

SECTION E

ENGINE

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All running clearances, fitting tolerances and dimensions are given in 'Technical Data'.

E.1. - GENERAL DESCRIPTION

The engine is a four cylinder, four stroke, twin overhead camshaft unit having a cast aluminium cylinder head which has fully machined hemispherical combustion chambers and separate ports for each valve. The valves, of which the inlets are longer than the exhaust, have replaceable guides and seat inserts and are at an angle of 27° to the vertical. They are operated by the camshafts acting directly on piston type cam followers (tappets). A spring tensioned single row chain drives the camshafts at half engine speed. The camshaft end float and location depends on a shoulder at the front of each shaft bearing in the head. The timing chain also drives the jackshaft which is situated in the right-hand wall of the cast-iron cylinder block and which drives the oil pump, distributor and fuel pump. The jackshaft is located by a thrust plate bolted to the cylinder block front face and runs in three steel-backed white metal bearings, while the camshafts each run in five bearings of this type. The oil pump, distributor and fuel pump are mounted on the right-hand side of the engine, the oil pump and distributor being driven by a single skew gear on the jackshaft and the fuel pump by a cam also on the same shaft.

The crankshaft, of cast iron construction and dynamically balanced, runs in five steel-backed lead bronze lined bearings, end float being controlled by split thrust washers located in the cylinder block on either side of the centre main bearing.

The connecting rods of 'H' section forgings have steel-backed bronze little end bushes and steel-backed copper lead big end liners, the big end bearing caps being located by two dowels and retained by two bolts. Solid skirt aluminium alloy pistons with two compression and one oil control ring situated above the gudgeon pin are used. The gudgeon pins are retained in position by circlips installed in grooves at each end of the gudgeon pin bore.

A cast-iron flywheel incorporating a steel ring gear drive for the starter, is located on the crankshaft flange and retained by six bolts fitted without lockwashers.

E.2. - LUBRICATION

General

The lubrication system is of the forced feed type, the oil being circulated by a mechanically driven oil pump bolted to the right-hand side of the cylinder block. The pump is driven by a skew gear on the jackshaft, and is of the eccentric bi-rotor type which

incorporates a non-adjustable plunger type relief valve.

Oil is drawn from the sump up an inlet pipe attached to the cylinder block and into the pump. When the relief valve opens, oil is passed back into the sump, returning via the base of the sump to prevent aeration. From the pump the pressurised oil flows through the integral full flow filter to a short oil gallery on the right-hand side of the engine. At the forward end of the gallery is a tapped take-off for the oil pressure transmitter. A cross drilling at the rear of this gallery takes the oil to the other side of the engine where the main oil gallery is situated from which all the main bearings are fed. A notch cut in the centre main bearing liner feeds oil to the crankshaft rear thrust washer. Oil is fed to the big end bearings through drillings in the camshaft front, centre and rear journals. Lubrication of the little end bushes, the gudgeon pins and the non-thrust sides of the cylinders is by oil mist and an oil jet forced through a small drilling in each connecting rod web, every revolution of the crankshaft.

The jackshaft bearings are fed from the front, centre and rear main bearings via drillings in the block and a metered jet of oil from a front drilling lubricates the chain and sprockets. Oil fed to the overhead camshafts is controlled by flats machined on the jackshaft front journal, and each camshaft bearing is then fed by a central drilling, blocked at the rear end by a tapered Allen screw. Surplus oil from these bearings then drains back into the sump by way of passages in the head.

Oil Level

The correct level is to the 'FULL' mark on the dipstick, which is located to the left-hand side of the timing cover. When checking the oil level the car must be standing on a level surface and the dipstick withdrawn, wiped, replaced and finally withdrawn and read, the depth of the oil on the end of the dipstick indicating the level of the oil in the sump. If oil needs to be added, remove the oil filler cap on the camshafts cover and pour in clean engine oil of the correct grade (see Section 'O') until the dipstick indicates that the sump is full. Do NOT overfill. Replace the oil filler cap securely (double notch) otherwise an oil loss could occur, with the resultant failure of the entire engine lubrication system. From new the oil should be changed after 500 miles (800 km.) and then after every 3,000 miles (5,000 km.). If the oil appears to be excessively dirty before this distance, it should be changed and a new filter element fitted.

The sump capacity is given in 'Technical Data'. Where possible it is better to drain the oil when the engine is warm (after having just completed a run) and has a lower viscosity to carry away any sediment.

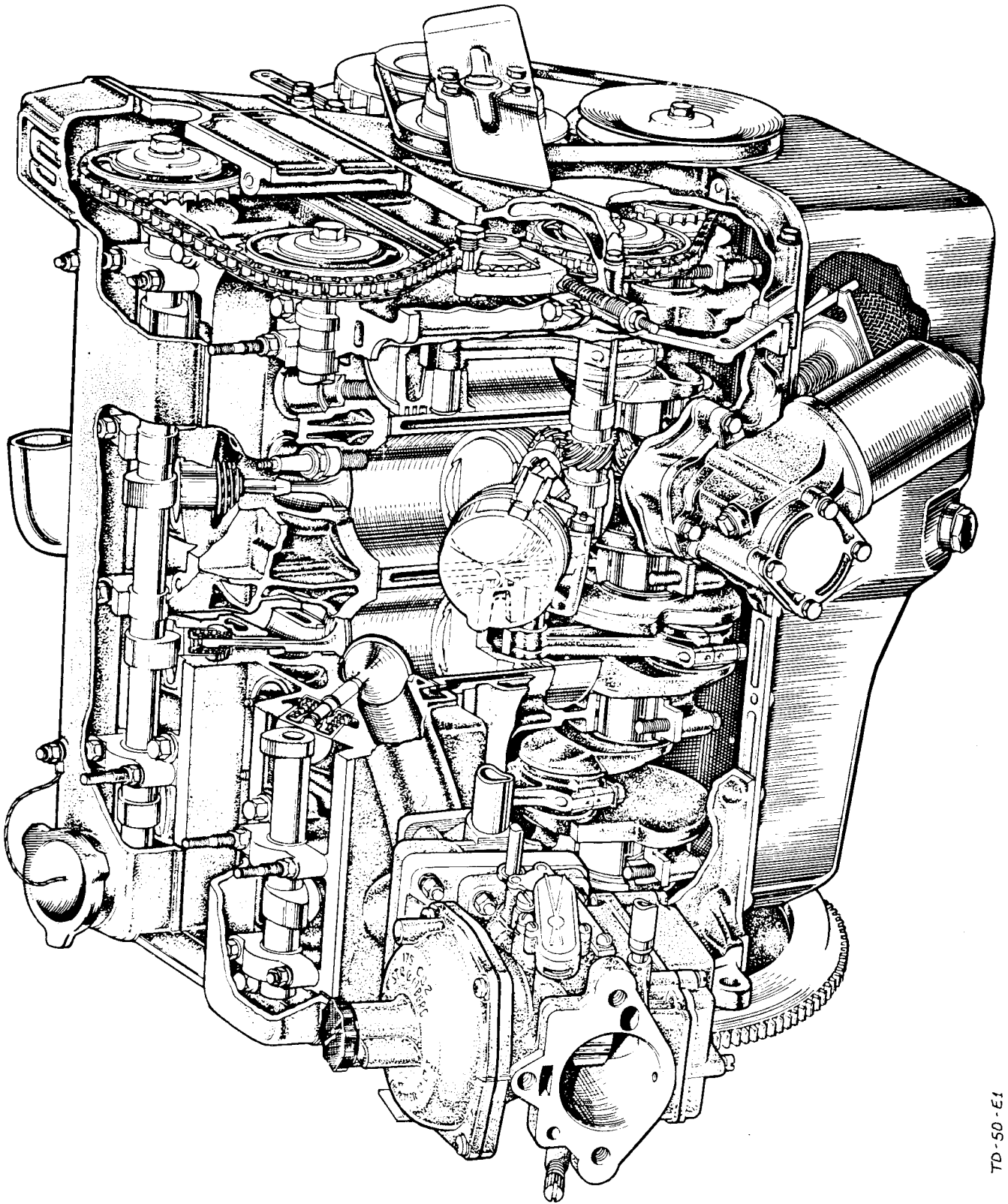


Fig. 1. ENGINE CUTAWAY

TD-50-E1

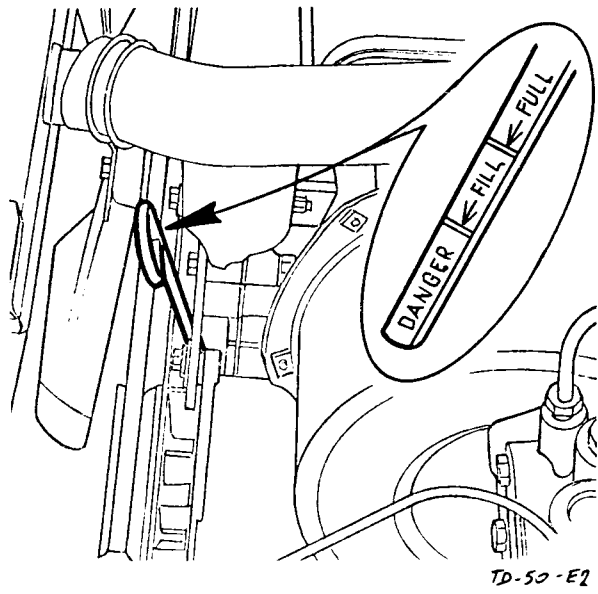


Fig. 2. DIPSTICK

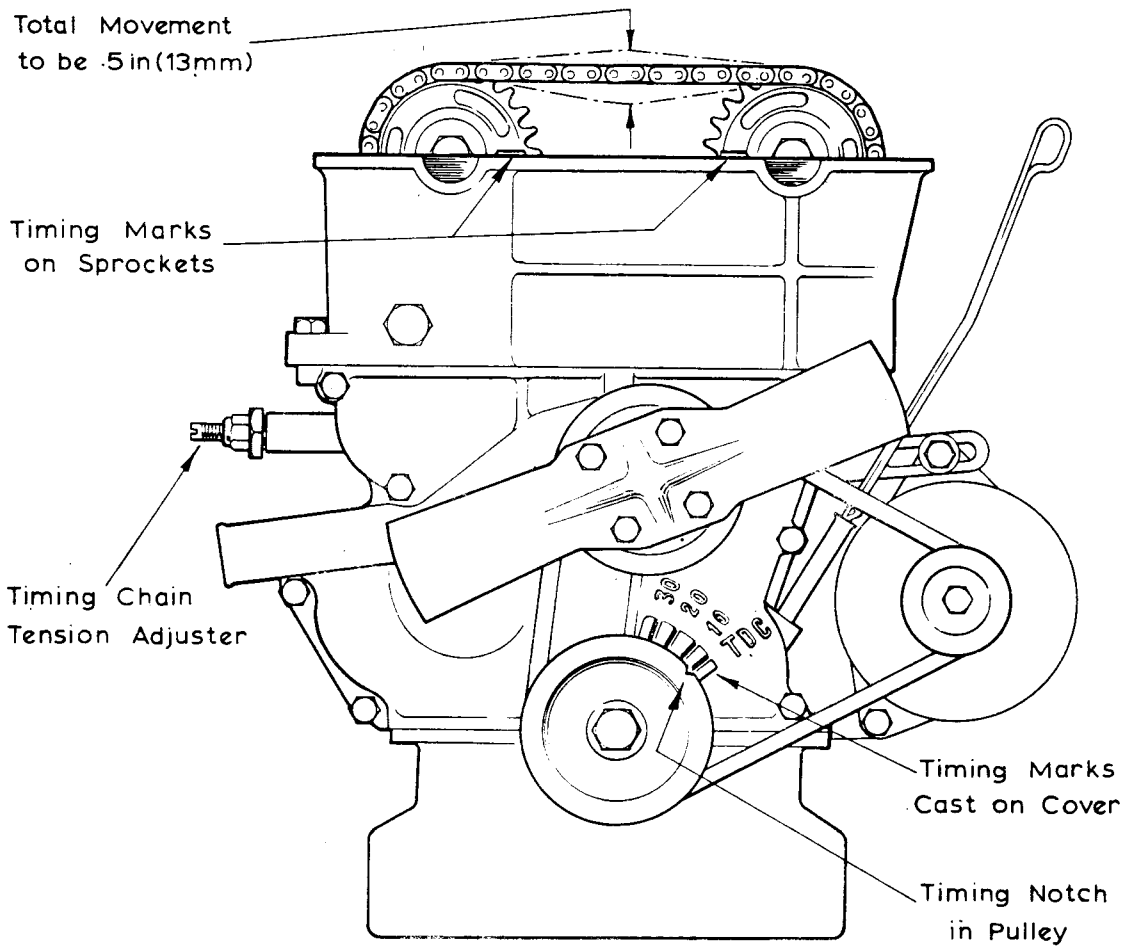


Fig. 3. TIMING MARKS & CHAIN TENSION

TD-50-3E

Oil Filter

A full flow filter is bolted to the pump body to make an integral unit. The oil flows through the filter and passes to the galleries. To remove the filter unscrew the central retaining bolt and withdraw the filter body and element. The element should be replaced at intervals of every 6,000 miles (10,000 km.) or more frequently if there are signs of excessive fouling. Extract the sealing ring and fit the replacement ring supplied with the new element by forcing on at four diametrically opposed points simultaneously. Clean out the filter body and refit the new filter assembly to the pump body.

Oil Sump

The sump is pressed steel construction bolted to the block with 18 bolts, the rear-most pair of which are longer than the others. Spring and thick flat washers are used, the flat washers being of great importance as they distribute the load and prevent distortion.

E.3. - ENGINE TUNE

1. Pull off the sparking plug leads and remove the plugs. Clean the plugs and reset the gaps to the dimensions given in 'Technical Data', or if the electrodes are badly burned, fit new plugs, and reconnect the plug leads.
2. Remove the distributor cap and examine the contact-breaker points. Replace the points if badly burned or excessive metal transfer is evident. Adjust the points gap to the dimension given in 'Technical Data' and refit the distributor cap.
3. Remove the fuel pump sediment bowl and filter screen. Wash both in clean petrol, ensure the gasket is in good condition and refit screen and sediment bowl to the fuel pump.
4. Remove the air cleaner element and clean by shaking through. If very clogged with dust or dirt, replace. Clean filter body of all accumulated dirt, reassemble and refit air cleaner assembly to car.
5. Disconnect the fuel feed pipes at the carburetters.
6. Weber Carburetters - Remove float chamber cover. Withdraw the float arm pivot and remove float and gasket. Unscrew all the jets and blow them clear with an air gun. Do NOT use wire as this will enlarge the jet orifice. Remove the needle valve and the needle valve body, and blow it clean with an air line. Clean the float, float chamber and filter gauze using clean petrol. Replace all the jets, needle valve body and needle valve. Place the gasket on the

carburettor body and fit float assembly. Check float setting (see Section 'L').

Refit float chamber cover.

7. Zenith Stromberg Carburetters - Disconnect air trunking from air box and remove air box. Remove carburetters from engine (see Section 'L') to a clean work bench. Release centre plug from the base of each carburettor. Remove float chambers by releasing the retaining screws, and withdrawing in a vertical motion to avoid damage to the float mechanism. Remove float chamber gasket. Take out floats. Remove needle valve from float chamber cover. Remove 'O' ring from centre plug. Thoroughly clean all removed parts in clean petrol. Refit needle valve into float chamber cover using a new washer. Replace float assembly and check (see Section 'L'). Refit float chambers with new gasket. Fit new 'O' ring to centre plug and replace securely. Refit carburetters to engine using new gaskets. Top up damper reservoirs with oil (see Section 'O').
8. Reconnect the fuel feed pipes at the carburetters.
9. Adjust the valve clearances (see Section 'E').
10. Connect the leads of a timing light in accordance with the manufacturers instructions. Check that the mark on the crankshaft pulley is visible; if not, mark with paint.
11. Start the engine and point the timing light at the crankshaft pulley, adjacent to the timing scale. Progressively increase the engine speed to 2,500 r.p.m. observing the timing mark, with the aid of the timing light to check that the distributor advances the ignition timing.
12. At 2,500 rev./min. adjust the ignition timing if necessary (see 'Technical Data') by slackening the distributor clamp and turning the distributor body as required. After making an adjustment tighten the clamp only sufficiently to hold the distributor in position - DO NOT OVERTIGHTEN. Remove the timing light.
13. Adjust the slow-running speed of the engine (see Section 'L').

E.4. - COMPRESSION CHECK

1. Warm-up the engine to its normal operating temperature then remove all sparking plugs. Set throttles to fully open position.
2. Place the gauge in a convenient position and insert the conical-ended rubber tube into No.1 sparking plug orifice. The normal compression pressure with an engine that has been run in correctly is given in 'Technical Data'. At altitudes above sea-level, proportionally lower pressures will be obtained. Compression is checked

with starter turning engine at 200 r.p.m. Battery and starter should be in good condition.

3. Test the remaining cylinders in a similar manner, replace sparking plugs and connect the plug leads.

E.5. - CAMSHAFT COVER

To Remove

1. Remove the eight nuts and washers retaining the camshafts cover.
2. Remove the cover together with its gasket.

To Replace

When refitting the camshafts cover, it is advisable to use a new gasket.

E.6. - TIMING CHAIN TENSION

1. Remove the camshafts cover (Section 'E.5.').
2. The timing chain tensioner is located at the right-hand side of the engine immediately below the cylinder head flange. Release the locknut and screw in (or out) the tensioner until a minimum noise level is achieved, approximately $\frac{1}{2}$ in. (12.5 mm.) total movement of the chain between the two camshaft sprockets.

E.7. - VALVE CLEARANCES

To Remove

1. Remove the camshafts cover (Section 'E.5.').
2. Turn the camshaft until the heel of the cam is on the cam follower (tappet) then, using feeler gauges, determine the distance between the cam follower and the cam heel. This clearance is given in 'Technical Data'.
3. Check all valve clearances, noting any which require adjustment.
4. Remove the camshaft (Section 'E.9.').
5. Remove the cam followers with the aid of a valve grinding tool, keeping them in their respective order.
6. Remove each adjustment shim now exposed, where the clearance requires adjustment, and substitute shims (one only to each valve) giving the correct clearance. A thinner shim will be required to increase the valve clearance, and a thicker one to reduce the clearance.

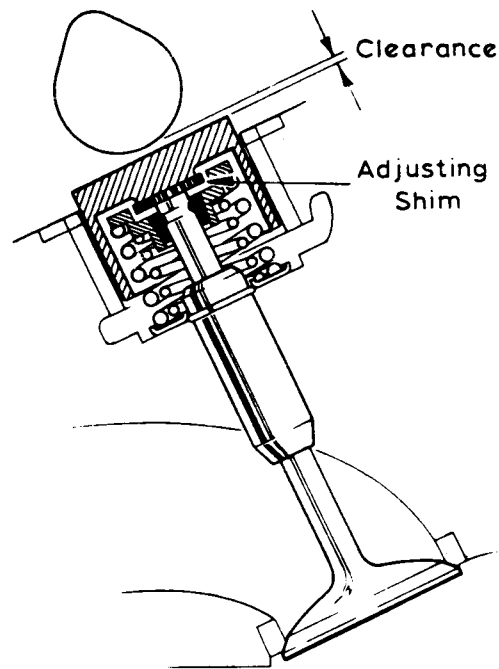


Fig. 4. VALVE ADJUSTMENT TD 50-4E

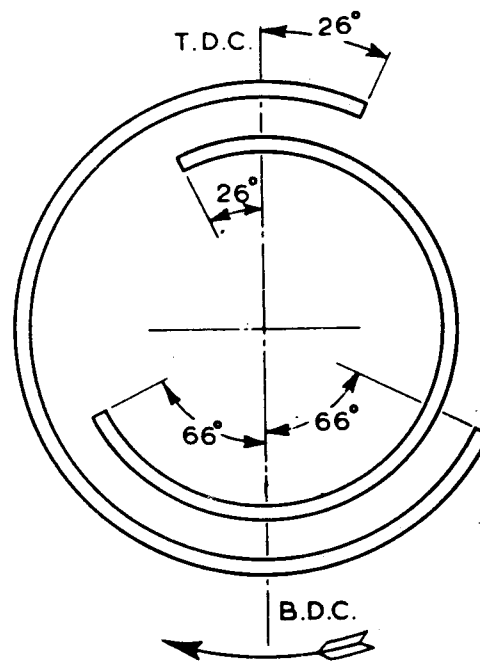


Fig. 5. VALVE TIMING TD 50-5E

TD-50-E6

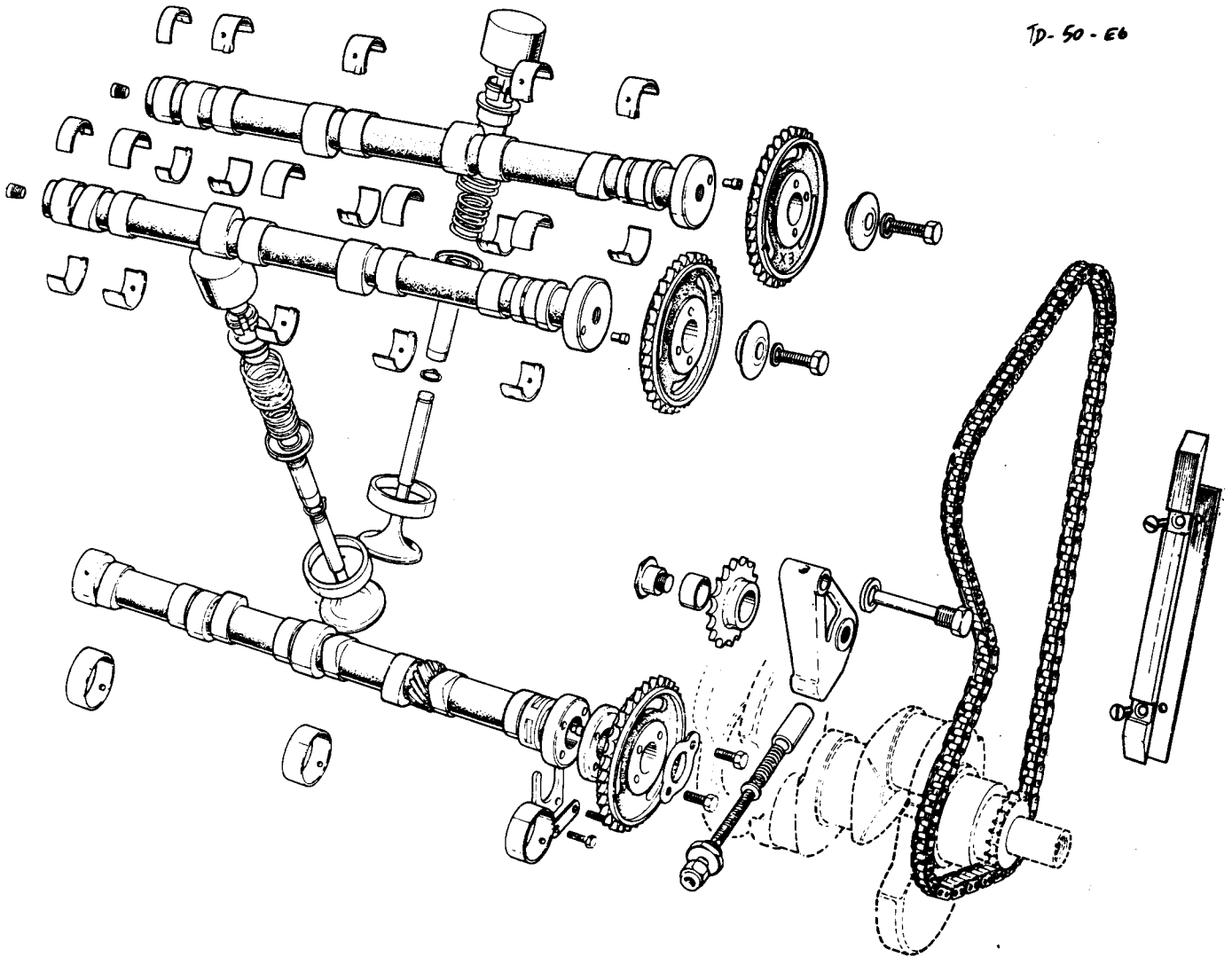


Fig. 6. VALVE GEAR COMPONENTS

Select a shim to give the correct size from the following formula:-

$$\text{Shim thickness required} = \text{A.C.} + \text{E.S.} - \text{C.C.}$$

Where A.C. is actual valve clearance

E.S. is existing shim thickness

C.C. is correct valve clearance

Measure the thickness of the shim accurately with a micrometer, even though the shim's thickness is etched around the periphery or on the underside of the shim.

Any roughness caused by the etching should be removed with fine emery cloth.

To Replace

1. Refit the cam followers in their respective bores.
2. Fit the camshafts and recheck the valve clearances, re-adjusting if necessary.
3. Refit the camshafts cover.

E.8. CAMSHAFTS SPROCKETS AND TIMING CHAIN

To Remove

1. Remove the camshafts cover (Section 'E.5.').
2. Slacken the timing chain tensioner (Section 'E.6.').
3. Set the engine in the timing position by aligning the timing mark on the crankshaft pulley with lower mark (T.D.C.) on the front cover, and the timing marks on the camshafts sprockets adjacent to each other and level with the camshafts cover mounting face.
4. Remove the sprockets by releasing their central retaining bolts, and disconnect the timing chain. To remove the timing chain the front cover (Section 'E.22.')

To Replace

1. Fit the camshafts sprockets and timing chain aligning the timing marks, as set during dismantling. Tighten the retaining bolts to the torque loading given in 'Technical Data'. Ensure correct sprocket replacement.
2. Adjust the timing chain tension (Section 'E.6').
3. Refit the camshafts cover (Section 'E.5').

E.9. - CAMSHAFTS AND BEARINGS

To Remove

1. Remove the camshafts cover (Section 'E.5').
2. Slacken the timing chain tensioner (Section 'E.6').
3. Set the engine in the timing position (Section 'E.8').

4. Remove the camshafts sprockets (Section 'E.8').
5. Remove the bolts securing the camshafts bearing caps, and remove the caps marking them (if not already marked) to ensure replacement in their original position.
Extract the bearing liners.

To Replace

1. Fit new bearing liners, noting that the location tags are correctly positioned in their locations in both cylinder head and bearing caps.
2. Fit the camshafts and their bearing caps, tightening the cap bolts progressively from the centre working outwards, to the torque loading given in 'Technical Data'. Check and adjust the valve clearances (Section 'E.7').
3. Fit the camshafts sprockets and adjust the timing chain tension (Section 'E.8') and finally, fit the camshafts cover (Section 'E.5').

E.10. - CYLINDER HEADTo Remove

1. Drain the cooling system (see Section 'K').
2. Remove the carburetters air box (see Section 'L').
3. Remove the radiator top hose (see Section 'K') and the heater hose (see Section 'P') from their connections at the cylinder head.
4. Disconnect the throttles and choke cables (see Section 'J').
5. Disconnect the water temperature gauge sender unit (see Section 'K').
6. Disconnect the throttles and choke cables (see Section 'L') fuel pipes from carburetters (see Section 'L') and exhaust manifold (see Section 'S').
7. Remove the camshafts cover (Section 'E.5').
8. Remove the camshafts sprockets (Section 'E.8').
9. Pull the leads from the sparking plugs.
10. Release the cylinder head bolts evenly and progressively working diagonally from the centre, and remove the cylinder head together with its gasket. Do NOT lay the cylinder head flat on its face while the camshafts are still fitted as this will CAUSE DAMAGE to the valves.

To Replace

1. Screw into diagonally opposite holes (front left, rear right) in the cylinder block face, two spare cylinder head bolts from which the heads have been removed and screwdriver slots cut. These studs locate the gasket whilst the cylinder head is

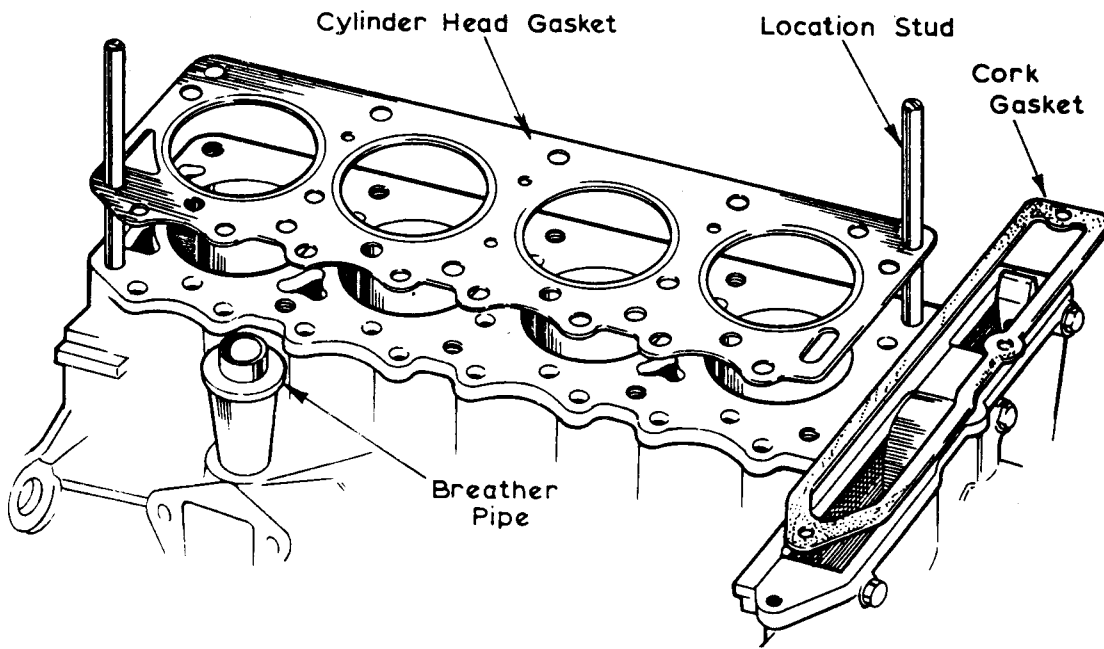


Fig. 7. CYLINDER HEAD LOCATION STUDS & GASKETS

TD-50-E7

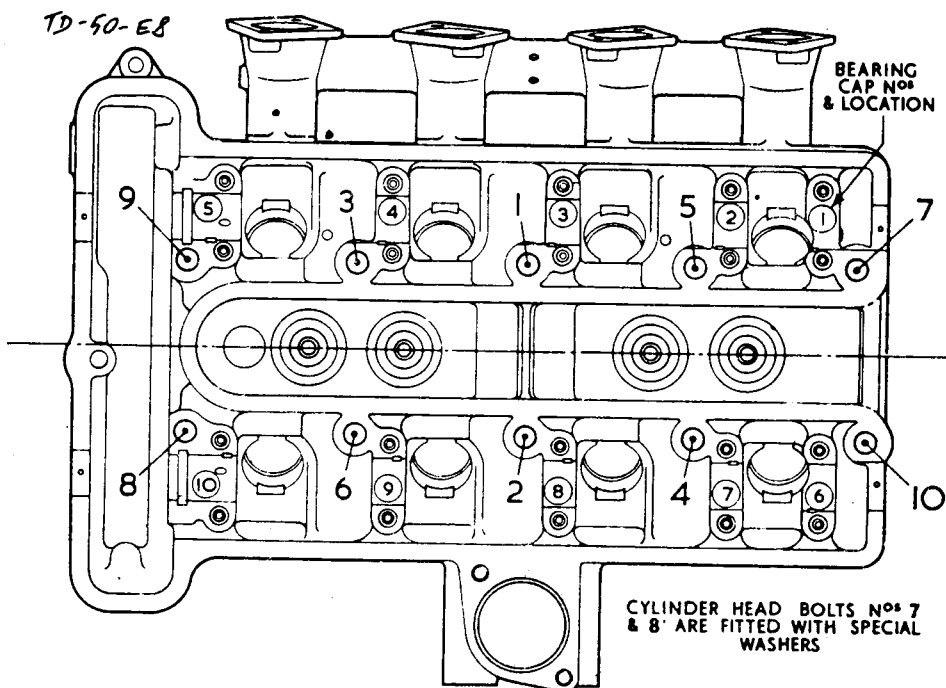


Fig. 8. ORDER OF TIGHTENING HEAD BOLTS

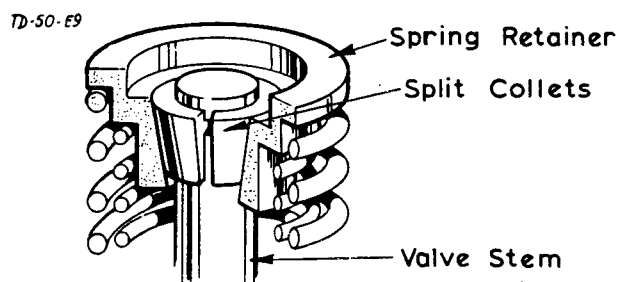


Fig. 9. VALVE SPRING RETAINER

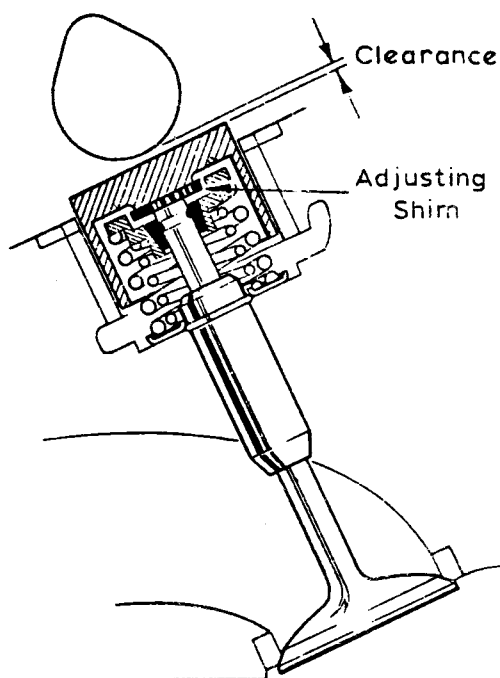


Fig. 10. VALVE ADJUSTMENT TD-50-4E

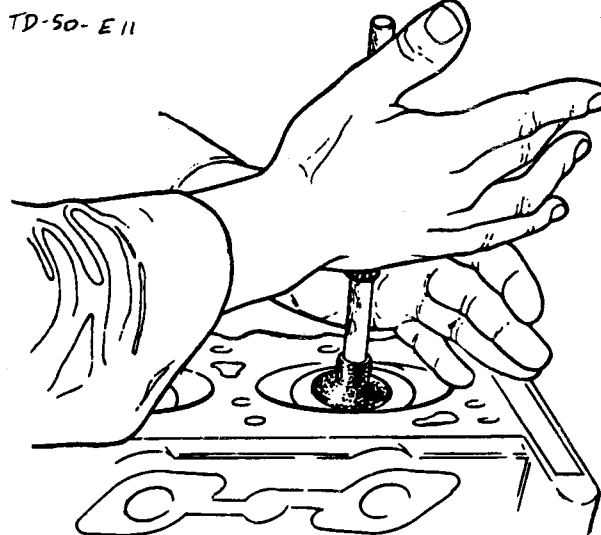


Fig. 11. GRINDING IN VALVES

being fitted. Use a new cylinder head gasket and a new cork gasket on top of the front cover. This cork gasket should have '3M's EC776 applied to its face which is in contact with the front cover, and 'Hylomar' applied to the face which will be in contact with the cylinder head.

2. Fit the cylinder head assembly, ensuring that the breather pipe is engaged in its bore. Loosely replace the cylinder head bolts. Extract the two gasket locating studs and fit the last two bolts. Tighten all bolts to the torque loading given in 'Technical Data' working progressively diagonally outwards from the centre. New cylinder head bolts (Part No. 26 E 027A) have recently been introduced, these having an improved material specification. There is no change to the tightening torque. Old and new bolts are interchangeable, but it is inadvisable to mix old and new bolts on the same cylinder head, as the thread lengths may differ slightly.
3. Fit the camshafts sprockets (Section 'E.8') and camshafts covers (Section 'E.5').
4. Reconnect exhaust manifold, throttle and choke cables, and fuel pipes to carburetters. Refit the brake servo vacuum hose, radiator top hose, water temperature gauge sender unit and the heater hose. Refit the carburetters air box.
5. Finally, refill the cooling system.

E.11. - VALVES

To Remove

1. Remove the cylinder head (Section 'E.10') and the camshafts (Section 'E.9').
2. Remove the cam followers and the adjusting shims (Section 'E.7').
3. Using a valve spring compressor, compress the valve springs and extract the split collets, valve spring retainer, valve springs and spring seat from each valve.
4. Remove the valve.

To Replace

1. Lightly lubricate the stem of the valve and insert into its guide.
2. Fit spring seat, valve springs, valve spring retainer. Place the valve spring compressor in position and compress the valve springs sufficiently to fit the split collets. Remove the valve spring compressor.
3. Replace the cylinder head (Section 'E.10') followed by the camshafts (Section 'E.9').
4. Check the valve clearances (Section 'E.7') and finally fit the camshafts sprockets (Section 'E.8') and the camshafts cover (Section 'E.5').

E.12. - DECARBONISE CYLINDER HEAD AND PISTONS

1. Remove carburettors (see Section 'L').
2. Remove cylinder head (Section 'E.10').
3. Remove the valves (Section 'E.11').
4. Using a suitable implement (such as a blunt scraper), remove all carbon deposits from cylinder head faces, inlet and exhaust ports, piston crowns and valve heads. A ring of carbon should be left around the periphery of each piston crown. The top of the cylinder bores should NOT be touched. It is important to note that loosened carbon is not left where it can contaminate any parts of the engine.
5. Clean each valve thoroughly and carefully examine for pitting. Valves in a pitted condition should be refaced with a suitable grinder or new valves should be fitted. Stamp any new valve with the number of the port to which it is fitted. If the valve seats show any signs of pitting or unevenness they should be trued by the use of service cutting tools. When using a cutting tool take care to remove only as much metal as is necessary to ensure a true surface. The removal of too much metal could cause the spring retainer to foul the cam follower.
6. When grinding a valve onto its seating the valve should be smeared lightly with fine or medium carborundum paste and then lapped in with a suction grinder. Avoid the use of excessive quantities of grinding paste and see that it remains in the region of the valve seating only. A light coil spring placed under the valve head will assist considerably in the process of grinding. The valve should be ground to its seat with a semi-rotary motion and occasionally allowed to rise by the pressure of the light coil spring. This assists in spreading the paste evenly over the valve face and seat. It is necessary to carry out the grinding operation until a dull, even, matt surface free from blemishes is produced on the valve seat and valve face. On completion, the valve seats and ports should be cleaned with a rag soaked in paraffin, dried, and then thoroughly cleansed by compressed air. The valves should be washed in paraffin and all traces of grinding paste removed. Check that no grinding paste has entered the valve guides.
7. Re-assemble the valves to the cylinder head (Section 'E.11').
8. Refit cylinder head (Section 'E.10') and carburettors (see Section 'L').

E.13. - VALVE SEAT INSERTSTo Remove

1. Remove the cylinder head (Section 'E.10') and dismantle as for decarbonising (Section 'E.12').
2. Remove valve seat inserts by inserting a suitable sharp chisel through the port and carefully locating its cutting edge between the base of the insert and the alloy material of the head. The chisel may then be tapped deftly with a hammer. Further similar attempts to dislodge the insert should be made round the periphery of the insert where access is possible. Ensure that the recesses in the cylinder head are ENTIRELY FREE of foreign matter, otherwise the new insert will NOT seat fully in its recess.

To Replace

Valve seat inserts are available in standard and up to .015 (.381 mm.) oversize (see Service Parts List).

1. Heat the whole cylinder head to a temperature NOT EXCEEDING 200° C. (392° F.) and freeze the insert with 'dry ice' to a temperature NOT LESS THAN -80° F. (-112° F.).
2. Press the insert into place using a suitable replacer tool, ensuring that the seat face is towards the combustion chamber. Allow the cylinder head to cool naturally in the air.
3. Rebuild (Section 'E.12') and refit the cylinder head (Section 'E.10').

E.14. - VALVE GUIDESTo Remove

1. Remove the cylinder head (Section 'E.10') and dismantle (Section 'E.12').
2. Remove the valve guide with a suitable drift, knocking upwards into the cam follower bore after heating the cylinder head to 100/150° C. (212/303° F.).

To Replace

Valve guides are available in standard and up to .006 in. (.152 mm.) oversize (see Service Parts List).

1. Heat the cylinder head to 100/150° C. (212/303° F.), locate a new circlip on the new guide and press the guide into its bore until the circlip seats completely in its recess. Care must be taken that the guides are NOT driven beyond this point (see 'Technical Data').