concentric with the main bore within 0.0127 mm (0.005 in.) total indicator reading.
4. This face to be square with the cylinder block bore within 0.0254 mm (0.001 in.) total indicator reading.
5. Hone this surface to 22 to 40 centre line average (surface finish) – see Ford Specification ES-2704E-6015-A.
6. 108.5977 to 108.6231 mm (4.2755 to 4.2765 in.) diameter
7. 0.0580 to 0.6350 mm (0.020 to 0.025 in.), chamfer at 45°.

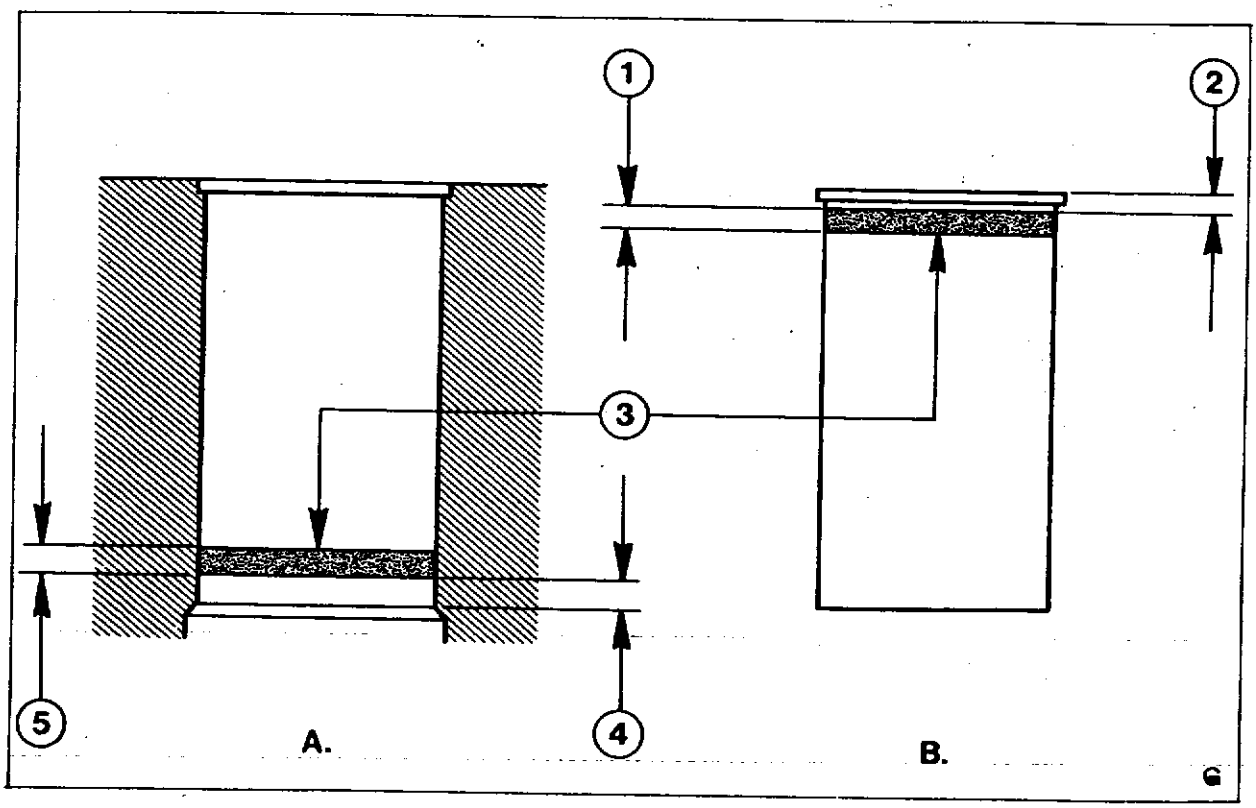
CYLINDER BLOCK–Continued

IMPORTANT: The squareness and the counterbore seat to cylinder block bore must be maintained.

NOTE: Parallel cast iron cylinder liners (part number 2704E-6055-B) must not be fitted to the 'Cromard' cylinder blocks because of the presence of the counterbore.

5. Remove all foreign matter and traces of oil from the cylinder block bores and remove the protective coating from the cast iron cylinder liners using 'Ardox Cleaner'.

6. Apply sparingly a 13 mm (0.5 in.) wide band of sealer (part number A70SX-19554-AA) approximately 13 mm (0.5 in) from the base of each bore. Approximately 6 mm (0.5 in) below the cylinder line lip apply sparingly a 13 mm (0.5 in.) wide band of sealer (part number A70SX-19554-AA) to the outside diameter of each liner as shown below.



A. Cylinder Block Bore
1. 13 mm (0.5 in.)
2. 6 mm (0.25 in.)
3. Band of Sealer

B. Cylinder Liner
4. 13 mm (0.5 in.)
5. 13 mm (0.5 in.)

7. Push the liners into the cylinder block by hand as far as they will go. Using the cylinder liner press, position the ram and the correct adaptor on the top end of the liner and connect the pull rod to the cross beam which locates across the sump face. Press the liner home steadily, using extreme care to ensure the liner lip is not overloaded as seating occurs.

8. Ensure that the liner is pressed home squarely and that the liner recess in the cylinder block remains clean, enabling the liner lip to seat correctly. Remove any sealer that may have accumulated on the lower edge of the liner.

9. Repeat operations 6 to 8 for the remaining five cylinder liners.

10. Measure the pre-finished bores of the liners and select the grades of pistons required (part numbers 733F-6012-GAA/GBA).

    Note: Piston to cylinder liner clearance is 0.15 to 0.17 mm (0.0058 to 0.0068 in.)

11. Reassemble the engine, fitting connecting rods with oil squirt holes (part number 723F-6200-AAA) and corresponding bearings (see Parts Required) if the engine was built before engine number S844447.

    Important: When fitting the cylinder head only cylinder head gasket (part number 683F-6051-GA) must be used.

PARTS REQUIRED:

Description	Part Number	Finis Code	Quantity Required
Cylinder liner	733F-6055-GAB	1544253	6
Piston, Pin, Rings, Retainer Assemblies (Grade 2)	733F-6102-GAA	1540318	As Required
(Grade 4)	733F-6102-GBA	1540319	As Required
Connecting Rod Assembly	723F-6200-AAA	1537591	6 (if before S844447)
Big End Bearing Liner – Upper – Standard	723F-6211-GA/1A	1537592	As Required
0.254mm (0.010 in.) Undersize	723F-6211-GB/1A	1537556	As Required
0.508mm (0.020 in.) Undersize	723F-6211-GC/1A	1537557	As Required
0.762mm (0.030 in.) Undersize	723F-6211-GD/1A	1537558	As Required
1.016mm (0.040 in.) Undersize	723F-6211-GE/1A	1537559	As Required
Big End Bearing Liner – Lower – Standard	2709E-6211-AA	1428375	As Required
0.254mm (0.010 in.) Undersize	2709E-6211-AB	1428376	As Required
0.508mm (0.020 in.) Undersize	2709E-6211-AC	1428377	As Required
0.762mm (0.030 in.) Undersize	2709E-6211-AD	1428378	As Required
1.016mm (0.040 in.) Undersize	2709E-6211-AE	1428379	As Required
Kit – Engine Overhaul Gasket	2704E-6008-C	1428986	1
Sealer	A70SX-19554-AA	1474588	As Required

It is not practical to carry out liner replacement with the cylinder block in situ, as distortion is likely to result.

NOTE: For identification the letter 'T' is stamped on the rear cylinder block pad to indicate for use on Turbocharged engines.

Internally, the crankcase incorporates five main bearings (4—cylinder) and seven main bearings (6—cylinder). The main bearing caps are retained by self locking bolts 15.88 mm. (5/8 in.) diameter fitted without washers. When dismantling the main bearing caps, ensure that the intermediate cap positions are marked as these caps are identical. Also ensure that the immediate and centre caps are fitted the correct way round, these caps are marked REAR to facilitate assembly.

Semi-finished main bearing caps are available and may be used to replace caps which have become worn or damaged.

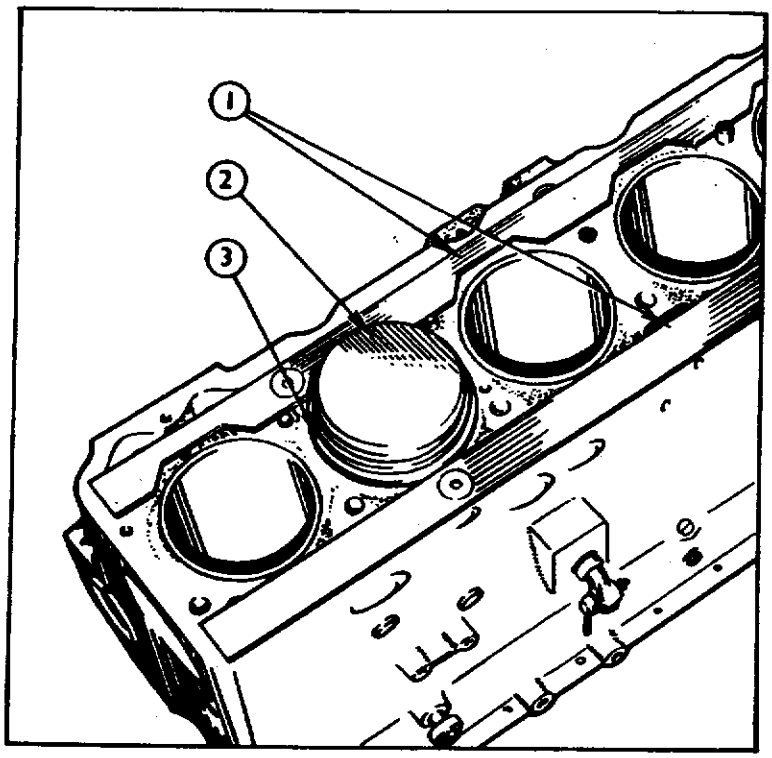


Fig. 8 Cylinder Liner

1 Protection Strips
2 Cylinder Liner Remover
3 Replacer Ring

CYLINDER BLOCK (continued)

When fitting one or more replacement main bearing caps in service all the caps must be assembled to the block, the main bearing bolts tightened to 163 to 176 Nm (16.59 to 17.97 kgf m or 120 to 130 lbf ft) torque and the main bearing bores line bored 0.38 mm (0.015 in) oversize. The finished dimension for the oversize bore is 80.81 to 80.82 mm (3.1815 to 3.1823 in) diameter. If the centre main bearing cap requires replacing it must be centralised on the cylinder block prior to machining (see Fig. 8). Machine recesses 99.01 to 99.30 mm (3.900 to 3.910 in) diameter on each side of the cap and if necessary reduce the bearing width by 0.508 mm (0.020 in) undersize. An equal amount of material should be machined off each side of the bearing to give a distance of 40.36 to 40.42 mm (1.589 to 1.591 in) between the thrust faces. The finished thrust faces must be square to the main bearing bore within 0.051 mm (0.002 in) total indicator reading and concentric within 0.152 mm (0.006 in) total indicator reading. If necessary, file back the thrust washer locating slots in the cap so that they are a little deeper than the thrust washer recesses (Fig. 12). Do not increase the width of the slots. Thrust washer recesses machined to the above dimensions, will require 0.245 mm (0.010 in) oversized thickness thrust washers, if the crankshaft journal width is standard; 0.38 mm (0.015 in) and 0.51 mm (0.020 in) oversizes are also available.

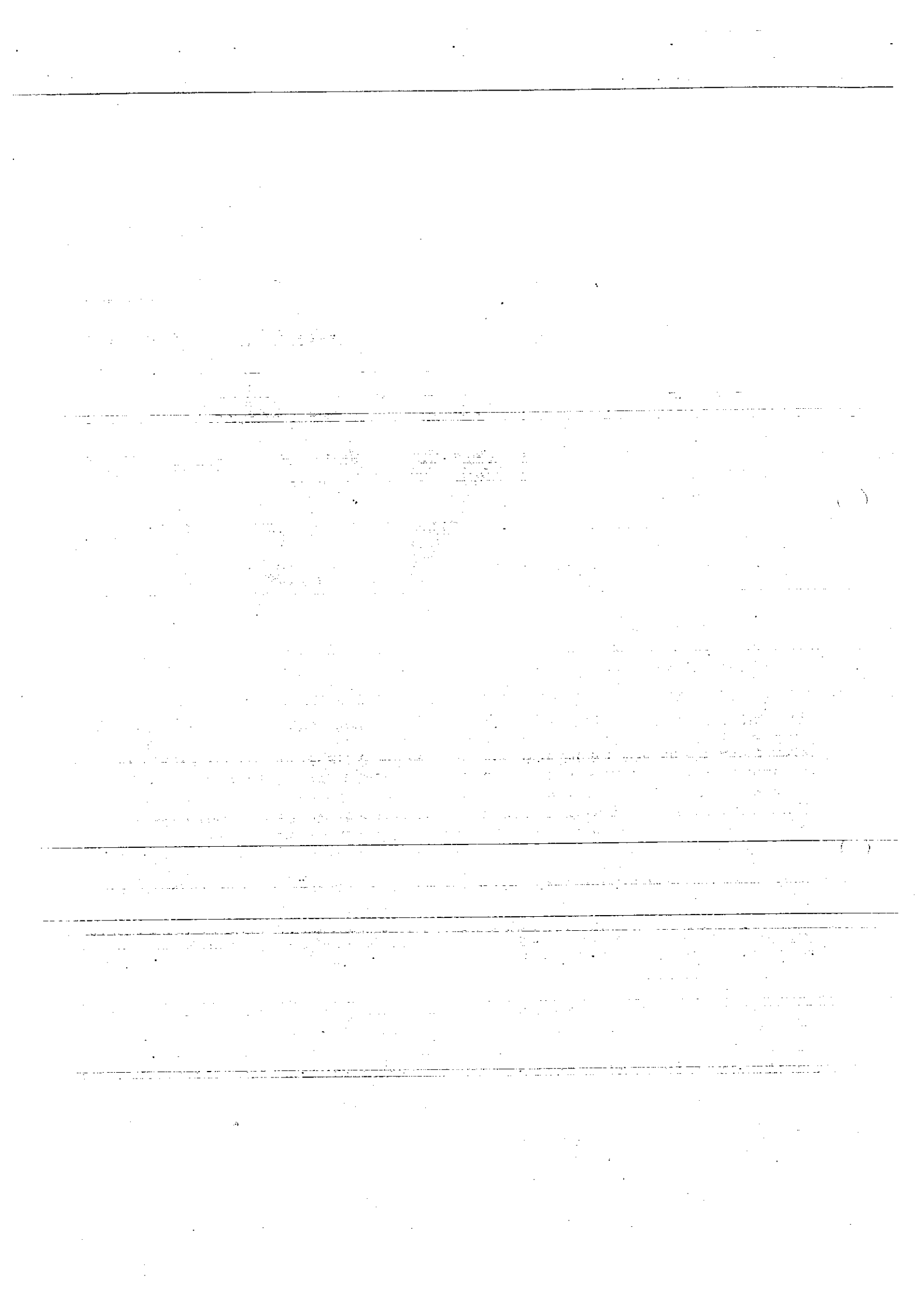
If a front bearing cap is being replaced remove the locating dowels and assemble the new cap to the cylinder block so that the front face is flush with the cylinder block front face. Tighten the main bearing bolts to the correct torque and, using the dowel holes in the cap as guides, drill two holes 9.53 mm. (3/8 in.) diameter through the cap into the cylinder block to the depth of the existing holes.

On removing the caps after machining fit oversize dowels to the cylinder block.

The parent bores for the camshaft bearings, where fitted, in the right-hand side of the crankcase may be standard or 0.508 mm. (0.020 in.) oversize.

Tappet bores and push rod tubes are drilled in the cylinder block along the right-hand side. Oil drain channels are also drilled to obviate the need for a separate tappet chamber and cover.

(Continued on page 7)



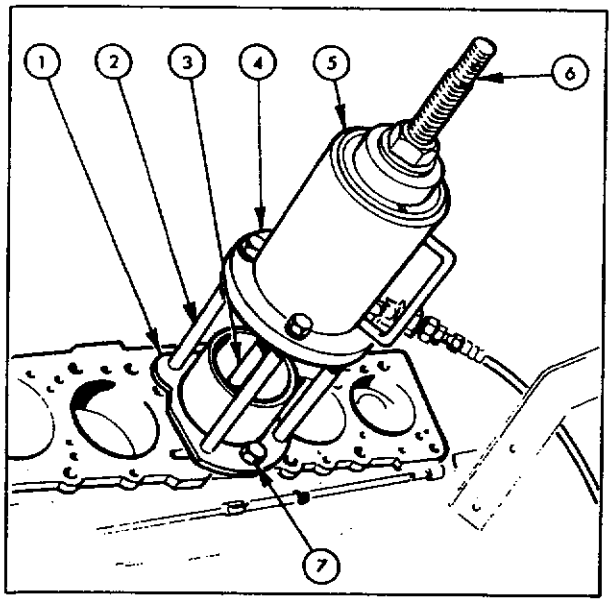


Fig. 9 – Cylinder Liner Removal

1 Cylinder Pressure Plate
2 Support Legs
3 Pull Rod
4 Ram Pressure Plate
5 Ram Assembly
6 Pull Rod
7 Locating Bolt

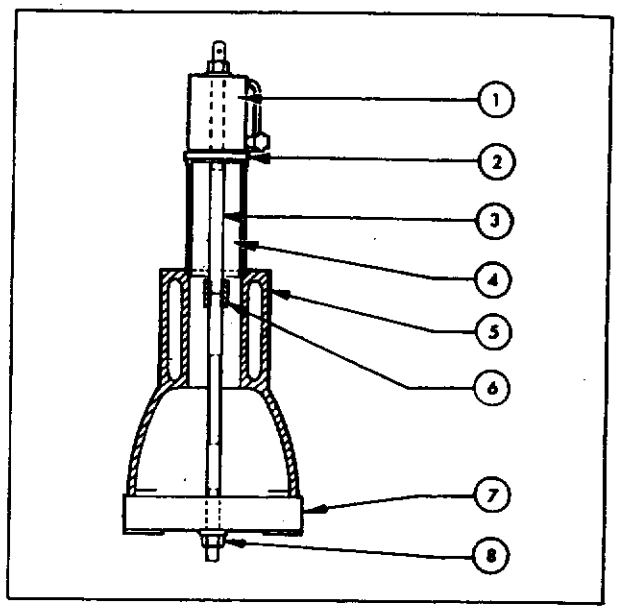


Fig. 10

1 Ram
2 Replacer Plate
3 Pull Rod
4 Liner
5 Cylinder Block
6 Pull Rod Coupler
7 Cross Beam
8 Nut and Washer

APRIL 1973

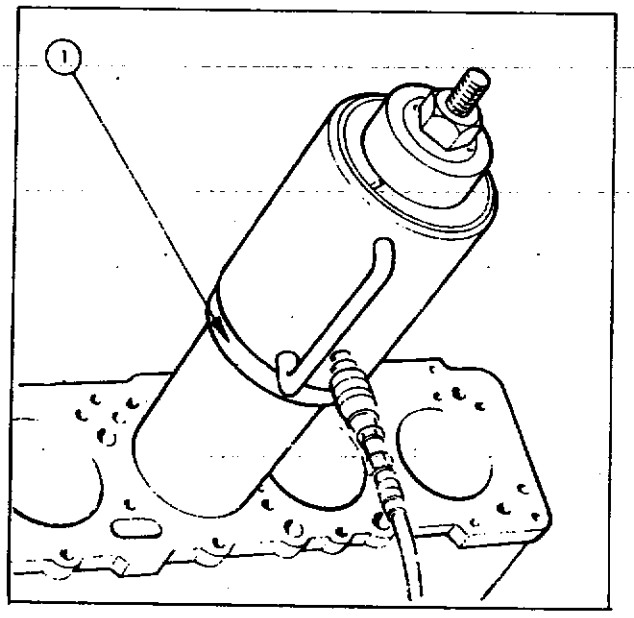


Fig. 11

1. Replacer Plate

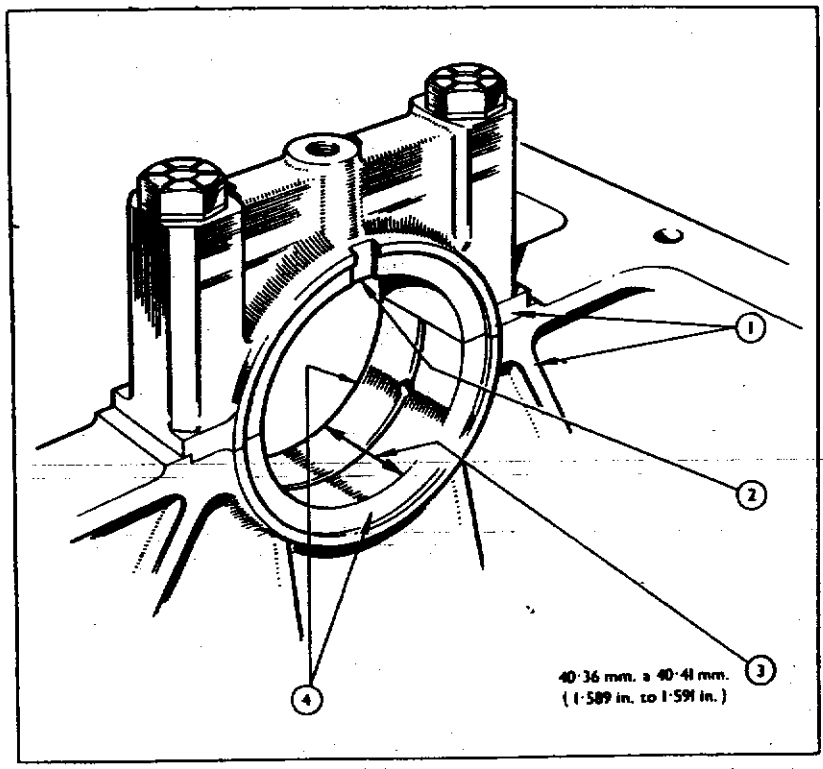


Fig. 12 Centre Main Bearing Cap

1 Align Cap and Block
2 File Back These Slots
3 Dimension
4 Machined Recess for Thrust Washer

CAMSHAFT AND GEAR

The cast camshaft is situated in the right hand side of the cylinder block and runs in 4 bearings (4 cylinder) or 6 bearings (6 cylinder). The bearings are steel backed, the front one being faced with copper lead the remainder white metal. Prior to Engine No. S790085, the camshaft in the majority of 4 cylinder engines ran directly in the cylinder block. When a heavy duty power take off is specified for a 4 cylinder engine, camshaft bearing bushes must be fitted.

Bushes available in service are pre-sized and require no machining after fitting. Bushes which are 0.508 mm. (0.020 in.) oversize on the outside diameter are also available. When one bush requires replacement it is advisable to replace all bushes as camshaft alignment may be affected if only one bush is changed.

The bushes can be removed and replaced using camshaft bearing remover and replacer Tool No. CT.6119A and adaptors Tool No. C.6119-2. Camshaft bearing remover and replacer Tool No. CT.6119 can be modified to make Tool No. CT.6119A by machining the internal diameter to 59.44 to 59.94 mm. (2.34 to 2.36 in.) and 38.1 mm. (1½ in.) deep. Alternatively the tool can be returned to the manufacturers for modification. Assemble the bushes with the split on the right-hand side and the two notches to the rear and vertical to ensure alignment of oil holes. After fitting the front bush bend the tang up to locate in the hole in the cylinder block front face. If bushes are fitted to a four cylinder engine or a new camshaft is to be used in a cylinder block already fitted with bearing bushes, ensure that the phosphate coating is lapped off all the camshaft bearing journals.

The cams on the camshaft are offset rearwards from the tappet centre lines and are also tapered. This causes the tappets and push rods to rotate, thus improving durability and eliminating the possibility of uneven wear. The nominal valve timing diagram is shown in Fig. 13. A fuel lift pump eccentric is incorporated between the two rear cams and an integral oil pump drive gear is provided between the rear two cylinders instead of an additional bearing journal.

The camshaft is retained by a thrust plate bolted through the timing gear housing to the cylinder block front face. Thrust washers are located on the camshaft on either side of the thrust plate by a spacer and are clamped in position between the timing gear and a separate collar adjacent to the front journal. These thrust washers are steel faced with bronze and must be fitted with the bronze faces towards each other. Camshaft end-float is 0.051 to 0.584 mm. (0.002 to 0.023 in.).