THE ENGINE

DESCRIPTION

The engines fitted to the Super Dexta and the Standard Dexta are three cylinder, four-stroke engines of 152 cu. in. (2,500 c.c.) and 144 cu. in. (2,360 c.c.) respectively. Both engines are of the same design, the difference between them being the cubic capacities. The 152 cu. in. (2,500 c.c.) capacity is obtained by having a bore of 3.6 in. (91.44 mm.) and a stroke of 5 in. (127 mm.) and the 144 cu. in. (2,360 c.c.) capacity by having a bore of 3.5 in. (88.9 mm.) and a stroke of 5 in. (127 mm.). The following description applies to both engines.

Overhead valves are employed, operated by tappets from a high-mounted, gear-driven camshaft located on the right-hand side of the cylinder block.

The valves are vertically located in replaceable guides in the cast iron, detachable cylinder head, and they have two springs per valve. The inlet valve head is larger in diameter than the exhaust valve.

Aluminium alloy pistons are fitted with five piston rings ; three compression and one oil control above the piston pin and one oil control below. The piston pins are fully floating and are retained in position by end circlips.

To ensure rigidity, an integrally cast cylinder block and crankcase is employed, and is fitted with full length, renewable, dry cylinder liners.

The crankshaft is supported in four main bearings. These bearings and the connecting rod big end bearings are of the detachable, steel backed type. Two cast iron balance weights are fitted to the crankshaft, one at the front crankweb, and the other at the rear crankweb. Crankshaft end-float is controlled by detachable thrust washers fitted at each side of the rear main bearing cap.

An enclosed camshaft, plunger type fuel injection pump is flange-mounted on the timing case, and gear driven from the crankshaft gear via an idler gear. The two-hole type injectors are located vertically in the left-hand side of the cylinder head.

On the 144 cu. in. engine, after engine No. 1530251, and on the 152 cu. in. engine, the speed is controlled by a mechanically governed fuel injection pump the operation of which is explained in the appropriate section of the Dexta Workshop Manual.

Prior to engine No. 1530251, the speed of the engine was controlled by a pneumatic governor mounted on the fuel injection pump.

To assist cold starting a heater plug and an induction primer are provided in the inlet manifold.

REPAIR PROCEDURE

The repair operations and data given in this section applies to both the 152 cu. in. and the 144 cu. in. engines and where differences between these engines apply specific reference will be made. In the case of operations affecting the pneumatically governed engine only, reference will be made in italics.

THE ROCKER SHAFT ASSEMBLY

To Remove

1. Lift off the primary air cleaner, and remove the vertical exhaust silencer (where fitted), and engine bonnet.

2. Slacken the rocker cover breather tube clip, unscrew the two self-locking nuts and remove the rocker cover and gasket.

3. Remove the union nut securing the rocker shaft oil feed pipe to the screwed adaptor at the rear right-hand corner of the cylinder head.

4. Gradually unscrew the four rocker shaft retainer nuts and lift off the rocker shaft.

To Dismantle

1. Stand the rocker shaft assembly on end with the oil pipe uppermost, remove the retaining circlip from the top end of the shaft and lift off the support brackets, spacer springs, rocker arms, spacers and the rocker shaft oil feed pipe in sequence.

To Reassemble

1. Fit the support brackets, spacer springs, spacers, rocker arms and the oil feed pipe in their correct order, as shown in Fig. 1, taking care to ensure that the stud holes in the rocker shaft support brackets are on the left when viewing the rocker shaft from the front. (Opposite end to the oil feed pipe.) The rocker arms are right- and left-handed and should be fitted with their " sets " positioned as shown in Fig. 1.

2. Complete the assembly by fitting a circlip in the groove at the end of the shaft.

To Replace

1. Fit the rocker shaft assembly to the studs on the cylinder head, entering the oil feed pipe into the screwed adaptor at the rear right-hand corner of the cylinder head.

2. Retain the rocker shaft in position with four flat washers and self-locking nuts.

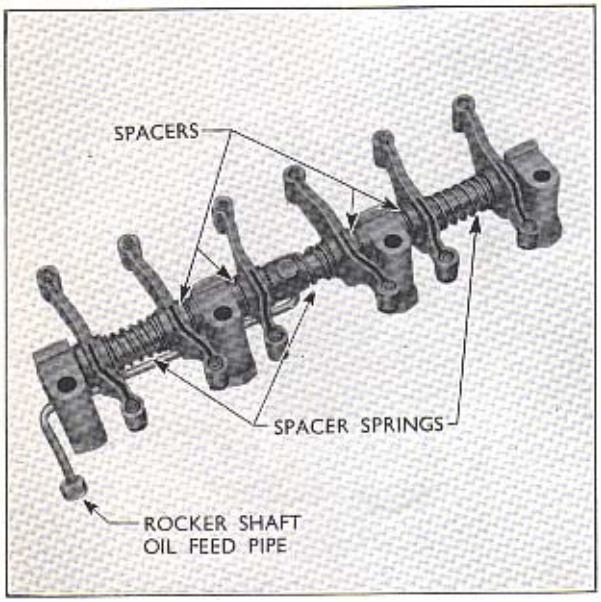


Fig. 1
Rocker Shaft Assembly

3. Tighten the rocker shaft oil feed pipe union nut securely.

4. Adjust the valve clearances as outlined on page 4.

5. Replace the rocker cover and gasket, taking care to ensure that the gasket is correctly located in the rocker cover. Refit the fibre washers, flat washers and self-locking nuts in that order, and securely tighten the nuts. Tighten the rocker cover breather tube clip.

6. Replace the primary air cleaner and vertical exhaust silencer (where fitted), and run the engine until its normal operating temperature is reached.

7. Remove the rocker cover, and if necessary readjust the valve clearances to 0.010 in. (0.25 mm.) as detailed on page 4.

8. Replace the engine bonnet.

CYLINDER HEAD ASSEMBLY AND GASKET

To Remove

1. Remove the radiator filler cap and drain the water from the cooling system through the two taps, one on the radiator and one on the left-hand side of the cylinder block.

2. Remove the primary air cleaner, vertical exhaust silencer (where fitted) and engine bonnet.

3. Disconnect the battery leads and remove the battery.

4. Remove the water temperature gauge capillary tube retaining clip from the left-hand engine lifting plate.

5. Remove the five set-screws securing the water outlet connection to the front of the cylinder head.

6. Where a horizontal exhaust silencer is fitted, release the exhaust manifold to cylinder head nuts and pull the manifold away from the cylinder head. If, however, a vertical exhaust system is fitted, completely remove the exhaust manifold.

7. Remove the injectors as outlined in the Fuel System Section, taking the recommended precautions regarding cleanliness.

8. Remove the nut, bolt and spring washer that secure the battery heat baffle to the bracket at the left-hand rear of the cylinder head.

9. Disconnect the following items from the inlet manifold :—heater plug lead, induction primer feed pipe and the air inlet hose.

9a. *In the case of the pneumatically governed engine it will also be necessary to remove the throttle link and governor pipe.*

10. Remove the inlet manifold. (Six nuts and spring washers.)

11. Remove the two set-screws securing the battery heat baffle to the bracket at the rear right-hand corner of the cylinder head.

12. Remove the two set-screws from the right-hand engine lifting plate and remove the bracket, battery heat baffle support bracket and the crankcase breather pipe.

13. Remove the camshaft chamber to rocker shaft oil feed pipe.

13a. *Remove the fuel lift pump to fuel filter, and the fuel filter to fuel injection pump feed pipes.*

13b. *Unscrew the two set-screws securing the fuel filter to the cylinder block and remove the fuel filter.*

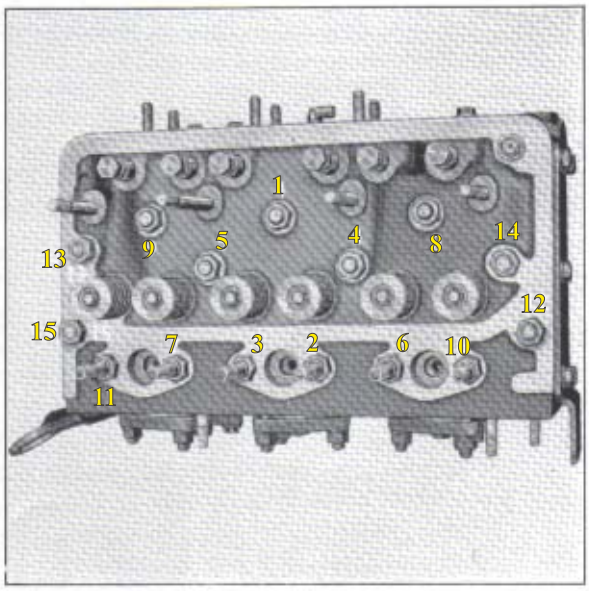


Fig. 2
Correct Sequence for Tightening Cylinder Head Nuts

13c. *Disconnect the governor pipe from the rear half of the governor case on the fuel injection pump.*

14. Remove the rocker cover and rocker shaft as outlined on page 1.

15. Unscrew the fifteen nuts retaining the cylinder head to the cylinder block in a sequence opposite to that shown on Fig. 2, using the special deep socket (Tool No. T.6095).

16. Lift off the cylinder head and remove the cylinder head gasket.

16a. *Unscrew the set-screw securing the governor pipe clip to the rear of the cylinder head, and remove the governor pipe and clip.*

To Replace

When fitting a new cylinder head take particular note of the diameter of the rear stud hole (exhaust manifold side). Where this hole is $\frac{19}{32}$ in. (15.08 mm.) diameter the current type stud (957E–6066–B) must be used and a washer fitted between the retaining nut and the head in order to provide adequate seating area for the nut. Where the hole is $\frac{15}{32}$ in. (11.91 mm.) the original type of stud, $\frac{1}{8}$ in. (3.18 mm.) shorter than that now used, will be satisfactory and no washer is needed.

1. Thoroughly clean all dirt, carbon, etc., from the cylinder block and the cylinder head faces.

2. Locate a new cylinder head gasket into correct position on the cylinder head studs.

The gasket for the 152 cu. in. engine is identified by the larger diameter bore hole. $3\frac{21}{32}$ in. (92.868 mm.) as against $3\frac{9}{32}$ in. (90.488 mm.) for the gasket of the 144 cu. in. engine. The gasket is marked to show which way it should be fitted, and it should be smeared on both sides with a coating of jointing compound.

2a. *Refit the governor pipe and clip under the appropriate set-screw at the rear of the cylinder head.*

3. Replace the cylinder head in position on the cylinder block.

4. Refit the cylinder head nuts and tighten in the correct order as shown on Fig. 2, to a torque of 55 to 60 lb. ft.

5. Replace the camshaft chamber to rocker shaft oil feed pipe.

6. Replace the right-hand lifting plate and the battery heat baffle bracket onto the cylinder head, and secure in position with two set-screws. The clip for the crankcase breather pipe fits under the lower of the set-screws.

7. Replace the set-screws securing the battery heat baffle to the cylinder head brackets.

7a. *Replace the fuel filter and fuel pipes, and bleed the fuel system as outlined in the Fuel System Section.*

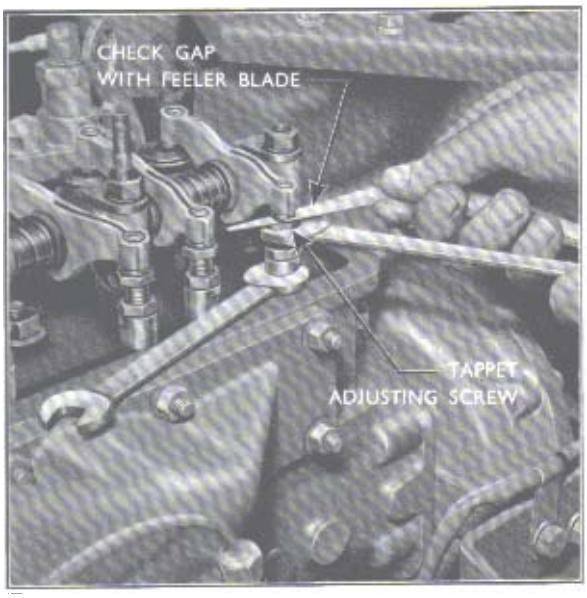


Fig. 3
Adjusting Valve Clearances

8. Replace the rocker shaft and adjust the valve clearances as outlined on page 1.

9. Replace the injectors as described in the Fuel System Section.

10. Replace the inlet and exhaust manifolds and refit the heater plug lead, induction primer feed pipe and air inlet hose.

10a. *Connect the throttle link and governor pipe to the inlet manifold.*

11. Refit the water outlet connection to the cylinder head, taking care to ensure that the gasket is correctly aligned and that there is a copper sealing washer fitted to the top left-hand retaining bolt (when viewed from the front of the engine).

12. Refit the water temperature gauge capillary tube retaining clip to the top set-screw on the left-hand engine lifting plate.

13. Refill the cooling system.

14. Replace the battery and reconnect the leads.

15. Replace the primary air cleaner and vertical exhaust silencer (where fitted).

16. Run the engine until its normal working temperature is reached, remove the rocker shaft and tighten the cylinder head nuts down to a torque of 55 to 60 lb. ft., using the sequence shown in Fig. 2.

17. Refit the rocker shaft, and check that the valve clearances are 0.010 in. (0.25 mm.). Replace the rocker cover and gasket, taking care to see that the gasket is correctly located in the rocker cover.

18. Replace the engine bonnet.

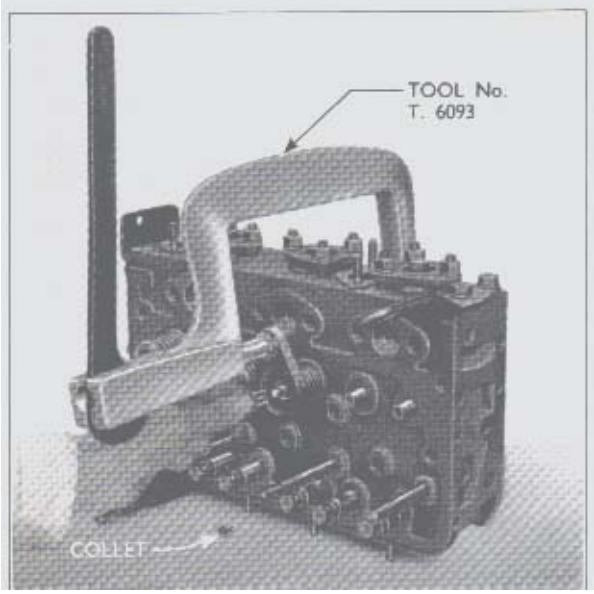


Fig. 4
Valve Spring Compressor

VALVES

The valves are mounted vertically in cast iron valve guides in the cylinder head, and are operated from a high-mounted camshaft by tappets and rocker arms. To improve engine breathing the diameter of the head of the inlet valve is greater than that of the exhaust valve.

To Adjust Valve Clearances

1. Run the engine until it is at its normal working temperature.

2. Remove the primary air cleaner, vertical exhaust silencer (where fitted) and the engine bonnet.

3. Unscrew the two self-locking nuts and remove the rocker cover and gasket.

4. Slacken the screw retaining the flywheel inspection plate in position on the left-hand side of the clutch housing, and move the plate to one side to expose the flywheel.

5. Turn the crankshaft until the line on the flywheel marked " TDC " is in line with the notch on the clutch housing, and No. 1 piston is on its compression stroke (both valves for No. 1 cylinder closed).

6. Check the valve clearance on Nos. 1, 2, 3 and 5 valves (numbered from front to rear) using a 0.010 in. (0.25 mm.) feeler gauge, inserted between the end of the rocker lever and the top of the tappet adjusting screw. If necessary adjust the clearances as shown on Fig. 3. After adjustment fully tighten the tappet adjusting screw locknut.

7. Turn the crankshaft through 360° (TDC mark again in line with the notch in the clutch housing) and check the valve clearance on Nos. 4 and 6 valves. Adjust if necessary as detailed above.

8. Replace the flywheel inspection plate in its correct location and tighten the retaining screw.

9. Replace the rocker cover and gasket taking care to ensure that the gasket is correctly located in the rocker cover. Refit the fibre washers, flat washers and self-locking nuts respectively, and tighten the nuts.

10. Replace the engine bonnet, vertical exhaust silencer (where fitted) and the primary air cleaner.

To Remove Valves

1. Remove the rocker shaft assembly and cylinder head as detailed on pages 1 and 2.

2. Lay the cylinder head on its side on a flat surface, and using the spring compressor Tool No. T.6093 (see Fig. 4), compress the springs in turn, extract the collets and remove the spring retainer, inner and outer springs and the spring locating washer (see Fig. 5).

3. Keep the valves and their components in order, so that they can be refitted to the ports from which they were removed.

VALVE SPRINGS

Two valve springs are fitted per valve, the springs being similar on both exhaust and inlet valves. They can be fitted either way up on the valves.

Before re-use all the valve springs should be carefully examined, with particular regard to squareness of ends, and pressure developed at specified compressed lengths. (See " SPECIFICATION AND REPAIR DATA—ENGINE") on page 22.

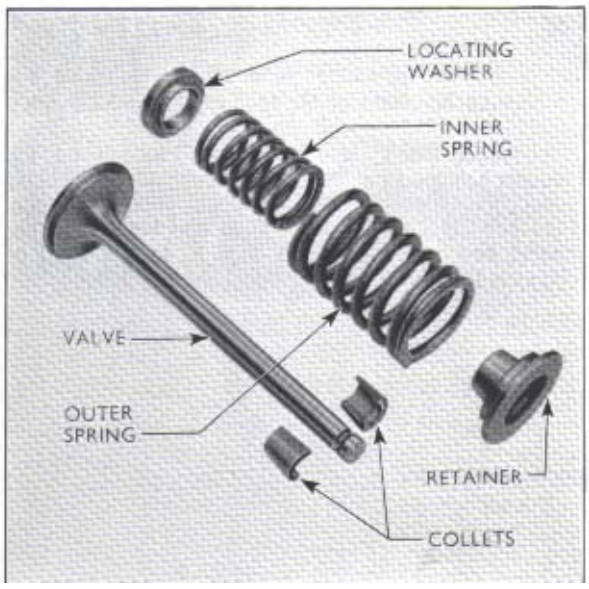


Fig. 5
Valve and Springs

VALVE GUIDES

The valve guides are a press fit in the cylinder head.

On engines produced before tractor engine No. 1473070 the vertical location of the guide was determined by a machined stop on the outer diameter of the guide. After engine No. 1473070 the valve guides were manufactured with a parallel O.D. and to ensure the correct guide protrusion of 0.584 in. (14.83 mm.) to 0.594 in. (15.09 mm.) a replacer stop T.6073–2A/g is used in conjunction with the main tool CT.6073 to replace the guides (see Fig. 6).

To Remove

1. Pass the rod (T.6073–2A/a) of the valve guide remover and replacer (Tool No. CT.6073) through the valve guide to be removed, from the top face of the cylinder head, until the step on the rod abuts the top of the valve guide. Fit the spacer (T.6073–2A/b) to the lower end of the rod and screw on the knurled retainer (T.6073–2A/d).

2. Turn the wing nut on the main tool and pull the guide from the cylinder head.

To Replace

1. Pass the rod of the valve guide remover and replacer through the valve guide bore in the cylinder head, so that the angled adaptor (T.6073–2A/e) fitted in the tool body abuts the valve seat in the cylinder head.

2. Locate the guide on the rod, slide the replacer stop (T.6073–2A/g) over the guide, and then retain it in position with the knurled nut.

3. Turn the wing nut to pull the guide into the head (see Fig. 6), and continue until the replacer stop T.6073–2A/g is tight against the cylinder head.

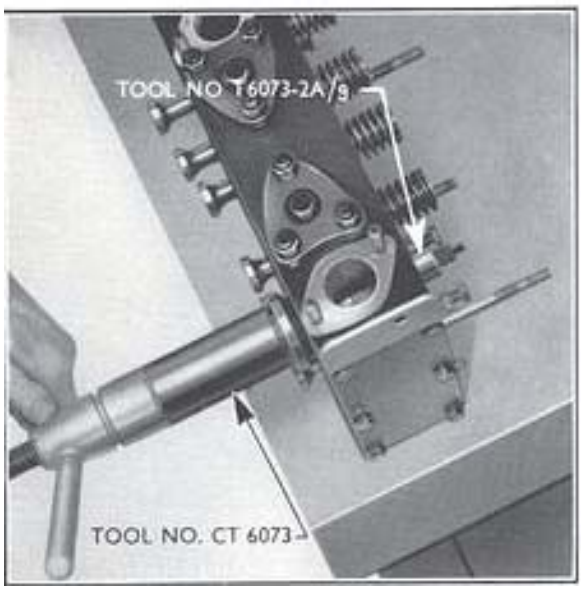


Fig. 6
Replacing a Valve Guide

Fig. 7
Checking Valve Head Clearance

VALVE SEATS

If the valve seats in the cylinder head show signs of pitting, burning or other evidence of gas leakage, they should be machined or hand ground according to their condition. Remember that hand grinding is a finishing process and on no account should excessive hand grinding be attempted ; otherwise the seat angles may be altered and the seat width increased excessively.

If it should be necessary to re-cut the valve seats, a set of valve seat cutters is available (exhaust valve seat cutter—tool No. FMC.317–23, inlet valve seat cutter—tool No. FMC.317–26, pilot—tool No. 316–10, and the handle—tool No. 316X). One of the proprietary portable valve seat grinding machines with the stone faced to 44° is also suitable.

As narrow a valve seat as possible should always be maintained.

Care should be taken when recutting the valve seats to ensure that too much metal is not removed, as the maximum clearance between the valve head and the cylinder head face should not exceed 0.140 in. (3.556 mm.). This dimension can be checked as shown in Fig. 7, using the depth gauge (tool No. T.6094), and if the measurement exceeds 0.140 in. (3.556 mm.) a new valve should be fitted.

VALVE GRINDING

If the valve face is found to be unduly pitted or distorted, it should be refaced on a suitable valve grinding machine to an angle of 45°. The grinding should continue only until the face is true and free from pits, as the removal of an excessive amount of metal may thin the edge of the valve head to a degree where it will curl and overheat under operating conditions. For a similar reason the valve will be

unduly lowered in its seating in the cylinder head and pocketing will result. If a valve tends towards thinness at the edge, particularly after refacing, it should be replaced.

Valves which are badly burned, distorted or which have been previously ground to the limits, should be discarded, and new parts fitted as replacements. Always grind a replacement valve into its seating.

Hand Grinding

1. With the valves removed, apply a small amount of medium or fine grinding paste to the valve face and replace it in its correct port.

2. Rotate the valve lightly, using a suitable suction grinding tool, first in one direction, then in the other, raising the valve off its seat from time to time and turning it approximately one quarter of a turn to ensure a concentric seat.

3. Add more fine grinding paste if necessary and continue the operation until an even, clean, matt-grey finish has been obtained on a seating between $\frac{1}{16}$ of an inch and $\frac{3}{32}$ of an inch in width (1.58 to 2.38 mm.). If the condition cannot be reached, it will be necessary to re-face or re-cut the valves and/or seats.

4. After grinding-in the valves, carefully clean all paste and foreign matter from the valves, and the seats and guides in the cylinder head.

To Replace the Valves

1. Oil the valve stems and guides to provide initial lubrication.

2. Insert each valve into its correct port.

3. Locate the spring locating washers, valve springs and the spring retainers in their correct positions on the valve stems.

4. Using the valve spring compressor (tool No. T.6093) compress each valve spring in turn and fit the valve collets.

5. Replace the cylinder head and adjust valve clearances as described on page 4.

TAPPETS

The tappets are of the mushroom foot type and operate directly in the cylinder head. With the cylinder head removed, it is necessary to remove the tappet adjusting screw and locknut, before the tappet can be slid out of its bore.

DECARBONISING

It is difficult to lay down any set period when it will be necessary to carry out decarbonising on a Diesel engine. All other factors contributing towards loss of power, etc., such as faulty injectors and dirty air cleaners, should be checked before assuming that the engine requires decarbonising.

1. Remove the cylinder head assembly as described on page 2.

2. If the valves require attention, they should be removed and treated as described on page 4.

Carbon Removal

It is essential that absolute cleanliness is observed through the following operation to prevent the possibility of consequential damage resulting from particles of carbon falling into the engine and causing scoring of the cylinder bores, pistons, bearings, etc.

1. Clean all carbon from the face of the cylinder head and from all ports. Ensure that no burrs are made on the machined face of the cylinder head.

2. It is not as a rule necessary to remove the covers of the combustion chambers during decarbonising as carbon rarely forms in these chambers. If, however, these covers are removed, new copper joints should be fitted when the covers are replaced, and the retaining nuts tightened fully to ensure there are no leakages.

3. Apply a smear of grease inside the top of No. 1 cylinder and rotate the crankshaft until No. 1 piston is at the top of its stroke. This causes the grease to fill up the gap between the piston crown and the cylinder wall and prevents carbon particles from reaching the ring grooves and subsequently causing wear.

4. Cover up Nos. 2 and 3 bores and all water and oilways with clean rag, to prevent the entry of carbon and dirt.

5. With a suitable scraper remove all the carbon from No. 1 piston crown, taking care not to scratch the piston.

6. When No. 1 piston crown is completely free of carbon, repeat the process of cleaning, as outlined above, on No. 2 piston and in turn No. 3 piston.

NOTE.—Leave the piston crowns absolutely clean and smooth as carbon will not deposit so fast on a smooth surface, but do not use any form of abrasive, as particles may find their way into the working parts of the engine.

7. Clean all piston crowns and cylinder bores with a paraffin moistened non-fluffy rag, lubricate with engine oil and cover for protection until the cylinder head assembly is to be replaced.

8. Reassemble the valves to the cylinder head and refit the head as described on page 3.

TIMING CASE COVER AND CRANKSHAFT FRONT OIL SEAL

To Remove the Timing Case Cover

1. Remove the front axle and radiator assembly as described on page 24.

2. Slacken the generator retaining bolts and remove the fan belt. Remove the bolt securing the generator to the slotted adjustment bracket on the timing case cover.

3. Slacken off the hose clamps on the two hoses fitted to the water pump.

4. Knock back the locking washer and remove the crankshaft ratchet nut using the box spanner (Tool No. T.6098).

5. Remove the crankshaft pulley using the puller (Tool No. 555) and adaptors (Tool No. T.555–2).

6. Remove the timing case cover set-screws and the top right-hand set-screw (viewed from the front of the engine) retaining the water pump in position.

7. Remove the timing case cover and water pump, taking care not to damage the crankshaft front oil seal, which is located in the timing case cover.

To Renew the Crankshaft Front Oil Seal

1. Carefully extract the oil seal from the timing case cover using a suitable lever.

2. Locate a new seal in the timing case cover with the lip of the seal towards the inside of the cover.

3. Tap the new seal into position using the adaptor (T.6097) on the universal handle (Tool No. 550).

To Replace the Timing Case Cover

1. Replace the timing case cover and water pump taking care not to damage the crankshaft front oil seal, as the cover is entered over the front end of the crankshaft.

2. Refit the timing case cover retaining screws, using a copper washer under the head of the lower screw, and refit the top right-hand water pump set-screw.

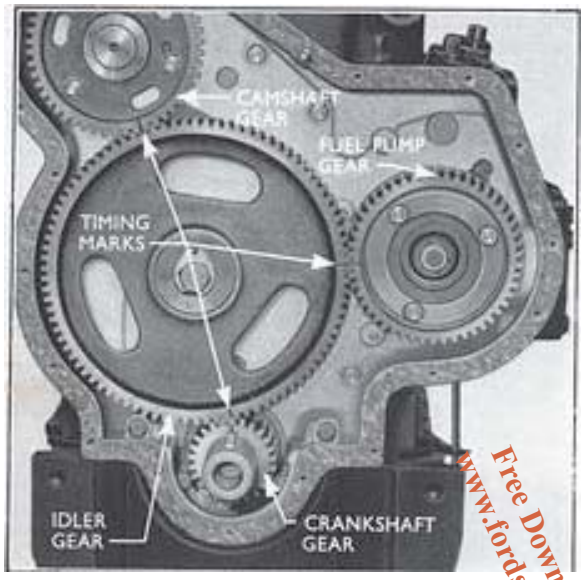


Fig. 8
Timing Marks

Fig. 9
Checking Timing Gear Backlash

3. Replace the crankshaft pulley, locking washer and ratchet nut. Tighten the ratchet nut with a box spanner (Tool No. T.6098) and bend up the locking washer.

4. Refit the two hoses to the water pump and tighten the clamps.

5. Replace the generator bracket and tighten the generator retaining bolts, so that there is 1 in. (25.4 mm.) fan belt free movement measured midway between the generator pulley and the crankshaft pulley.

6. Replace the front axle and radiator assembly as described on page 24.

TIMING GEARS

The camshaft and the fuel pump are driven by the crankshaft gear via an idler gear. All the gears are suitably marked during production to facilitate re-timing, the marks being in line, when No. 1 piston is at top dead centre on its compression stroke (see Fig. 8).

All the following operations under the general heading ' TIMING GEARS ' pre-supposes that the operations necessary to remove the timing case cover have been carried out as previously described.

To Check Timing Gear Backlash

1. Check the backlash between the gears using a suitable feeler gauge. The backlash should be between 0.003 in. to 0.006 in. (0.076 mm. to 0.152 mm.) (see Fig. 9).

2. If the backlash is within the recommended limits, replace the timing case cover as described on this page. If not, renew the gears concerned.

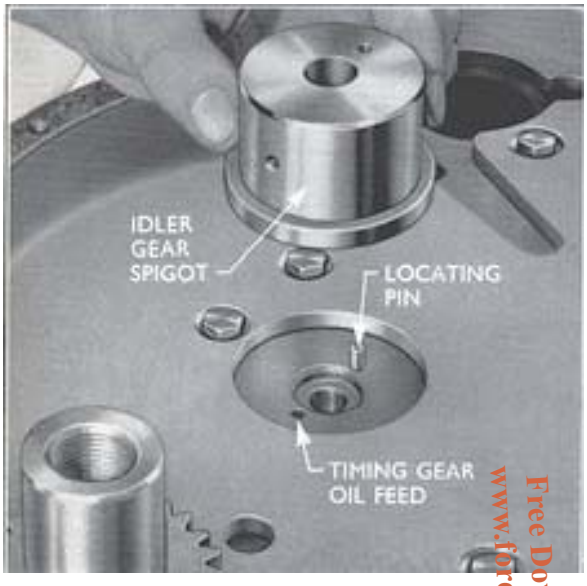


Fig. 10
Idler Gear Spigot

To Remove the Idler Gear and Spigot

1. Turn the crankshaft until all the timing marks on the gears are in line (see Fig. 8).

2. Bend back the locking washer on the idler gear retaining set-screw, and remove the set-screw, large washer and locking washer.

3. Lift the idler gear off its spigot.

4. Remove the idler gear spigot from its machined location in the timing case.

To Replace the Idler Gear and Spigot

1. Replace the idler gear spigot so that the small locating peg is entered into the through drilling in the spigot (see Fig. 10).

2. Fit the new idler gear on the spigot with the long tapered centre boss of the gear towards the cylinder block, and the timing marks aligned (see Fig. 8).

3. Refit the large flat washer, locking washer and the retaining set-screw. Fully tighten the set-screw and bend up the locking washer. Ensure that the idler gear has end-float on the spigot.

4. Replace the timing case cover as described on page 7.

To Renew the Camshaft Gear

Camshafts used prior to engine No. 1400687 were marked with the letter ' D ' on the front end flange in a position approximately in line with the No. 2 cam. Camshaft gears supplied through service at this time did not carry a timing mark. After engine No. 1400687 the letter ' D ' was placed on the boss immediately in front of the front end flange of the camshaft in a position approximately in line with No. 1 cam. Timing marks were also placed on all camshaft gears supplied through service after this change was introduced in production. These changes affect the procedure for changing the camshaft gear.

Where the ' D ' on the Camshaft is on the Front End Flange (i.e. early type)

1. Turn the crankshaft until the timing marks on the gears line up as in Fig. 8.

2. Remove the rocker shaft assembly.

3. Remove the idler gear and the camshaft gear.

4. Turn the camshaft until No. 3 cam is upright, i.e. No. 3 tappet at its highest point.

5. Position the new camshaft gear on the camshaft so that the plain hole adjacent to the letter ' D ' on the gear is in line with the tapped hole at the top of the camshaft flange (see Fig. 11). Secure the gear in position.

6. If the camshaft gear being used does not carry any timing marks, draw a line through the centre of the camshaft and the centre of the plain hole adjacent to the letter ' D ' on the camshaft gear as shown in Fig. 12.

From this line count off eight teeth in a clockwise direction and scribe a mark on the gear between the eighth and ninth teeth.

If the new gear is already marked this procedure will not be necessary.

7. Refit the idler gear, at the same time turning the camshaft so that the timing marks on all gears line up as shown in Fig. 8.

8. Replace the rocker shaft assembly and timing case cover as previously described.

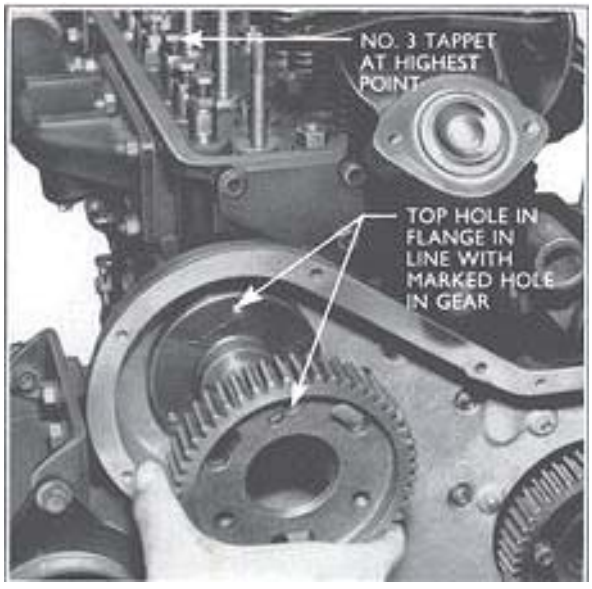


Fig. 11
Fitting the Camshaft Gear

Where the ' D ' on the Camshaft is on the Front Boss (i.e. current type)

1. Turn the crankshaft until the timing marks on the gears line up as in Fig. 8.

2. Remove the camshaft gear.

3. Fit the new camshaft gear to the camshaft, securing it in such a position that the ' D ' marking on the camshaft gear is aligned with the ' D ' marking on the camshaft.

4. If the new gear is of the original type (i.e. without a timing mark) follow the procedure for marking the gear as described under Operation 6 for the early type camshaft.

5. Check that all gear timing marks line up as shown in Fig. 8.

6. Replace the timing case cover as previously described.

To Renew the Fuel Pump Gear

1. Turn the crankshaft until all the timing marks are in line (see Fig. 8).

2. Remove the small inspection plate from the left-hand side of the timing case.

3. Remove the three set-screws that retain the fuel pump gear onto the fuel pump gear adaptor and remove the gear and large retaining washer.

When the gear is removed the fuel pump camshaft will probably revolve slightly, so that the pump timing marks are out of alignment. It will therefore be necessary when fitting the new gear to turn the fuel pump camshaft using a suitable spanner, until the line marked " S " (*pneumatic governor*) or " T.C." (mechanical governor) on the adaptor is in line with

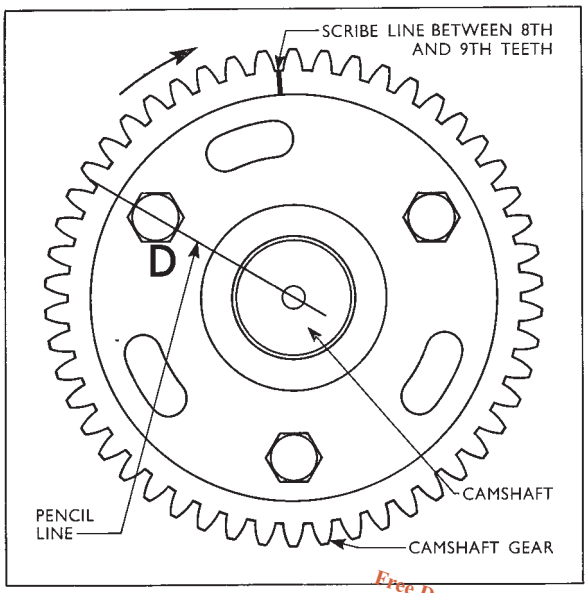


Fig. 12
Marking New Camshaft Gear

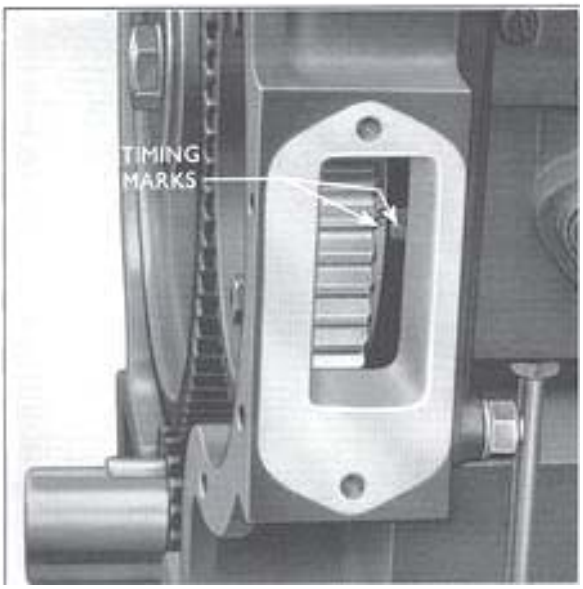


Fig. 13
Fuel Pump Timing Marks (T.D.C.)
(pneumatic governor)

the fixed pointer on the fuel pump mounting flange (see Fig. 13).

4. Fit the new fuel pump gear onto the fuel pump gear adaptor so that it meshes with the idler gear. The fuel pump gear will only fit in one position on the adaptor and the three tapped holes in the adaptor must be positioned centrally in the slots in the fuel pump gear to allow for any adjustments that may be necessary in service.

5. Replace the large retaining washer and the three set-screws to the fuel pump gear, and tighten the set-screws fully.

6. With a suitable scriber, mark the tooth on the fuel pump gear that is adjacent to the marked tooth on the idler gear.

7. Replace the timing case cover as described on page 7.

To Remove the Crankshaft Gear

1. Turn the crankshaft until all the timing marks are in line (see Fig. 8).

2. Remove the sump drain plug and drain off the engine oil. Replace the drain plug when all the oil has been removed.

3. Support the sump and unscrew the nuts and set-screws retaining it to the cylinder block and the engine adaptor plate. Remove the sump.

4. Remove the oil pump suction and delivery pipes.

5. Unscrew the two set-screws securing the small lower section of the timing case to the main timing case, and remove the lower section.

6. Remove the oil pump idler gear retaining clip and lift off the idler gear.

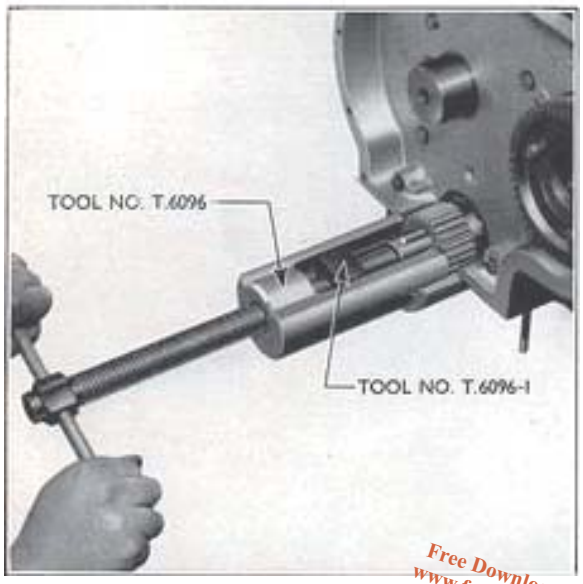


Fig. 14
Removing Crankshaft Gear

7. Unscrew the three set-screws and remove the oil pump from its dowelled location on the front main bearing cap.

8. Remove the idler gear from its location on the idler gear spigot.

9. Remove the crankshaft gear using the puller (Tool No. T.6096), with the thrust button (T.6096–1) screwed into the front end of the crankshaft (see Fig. 14).

To Replace the Crankshaft Gear

1. Screw the alignment adaptor (T.6103–1/a) of the crankshaft gear replacer into the front of the crankshaft so that it is in as far as is possible and the pegs on the adaptor are in line with the woodruff key in the front of the crankshaft (see Fig. 15).

NOTE.—Before Engine No. 1457993 the length of the crankshaft key-way was shorter by approximately 1.125 in. (28.57 mm.).

2. Push the crankshaft gear onto the adaptor with the timing mark on the gear facing outward, until the gear contacts the end of the crankshaft.

3. Screw the centre bolt of the crankshaft gear replacer (Tool No. T.6103) into the adaptor and fit the semi-circular key locator (T.6103–1/b). The boss on the outside of the key locator must be fully entered into the slot on the tool body, and the slot on the inside of the locator must locate over the key in the crankshaft (see Fig. 16).

4. Replace the gear by screwing in the wing nut of the tool, taking care to ensure that the key does not ride out of the keyway in the crankshaft. The spacer behind the crankshaft gear is fitted with the chamfer towards the front main bearing journal on the crankshaft.

5. Replace the idler gear so that all the timing marks are in line.

6. Replace the oil pump on the front main bearing cap and secure with three set-screws and shakeproof washers.

7. Replace the oil pump idler gear and secure in position with a retaining clip.

8. Replace the lower section of the timing case, taking care to ensure that its front face is flush with the main timing case.

Before fitting the retaining screws check the height of the bosses around the screw holes. Where this height is $1\frac{3}{8}$ in. (34.9 mm.), use screws 2 in. (50.8 mm.) in length—where the boss height is $\frac{3}{4}$ in. (19 mm.), use screws $1\frac{3}{8}$ in. (34.9 mm.) in length.

9. Refit the oil pump suction and delivery pipes.

10. Fit new gaskets and cork strips, replace the sump and tighten all retaining set-screws evenly.

11. Replace the timing case cover as described on page 7.

12. Refill the sump with the approved grade of oil to the correct level.

CAMSHAFT

To Remove

1. Remove the rocker shaft assembly as described on page 2.

2. Remove the front axle and radiator assembly as described on page 24.

3. Remove the timing case cover as detailed on page 6.

4. Turn the crankshaft until the timing marks on the timing gears are in line (see Fig. 8).

5. Lift the tappets and remove the camshaft and gear from its location in the cylinder block, taking care not to damage the journals or cams.

To Replace

1. Lift the tappets and fit the camshaft and gear, with the timing marks aligned, taking care not to damage the cams or bearing journals.

2. Replace the timing case cover as outlined on page 7.

3. Refit the front axle and radiator assembly as described on page 24.

4. Replace the rocker shaft assembly as described on page 2.

TIMING CASE

To Remove

1. Remove the front axle and radiator assembly, and the timing case cover as described on pages 24 and 6 respectively.

2. Remove the rocker shaft assembly as described on page 2.

3. Remove the sump as described on page 29.

4. Unscrew the retaining set-screw and remove the idler gear and spigot.

5. Lift the tappets and remove the camshaft assembly, taking care not to damage the cams or bearing journals.

6. Disconnect the following from the fuel injection pump :—fuel tank to fuel lift pump pipe, fuel lift pump to fuel filter pipe, fuel filter to fuel pump gallery pipe, stop control cable, and the proofmeter drive cable.

7. Remove the twelve short and the two long set-screws and shakeproof washers securing the timing case to the cylinder block, and remove the timing case and fuel injection pump as an assembly.

8. Part the injection pump from the timing case by removing the five set-screws and spring washers that secure the pump to the timing case. Ensure that all fuel inlet and outlet connections on the fuel injection pump are sealed with the appropriate size plugs to stop the ingress of dirt.

To Replace

1. Refit the fuel injection pump to the timing case, and secure in position with five set-screws and spring washers.

2. Fit a new gasket to the cylinder block front face and replace the timing case and fuel injection pump as an assembly. Refit the two long and twelve short set-screws and shakeproof washers loosely in position.

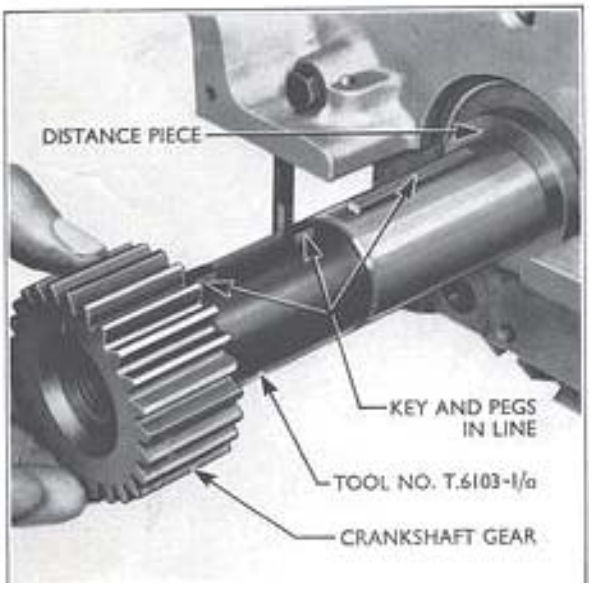


Fig. 15
Fitting the Crankshaft Gear to the Alignment Adaptor

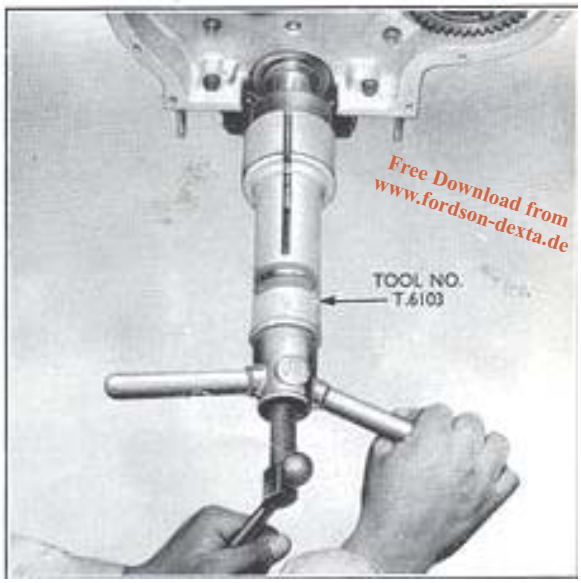


Fig. 16
Replacing the Crankshaft Gear

3. Replace the idler gear spigot so that the locating peg locates in the through drilling in the spigot (see Fig. 10).

4. With the idler gear spigot fully located against the front of the cylinder block, tighten the timing case set-screws.

5. Turn the engine crankshaft until No. 1 piston is at top dead centre (key on the front of the crankshaft vertically upwards).

6. Replace the idler gear on its spigot, with the long tapered centre flange of the gear towards the cylinder block and the timing marks on the crankshaft gear, fuel pump gear and the idler gear in line.

7. Secure the idler gear in position with a large flat washer, locking washer and retaining set-screw. Bend the locking washer up against the head of the set-screw.

8. Lift the tappets and replace the camshaft so that the timing mark on the camshaft gear is adjacent to the timing mark on the idler gear.

9. Replace the sump as described on page 29.

10. Replace the cylinder head assembly as described on page 3.

11. Replace the timing case cover and refit the front axle and radiator assembly to the tractor as described on page 24.

12. Refit the following items to the fuel injection pump :—stop control cable, fuel filter to fuel pump gallery pipe, fuel lift pump to fuel filter pipe, fuel tank to fuel lift pump pipe and the proofmeter drive cable. When fitting the stop control cable ensure that there is approximately $\frac{1}{4}$ in. (6.3 mm.) free

Fig. 17
Flywheel and Ring Gear

movement at the stop control knob on the control panel.

FLYWHEEL AND RING GEAR

To Remove the Flywheel

1. Separate the engine from the gearbox as described in the section dealing with this subject on page 23.

2. Evenly unscrew the set-screws and spring washers securing the clutch pressure plate assembly to the flywheel and detach the clutch assembly and disc.

NOTE.—When a double clutch is fitted it is secured to an adaptor plate which is in turn secured to the flywheel. Prior to tractor Serial No. 33407, spacing washers were fitted between the adaptor plate and the flywheel at each fixing screw location. These washers are not required with adaptor plates fitted to tractors after the above Serial number.

3. The flywheel is secured by six set-screws which are wired together. Remove the locking wire and unscrew the flywheel retaining set-screws.

4. Carefully ease the flywheel off the crankshaft spigot.

To Renew the Flywheel Ring Gear

1. Unscrew the six screws retaining the ring gear to the flywheel and remove the screws and lock-washers.

2. Tap off the ring gear. There is no necessity to apply heat to remove or refit the gear.

3. Fit a new ring gear with the lead-in on the teeth to the front of the flywheel and retain in position with six screws and lockwashers (see Fig. 17).

To Replace the Flywheel

1. Carefully clean the crankshaft flange and the mating flange on the flywheel.

2. Mount the flywheel on the crankshaft flange so that the untapped hole in the flange (in the bottom centre position when No. 1 piston is at top dead centre) is in line with the unused hole in the flywheel (smaller hole than the remaining six). This ensures that the flywheel timing marks are in the correct position when No. 1 piston is at top dead centre.

3. Fit the six set-screws and flat washers and tighten to a torque of 75 lb. ft.

Fig. 18
Checking Flywheel "Run-Out"

Fig. 19
Removing Clutch Pilot Bearing

Fig. 20
Replacing Clutch Pilot Bearing

4. It is essential that the flywheel runs true, as dirt, etc., between the mating flange faces could cause it to run out of balance. The " run-out " of the flywheel should be checked with a dial indicator gauge (see Fig. 18) and the total indicator reading obtained should not exceed the figure laid down in the Specification Section on page 22.

5. If the " run-out " exceeds this figure, remove the flywheel and check the mating flanges for burrs, etc.

Refit the flywheel to the crankshaft and recheck the " run-out " as detailed above.

6. Lock the flywheel set-screws with wire.

7. Replace the clutch assembly using the clutch disc locator (Tool No. T.7079) to centralise the clutch disc (single clutch only). When fitting a double clutch assembly a centralising tool is not required.

8. Replace the engine as described on page 23.

CLUTCH PILOT BEARING

To Renew

1. Separate the engine from the gearbox as described on page 23.

2. Remove the clutch disc and pressure plate as described on page 12.

3. Withdraw the clutch pilot bearing from the flywheel, using the remover (Main Tool No. 7600 and adaptor CPT.7600–3) as shown in Fig. 19.

4. Pack the new bearing with high melting point grease and locate it in the flywheel, with the baffle face outwards. Tap the bearing in using the adaptor (CPT.7061), and the universal handle (Tool No. 550) as shown in Fig. 21.

5. Replace the clutch disc and pressure plate as outlined above.

6. Reconnect the engine and front axle assembly to the gearbox as outlined on page 23.

CRANKSHAFT REAR OIL SEAL

To Remove

1. Disconnect the engine from the transmission as described on page 23, and move the engine and front axle assembly forward away from the gearbox.

2. Remove the clutch assembly taking care to slacken the pressure plate to flywheel set-screws evenly.

3. Remove the wire from the six flywheel retaining set-screws, remove the set-screws, and lift the flywheel from its location on the crankshaft.

4. Remove the sixteen set-screws securing the engine adaptor plate to the cylinder block and sump, and remove the adaptor plate from the two dowels in the cylinder block.

5. Remove the self-locking nuts from the two bolts that pass through the half housings of the crankshaft rear oil seal retainer, and remove the bolts.

6. Unscrew the three set-screws from each of the half housings of the oil seal retainer, and remove the housings.

To Replace

1. Fit a new oil seal to each of the half housings of the oil seal retainer. The seals should previously be soaked in engine oil for one hour, and when fitted should protrude at the ends 0.010 in. (0.25 mm.) to 0.020 in. (0.51 mm.) above the respective half housing faces.

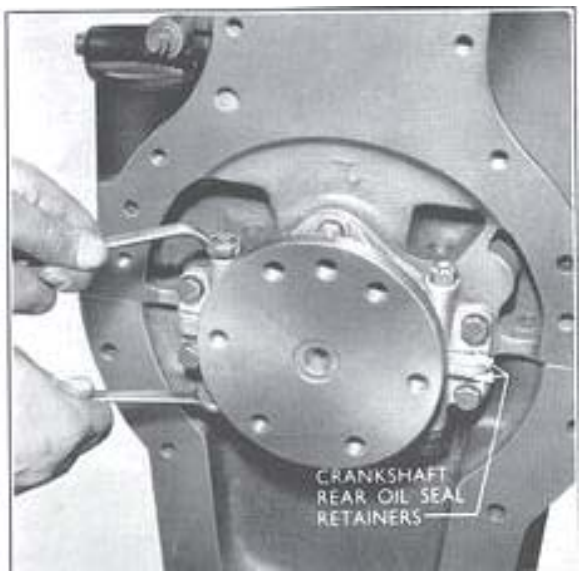


Fig. 21
Crankshaft Rear Oil Seal Retainer

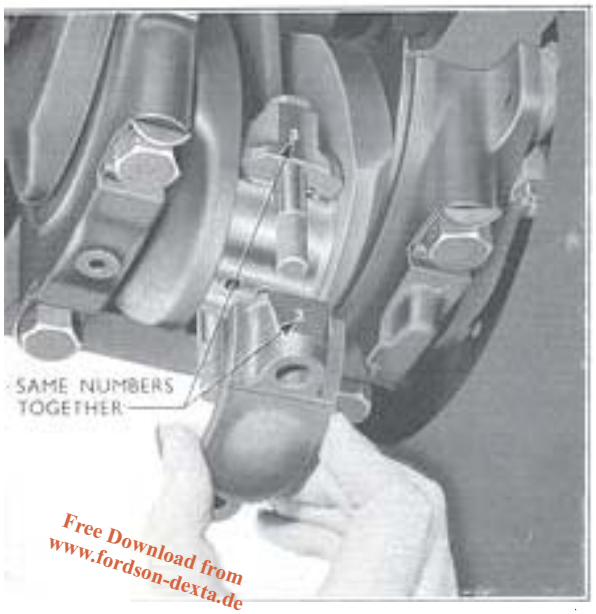


Fig. 22
Replacing Connecting Rod

2. Remove all traces of the old gasket from the cylinder block and rear main bearing cap faces, and fit new gaskets smeared with jointing compound. Replace the half housings and retain them loosely in position with the six set-screws and shakeproof washers.

3. Refit the two long bolts and self-locking nuts and tighten fully (see Fig. 21).

4. Fully tighten the six set-screws securing the half housings of the oil seal retainer to the rear main bearing cap and cylinder block.

5. Replace the engine adaptor plate on the dowels at the rear of the cylinder block, and secure in position with sixteen set-screws. The eight long set-screws retain the adaptor plate to the cylinder block, and the other eight set-screws retain the adaptor plate to the sump.

6. Replace the flywheel as described on page 12, and check the flywheel " run-out."

7. Refit the engine and front axle assembly to the transmission as described on page 23.

PISTONS AND CONNECTING RODS

Connecting rods are numbered on rod and cap when installed in the engine to facilitate correct reassembly, should they be dismantled in service.

The numbers are stamped on the left-hand side of the big end (opposite side to camshaft) so that a cap replaced with the numbers together must be in the original position (see Fig. 22). Never reassemble the cap to the connecting rod incorrectly otherwise a true bearing surface cannot be assured.

It is advisable before removing connecting rods from an engine, to ascertain that they have been numbered, as they may have been installed at some time after the engine left the factory in which case the numbering may not have been carried out. Such connecting rods should be suitably stamped.

To Remove a Connecting Rod and Piston Assembly

1. Remove the sump as described on page 29.

2. Remove the cylinder head and gasket as described on page 2.

3. Remove the carbon from the top of the cylinder bore with a suitable scraper.

4. Remove the oil pump suction and delivery pipes.

5. Turn the crankshaft so that the piston to be removed is at the bottom of its stroke.

6. Remove the self-locking nuts from the connecting rod bolts, and remove the cap, bottom half of the big end bearing liner and the connecting rod bolts.

7. Turn the crankshaft until the piston is at the top of its stroke, and push the piston and connecting rod assembly up and out of the bore taking care not to dislodge the top half of the bearing liner. Keep the two halves of the big end liner in their respective positions in the rod and cap.

To Replace a Piston and Connecting Rod Assembly

1. Thoroughly clean out the cylinder bore with a clean dry rag.

2. Ensure that the piston is thoroughly clean and apply a liberal coating of oil to the cylinder bore, piston and rings.

3. Position the three solid piston rings (two top compression, and the lower oil control) so that the gaps are equally spaced around the piston, and no gap is in line with the piston pin bore.

4. Position the four laminations of the third compression ring, so that the gaps are 180° apart, above each end of the piston pin.

5. The ring gaps on the laminated oil control ring (one above the piston pin) should be positioned at equal distances around the piston, with none of the gaps in line with the piston pin.

6. Fit the top half of the bearing liner in the connecting rod, ensuring that the tongue on the liner engages in the machined recess in the big end bore. Smear freely with clean oil to provide initial lubrication.

7. Fit a suitable piston assembly ring on the piston, entering it over the connecting rod end with the chamfer up towards the piston, and insert the piston and connecting rod assembly in the bore. Ensure that the number stamped on the connecting rod big end is to the left-hand side of the engine (opposite side to camshaft).

Fig. 23
Piston Ring Lay-Out

8. Push the piston down the bore through the assembly ring.

9. Turn the crankshaft until the piston is at the bottom of its stroke, and refit the big end bolts ensuring that they are fully located.

10. Locate the lower half of the big end bearing liner in the cap with the tongue registering in the machined recess, and refit the cap with the stamped numbers together (see Fig. 22), and the liner smeared freely with clean oil.

11. Fit new self-locking nuts to the connecting rod bolts and tighten to the correct torque. (See "SPECIFICATION AND REPAIR DATA—ENGINE") on page 22.

12. Refit the oil pump suction and delivery pipes. The bracket on the suction pipe fits under a set-screw on No. 2 main bearing cap.

13. Replace the cylinder head as detailed on page 3.

14. Replace the sump as described on page 29.

PISTON PIN

The piston pins are fully floating and are located in the pistons by circlips.

To Remove a Piston from a Connecting Rod

1. Remove the connecting rod and piston assembly as described on page 14. If the piston is to be used again mark the piston relative to the connecting rod, so that it can be replaced in the same position.

2. Remove the two circlips retaining the piston pin in the piston.

3. Push out the piston pin. To assist in removing the piston pin the piston may be warmed by insertion in boiling water.

To Replace a Piston on a Connecting Rod

1. Replace one circlip in position in the piston, to serve as a location for the piston pin on replacement.

2. Heat the piston in boiling water to allow easy assembly of the piston pin.

3. Insert the connecting rod between the piston bosses so that the marks made at the time of disassembly are in line. In the case of a new piston it can be fitted in either of two positions.

4. Insert the piston pin and fit the retaining circlip.

5. Oil the parts and reassemble in the engine as described on page 14.

PISTON RINGS

Three compression rings and two oil control rings are fitted to each piston. The ring lay-out is (see Fig. 23) :—top compression ring, cast iron chrome plated ; second compression ring, cast iron plain faced ; the third compression ring is made up from four $\frac{1}{32}$ in. (0.794 mm.) thick laminated rings.

The oil control ring above the piston pin is a laminated type, consisting of four segments with a spring ring between each pair, to hold them firmly against the groove sides, and an expander between the segments and the back of the groove (see Fig. 24). The oil control ring below the piston pin is a cast iron slotted type.

To Remove

1. Remove the connecting rod and piston assembly as described on page 14.

2. Remove the rings, using guide strips if necessary, and remove all the carbon from the piston crown and grooves, taking care not to damage the piston.

Checking Piston Ring Gaps

1. Insert the piston ring in the cylinder bore, centralising it by means of a piston until the ring is on an unworn part of the bore. The gap should then be checked by means of a feeler gauge to ensure that it is within the specified limits.

If necessary file the rings to give the correct gap, taking care to ensure that the ends of the rings are flat and square.

The gaps on the laminated rings are pre-set and do not require checking.

2. Check that the piston ring grooves are clean, especially the oil control ring grooves and ensure that the oil return holes are clear.

3. Check that the piston ring to groove clearance is within the specified limits—solid rings only.

To Replace

1. Replace the lower oil control ring using guide strips if necessary.

2. Refit the laminated oil control ring in the groove immediately above the piston pin. Place the expander ring in the back of the groove and spiral in two of

the laminated segments. The centre spring ring can now be fitted and then the other two segments. The last segment entered will require slight pressure applied to it to overcome the action of the centre spring ring.

3. The laminated rings for the third compression ring are concave or convex depending on which way up they are laid. When assembled to the piston the rings should be as shown on Fig. 24, i.e. the first lamination is fitted with its concave face upwards ; second lamination, convex face upwards ; third lamination, concave face upwards ; and the top lamination, convex face upwards.

4. Refit the plain cast-iron ring to the second groove, and the chrome-plated ring to the top groove.

5. Position the piston ring gaps as detailed on page 14 and lubricate the cylinder bore, piston and rings.

6. Replace the piston and connecting rod assembly as described on page 14.

PISTONS

The pistons are of high silicon aluminium alloy, and are available in service in a 0.030 in. (0.762 mm.) diameter oversize for the 144 cu. in. (2,360 c.c.) engine.

It is essential that the limit for the diameter of the finished bore of the liners, as laid down in the Specification Section, is strictly adhered to ; to ensure correct fit of the pistons.

CYLINDER LINERS

Renewable, full length, unshouldered cast-iron liners are fitted to the 144 cu. in. and the 152 cu. in. engine. The liner fitted to the 144 cu. in. engine is of the thick wall type and that fitted to the 152 cu. in. engine the thin wall type. Both types of liners are

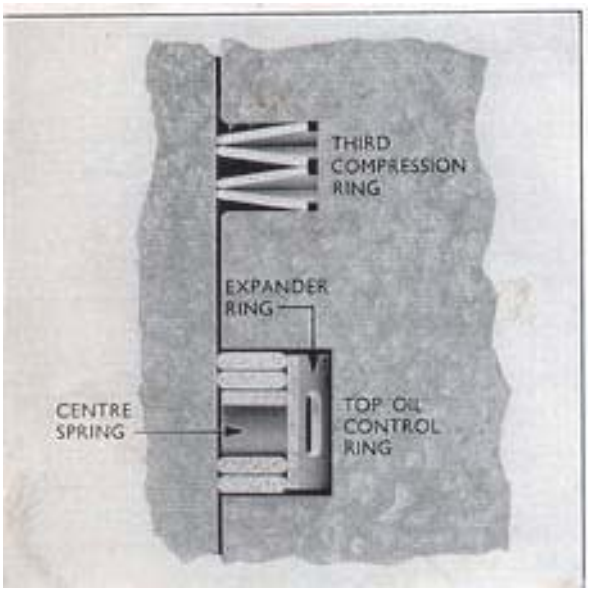


Fig. 24
Laminated Ring Arrangement

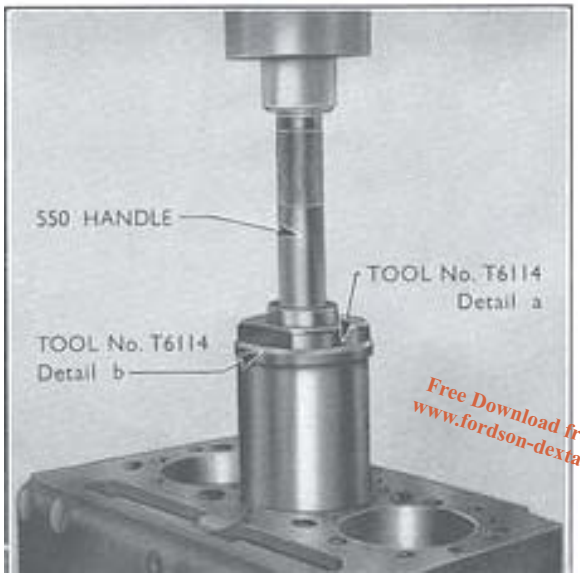


Fig. 25
Replacing a Cylinder Liner

an interference fit in the cylinder blocks, and they are bored out to the required sizes after fitting.

If reboring equipment is available the cylinder liners may be removed as described in the next paragraph, and new liners fitted where necessary.

To Remove the Cylinder Liners

1. Remove the engine as described on page 23.
2. Completely dismantle the engine as detailed on page 25.
3. Remove the main bearing cap locating dowels.
4. Thoroughly clean the cylinder block.
5. Support the cylinder block, cylinder head face downward on a sleeving table mounted on a hydraulic press. The bore from which the liner is to be removed must be directly beneath the ram of the hydraulic press.
6. Fit the liner remover adaptor (Tool No. T.6101/a) in the bore, and press out the liner from the crankcase side.

Fitting New Cylinder Liners

1. Ensure that the outer surface of the liner and the cylinder block bore are perfectly clean. Check the cylinder block bore diameter which should be 3.6865 in. (93.637 mm.) to 3.6875 in. (93.663 mm.) for the 144 cu. in. engine and 3.6875 in. (93.663 mm.) to 3.6887 in. (93.793 mm.) for the 152 cu. in engine.
2. Support the cylinder block, cylinder head face uppermost, making sure that the bore which is to receive the liner is directly beneath the ram of the hydraulic press.
3. Apply a thin coating of tallow to the outer surface of the liner to act as a lubricant during the pressing-in operation. **Do not use oil or grease.**

4. Enter the liner into its bore in the cylinder block with the long chamfer in the line bore downwards. Assemble replacer ring (Tool No. T.6114/a to adaptor (Tool No. T.6114/b) and locate in the cylinder liner (see Fig. 25).

5. Ensure that the liner is in correct alignment with the locating bore in the cylinder block then press the liner into the block until the top of the liner is flush with the top face of the block. Use an even pressure to prevent any tendency for binding or scoring.

Using a suitable boring machine, finish bore the liners to the internal diameters shown below.

	144 *cu. in. Engine*	152 *cu. in. Engine*
Finish bore size		
	3.501 in. (88.925 mm.) to 3.502 in. (88.951 mm.)	3.600 in. (91.44 mm.) to 3.601 in. (91.465 mm.)
Liner bore size		
	3.478 in. (88.341 mm.) to 3.482 in (88.443 mm.)	3.555 in. (90.297 mm.) to 3.560 in. (90.424 mm.)

6. Thoroughly clean the cylinder block, taking great care to ensure that all oil passages and tapped holes are clear of swarf and dirt.

7. Replace the main bearing cap locating dowels.

8. Reassemble the engine as described on page 26.

9. Replace the engine in the tractor as described on page 24.

CONNECTING RODS

The connecting rods are forgings of " H " section having steel backed big end bearing liners, and separate bolts and self-locking nuts. The piston pins are fully floating and the small end of the connecting rod is fitted with a bronze lined, steel backed bush.

Renewing Connecting Rod Liners

Connecting rod liners may be changed without removing the piston and connecting rod assembly from the engine.

Connecting rod liners are available in standard and 0.010 in. (0.254 mm.), 0.020 in. (0.508 mm.) and 0.030 in. (0.762 mm.) undersize in the bore diameter.

1. Remove the sump as described on page 29.

2. Remove the oil pump suction and delivery pipes.

3. Turn the crankshaft to bring the required big end to bottom dead centre. Remove the self-locking nuts and detach the cap.

4. Push up the connecting rods sufficiently to clear the crankpin and move the big end to one side. The upper half of the liner may now be extracted from the rod and the new one inserted with the tongue in the liner engaged in the machined recess in the big end bore.

5. The lower half of the liner may now be extracted from the cap and a new one inserted with the tongue in the liner engaging in the machined recess in the big end bore.

6. Lubricate the liner and refit the big end to the crankpin, taking care that the upper half of the liner is not dislodged.

7. Replace the big end cap with the stamped numbers together (ensure that the cap bolts are right down with the bolt heads locating against the sides of the rod).

8. Fit new self-locking nuts and tighten to the correct torque. (See " SPECIFICATION and REPAIR DATA—ENGINE ") on page 22.

9. Replace the oil pump suction and delivery pipes.

10. Fit new gaskets and cork strips and refit the sump as described on page 29.

Connecing Rod Alignment

Connecting rod alignment can be checked by using the connecting rod alignment jig (Tool No. 335) and arbor adaptor (Tool No. FMC 336–1).

Checking for Twisted Connecting Rods

1. Remove the piston as described on page 14. Insert the piston pin in the small end of the connecting rod, in which it must be a good fit otherwise misleading results will occur.

2. Bolt the connecting rod, without bearing liners to the arbor adaptor, and with the gauge mounted on the piston pin with the two horizontal pins towards the jig, move the arbor adaptor along until the pins touch the machined surface.

3. Clamp the arbor in this position. Clearance between the face of the jig and one of the pins, indicates a twist in the connecting rod.

Checking for Bent Connecting Rods

The procedure is the same as for checking for twisted connecting rods, except that the vertical pins of the gauge are brought into contact with the machined surface. Clearance between one of the pins and the machined face of the jig indicates that the small end and big end bores are out of parallel and the connecting rod is bent.

Where any connecting rods are found to be either twisted or bent, they should be replaced. No attempt should be made to straighten these connecting rods.

MAIN BEARING CAPS

The main bearing caps are of high duty cast iron, and are located on ring dowels in the cylinder block. Two high tensile set-screws are fitted per cap and are locked by tab washers. The tab washers must only be used once.

In manufacture, the main bearing liner bores in the cylinder block and caps are machined in-line, with the caps fitted in their correct location. If the caps are interchanged or replaced incorrectly, they will not then match and possibly lead to bearing failure with consequential damage to the engine.

Fig. 26
Checking Crankshaft End-float

It is for this reason that great care must be taken when the engine is dismantled, to keep its own bearing caps separate from any others and refitted in exactly the same positions from which removed.

For identification purposes there are numbers stamped on the cap and cylinder block. On reassembly the cap number must be adjacent to the corresponding number on the cylinder block.

MAIN BEARING LINERS

The main bearing liners are held in position by tongues which register with suitable locations in the cylinder block and cap, to prevent them from turning or moving out of position.

In addition to standard sizes, main bearing liners are supplied in sizes 0.010 in. (0.254 mm.), 0.020 in. (0.508 mm.) and 0.030 in. (0.762 mm.) undersize in the bore diameter.

Should it be necessary to renew crankshaft main bearings following failure due to oil shortage, it is imperative that all oilways and the oil pump are thoroughly clean, otherwise mere replacement of liners may lead to repeated failure. In this event the engine must be removed.

It should be noted that several different types of main bearing liners have been used and it is therefore important to fit upper and lower liners of the same type to any one main bearing location. When a complete engine overhaul is being undertaken it is recommended that all main bearing liners should be fitted to the same type. Identification numbers are stamped on the back of each liner therefore each pair of top and bottom liners should have the same identification number. These numbers are not the Ford part numbers, which differ with each liner.

CRANKSHAFT END-FLOAT

The crankshaft end-float is controlled by detachable thrust washers fitted at each side of the rear main bearing cap. The lower halves of these thrust washers have suitable locating lugs to prevent them from turning out of position. Fit the crankshaft thrust washers in the recess at each side of the rear main bearing cap with their oil grooves outwards (see Fig. 27).

It should be noted that prior to Engine No. 1449364 the lower thrust washer incorporated a semi-circular off-set locating tag. Subsequent to this engine number the tag was positioned centrally on the washer and its shape was changed to rectangular form. Corresponding changes were made to the locating slots in the rear main bearing cap, care must therefore be taken to fit the correct type of thrust washer for the cap in use.

To check the crankshaft end-float, carefully push the crankshaft forward as far as it will go, and check the gap between the machined shoulder on the crankshaft web and the crankshaft thrust washers, using a feeler gauge (see Fig. 26). Check the corresponding gap on the other side of the crankweb with the crankshaft pushed fully rearward.

The gaps should be identical and within the specified limits. If the gaps are identical but outside the specified limits, a new set of thrust washers should be fitted. If, however, the gaps are not identical, it indicates that a component other than the thrust washers is affecting the end-float, i.e., incorrect radii in the corner of the main bearing journal after regrinding, main bearing liners misplaced, etc.

THE CRANKSHAFT

The crankshaft is forged from chrome molybdenum steel and the journals are induction hardened.

Two cast iron balance weights are fitted, secured

Fig. 27
Crankshaft Thrust Washers

to the front and rear crankwebs by set-screws. The set-screws retaining the balance weights are locked in position by tab washers.

To Remove the Crankshaft

1. Separate the engine and front axle assembly away from the gearbox as described on page 23.

2. Remove the front axle from the engine as described on page 24.

3. Remove the clutch, flywheel and engine adaptor plate.

4. Fix the engine stand bracket (Tool No. T.6091), to the engine (see Fig. 28) and mount the engine on the engine stand (Tool No. 200 or 35).

5. Remove the timing case cover.

6. Remove the sump.

7. Remove the small lower section of the timing case.

8. Remove the oil pump and pipes.

9. Unscrew the connecting rod and big end cap nuts, detach the caps and push the pistons up the cylinder bores. Take care not to dislodge the big end bearing liners in the rods and caps.

10. Remove the two long bolts and self-locking nuts securing the half housings of the crankshaft rear oil seal retainer.

11. Bend down the main bearing cap set-screw locking washers and remove the set-screws. Detach the main bearing caps taking care not to drop the liners or the thrust washers.

12. Lift the crankshaft carefully out of the cylinder block.

13. Extract the upper halves of the main bearing liners and thrust washers from the cylinder block, and the halves of the crankshaft rear oil seal from their locations in the half housings on the rear main bearing cap and the cylinder block.

14. Thoroughly clean all the oil passages in the block after removing the oil filter and the oil pressure switch. The crankshaft oilways and bearing surfaces must also be cleaned.

To Replace the Crankshaft

1. Locate the upper halves of the main bearing liners in their block locations. Ensure that all oilways and passages are clear, and lightly lubricate the liners.

2. Fit the new crankshaft rear oil seal, upper half to the cylinder block and the lower half to the rear main bearing cap. The oil seal must be previously soaked in engine oil for at least one hour.

3. Locate the upper halves of the crankshaft thrust washer on either side of the rear wall of the cylinder block with the oil grooves outwards (see Fig. 27). The upper halves of these washers do not have locating tabs.

4. Check that the ends of the thrust washers are level with the cylinder block face, otherwise they may be distorted when fitting the bearing cap. A light coating of grease will assist in holding the washers in place until the crankshaft is fitted.

5. Check that the liners are seating correctly in the caps with the tongues engaging in the machined recesses, and that the crankshaft thrust washers are located on either side of the rear main bearing. The washers must be fitted with the oil grooves outwards and the locating tabs in the recesses of the cap.

6. Refit the main bearing caps so that the numbers on the caps are adjacent to the corresponding numbers on the cylinder block. The caps must be fully located on the ring dowels.

7. Refit the main bearing cap set-screws and new locking washers. Tighten the bolts to a torque of 90 to 95 lb. ft.

8. Push the crankshaft fully endwise and check the end-float as shown in Fig. 26, which should be within the limits specified. If this limit is exceeded fit new thrust washers.

9. Secure the main bearing cap set-screws by bending the tab washers up against the flats on the hexagon heads of the set-screws.

10. Refit the connecting rods to the crankpins, ensuring that the liners are correctly positioned with the tongues engaging in the machined recesses. Connecting rod caps must be fitted with the stamped numbers together and on the left-hand side of the engine (opposite side to camshaft).

11. Refit the two long bolts through the half housings of the crankshaft rear oil seal retainer and secure with two self-locking nuts.

12. Use new self-locking nuts on the big end bearing bolts and tighten to the correct specified torque. Ensure that the heads on the bolts are correctly located.

13. Replace the oil pump and pipes.

14. Replace the small lower section of the timing case ensuring that its front face is flush with the front face of the timing case.

15. Replace the sump.

16. Replace the timing case cover.

17. Support the engine and remove it from the engine stand. Unscrew the retaining bolts and remove the engine stand bracket.

18. Replace the engine adaptor plate, flywheel and clutch assembly, checking the flywheel " run-out " as described on page 13.

19. Replace the front axle to the engine as described under " MAJOR REPAIR OPERATIONS " on page 24.

20. Replace the engine and front axle assembly as described on page 24.

SPECIFICATION AND REPAIR DATA—ENGINE

General Data

	Standard Dexta	*Super Dexta*
Bore	3.501 to 3.502 ins. (88.925 to 88.951 mm.)	3.600 to 3.601 ins. (91.44 to 91.465 mm.)
Stroke	4.995 to 5.005 ins. (126.87 to 127.127 mm.)	4.995 to 5.005 ins. (126.873 to 127.127 mm.)
Capacity	144 cu. in. (2,360 c.c.)	152 cu. in. (2,500 c.c.)
B.H.P. (Max.)	32 at 2,000 r.p.m.	39.5 at 2,000 r.p.m.
Torque (Max.)	92 lb/ft. at 1,200 r.p.m.	112 lb/ft. at 1,250 r.p.m.
Combustion system	Swirl chamber	
Compression ratio	16.5 : 1	17.4 : 1
Number of cylinders	3 in line	3 in line
Firing order	1, 2, 3	1, 2, 3
Location of No. 1 cylinder	Next to radiator	
Location of engine number	On water rail boss, at the top front of the left-hand side of the cylinder block	

Cylinder Liners

	Standard Dexta	*Super Dexta*
Method of retention	Interference fit	Interference fit
Amount of interference	0.002 to 0.004 in. (0.051 to 0.102 mm.)	0.002 to 0.005 in. (0.051 to 0.127 mm.)
Liner protrusion	Nil—Flush with top face of the cylinder block	
Outside diameter bore in cylinder block	3.6895 to 3.6905 ins. (93.637 to 93.663 mm.)	3.6915 to 3.6925 ins. (93.663 to 93.685 mm.)
Internal diameter (before finish boring)	3.478 to 3.482 ins. (88.341 to 88.443 mm.)	3.555 to 3.560 ins. (90.297 to 90.424 mm.)
Diameter of finished bore (standard)	3.501 to 3.502 ins. (88.925 to 88.951 mm.)	3.600 to 3.601 ins. (91.44 to 91.465 mm.)
Diameter of finished bore 0.030 in. (0.762 mm.) o/s	3.531 to 3.532 ins. (89.687 to 89.713 mm.)	Not applicable

Piston

Type	High silicon, aluminium alloy	
Piston diameter at bottom of skirt (standard piston) :		
At 90° to piston pin	3.4964 to 3.4974 ins. (88.808 to 88.834 mm.)	3.5945 to 3.5955 ins. (91.298 to 91.323 mm.)
In line with piston pin	3.4944 to 3.4962 ins. (88.758 to 88.803 mm.)	3.5900 to 3.5918 ins. (91.186 to 91.231 mm.)
Piston oversizes	0.030 in. (0.762 mm.)	Not applicable
Diameter of piston pin bore	1.2495 to 1.2500 ins. (31.737 to 31.750 mm.)	1.2495 to 1.2500 ins. (31.737 to 31.750 mm.)

Piston Rings

Type and material:	
Top compression	Cast iron, chrome plated
Second compression	Cast iron, plain faced
Third compression	Laminated spring steel rings
Top oil control	Laminated spring steel rings
Lower oil control	Cast iron, slotted
Width of piston ring grooves :	
Top compression	0.0957 to 0.0967 in. (0.243 to 0.246 mm.)
Second compression	0.0957 to 0.0967 in. (0.243 to 0.246 mm.)
Third compression	0.127 to 0.128 in. (0.323 to 0.325 mm.)
Top oil control	0.252 to 0.253 in. (0.640 to 0.643 mm.)
Lower oil control	0.252 to 0.253 in. (0.640 to 0.643 mm.)
Width of piston ring :	
Top compression	0.0928 to 0.0938 in. (0.236 to 0.238 mm.)
Second compression	0.0928 to 0.0938 in. (0.236 to 0.238 mm.)
Third compression	0.03125 in. (0.794 mm.) Nominal (4 rings per groove)
Top oil control	Not applicable
Lower oil control	0.249 to 0.250 in. (0.632 to 0.635 mm.)

Piston Rings—*continued*

Ring to groove clearance :	
Top compression	0.0019 to 0.0039 in. (0.048 to 0.099 mm.)
Second compression	0.0019 to 0.0039 in. (0.048 to 0.099 mm.)
Third compression	Not applicable
Top oil control	Not applicable
Lower oil control	0.002 to 0.004 in. (0.051 to 0.102 mm.)
Piston ring gap in cylinder bore (unworn) :	
Top Compression	0.010 to 0.015 in. (0.254 to 0.381 mm.)
Second compression	0.009 to 0.013 in. (0.229 to 0.330 mm.)
Third compression	0.008 to 0.010 in. (0.203 to 0.254 mm.)
Top oil control	0.018 to 0.037 in. (0.457 to 0.940 mm.)
Lower oil control	0.009 to 0.013 in. (0.229 to 0.330 mm.)

Piston Pin

Type	Fully floating
Length	2.961 to 2.965 in. (75.2 to 75.3 mm.)
Outside diameter	1.24975 to 1.2500 in. (31.744 to 31.75 mm.)
Clearance in piston	0.00025 to 0.0005 in. (0.0064 to 0.0127 mm.)
Clearance in small end bore	0.0005 to 0.00175 in. (0.0127 to 0.0445 mm.)
Method of retention	End circlips

Connecting Rod

Length between centres	8.999 to 9.001 in. (228.575 to 228.625 mm.)
Big end bore (without liners)	2.3950 to 2.3955 in. (60.833 to 60.846 mm.)
Big end bore (with liners)	2.251 to 2.252 in. (57.175 to 57.201 mm.)
Undersizes of liners	0.010 in. (0.254 mm.), 0.020 in. (0.508 mm.), 0.030 in. (0.762 mm.)
Connecting rod big end width	1.5502 to 1.5525 in. (39.375 to 39.434 mm.)
Liner thickness (standard)	0.07175 to 0.0720 in. (1.822 to 1.829 mm.)
Clearance on crankpin	0.002 to 0.0035 in. (0.051 to 0.089 mm.)
End-float on crankpin	0.0095 to 0.0133 in. (0.241 to 0.338 mm.)
Small end bore (with bush)	1.2505 to 1.2515 in. (31.763 to 31.788 mm.)
Clearance between small end and piston pin	0.0005 to 0.00175 in. (0.0127 to 0.0445 mm.)

Crankshaft and Main Bearings

Crankpin journal length	1.5620 to 1.5635 in. (39.675 to 39.713 mm.)
Crankpin journal diameter	2.2485 to 2.249 in. (57.112 to 57.125 mm.)
Crankshaft end-float	0.00225 to 0.01025 in. (0.0572 to 0.2604 mm.)
Rear main bearing thrust washer thickness	0.123 to 0.125 in. (3.124 to 3.175 mm.)
Main bearing liner thickness (standard)	0.08225 to 0.0825 in. (2.089 to 2.096 mm.)
Undersizes	0.010 in. (0.254 mm.), 0.020 in. (0.508 mm.), 0.030 in. (0.762 mm.)
Main bearing journal diameter	2.7485 to 2.749 in. (69.812 to 69.825 mm.)
Main bearing journal clearance	0.0025 to 0.0045 in. (0.064 to 0.114 mm.)
Number of teeth on crankshaft gear	25
Effective diameter of crankshaft pulley	5.21875 in. (132.556 mm.)
Crankshaft pulley fit	0.00025 to 0.00175 in. clearance (0.0064 to 0.0445 mm.)
Crankshaft gear fit	0.001 in. (0.025 mm.) interference to 0.001 in. (0.025 mm.) clearance

Idler Gear

Number of teeth on idler gear	90
Internal diameter of gear	2.125 to 2.1266 in. (53.975 to 54.016 mm.)
Diameter of idler gear spigot	2.123 to 2.1238 in. (53.924 to 53.945 mm.)
Clearance between gear and spigot	0.0012 to 0.0036 in. (0.030 to 0.091 mm.)

Camshaft

Camshaft drive	Gear
Maximum cam lift	0.30955 to 0.31555 in. (7.863 to 8.015 mm.)
Maximum valve lift	0.348 in. (8.84 mm.)
Journal diameter front	1.869 to 1.870 in. (47.473 to 47.498 mm.)
Journal diameter centre	1.859 to 1.860 in. (47.219 to 47.244 mm.)
Journal diameter rear	1.839 to 1.840 in. (46.711 to 46.736 mm.)
Bearing clearance	0.004 to 0.008 in. (0.102 to 0.203 mm.)
Number of teeth on camshaft gear	50
Backlash—all timing gears	0.003 to 0.006 in. (0.076 to 0.152 mm.)

Valves and Guides

Valve clearance—inlet and exhaust	0.010 in. (0.254 mm.) Hot
Valve head diameter—inlet	1.532 to 1.536 in. (38.913 to 39.014 mm.)
Valve head diameter—exhaust	1.313 to 1.317 in. (33.350 to 33.452 mm.)
Valve stem diameter—inlet and exhaust	0.311 to 0.312 in. (7.899 to 7.925 mm.)
Valve length—inlet and exhaust	4.486 to 4.514 in. (113.95 to 114.66 mm.)
Angle of valve head	45°
Angle of valve seat in cylinder head	44°
Length of valve guide	2.59275 to 2.59475 in. (65.856 to 65.907 mm.)
Valve guide internal diameter	0.314 to 0.3155 in. (7.976 to 8.014 mm.)
Valve guide outside diameter	0.5005 to 0.501 in. (12.713 to 12.725 mm.)
Stem to guide clearance	0.002 to 0.0045 in. (0.051 to 0.114 mm.)
Valve depth in cylinder head (new)	0.059 to 0.087 in. (1.498 to 2.210 mm.)
Valve depth in cylinder head (max.)	0.140 in. (3.556 mm.)

Valve Springs

Number of coils on valve spring :	
Inner	7.75 approx.
Outer	7.25 approx.
Free length of valve spring :	
Inner	1.365 to 1.405 in. (34.671 to 35.687 mm.)
Outer	1.783 to 1.803 in. (45.288 to 45.796 mm.)
Compressed length and load :	
Inner	0.838 in. at 21 to 25 lb. (21.285 mm. at 9.53 to 11.34 kg.)
Outer	1.151 in. at 48 to 52 lb. (29.235 mm. at 21.77 to 23.59 kg.)

Tappets

Diameter of tappet stem	0.62225 to 0,62375 in. (15.805 to 15.843 mm.)
Tappet to cylinder head clearance	0.00075 to 0,0035 in. (0.019 to 0.089 mm.)

Rocker Shaft

Rocker shaft length	12.235 to 12.265 in. (310.77 to 311.53 mm.)
Rocker shaft diameter	0.62225 to 0.62375 in. (15.805 to 15.843 mm.)
Clearance between rocker arm and shaft	0.00075 to 0.0035 in. (0.019 to 0.089 mm.)

Valve Timing

Inlet opens	13° before T.D.C.
Inlet closes	43° after B.D.C.
Exhaust opens	46° before B.D.C.
Exhaust closes	10° after T.D.C.

Flywheel

Flywheel outside diameter	15.5 in. (393.7 mm.)
Flywheel run-out clutch face (max. T.I.R.)	0.001 in. (0.025 mm.) per inch (25.4 mm.) of radius from centre of flywheel to the dial indicator
Flywheel ' run-out ' outside diameter (max. T.I.R.)	0.012 in. (0.305 mm.)
Method of flywheel retention	Spigot and six set-screws
Number of teeth on starter ring gear	122
Method of starter ring gear retention	6 cross-headed screws

Torque Tightening Figures

Cylinder head nuts	55 to 60 lb. ft. (7.601 to 8.292 kg.m.)
Main bearing cap bolts	90 to 95 lb. ft. (12.438 to 13.129 kg.m.)
Big end cap nuts	
Cadmium plated	50 to 55 lb. ft. (6.910 to 7.601 kg.m.)
Unplated	65 to 70 lb. ft. (8.893 to 9.674 kg.m.)
Flywheel bolts	75 lb. ft. (10.365 kg.m.)

REMOVAL AND REPLACEMENT

TO SEPARATE THE ENGINE AND FRONT AXLE ASSEMBLY FROM THE GEARBOX

Should it be necessary to dismantle the tractor to carry out repairs to the clutch, gearbox, crankshaft rear oil seal, etc., the following general dismantling procedure can be adopted.

To Remove the Engine and Front Axle Assembly

1. Remove the primary air cleaner, vertical exhaust silencer (where fitted) and the engine bonnet.

2. Disconnect the battery leads and remove the battery.

3. Disconnect the starter motor control rod and leads.

4. Disconnect the heater plug lead and induction primer atomizer feed pipe from the inlet manifold. Disconnect the governor control linkage at the right-hand end of the friction pad rod.

4a. *Remove the set-screws securing the battery heat baffle to the brackets at either side of the rear of the cylinder head. Disconnect the throttle control rod and air inlet hose from the inlet manifold.*

5. Disconnect the generator leads from the terminal posts on the generator.

6. Disconnect the headlamp wiring snap connectors at the right-hand side of the tractor, near the top radiator support bracket.

7. Remove the temperature gauge bulb from the cylinder head water outlet connection and release the capillary tube clip from beneath the upper of the two set-screws on the left-hand engine lifting plate. Replace the set-screw.

8. Remove the proofmeter drive cable by unscrewing the knurled retaining nut at the rear of the fuel injection pump.

9. Disconnect the oil pressure warning light lead from the pressure switch on the left-hand side of the cylinder block.

10. Turn the fuel tap to the " OFF " position and remove the fuel tank to lift pump pipe, at the lift pump end.

11. Unscrew the pinch screw on the stop lever, and the outer cable retaining clip, and remove the stop control inner and outer cables.

12. Disconnect the fuel leak-off pipe from the union at the rear of the cylinder head.

13. Fit suitable wedges between the front axle centre beam and the front axle support bracket to balance the engine and prevent it rotating.

14. Disconnect the radius rods and drag links at their rear ends, and tie the drag links to the radius rods so that the wheels are in the straight ahead position.

15. Using a suitable jack or lifting tackle, support the transmission under the gearbox housing.

16. Fit lifting tackle to the two lifting plates on the engine, and take the weight on a joist or gantry.

17. Remove the ten nuts and bolts securing the engine to the transmission, and wheel the engine and front axle assembly forward from its dowelled location on the clutch housing.

To Replace the Engine and Front Axle Assembly

1. Move the engine and front axle assembly towards the gearbox, ensuring that the gearbox main drive shaft lines up with the clutch disc splines and the clutch pilot bearing.

When replacing an engine fitted with a double clutch, the splines on both the power take-off input and the main drive shafts must be aligned with the splined hubs of their respective clutch discs.

2. With the engine fully located on the two dowels in the clutch housing, replace the ten nuts and bolts that secure the engine to the transmission, and tighten the nuts fully.

3. Remove the lifting tackle from the engine and the support from beneath the gearbox housing.

4. Replace the radius rods and the drag links, and tighten the securing nuts fully. Remove the front axle wedge tool.

5. Reconnect the fuel leak-off pipe to the union at the rear of the cylinder head.

6. Replace the stop control inner and outer cables, so that there is approximately $\frac{1}{4}$ in. (6.35 mm.) free movement at the stop control knob on the control panel.

7. Replace the fuel tank to fuel lift pump pipe onto the lift pump.

8. Reconnect the oil pressure warning light lead to the pressure switch on the left-hand side of the cylinder block.

9. Replace the proofmeter drive cable into the square hole at the rear of the fuel injection pump camshaft, and tighten the knurled nut fully.

10. Replace the temperature gauge bulb in the cylinder head water outlet connection and refit the capillary tube clip beneath the top set-screw on the left-hand engine lifting plate.

11. Reconnect the headlamp wiring by joining the snap connectors.

12. Reconnect the generator leads to the terminal posts on the generator.

12a. *Replace the set-screws securing the battery heat baffle to the brackets on the cylinder head and connect the throttle control rod and air inlet hose to the inlet manifold.*

13. Refit the heater plug lead and induction primer

atomizer feed pipe, to their appropriate locations on the inlet manifold. Reconnect the governor control linkage.

14. Reconnect the starter motor control rod and leads.

15. Replace the battery and reconnect the battery leads.

16. Refit the engine bonnet, primary air cleaner and vertical exhaust silencer (where fitted).

17. Turn the fuel tap to the " ON " position and bleed all air from the fuel system (as detailed in the Fuel System Section).

TO SEPARATE THE FRONT AXLE AND RADIATOR ASSEMBLY FROM THE ENGINE

For certain repair operations on the front of the engine, it will be necessary to remove the front axle and radiator as an assembly. This can be accomplished quite easily as detailed in the following paragraphs :—

To Remove the Front Axle and Radiator Assembly

1. Drain the cooling system, through the taps on the radiator and the left-hand side of the cylinder block.

2. Remove the primary air cleaner, vertical exhaust silencer (where fitted) and the engine bonnet.

3. Remove the four set-screws that retain the radiator top support brackets to the cylinder head water outlet connection.

4. Unscrew the two set-screws securing the water outlet adaptor to the water outlet connection.

5. Disconnect the headlamp wires at the snap connectors, on the top right-hand radiator support bracket.

6. Disconnect the lower radiator hose at the water pump.

7. Disconnect the radius rods and drag links at their rear ends, and tie the drag links to the radius rods so that the wheels are in the straight ahead position.

8. Support the front of the tractor, and fit suitable wedges in between the centre axle beam and the front axle support bracket.

9. Remove the six nuts and spring washers securing the front axle support bracket to the sump, and move the axle and radiator assembly forward away from the engine.

To Replace the Front Axle and Radiator Assembly

1. Wheel the front axle and radiator assembly back against the front axle support bracket, and secure in position on the studs with six nuts and spring washers.

2. Replace the radius rods and the drag links, and tighten the securing nuts fully. Remove the front axle wedges, and the support from under the front of the tractor.

3. Replace the lower radiator hose onto the water pump.

4. Replace the two set-screws securing the water outlet adaptor to the water outlet connection on the cylinder head.

5. Replace the radiator top support brackets on the water outlet connection, and secure with four set-screws.

6. Reconnect the headlamp wires by pushing in the snap connectors on the right-hand side of the tractor.

7. Refill the cooling system.

8. Replace the engine bonnet, primary air cleaner and the vertical exhaust silencer (where fitted).

MAJOR REPAIR OPERATIONS

Most operations of dismantling and repair on the engine, can be carried out without removing the engine from the tractor, but should removal be necessary the procedure for removing the front axle and engine assembly as detailed on page 23, should be adopted.

The following additional operations are then needed to remove the engine from the front axle.

To Remove the Engine

1. Drain the cooling system, through the taps on the radiator and the left-hand side of the cylinder block.

2. Remove the four set-screws that retain the radiator top support brackets to the water outlet connection on the cylinder head.

3. Unscrew the two set-screws securing the water outlet adaptor to the water outlet connection.

4. Disconnect the lower radiator hose at the water pump.

5. Remove the six nuts and spring washers securing the front axle support bracket to the sump, and move the axle and radiator assembly forward away from the engine.

To Replace the Engine

1. Wheel the front axle and radiator assembly back against the front axle support bracket and secure in position on the studs with six nuts and spring washers.

2. Replace the lower radiator hose onto the water pump.

3. Replace the two set-screws securing the water outlet adaptor to the water outlet connection, ensuring that the gasket is in good order.

4. Replace the radiator top support brackets on the

water outlet connection, and secure with four set-screws.

5. Refill the cooling system.

6. Replace the engine and front axle assembly as detailed on page 24.

DISMANTLING THE ENGINE

The following sequence is given as a guide, and where necessary, reference can be made to the appropriate sections for detailed instructions covering the dismantling and reassembling of any particular sub-assembly.

1. Disconnect the governor control rod from the governor arm, remove the inlet hose from the inlet manifold and remove the set-screws securing the battery heat baffle to the engine block. Remove the heat baffle complete with air cleaner and governor linkage.

2. Remove the sump drain plug and drain off the engine oil. Replace the drain plug when all of the oil has been removed.

3. Remove the clutch assembly taking care to slacken the pressure plate to flywheel bolts evenly.

4. Unscrew the retaining set-screw and remove the starter motor.

5. Remove the wire from the six flywheel retaining bolts, unscrew the bolts, and remove the flywheel from its location on the crankshaft.

6. Remove the sixteen set-screws and spring washers securing the engine adaptor plate to the cylinder block and sump, and remove the adaptor plate from its dowelled position on the cylinder block.

7. Bolt the engine stand bracket (Tool No. T.6091) to the engine in the position shown on Fig. 28. The engine and bracket can then be positioned on the engine stand (Tool No. 200 or 35) in the normal manner.

8. Remove the thermostat from the cylinder head water outlet connection.

9. Disconnect the fuel leak-off pipe and remove the injectors, taking the recommended precautions regarding cleanliness.

10. Remove the two nuts retaining the rocket cover and lift off the cover and gasket.

11. Remove the four nuts retaining the rocker shaft assembly, detach the rocker shaft oil feed pipe from the union at the rear right-hand corner of the cylinder head, and lift off the rocker shaft assembly.

12. Remove the exhaust manifold by unscrewing the four brass nuts securing it to the cylinder head.

12a. *Remove the governor pipe from the inlet manifold and the fuel injection pump. To remove the pipe completely from the engine it is necessary to remove the clip at the rear of the cylinder head.*

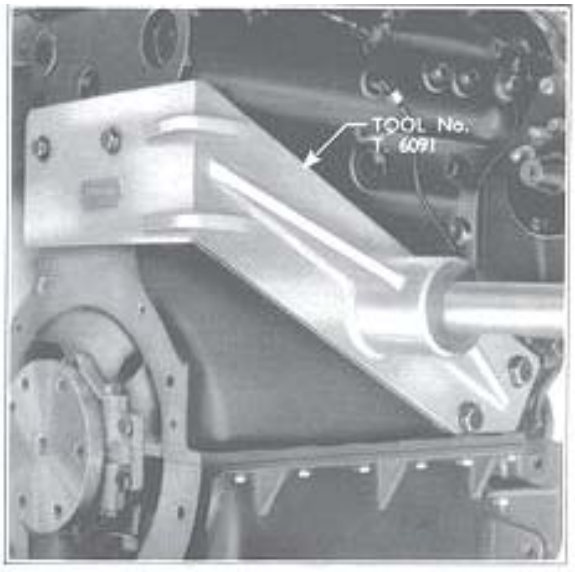


Fig. 28
Engine Stand Bracket

13. Remove the six nuts and spring washers from the inlet manifold retaining studs, and remove the inlet manifold.

14. Remove the engine lifting plate from the right-hand side of cylinder head, and remove the camshaft chamber to cylinder head and the oil pressure gallery to camshaft chamber oil pipes.

15. Unscrew the five set-screws securing the water outlet connection to the front of the cylinder head, and remove the connection and water hose.

16. Unscrew the cylinder head retaining nuts in the opposite sequence to that shown in Fig. 2, and lift off the cylinder head. To dismantle the cylinder head assembly refer to page 5.

17. Remove the generator, fan belt and the generator support brackets.

18. Remove the lubricating oil filter, cylinder block drain tap, oil pressure warning light switch and the cylinder block water connection (at the top of the left-hand side of the cylinder block).

19. Remove the fuel filter and pipes, taking the recommended precautions regarding cleanliness.

20. Remove the four nuts and shakeproof washers securing the water pump to the timing case cover, and detach the water pump.

21. Bend back the locking washer fitted behind the crankshaft ratchet nut, and unscrew the nut, using the box spanner (Tool No. T.6098).

22. Draw off the crankshaft pulley using the universal puller (Tool No. 555) and the three screwed adaptors (Tool No. T.555–2).

23. Remove the timing case cover set-screws and carefully remove the cover.

24. Unscrew the idler gear retaining bolt, and remove the idler gear and spigot.

25. Lift the camshaft and gear from its location in the cylinder block, taking care not to damage the cams or bearing journals.

26. Invert the engine on the stand, and remove the nuts and set-screws retaining the sump to the cylinder block. Lift off the sump and gaskets.

27. Remove the oil pump suction and delivery pipes.

28. Remove the fourteen set-screws and shakeproof washers securing the timing case to the cylinder block, and remove the timing case and fuel pump as an assembly.

29. Remove the oil pump idler gear and unscrew the three set-screws retaining the oil pump to the front main bearing cap. Remove the oil pump from its dowelled location on the main bearing cap.

30. Remove the connecting rods and pistons.

31. Unscrew the two nuts and bolts holding the half housings of the crankshaft rear oil seal retainer together

32. Bend back the locking washers on the main bearing cap set-screws, and remove the set-screws, caps, liners and crankshaft thrust washers. Carefully lift out the crankshaft and extract the upper halves of the thrust washers and the main bearing liners.

33. Using a suitable stud remover, unscrew the cylinder head studs.

34. Thoroughly clean the cylinder block, before inspecting the block for cylinder bore wear, cracks, core plug leaks, etc.

REASSEMBLING THE ENGINE

Before reassembling the engine all parts will require checking dimensionally against the general specification, and where necessary new parts should be fitted. Lubricate all bearing surfaces and moving parts before assembly, and soak the new crankshaft rear oil seals in engine oil for one hour before fitting.

1. Fit new crankshaft rear oil seals to the half housings of the crankshaft rear oil seal retainer (one on the rear main bearing cap, and the other is on the rear of the cylinder block).

2. Fit the top halves of the main bearing liners and thrust washers, install the crankshaft and fit the main bearing caps, lower halves of the liners and thrust washers, new locking washers and the main bearing cap set-screws. Fully tighten the main bearing cap set-screws, and check the crankshaft end-float.

3. Replace the two bolts and self-locking nuts that hold the half housings of the crankshaft rear oil seal retainer together.

4. Locate the piston and connecting rod assemblies in their appropriate bores with the number stamped on the connecting rod big end positioned on the left-hand side of the engine (opposite side to camshaft). Compress the piston rings using a suitable piston assembly ring, push the pistons down the cylinder bores and reassemble the big end caps to the crankshaft, with the corresponding numbers on cap and rod adjacent. Always use new self-locking nuts.

5. Replace the cylinder head studs in the cylinder block. The six long studs fit in the tapped holes on the left-hand side of the cylinder block top face.

6. Replace the oil pump in the dowelled location on the front main bearing cap, and secure in position with three set-screws and shakeproof washers. Refit the oil pump idler gear and retaining clip.

7. Place the idler gear spigot and locating peg in their locations in the cylinder block, and fit the timing case, set-screws and shakeproof washers. Fully tighten the set-screws.

8. Refit the idler gear, and secure in position with a large flat washer, locking washer and bolt. Bend the locking washer up against the bolt head. Check that the idler gear has end-float on its spigot.

9. Refit the camshaft and gear, taking care not to damage the cams or bearing journals.

10. Replace the timing case cover, crankshaft pulley, locking washer and ratchet nut. Bend up the locking washer against the ratchet nut.

11. Replace the oil pump suction and delivery pipes, sump and gaskets. Tighten the sump retaining set-screws evenly.

12. Replace the cylinder head and gasket and tighten the cylinder head nuts in the correct sequence (see Fig. 2) to a torque of 55 to 60 lb. ft., using the extra deep socket (Tool No. T.6095). Before fitting the cylinder head gasket it should be covered on both sides, with a thin coating of jointing compound.

13. Replace the water outlet connection and hose.

14. Refit the oil gallery to camshaft chamber and the camshaft chamber to cylinder head oil pipes, and replace the right-hand engine lifting plate.

15. Refit the lubricating oil filter, cylinder block drain tap, oil pressure warning light switch, cylinder block water connection and the fuel filter and pipes.

16. Replace the water pump, generator support brackets, generator and fan belt. The fan belt should have 1 in. (25.4 mm.) free travel measured midway between the generator pulley and the crankshaft pulley.

17. Replace the inlet and exhaust manifolds.

17*a*. *Refit the governor pipe to the manifold and injection pump.*

18. Install the rocker shaft assembly, and reconnect the rocker shaft oil feed pipe to the union at the rear of the cylinder head.

19. Refit the rocker cover and gasket, taking care to ensure that the gasket is correctly located in the cover.

20. Refit the injectors, injector pipes and the fuel leak-off pipe.

21. Replace the thermostat in its location in the water outlet connection.

22. Remove the engine from the engine stand, and unbolt the engine stand bracket.

23. Refit the engine adaptor plate and flywheel. Wire up the flywheel bolts, and check the flywheel run-out.

24. Replace the starter motor and secure in position with one set-screw.

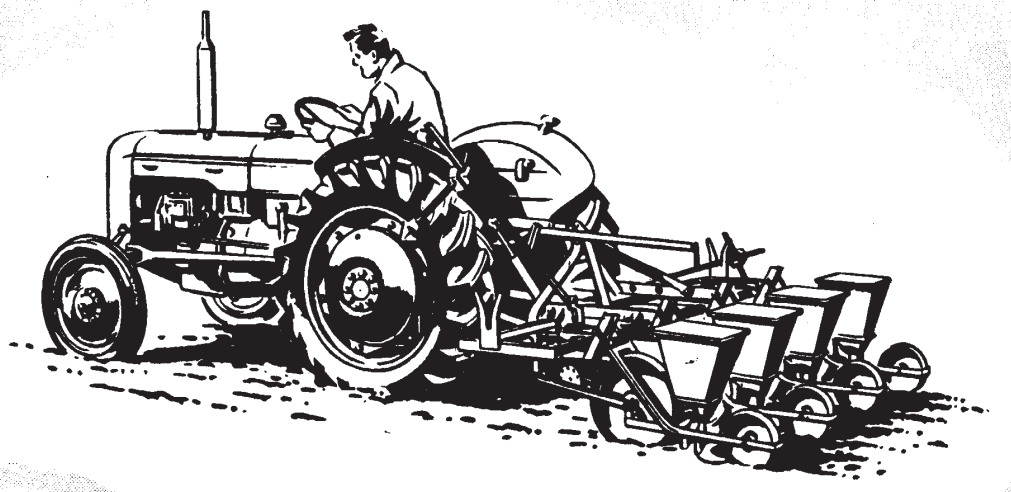
25. Replace the clutch assembly using the clutch disc locator (Tool No. T.7079), to centralise the clutch disc (single clutch only). When fitting a double clutch assembly a clutch disc locator is not required.

26. Refill the engine with clean oil of the approved grade, to the correct level.

27. Refit the battery heat baffle to the engine block and connect the air inlet hose to the inlet manifold and the governor control rod to the governor arm.

Just a joke from the Webmaster:

Two farmers are meeting together. One farmer told: I bought a new tractor, it's a english build one. You can indicate an english build tractor on the steering wheel. The other farmer: What about the steeering wheel? Farmer one: The steering wheel is fixed on the other side.



LUBRICATION SYSTEM

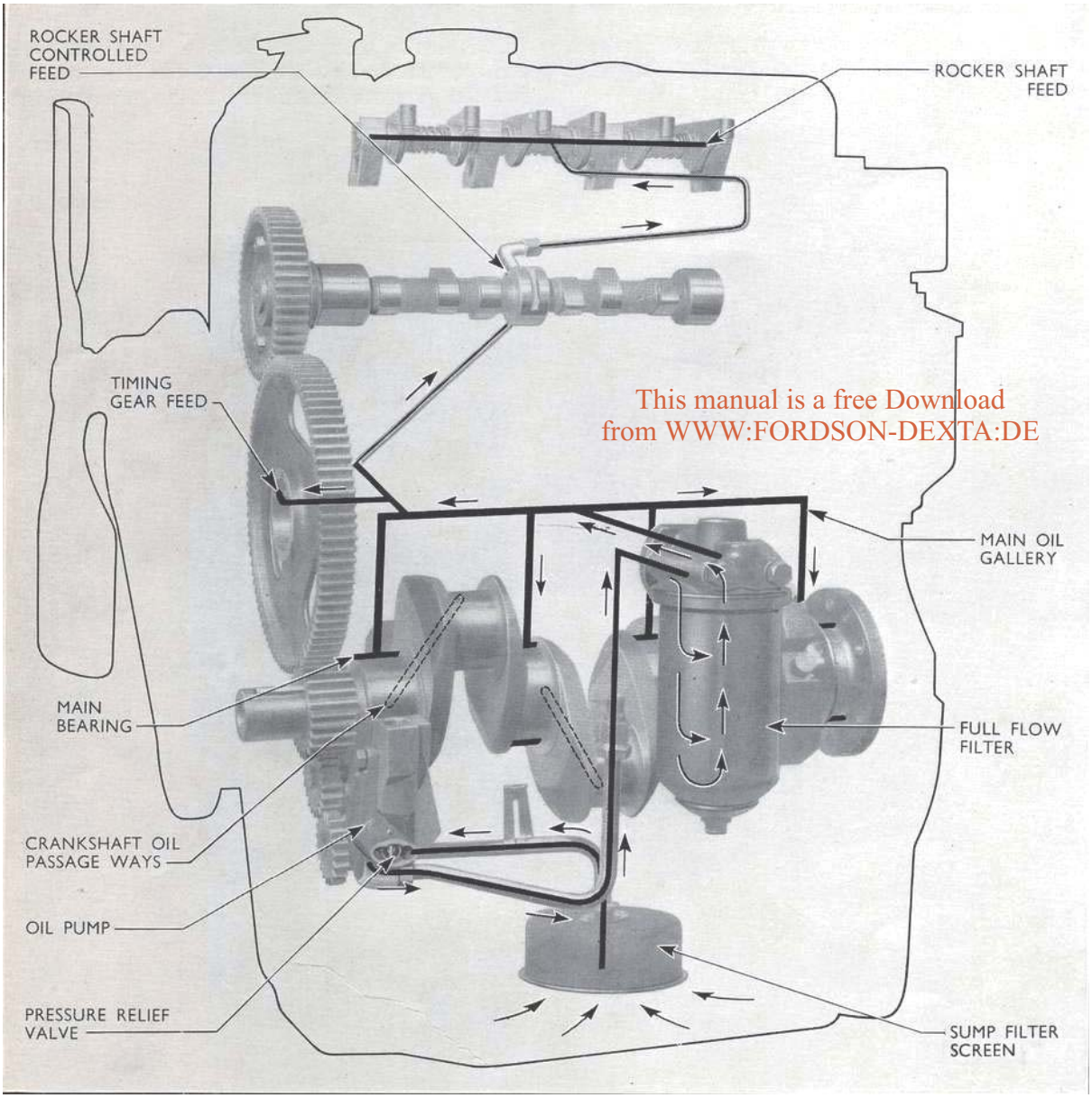


Fig. 29
Engine Lubrication System

Description

The lubrication system is of the forced feed type, the oil being circulated, under pressure, by a rotor type pump bolted to the front main bearing cap, and driven via an idler gear by the crankshaft gear. Oil is drawn through a sump filter screen and a suction pipe before entering the pump, it is then pumped via a pipe and a drilling in the cylinder block to a renewable-element type, externally mounted, full-flow filter. Any excess pressure of oil passes back into the sump through a pressure relief valve located on the outlet side of the pump.

After passing through the filter which is located on the left-hand side of the engine, the oil passes through a drilling in the cylinder block into the main oil gallery. This gallery runs the complete length of the cylinder block, on the left-hand side of the engine.

From the main oil gallery the oil is fed through oilways in the cylinder block to Nos. 1, 2, 3 and 4 main bearings. The main bearings also supply oil, under pressure, through oilways in the crankwebs to the big end bearings. A tapping in the main oil gallery provides a location for the oil pressure warning switch, which comes into operation when the oil pressure is below 7–9 lbs. per square inch.

A transverse drilling at the front of the cylinder block, feeds oil under pressure from the main oil gallery to an external pipe located at the right-hand side of the engine. This pipe feeds oil to the centre camshaft bearing. A machined slot on the centre camshaft journal allows oil, under pressure, to be forced to the rocker shaft via an external pipe, once every revolution of the camshaft, when the slot in the camshaft journal and the oil passages in the camshaft bearing are in line.

Oil from the rocker shaft lubricates the valves, guides and tappets via a small hole in each rocker arm. The camshaft is lubricated by oil draining down from the rocker gear, the level of the oil in the camshaft chamber being controlled by a hole cast in the cylinder block, which diverts excess oil onto the timing gears.

As well as being splash lubricated the timing gears have pressure oil fed to them from a drilling in the idler gear spigot, which connects with the transverse drilling across the front of the cylinder block. A controlled feed of oil is maintained by a drilling in the idler gear that lines up with the drilling in the idler gear spigot once every revolution of the idler gear. After lubricating the timing gears the oil returns to the sump through a passage in the timing case. A spring-loaded rubber seal in the timing case cover bears on the journal of the crankshaft pulley and prevents any leakage of oil or ingress of dirt at this location.

The pistons, cylinder walls and connecting rod small-end bearings are lubricated by splash and oil mist.

Oil is prevented from leaking into the clutch housing by a rubber cored asbestos type oil seal fitted to the crankshaft at the rear of No. 4 main bearing cap, and an oil return scroll machined on the crankshaft.

ENGINE OIL

The engine oil should be changed at the initial 25 hour service and then normally at intervals of 200 hours.

The sump capacity of the engine is 12 Imperial pints (6.82 litres). In addition $\frac{3}{4}$ pint (0.43 litres) is required for a dry oil filter. The engine oil level indicator is located on the left-hand side of the sump adjacent to the oil filter.

Temperature Range	*S.A.E. H.D. Grade*
Below 20°F. (—6.6°C.)	10
20°F. to 90°F. (—6.6°C. to 32.2°C.)	20
ABOVE 90°F. (32.2°C.)	30

THE OIL SUMP

To Remove the Sump

1. Arrange the tractor on level ground, and run the engine until the normal operating temperature is reached.

2. Place a suitable can under the sump and remove the sump drain plug. When all the oil has drained out replace the drain plug.

3. Remove the front axle and radiator assembly as described on page 24.

4. Support the sump and unscrew the nuts and bolts securing it to the cylinder block and engine adaptor plate.

5. Lower the sump and remove it from beneath the engine.

To Replace the Sump

1. Wash the sump and filter screen thoroughly in petrol or paraffin.

2. Clean off the gasket faces on the sump, cylinder block, rear main bearing cap and the timing case.

3. Smear the new gaskets with jointing compound and locate them on the cylinder block faces.

4. Fit new cork strips to the timing case and the rear main bearing cap so that the ends are over the gaskets already fitted.

5. Replace the sump ensuring that all gaskets are correctly aligned. Fit and tighten all the retaining nuts and bolts evenly.

6. Replace the front axle and radiator assembly as described on page 24.

7. Refill the sump with the approved grade of oil to the correct level.

ENGINE OIL FILTER

The oil filter is a full-flow, replaceable element type, and is secured to the left-hand side of the cylinder block by two set-screws and spring washers.

Impurities removed from the oil are collected by the element located in the filter body. The element should normally be renewed every 200 hours.

If at any time the element becomes blocked, a relief valve in the filter head set to operate between 13 to 17 lbs. per square inch differential pressure, comes into action and allows unfiltered oil to by-pass the filter and enter the engine.

Filter assemblies may be " bottom servicing " type, where the retaining bolt passes up through the filter, or " top servicing " type in which case the retaining bolt passes down through the filter head. Replaceable elements supplied through service are suitable for both types of filter but the remaining parts of the filter assembly must be of the same type as the particular filter assembly in use.

To Renew the Filter Element

1. Unscrew the centre retaining bolt and withdraw the filter body and element (see Fig. 30).

2. Discard the element, and thoroughly clean the filter body.

3. Remove the rubber sealing ring from the top casting, and replace it with a new sealing ring, having first ensured that the groove in the top casting is perfectly clean.

4. Fit a new element in the body, replace in position on the top casting and tighten the centre bolt to a torque of 10 lbs. ft.

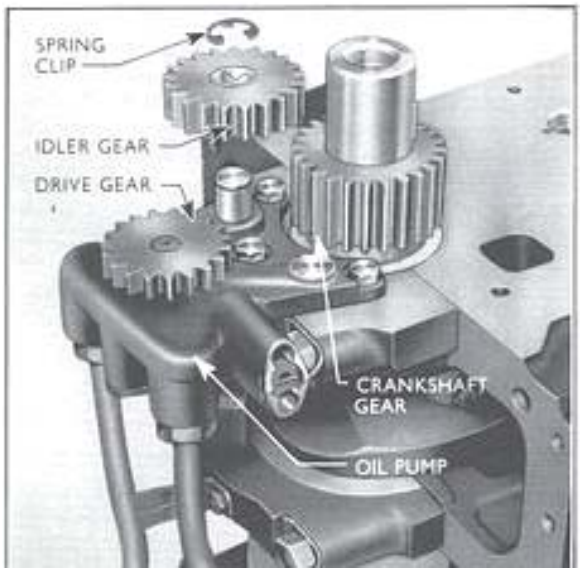
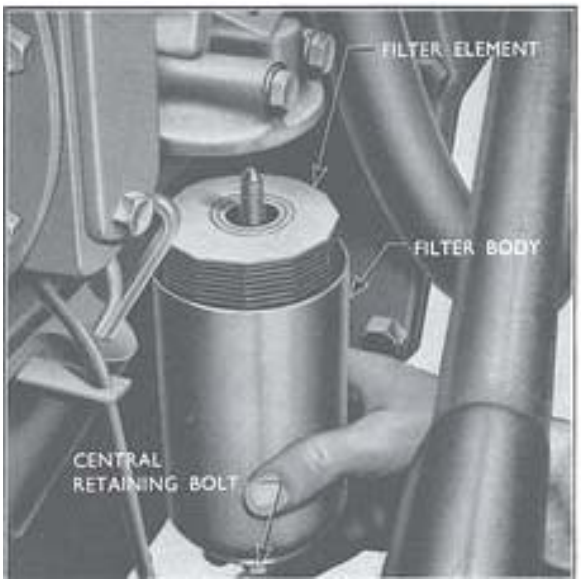


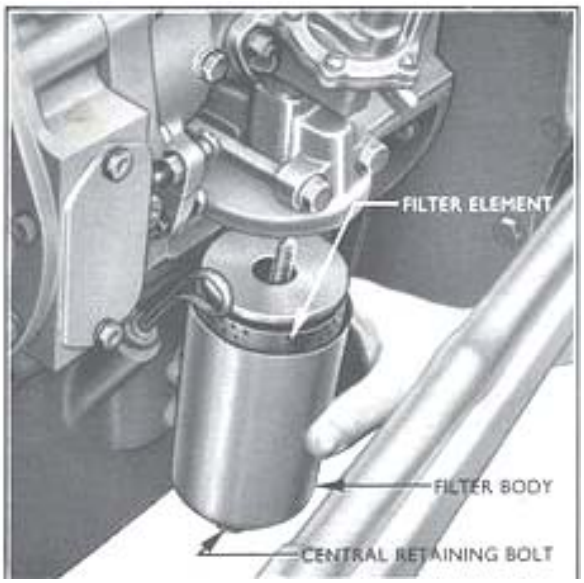
Fig. 31
Oil Pump and Idler Gear

THE OIL PUMP

The oil pump is secured to the front main bearing cap by three set-screws, a dowel on the pump locating in a hole in the bearing cap to give positive location. The pump and plate is secured to the pump body by three cross-headed screws and to ensure effective sealing between the pump body and the end plate an oil sealing ring is fitted in a groove in the pump body (see Fig. 32).



Early Type



Current Type

Fig. 30
Removing Oil Filter Element

NOTE.—Prior to Engine No. 1415168 the end face of the oil pump body did not have the oil sealing ring groove present on pumps after the above engine number.

The bushed idler gear which is free to rotate on a shaft pressed into the pump body, transmits the drive from the crankshaft gear to the oil pump gear.

The oil pump gear is keyed to the pump drive shaft, to the other end of which is fitted a four-lobed drive rotor. This rotor meshes with a five-lobed driven rotor, which is free to rotate in the cast iron pump body (see Fig. 32).

As the pump rotors rotate, the pockets formed between the rotor lobes increase then decrease in volume to propel oil from the suction side to the pressure side of the pump.

A pressure relief valve mounted on the pressure side of the pump body controls the maximum oil pressure at 60 lbs. per square inch, any excess pressure oil returning direct to the sump.

The suction pipe from the filter screen and the delivery pipe to the full-flow filter are screwed into the cast inlet and outlet ports on the pump body.

Before Engine No. 1450597 two adaptors were screwed into the inlet and outlet ports on the pump body and to these were attached the suction pipe and delivery pipe.

To Remove the Oil Pump

1. Remove the timing case cover as described on page 6.
2. Remove the sump as detailed on page 29.
3. Remove the oil pump suction and delivery pipes.
4. Unscrew the two set-screws securing the small lower section of the timing case to the main timing case, and remove the lower section.
5. Remove the oil pump idler gear retaining clip and lift off the idler gear (see Fig. 31).
6. Unscrew the three set-screws and remove the oil pump from its dowelled location on the front main bearing cap.

To Dismantle

1. Remove the oil pump gear using the puller Tool No. T.6129 and the thrust button STN. 6878.
2. Remove the key from the keyway in the drive shaft.

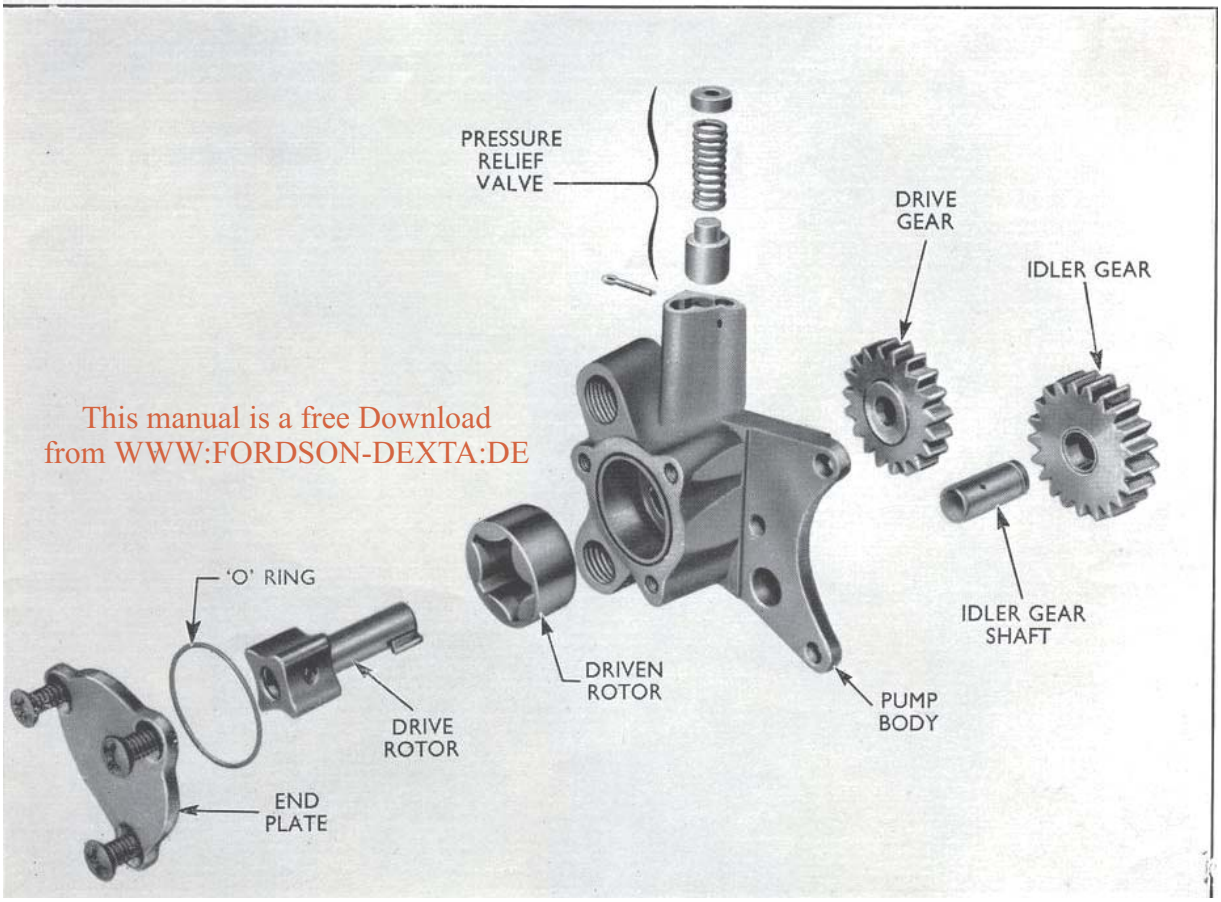


Fig. 32
Explored View of Oil Pump

Fig. 33
Checking Drive to Driven Rotor Clearance

3. Unscrew the three countersunk screws retaining the end plate in position on the pump body, and remove the end plate. Extract the sealing ring (if fitted).

4. Carefully remove the drive and driven rotors from the pump body.

Inspection

1. Thoroughly clean all the parts, and inspect the rotors for cracks or scores.

2. Install the drive and driven rotors in the pump body, and check the clearances between the rotors, at all points, with a feeler gauge as shown in Fig. 33. If the clearance exceeds 0.006 in. (0.152 mm.) replace the drive and driven rotors as a matched assembly.

3. Check the clearance between the driven rotor and the pump body as shown in Fig. 34. If the clearance exceeds 0.010 in. (0.254 mm.) replace the pump body and rotor assembly.

4. Check the clearance between the top of the rotors and the surface of the pump body with a feeler gauge and a straight edge as shown in Fig. 35. If the clearance exceeds 0.003 in. (0.076 mm.) replace the pump body and rotor assembly.

To Assemble

1. Fit the drive and driven rotors in the body, replace the key in the key-way and press the pump gear onto the shaft until it is flush with the end of the shaft. The flat side of the gear faces outward.

NOTE.—When replacing the gear onto the drive shaft the shaft must be supported from underneath. The force should not be allowed to be transmitted through the drive rotor.

2. Fit a new sealing ring and secure the end plate to the pump body with the three cross-headed countersunk screws. Tighten the screws securely.

To Replace the Oil Pump

1. Fit the oil pump to the front main bearing cap with the dowel on the pump fully located in the dowel hole in the cap, and secure in position with three set-screws and shakeproof washers.

2. Replace the oil pump idler gear, and retain on the shaft with a spring clip.

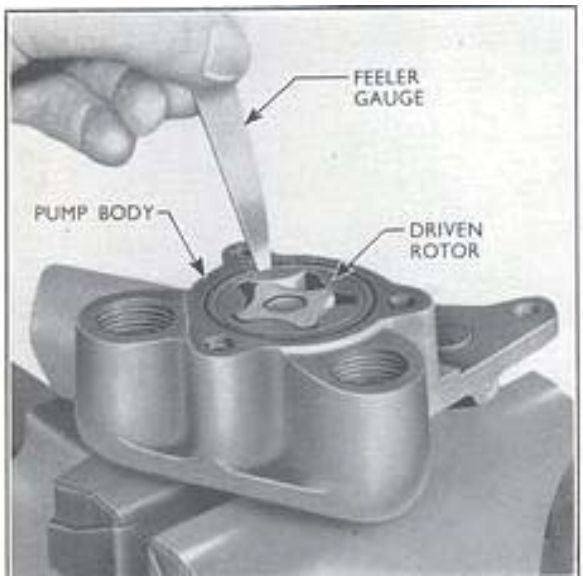


Fig. 34
Checking Driven Rotor to Body Clearance

Fig. 35
Checking Rotor End-float

3. Replace the lower section of the timing case, taking care to ensure that its front face is flush with the front face of the main timing case. Ensure that the correct length of fixing screw is used—see operation 8, page 10.

4. Refit the oil pump suction and delivery pipes. Fit the support bracket of the suction pipe to No. 2 main bearing cap.

5. Replace the sump as described on page 29.

6. Replace the front axle and radiator assembly as described on page 24.

OIL PRESSURE SWITCH

This switch is mounted externally and screws into a tapping in the main oil gallery on the left-hand side of the engine. It is connected by a purple wire to the green indicator lamp on the instrument panel.

In operation the switch breaks contact (green warning lamp on the instrument panel goes out) when the engine oil pressure reaches 7–9 lbs. per square inch, and makes contact (green warning lamp comes on) when the pressure drops below this figure.

Therefore, immediately the engine is started the green lamp should go out, if however, it does not, or the light comes on when the tractor is being operated, the engine should be immediately stopped, and the reason for the low oil pressure checked (see the Fault Diagnosis Section).

OIL PRESSURE RELIEF VALVE

The oil pressure relief valve is fitted in the cast boss on the pressure side of the pump body, and consists of a hardened seat in the pump body, a hollow plunger and a non-adjustable spacing seat, the whole assembly being held in position by a split pin (see Fig. 32). The relief valve opening pressure is pre-set at 60 lbs. per square inch in the factory and no attempt should be made to adjust it in service.

Effective with Engine No. 1400273 the ball type relief valve previously used in the oil pump was replaced by a solid plunger type valve and the adjusting screw was replaced by a non-adjustable spring seat (see Fig. 32).

A further change was made from Engine No. 1420249 when the solid plunger was replaced by a hollow type and a new spring was introduced. Only the hollow type plunger and the current type spring are supplied through service. The current type spring has a free length of 1½ in. (38 mm.) as against the previous spring which had a free length of 1.31 in. (33.34 mm.).

If it is suspected that the relief valve is not functioning correctly the oil pressure warning switch may be removed from its tapped location on the left-hand side of the cylinder block and a master oil pressure gauge located in its place. With the engine running at its normal operating speed and temperature, the pressure obtained should be 40 lbs. per square inch.

If the oil pressure is low and all other causes of low oil pressure have been checked (see Fault Diagnosis Section), the oil pump should be removed as described on page 31 and the relief valve ball examined to see that it is seating correctly. If the relief valve ball and seat appear to be satisfactory, the pump should be stripped and inspected as described on page 32.

SPECIFICATION AND REPAIR DATA—LUBRICATION SYSTEM

Temperature Range	*H.D. Oil S.A.E. No.*
Above 90°F. (32.2°C.)	30
20°F. to 90°F. (—6.6°C. to 32.2°C.)	20
Below 20°F. (—6.6°C.)	10
Sump capacity	12 Imp. pints (6.82 litres) plus ¾ pint (0.43 litre) for a dry oil filter

Oil Filter	
Type	Full flow, pressure relief, replaceable element
By-pass valve setting	13 to 17 lbs./sq. in. (913.9 to 1195.1 gm./sq. cm.)
Tightening torque for centre bolt	10 lbs. ft. (1.382 kg.m.)

Oil Pump

Pump shaft diameter	0.498 to 0.4985 in. (12.649 to 12.662 mm.)
Diameter of shaft bore in pump housing	0.500 to 0.501 in. (12.700 to 12.725 mm.)
Shaft clearance	0.0015 to 0.003 in. (0.038 to 0.076 mm.)
Idler gear shaft diameter	0.65475 to 0.65535 in. (16.631 to 16.646 mm.)
Idler gear bush internal diameter	0.6562 to 0.6572 in. (16.667 to 16.693 mm.)
Shaft clearance	0.00085 to 0.00245 in. (0.022 to 0.062 mm.)
Fit of idler gear shaft in pump body	0.00025 to 0.00185 in. (0.0064 to 0.047 mm.) interference
Clearance between drive rotor and driven rotor	0.006 in. Max. (0.152 mm.)
Clearance between drive rotor and body	0.010 in. Max. (0.254 mm.)
End-float of rotors	0.003 in. Max. (0.076 mm.)

Oil Pressure

At normal working speed	40 lb./sq. in. (2812 gm./sq. cm.)

FAULT DIAGNOSIS

1. Low Oil Pressure (checked by fitting a master oil pressure gauge in place of the oil pressure switch).

Possible Cause	*Possible Remedy*
(*a*) Engine oil level low.	(*a*) Add oil to bring it up to correct level.
(*b*) Wrong grade of oil.	(*b*) Drain and refill with oil of the approved grade.
(*c*) Blocked sump filter screen.	(*c*) Remove and clean the screen.
(*d*) Oil pressure relief valve not seating correctly.	(*d*) Clean the relief valve ball and seat.
(*e*) Excessive main or big end bearing clearances.	(*e*) Renew the worn parts.
(*f*) Faulty oil pump.	(*f*) Overhaul the oil pump.
(*g*) Oil pump suction or delivery pipe union nuts loose.	(*g*) Tighten the union nuts.

2. Low Oil Pressure (oil pressure warning light " ON," engine running).

Possible Cause	*Possible Remedy*
(*a*) Low oil pressure.	(*a*) See Section 1 above.
(*b*) Faulty oil pressure warning switch.	(*b*) Renew switch.
(*c*) Oil pressure warning light circuit faulty.	(*c*) Check circuit.

3. Oil Pressure Warning Light fails to Operate with Main Control Switch in the "ON" Position.

Possible Cause	*Possible Remedy*
(*a*) Faulty oil pressure warning switch.	(*a*) Renew switch.
(*b*) Oil pressure warning light circuit faulty.	(*b*) Check circuit.
(*c*) Broken filament in oil pressure warning light bulb.	(*c*) Renew the bulb.

4. Excessive Oil Consumption

Possible Cause	*Possible Remedy*
(*a*) Engine oil level too high.	(*a*) Keep oil at the correct level.
(*b*) External oil leaks from engine.	(*b*) Renew gaskets and/or seals.
(*c*) Worn valves and guides.	(*c*) Renew.
(*d*) Excessive piston and cylinder wear.	(*d*) Rebore the cylinder liners and/or renew the pistons and rings.
(*e*) Incorrect grade of oil.	(*e*) Drain, and refill with oil of the approved grade.

COOLING SYSTEM

DESCRIPTION

The water in the cooling system is circulated by thermo-syphon action assisted by a centrifugal type impeller pump.

A by-pass thermostat is fitted in the water outlet connection on the cylinder head, to assist in bringing the engine up to normal working temperature as quickly as possible. The most satisfactory operating temperature is when the needle of the temperature gauge is within the green sector.

A tap is provided in the base of the radiator and also in the left-hand side of the cylinder block, just below the fuel filter, to allow the system to be drained.

A radiator pressure cap is fitted as standard equipment on export tractors but on domestic tractors it is offered as an option to a normal type radiator cap. According to operating conditions a two- or four-bladed fan is used. The fan is mounted on the water pump shaft and is belt driven from the crankshaft pulley.

To Drain the Cooling System

1. With the tractor standing on level ground, open the drain taps in the radiator and the left-hand side of the cylinder block and remove the radiator cap. It is advisable to drain the water into a clean container, and retain it for further use as this will reduce the possibility of scale forming in the engine and radiator, due to impurities that are present in normal tap water.

WARNING—Do not remove the radiator cap when the cooling water is near boiling point.

2. When the water has finished running, probe the tap holes to make sure that no scale etc., has prevented the entire contents of the cooling system from draining away.

NOTE.—It is advisable to leave an indication on the tractor that the cooling water has been drained.

Under no circumstances should the tractor be started without water in the cooling system. Take the water to the tractor, not the tractor to the water.

To Fill the Cooling System

1. Close the radiator and cylinder block drain taps.

2. Pour the water that has been retained, back into the cooling system, filling slowly to avoid air locks. If the liquid present is not sufficient to fill the cooling system, and an anti-freeze is in use, add additional anti-freeze as required.

3. Replace the radiator cap securely, and check the system for water leakage.

ANTI-FREEZE MIXTURE

An anti-freeze solution should be used during the winter months to prevent damage to the engine through the water in the cooling system freezing.

Salt solutions such as calcium, sodium and magnesium chloride or organic solutions such as honey, sugar and glucose solutions are extremely harmful and should never be used. Glycerine, ethylene glycol and alcohol are solutions which are satisfactory for anti-freeze purposes, but these inorganic compounds do not contain an anti-rust inhibitor. A ' Ford ' anti-freeze solution is available which contains a suitable inhibitor which will reduce rust formation and corrosion in the cooling system to a minimum.

The percentage of anti-freeze solution in the cooling water will determine the degree of protection and it is advisable to allow a margin of safety in cases where lower temperatures may be met.

The cooling system should be flushed out thoroughly before adding anti-freeze solution, and it is advisable to mix the solution with water in a separate container before adding it to the cooling system.

The quantities of ' Ford ' anti-freeze part No. ME-1163-B for various degrees are given in the table in the Specification Section.

The approximate percentage of anti-freeze solution in the cooling system can be checked by measuring the specific gravity of the liquid and a suitable hydrometer is required having a range of 1.000 to 1.050, calibrated at 60°F. (15.5°C.).

When checking the specific gravity the temperature of the cooling water should be 58°F. to 62°F. (14.4°C. to 16.6°C.). Compare the hydrometer readings with the figures given in the Specification Section.

WATER PUMP

The water pump is mounted on the front face of the timing case cover, and is driven by a fan belt from the crankshaft pulley. Fig. 36 shows an exploded view of the water pump.

The water pump bearing is pre-packed with grease and does not require subsequent lubrication. The pump seal assembly consists of a carbon-faced rubber seal with a coil spring to maintain the carbon face in contact with the impeller. The pump shaft and bearing assembly are serviced as one unit and should not be dismantled.

To Remove the Water Pump

1. Remove the radiator assembly as described on page 39.

2. Remove the fan blades.

3. Slacken the generator adjusting locking screw and the two generator mounting bolts and move the generator in towards the engine. Detach the fan belt.

4. Loosen the clamps securing the remaining water hoses to the water pump.

5. Unscrew the four nuts retaining the water pump to the timing case cover, and remove the pump and gasket from the studs.

Overhauling the Water Pump

Throughout the following operations the water pump overhaul kit tool No. T.7000–17 is used in conjunction with the main tool No. T.7000, the appropriate adaptors for the operations being indicated by means of their respective tool numbers.

1. Remove the pump pulley from the shaft using the split adaptors (T.7000–17a) as shown on Fig. 37. Screw adaptor (T.7000–17b) onto the centre screw of the main tool, so that it pushes against the centre of the pump shaft.

2. Press the impeller, seal, slinger and the shaft and bearing assembly out of the pump housing, using the split adaptors and the adaptor (T.7000–17g). The adaptor (T.7000–17g) is hollow so that it fits over the shaft and bears against the outer diameter of the shaft bearing.

3. Press the impeller off the end of the shaft, using the solid ring adaptor (T.7000–17d) in the split adaptors as shown on Fig. 38.

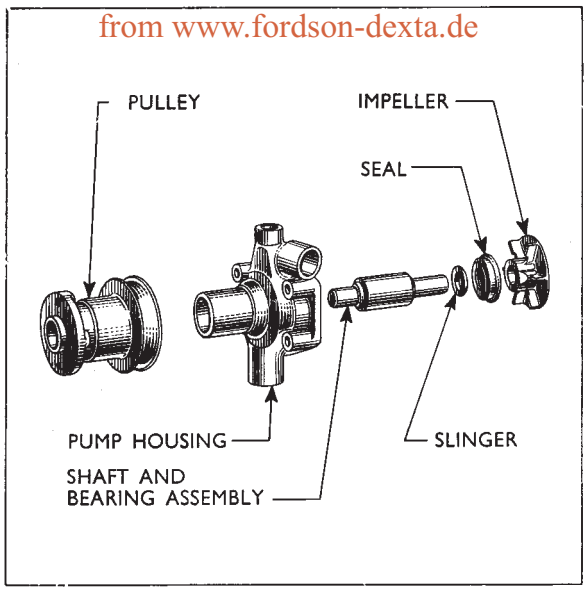


Fig. 36
Exploded View of Water Pump

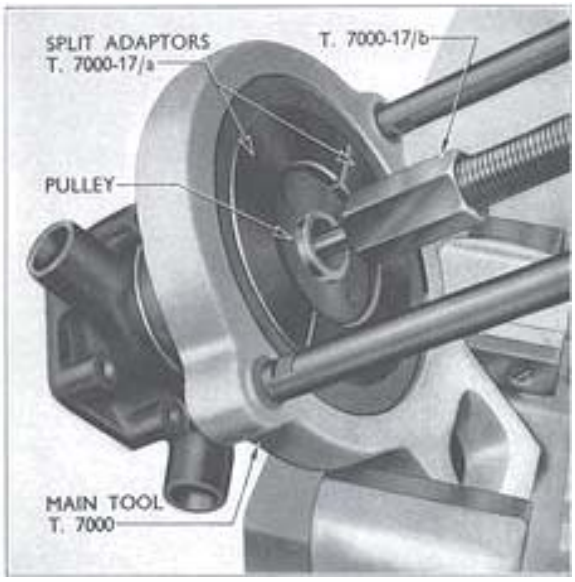


Fig. 37
Removing the Pulley

4. Remove the pump seal from the shaft and carefully split the slinger bush with a chisel to detach it from the shaft.

To Reassemble the Water Pump

1. Press the shaft and bearing assembly into the housing (long end of the shaft towards the impeller end of the pump) until the bearing is flush with the housing, using split adaptors (T.7000–17a) and the hollow adaptor (T.7000–17g) as shown on Fig. 39.

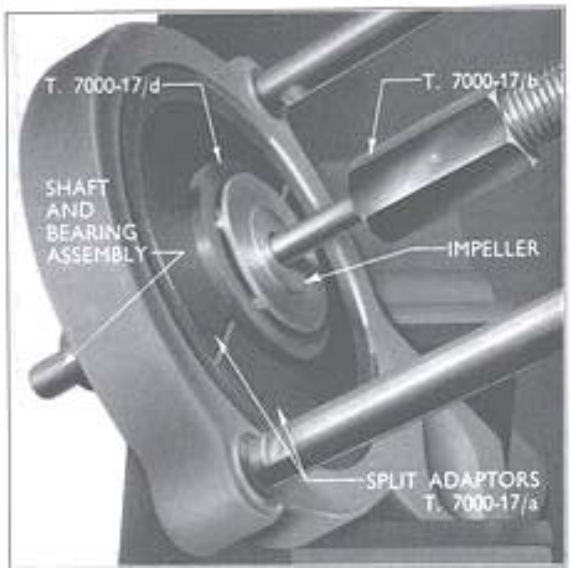


Fig. 38
Removing the Impeller

Fig. 39
Replacing the Shaft and Bearing Assembly

2. Press the pulley onto the front end of the shaft until it is flush with the end of the water pump shaft, using the split adaptors as shown in Fig. 40.

3. Replace the slinger bush (flanged end first) on the end of the shaft, using the hollow driver (T.7000–17f), and refit the pump seal on the slinger bush with the thrust face towards the impeller.

4. Press the impeller onto the shaft using the solid adaptor (T.7000–17e) fitted in the ring and split adaptors, until a clearance of 0.005 in. to 0.020 in. (0.13 mm. to 0.51 mm.) is obtained between the impeller blades and the housing face as shown on Fig. 41.

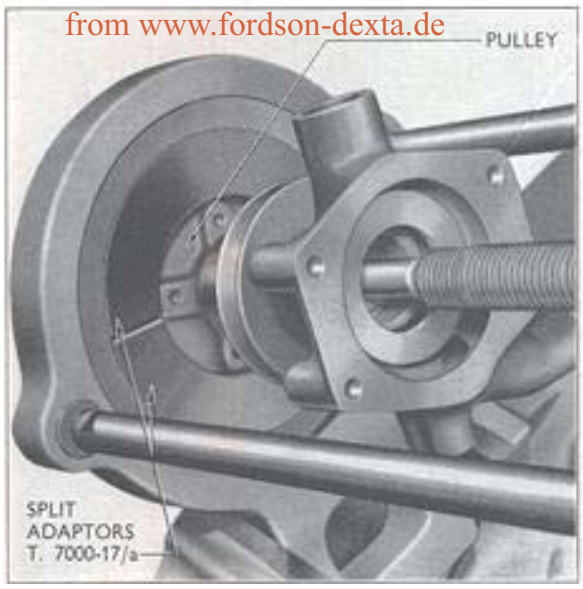


Fig. 40
Replacing the Pulley

To Replace the Water Pump

1. Clean the front face of the timing case cover, and locate a new gasket over the four studs.

2. Refit the water pump, locating the two water hoses as the pump is entered along the studs. Retain the pump with four nuts and spring washers, tightening the nuts evenly and securely.

It is most important that a watertight joint is made between the pump and the timing case cover.

3. Securely tighten the hose clamps on the water hoses.

4. Replace the fan belt and tighten the generator adjusting bolts so that there is 1 in. (25.4 mm.) free movement of the belt midway between the generator and crankshaft pulleys.

5. Replace the fan blades and tighten the set-screws evenly.

6. Replace the radiator assembly as described on page 40.

7. Refill the cooling system, run the engine and check all connections and joints for water leaks.

FAN BELT

A single V-type belt is used to drive the generator and water pump from the crankshaft pulley, the fan being mounted on the end of the water pump shaft.

Correct fan belt adjustment is important, otherwise the belt itself may be damaged or undue strain placed upon the generator or water pump bearings.

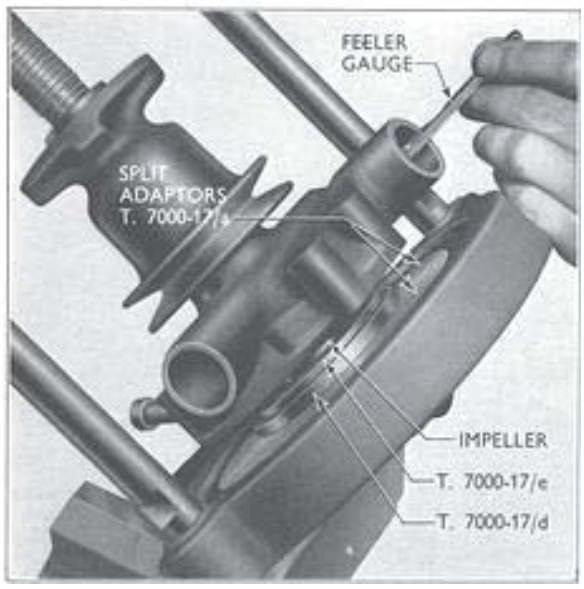


Fig. 41
Replacing the Impeller

There is provision for fan belt adjustment by moving the generator on its mountings and it is important that this adjustment be released when a new fan belt is being fitted, otherwise any attempt to strain the new belt over the sides of the pulley, using a lever, can easily cause damage to the rubber plies.

To Adjust the Fan Belt Tension

The correct tension of the fan belt is such that when the belt is alternately pushed and pulled at a point midway between the generator and crankshaft pulleys, a total movement of 1 in. (25.4 mm.) is obtained.

1. Slacken the generator adjustment locking screw and the two generator mounting bolts.

2. Move the generator towards or away from the engine as necessary until the correct belt tension is obtained, testing the tension midway between the generator and crankshaft pulleys.

3. Lock the adjustment locking screw and tighten the two generator mounting bolts.

To Renew the Fan Belt

The fan belt should be renewed when it becomes frayed, or stretched to an extent that no further adjustment is possible.

1. Slacken the generator adjustment locking screw and two mounting bolts and move the generator towards the engine.

2. Slip the belt over the edge of the generator pulley taking care not to damage the pulley. If necessary, slide the belt over the leading edge of the pulley in the same direction as it rotates and then turn the engine over to bring the belt off the pulley. The belt may then be detached from the crankshaft and the water pump pulleys.

3. Pass the new fan belt around the water pump and crankshaft pulley and engage it in the generator pulley. Readjust the fan belt tension as described above and tighten the generator adjustment locking screw and mounting bolts.

THERMOSTAT

A shrouded by-pass type thermostat is located in the cylinder head water outlet connection.

To Remove

1. Drain the cooling system as described previously.

2. Unscrew the two bolts securing the water outlet adaptor to the cylinder head water outlet connection.

3. Move the outlet adaptor to one side, lift off the gasket and remove the thermostat from the recess in the water outlet connection.

Testing the Thermostat

If it is suspected that the thermostat is not operating correctly it may be tested in the following manner :—

Immerse the thermostat in a suitable container and gradually heat the water, check the temperature at frequent intervals with an accurate thermometer. The valve should commence to open at 156°F. to 165°F. (68.8°C. to 73.9°C.) and be fully open at 185°F. (85°C.). If the thermostat does not function properly do not attempt any adjustment but replace with a new unit.

To Replace

Effective with Engine No. 1433392 (approximately) a new cylinder head water outlet adaptor was introduced. The distance between the fixing bolt holes on this adaptor is $3\frac{1}{8}$ in. (7.9 cm.) as against $2\frac{7}{8}$ in. (7.3 cm.) on the previous adaptor.

Similarly, a new gasket and cylinder head water outlet connection with hole centres to suit the adaptor were also introduced.

1. Locate the thermostat in the recess in the water outlet connection, fit a new gasket and replace the outlet adaptor, securing with two bolts and spring washers.

2. Refill the cooling system and check for leaks.

RADIATOR

To Remove

1. Drain the cooling system.

2. Remove the primary air cleaner and the vertical exhaust silencer (where fitted).

3. Remove the engine bonnet after removing the two screws and nuts fitted front and rear, that secure the bonnet to the radiator shell and the fuel tank.

4. Disconnect the headlamp wiring from the main wiring loom.

5. Remove the two bolts, fitted on either side of the inside of the radiator shell, that secure the shell to the front end of the radiator support brackets.

6. Unscrew the two bolts on each side of the outside of the radiator shell that retain the shell in position on the front axle support bracket, and remove the radiator shell.

7. Disconnect the upper and lower radiator hoses at the radiator end by unscrewing the hose clamps.

8. Remove the plastic pipe from the overflow pipe on the radiator.

9. Unscrew the two self-locking nuts securing the radiator to the front axle support bracket, and remove the flat washers and rubber pads fitted under the nuts.

10. Lift the radiator from its location on the front axle support bracket taking care not to lose the pads fitted between the radiator and the support bracket.

11. Remove the four screws and nuts retaining the fan shroud to the radiator. Remove the shroud and the two support brackets.

To Replace

1. Fit the fan shroud and the two support brackets to the radiator (the two brackets are retained by the two top screws) and secure in position with four screws and nuts.

2. Place the radiator in position on the front axle support bracket, with the two large rubber pads between the radiator and bracket. Replace the small rubber pads, flat washers and self-locking nuts in that order on the bolt, and tighten the nuts up until the rubber pads are just compressed.

3. Replace the upper and lower hoses to the radiator, and tighten the hose clamps securely.

4. Replace the plastic pipe onto the overflow pipe on the radiator.

5. Refit the radiator shell and secure in position with four bolts, flat washers and spring washers.

6. Reconnect the headlamp wiring to the main wiring loom.

7. Refit the engine bonnet and secure with two nuts and screws, front and rear.

8. Close the drain taps on the radiator and cylinder block and fill the cooling system.

9. Replace the primary air cleaner, and the vertical exhaust silencer (where fitted), run the engine and check for water leaks.

SPECIFICATION AND REPAIR DATA—COOLING SYSTEM

Capacity	15 Imp. pints (8.52 litres)
Fan up to 90°F. (32.2°C.)	2 blade, 15 in. (381 mm.) diameter
Fan above 90°F. (32.2°C.)	4 blade, 15 in. (381 mm.) diameter

Water Pump

Pump shaft bearing fit in pump body	0.0001 to 0.0011 in. (0.0025 to 0.0279 mm.) interference
Clearance between impeller blades and body	0.005 to 0.020 in. (0.127 to 0.508 mm.)
Pump shaft fit in impeller bore	0.00045 to 0.0017 in. (0.0114 to 0.0432 mm.) interference
Pump pulley fit on pump shaft	0.0015 to 0.0028 in. (0.0381 to 0.0711 mm.) interference

Thermostat

Opening temperature	156°F. (68.8°C.) to 165°F. (73.9°C.)
Fully open temperature	185°F. (85°C.)

Anti-Freeze

Capacity of Cooling System	*Volume of ME-1163-B in Water*	*Anti-Freeze Protection*	*Specific Gravity*	*ME-1163-B*		*Water*	
				Pints	*Litres*	*Pints*	*Litres*
15 Imp. pints (8.52 Litres)	10%	Down to 17°F. (—8.3°C.)	1.017	1.5	0.85	13.5	7.67
	15%	Down to 7°F. (—13.9°C.)	1.024	2.25	1.28	12.75	7.25
	20%	Down to —3°F. (—19.4°C.)	1.032	3.00	1.70	12.0	6.82
	25%	Down to —20°F. (—28.9°C.)	1.040	3.75	2.13	11.25	6.39

FAULT DIAGNOSIS

Engine Overheats

Possible Cause	*Possible Remedy*
(*a*) Water level low due to leaks.	(*a*) Rectify the leaks by fitting new gaskets, tightening hose clamps, etc.
(*b*) Fan belt slipping.	(*b*) Replace belt or adjust tension.
(*c*) Radiator pressure cap faulty.	(*c*) Fit a new pressure cap.
(*d*) Water leak from the hole in the underside of the water pump body.	(*d*) Overhaul the water pump.
(*e*) Temperature gauge defective.	(*e*) Check and replace if necessary.
(*f*) Fuel injection pump timing incorrect.	(*f*) Check and adjust if necessary.
(*g*) Cooling system impeded by deposits.	(*g*) Flush the system with a suitable solvent and refill with soft water.
(*h*) Radiator fins and screens clogged with dirt or chaff.	(*h*) Remove radiator chaff screens and clean radiator fins and screens with air or water under pressure.
(*j*) Thermostat stuck in closed position.	(*j*) Install a new thermostat.
(*k*) Insufficient lubricating oil.	(*k*) Fill up with the approved grade of oil to the correct level.
(*m*) Faulty injector(s).	(*m*) Change or recondition the injectors.