

Section A – ENGINE – PETROL MODELS

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ENGINE REMOVAL AND DISMANTLING PROCEDURE**Removing engine** **Operation A/2**

1. If fitted, remove the spare wheel from bonnet panel.
2. Remove the bonnet panel.
3. Disconnect the battery leads.
4. Disconnect the air intake pipe from the carburetter and remove air cleaner.
5. Drain the coolant from system (one tap at bottom L.H. side of radiator and one tap at L.H. side of cylinder block).
6. Disconnect the side lamp leads at snap connectors at each side of the grille panel assembly and the front lamp harness from the junction box at R.H. side of scuttle, then pull the wiring clear to front of engine.
7. Detach the top hose at radiator header tank and the bottom hose from water pump inlet.
8. Remove the fan blades.
9. Remove the bolts securing the grille panel to the front cross member and front wings.
10. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle.
11. Disconnect the exhaust pipe from exhaust manifold.
12. Disconnect the heater pipes (if fitted) at the engine side of scuttle.
13. Disconnect the petrol pipe at carburetter.
14. Disconnect the throttle return spring, throttle linkage (at a ball joint) and the cold start control cable at carburetter and clamp. If fitted, disconnect the engine governor operating rod. Section T.
15. Disconnect:
Dynamo wiring; ignition coil leads; starter lead from switch; oil pressure switch wire; mixture control switch wire (at rear of cylinder head).
16. Secure a sling to the engine and with suitable lifting tackle just take the strain.
17. Remove the front floor and gearbox cover.
18. Support the gearbox assembly with a jack or packing blocks.
19. Remove the remaining nuts and washers securing the gearbox to the flywheel housing.
20. Remove the bolts from engine front support brackets and allow the engine to move forward and thus clear the gearbox input shaft. Ensure

that the speedometer cable and all wires, etc., are clear, then hoist the engine gently from the vehicle.

21. Drain the oil from sump.
22. Bolt the engine to a suitable stand.

DISMANTLING ENGINE**Externals** **Operation A/4**

1. Disconnect the accelerator linkage (at a ball joint), distributor vacuum pipe and remove carburetter. Detach sparking plug covers and leads, remove locating screw and withdraw the distributor. Remove sparking plugs.
2. If fitted, disconnect the heater pipe and flow control tap from cylinder head.
3. Remove the exhaust rocker cover.
4. Remove the dynamo and starter motor.
5. Remove the exhaust and inlet manifolds.
6. Remove the external full flow oil filter complete.
7. Disconnect the oil feed pipe—gallery to cylinder head.
8. Remove the dipstick and tube, then drain and remove sump.

Oil pump **Operation A/6**

1. Slacken the locknut securing oil pressure adjusting screw, then remove screw, washer, spring, plunger and ball (which may remain in the pump and can be removed when the pump complete is withdrawn).
2. Remove the pump locating screw.
3. Withdraw the pump, leaving the drive shaft in position.
4. If necessary, withdraw the oil pump drive shaft. Operation A/18.

Note: See Section AO for details of oil pump strip and assembly.

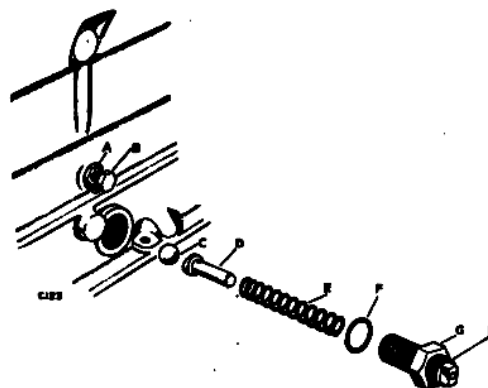


Fig. A-1—Oil pressure relief valve

- | | |
|---------------------------|--------------------------------|
| A—Locknut | E—Spring |
| B—Locating screw—oil pump | F—Washer |
| C—Ball | G—Locknut |
| D—Plunger | H—Adjusting screw—oil pressure |

Vibration damper**Operation A/8**

1. Remove the starter dog, using spanner Part No 263055 or 530102.
2. Withdraw the vibration damper complete.
3. Remove the plate, shims (if fitted), rubber disc, driving flange and second disc from the damper flywheel. Six set screws.
4. If necessary, remove the flywheel bush.

Water pump and front cover **Operation A/10**

1. Remove the thermostat housing from the cylinder head complete with thermostat, outlet pipe, inlet elbow and joint washer.
2. Remove the copper tube and rubber joint ring from either the bottom face of the thermostat housing or the top face of the water pump casing.
3. Remove the water pump complete with joint washer and inlet pipe; as the pump casing is spigoted in the block, it will be necessary to oscillate it slightly as it is removed.

To strip water pump completely for overhauling purposes, refer to Section L.

4. Remove the securing bolts and remove the front cover.

Timing chain tensioner and chain wheels**Operation A/12**

1. Remove the crankshaft oil thrower.
2. Release the pawl from the ratchet, compress the tensioner spring by lifting the jockey pulley arm as far as possible, and fit clip, Part No. 262748, over the tensioner.

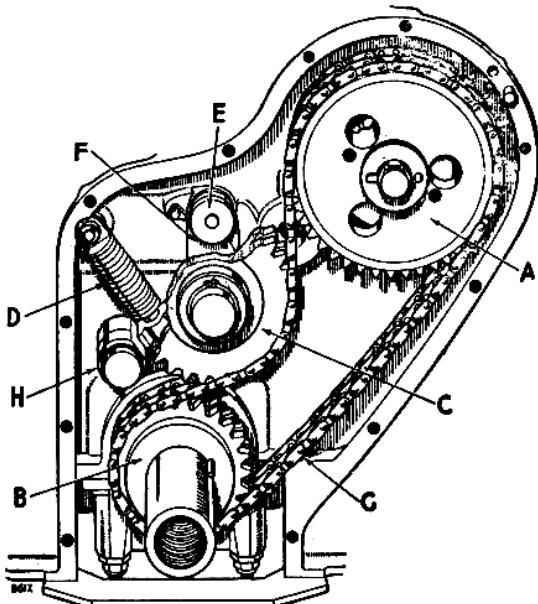
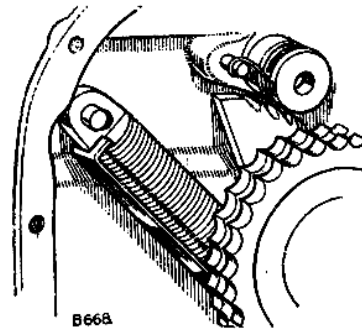


Fig. A-2—Timing chain and tensioner

- | | |
|-------------------------|-------------------------------|
| A—Camshaft chainwheel | E—Pawl |
| B—Crankshaft chainwheel | F—Ratchet |
| C—Jockey pulley | G—Timing chain (driving side) |
| D—Hydraulic tensioner | H—Jockey pulley arm |

Fig. A-3—
Clip for timing
chain tensioner

3. Remove the jockey pulley; remove the driving chain.
4. Withdraw the jockey pulley arm and tensioner.
5. Carefully remove the special clip and part the tensioner spring, piston, cylinder and, if necessary, extract the ball and the two retaining springs from the cylinder.
6. If necessary, extract the pawl pivot pin (5/16 in. B.S.F. tapped hole); remove the pawl and pawl spring.
7. Remove the camshaft chainwheel, using extractor, Part No. 262750, or Part No. 507231.

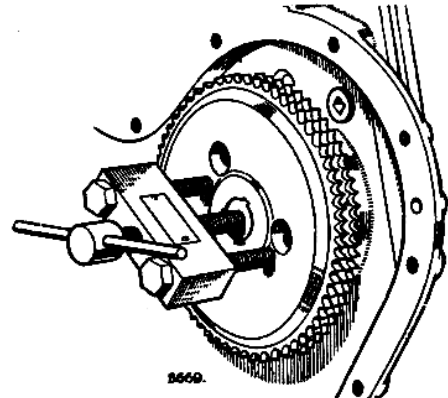


Fig. A-4—Removing camshaft chainwheel

8. If necessary, remove the crankshaft chainwheel, using a claw extractor.
9. Wash and dry all tensioner components and renew any worn part.

Cylinder head and inlet rocker gear**Operation A/14**

1. Remove the inlet rocker cover.
2. Remove the rocker shaft complete with all components.
Note: The 3/8 in. (spanner size) nuts have 7/16 in. threads.
3. Remove the components and lay out in the following order: Rear bracket (located by set screws); spring; R.H. rocker; bracket; L.H. rocker; two brackets; spring; R.H. rocker; bracket; L.H. rocker; spring; front bracket.
4. Withdraw the push rods and insert them in a piece of cardboard pre-pierced and marked.
5. Loosen the securing bolts evenly and lift the cylinder head clear.

- Using a valve spring compressing tool, Part No. 276102, remove the valve assemblies. The valves should be inserted in a piece of cardboard pre-pierced and marked. Retain the springs in pairs; they are selected to ensure an interference fit.

Exhaust valves Operation A/16

- Slacken the tappet adjusting screws right back.
- Set each rocker on the back of its cam, and using a valve spring compressing tool, Part No. 276102, remove the valve assemblies. The valves should be inserted in a piece of cardboard pre-pierced and marked. Retain the springs in pairs; they are selected to ensure an interference fit.

Exhaust rocker shafts and distributor housing Operation A/18

- Remove the plug and fibre washer from the flywheel end of the cylinder block.

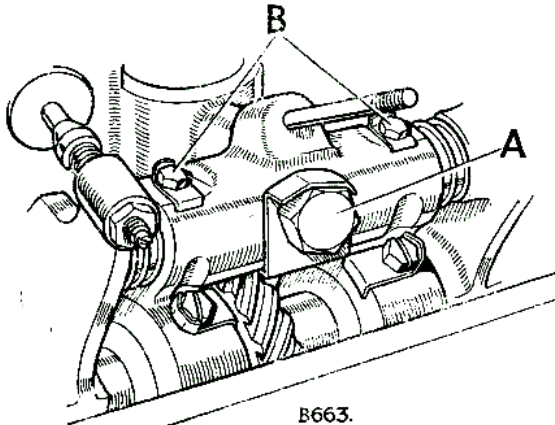


Fig. A-5—Exhaust rocker shaft and distributor housing location bolts

A—Distributor housing location bolt.
B—Exhaust rocker shaft location bolts.

- Remove the location bolts; two for the rocker shafts and a hollow bolt for the distributor housing. Withdraw the distributor housing, and remove oil pump drive shaft.
- Withdraw the rear shaft using extractor, Part No. 262749.
Lay out the components in order:—
Spring; R.H. rocker; washer; R.H. cam follower; washer; L.H. rocker; spring. Same order applies to both rocker shafts.
- Repeat for the front shaft.

Camshaft and camshaft bearing removal Operation A/20

- Remove the camshaft thrust plate.
- Remove the bolt and lock washers locating each of the three front bearings.
- Withdraw the camshaft until the third bearing is clear of No. 2 bearing housing; split the bearings and lay aside. Remove the camshaft and front bearing. Split the front bearing and remove.

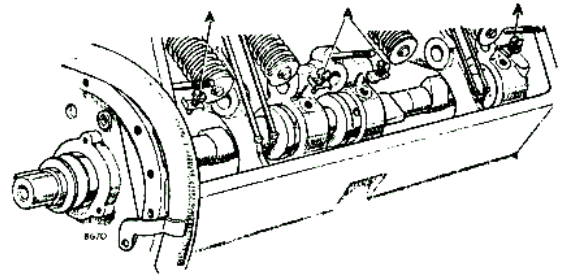


Fig. A-6—Camshaft bearing location bolts
A—Location bolts

- If necessary, remove the bolt and lock washer from the rear bearing. Remove the rear camshaft cover.
- Remove the rear bearing; preserve all bearings in their respective pairs.

Flywheel Operation A/22

- Remove the clutch assembly, then the flywheel securing bolts and withdraw the flywheel. The primary pinion bush may be extracted if necessary.

Pistons and connecting rods Operation A/24

- Remove the connecting rod caps, bearings and bolts.
- Push each connecting rod up and turn, in order to engage the slots at the bottom of the cylinder bore. Remove the circlips; withdraw the gudgeon pin, using extractor, Part No. 278668; remove the piston.

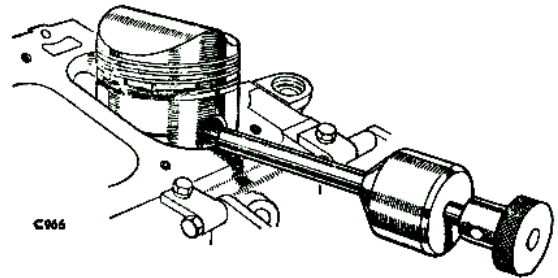


Fig. A-7—Removing gudgeon pin

- Lower each connecting rod, turning the crankshaft as necessary to effect withdrawal.
- Remove the piston rings.
Note: Mark all components in sets.

Crankshaft, main bearing and rear bearing oil seal Operation A/26

- Remove the flywheel housing.
- Remove the main bearing caps and shells. The lower half of the rear main oil seal may be removed complete with rear main bearing cap.
- Lift out the crankshaft and remaining bearing halves. The bearing halves must be preserved in pairs. Ensure that the thrust washers are retained in original housings if used again.

ENGINE ASSEMBLY

Camshaft Operation A/28

Note: The bearings must be fitted dry and must be a hand push fit in the cylinder blocks; they must always be renewed in paired halves and the numbers stamped on one of the end faces of each of the bearing halves must be adjacent.

The rear bearing is provided with four lateral holes.

1. Checking bearing clearance on camshaft, if new bearings are fitted, make sure that they can be dismantled and assembled without difficulty.
2. Insert the camshaft partly into the cylinder block, assemble the bearings on to the shaft with the locating holes in line with the holes in the housing, and push the shaft into position.
3. Line up the locating holes in the bearings and housings, and before replacing the set bolts, squirt oil down the holes to lubricate the bearings until oil pressure is built up. Replace set bolts. See Fig. A 6.
4. Fit the camshaft thrust plate and chain wheel. The camshaft should have .003 in. (0,07 mm) to .005 in. (0,12 mm) end-float, measured between the chain wheel and the thrust plate.

Crankshaft, main bearing and seals

Operation A/30

1. To check that the bearing caps have not been filed, first assemble the caps without bearing shells to the crankcase, ensuring that they are correctly located by means of the dowels. Tighten both securing bolts for each cap, then slacken one bolt of each pair right off. There should be no clearance at the joint face.

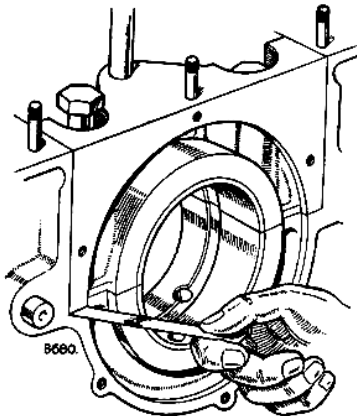


Fig. A-8—Checking main bearing nip

2. Remove the bearing caps and fit the bearing shells, locating by means of the tags. Tighten the caps down and slacken off one bolt of each pair. Check the bearing nip, as illustrated in Fig. A-8, ensuring that the clearance does not exceed .004 to .006 in. (0,10 to 0,15 mm). The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.

3. When the bearing nip has been checked, remove the caps and bearing shell bottom halves. Position a standard-size thrust bearing at each side of centre bearing shell—top half, and fit the crankshaft.
4. Refit the bearing shell bottom halves and bearing caps. Tighten the securing bolts evenly and check each bearing in turn for correct clearance. The crankshaft should resist rotation when a feeler paper, .0025 in. (0,06 mm) thick, is placed between any one bearing shell and crankshaft journal, and turn freely by hand when the feeler paper is removed. Adjust by selective assembly of bearing shells.
5. Check the crankshaft end-float with a feeler gauge (Fig. A-9); adjust at centre bearing by selective assembly of thrust washers to give .002 to .006 in. (0,05 to 0,15 mm) end-float.

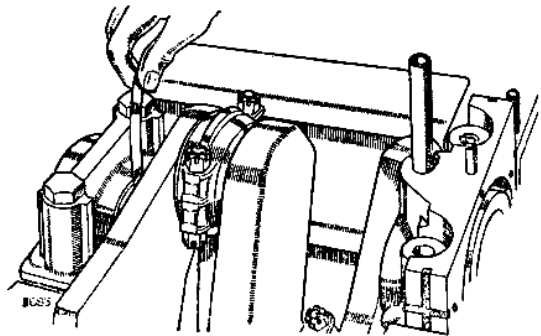


Fig. A-9—Checking crankshaft end-float

6. Remove the bearing caps, bottom half shells and crankshaft.
7. To the rear main bearing cap fit neoprene seals in recess at each side, and on the rear face fit the lower half of crankshaft rear bearing seal.
8. Fit the top half of crankshaft rear bearing oil seal to the crankcase. Lubricate bearing face with Silicone MS4 Compound.
9. If the crankshaft end-float reading, obtained in Item 5, was not within the limits, fit suitable oversize thrust bearings. The variation of thrust bearing thickness at each side must not exceed .003 in. (0,07 mm) to ensure that the crankshaft remains centralised.

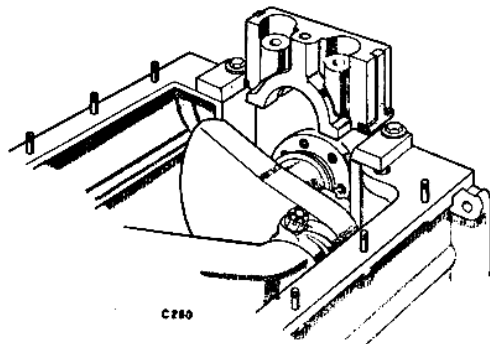


Fig. A-10—Guide in position on cylinder block

Lubricate the crankshaft journals, main bearing shells and thrust bearings, then refit crankshaft.

Smear bearing face of crankshaft rear bearing oil seal with Silicone MS4 compound.

Fitment of the rear main bearing cap with side seals in position, will be facilitated by using a lead tool (Part No. 270304) fitted to the sump studs adjacent to rear bearing cap aperture.

It will be found advantageous to cut a slight lead on to the bottom edges of the side seals, as this will prevent them from folding under the cap during fitment, thus causing an oil leak due to the cap not seating properly. Smear seals with Silicone MS4 Compound when fitting.

Connecting rods

Operation A/32

1. The oil hole in gudgeon pin bush is pre-drilled and care must be taken to ensure that the oil holes of bush and connecting rod will align when the bush is pressed into position. The gudgeon pin bushes should be a .001 to .002 in. (0,02 to 0,05 mm) interference fit in connecting rods. Ream the bush when fitted to connecting rod to allow a .0003 to .0005 in. (0,007 to 0,012 mm) gudgeon pin clearance. Ensure that correct alignment is maintained while reamering.

This fit is selected to give the smallest possible clearance consistent with a smooth revolving action.

2. Fit each connecting rod to a suitable test rig and check for twist and mal-alignment.

3. To check that the connecting rod has not been filed:—

Select the correct cap for each connecting rod, as denoted by the number stamped near the joint faces. This number also indicates the crankpin to which it must be fitted.

Assemble the connecting rods, less shell bearings, with corresponding numbers together.

Tighten the securing nuts, then slacken one of them right off and check that there is no clearance at the joint face.

4. Check the bearing nip as follows:—

Fit the bearing shells and tighten both securing nuts—slacken one nut as before and check the nip with a feeler gauge; this should be .002 to .004 in. (0,05 to 0,10 mm).

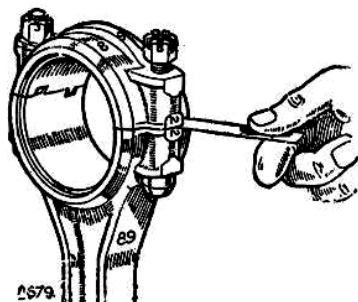


Fig. A-11—Checking big-end bearing nip

5. If the bearing nip is too great, decrease by rubbing down the joint faces of the bearings on fine emery cloth; if the bearing nip is too small, select another pair of bearings, and re-check the bearing nip.

If the bearing nip is still small, re-check that the connecting rod has NOT been filed (see Item 3).

6. Assemble the big-end of each connecting rod to its respective crankpin, then check for correct end-float, by inserting a feeler gauge between the end face of the rod and the crankpin shoulder. End-float should be .009 to .013 in. (0,23 to 0,33 mm).
7. Remove the connecting rods from the crankshaft, ensuring that the bearing shells are kept with the rods to which they were fitted.

Pistons

Operation A/34

1. When fitting pistons, standard or oversize, the cylinder bore clearance should be in accordance with the dimensions laid down in the data section. When reboring, the block must be honed to suit the selected pistons. In the absence of suitably accurate measuring instruments, a long feeler .0025 in. (0,06 mm) thick may be inserted against the thrust side of the bore as illustrated in Fig. A-12 and the piston located crown downward. The piston should become a tight fit when the top of the skirt (immediately below the bottom scraper ring) enters the bore.

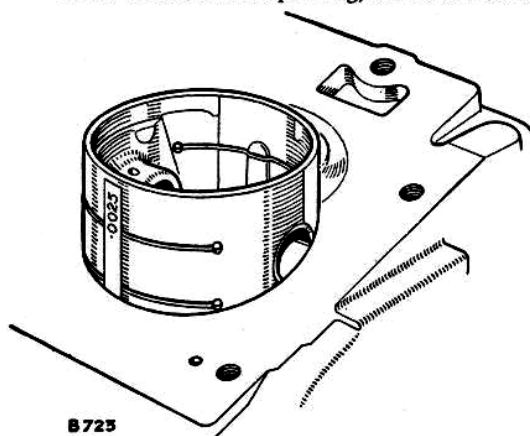


Fig. A-12—Checking piston clearance

Piston ring fitting

Check gap and side clearance. To check gap, support the ring in the cylinder bore with an old piston.

Stepped scraper rings, where used, must be fitted with the larger diameter at the top.

Compression "T" or "Top" on one face.

3. The gudgeon pin, when cold and dry, should be an easy sliding fit in the connecting rod and should have a slight interference fit in both piston bores, i.e. so that it can be pressed in by hand, but will not fall out under its own weight.

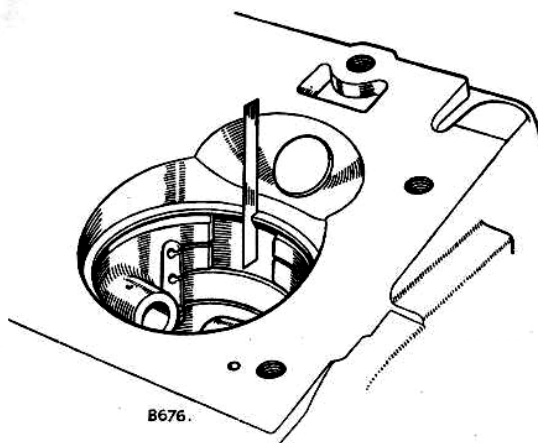


Fig. A-13—Checking piston ring gap

Pistons to connecting rods Operation A/36

1. Enter the connecting rod, without bolts, up into the cylinder bore and engage in the cylinder block slots.
2. Enter the skirt of the piston into the top of the bore, with the flat top of the piston in line with the oil hole in the connecting rod.
3. Fit the gudgeon pin, using thimble Part No. 272103, to align piston and connecting rod. Lock the pin in position with circlips.

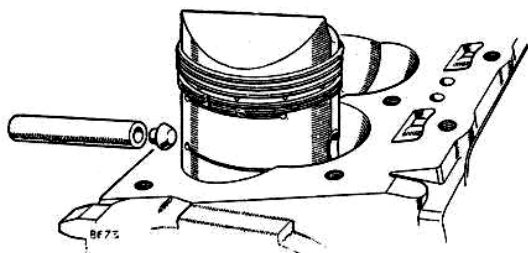


Fig. A-14—Fitting gudgeon pin

Piston and connecting rod to cylinder block and crankshaft Operation A/38

1. The connecting rod bolts are a tight fit in the rod and must be tapped into place with a 'Z' shaped bar.
2. Turn the crankshaft until the crank journals relative to numbers 1 and 4 cylinders are at B.D.C. Squirt oil on to the journal, refit appropriate bearings to cap and connecting rod, pull the rod down to the journal and fit cap, ensuring that the oil hole in the connecting rod is on the opposite side to the camshaft. Tighten the nuts to 30 lb/ft. (4 mKg) on 1948-53 models and to 40 lb/ft. (5,5 mKg) on 1954-58 models and then turn on to the next split pin hole. Fit split pin.

Re-boring Operation A/40

1. Re-boring conforms to normal practice. It is necessary to employ a jig block, Part No. 261287, to enable standard equipment to be used.

It should also be noted that on early engines the upper portion of the bores is chromium plated; the chromium is too hard for standard cutters,

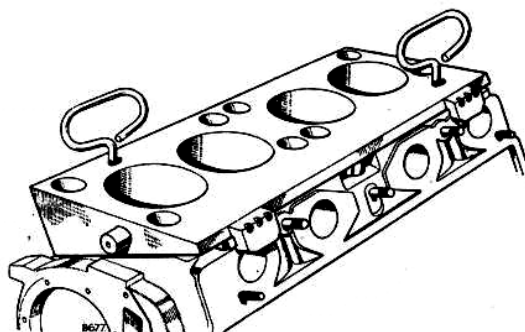


Fig. A-15—Re-boring jig block

so that the first cut, starting from the top of the bore, must be sufficiently deep to cut behind the plating.

2. If the cylinder block has already been bored out to maximum size, cylinder liners may be fitted.

Cylinder liners**Operation A/42**

1. Fitting conforms to standard practice; note the following points:—
2. Machine the cylinder block bores as follows:

1948-51 1.6 litre	....	2.937 in. + .001
		(74,60 mm + 0,025)
1952-54 2.0 litre	....	3.188 in. + .001
		(80,97 mm + 0,025)
1955-58 2.0 litre	....	3.245 in. + .001
		(82,42 mm + 0,025)

This gives an interference fit of .003 to .004 in. (0,075 to 0,10 mm).

3. Prior to pressing in the liner, allowance must be made for twist up to 3/16 in. (5 mm) clockwise. To facilitate re-alignment should the liner not be positioned correctly at the first attempt, scribe lines down the sides of the liner from the two peaks and make corresponding marks on the cylinder block.
4. Press in the liner, using press block Part No. 262864, until the top edge is level with the bottom of the exhaust valve pocket. Blend to the shape of the cylinder block.
5. Bore to suit the selected pistons. Operations A/40 and A/34.

Liners for the 1.6 litre engine can be bored out to a maximum of .040 in. (1,00 mm).

Liners for the 2.0 litre engine can only be bored out to suit standard or .010 in. (0,25 mm) oversize pistons.

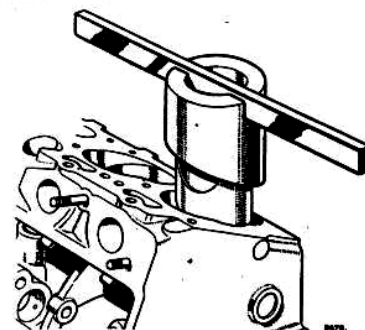


Fig. A-16—Fitting cylinder liner

Flywheel housing and flywheel**Operation A/44**

1. Ensure that the rear main bearing oil seal is in good condition, then secure the flywheel housing to cylinder block.
2. Fit the flywheel and tighten the securing bolts to 70 lb/ft (9,8 mKg).
3. Check the run-out on the flywheel face as illustrated by Fig. A-17. The run-out must not exceed .005 in. (0,12 mm) at outer edge of face.

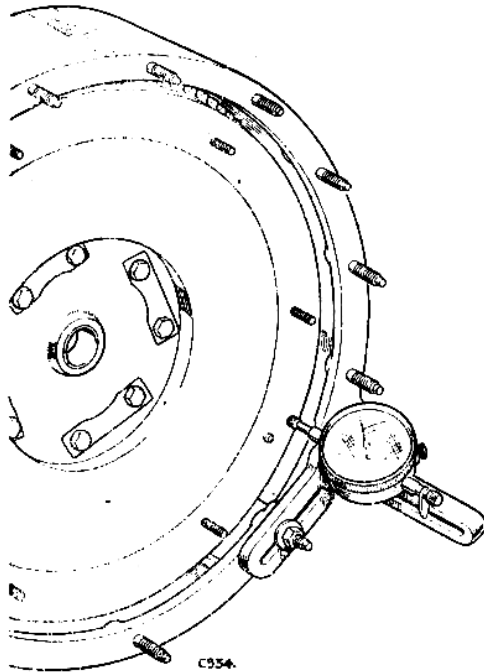


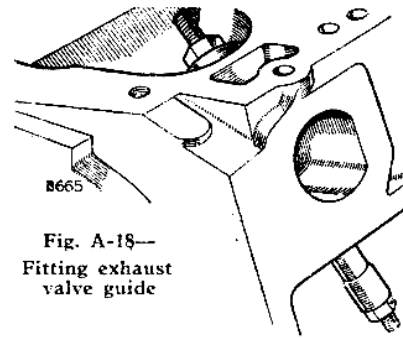
Fig. A-17—Checking run-out on flywheel face

Exhaust valves**Operation A/46**

1. Grind the seats to $45^\circ + \frac{1}{4}$, using 'Vibro-centric' equipment.
2. Face the valves to $45^\circ - \frac{1}{4}$ and lap into their respective seats.
3. Wash each valve, seat, port and guide in paraffin.
4. Locate each valve into their respective guides and, using compressor Part No. 276102, fit the spring assemblies, caps and split cones. A new 'O' ring seal must be fitted to each guide.

To fit new guides

5. Remove the guide with a drift, Part No. 263051.
6. Pull in the new guide, using tool Part No. 262753, and ream to .3448 in.—.0005 (8,757 mm—0,012)
7. Repeat items 1 to 4 inclusive.

Fig. A-18—
Fitting exhaust
valve guide**To fit new seats**

Note.—Special attention is needed to prevent possible injury from flying fragments when the insert is broken.

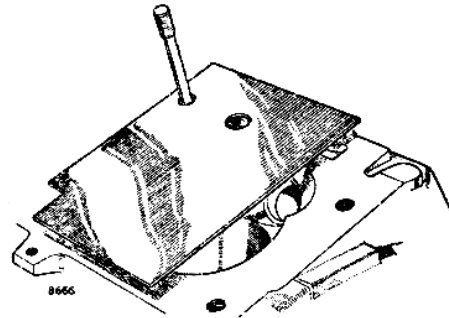


Fig. A-19—Removing exhaust valve seat

8. Secure protection plate, Part No. 263050, over the appropriate cylinder bore, and cover the opening below the insert with a heavy pad of rag.
9. Break the insert by means of a chisel applied through the hole in the plate.
10. Remove the valve guide by means of a piloted drift, Part No. 263051.

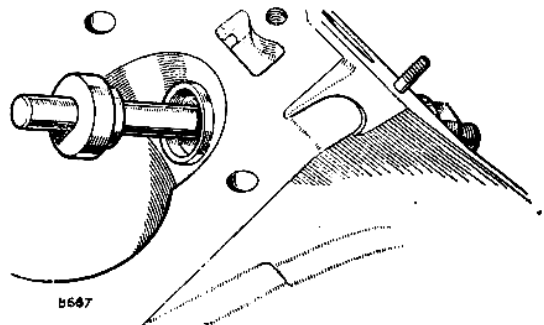


Fig. A-20—Fitting exhaust valve seat

11. Clean the seat recess and pull the new insert into position, using tool Part No. 262752. It is not necessary to heat the block or freeze the insert, but light taps on the tool may be required to ensure that the insert enters smoothly.

12. Continue precautions against fragmentation for a few minutes, as the insert may shatter a short time after fitting.
13. Pull in the new valve guide, using tool Part No. 262753.
14. Repeat items 1 to 4 inclusive.

Exhaust rocker shafts assembly

Operation A/48

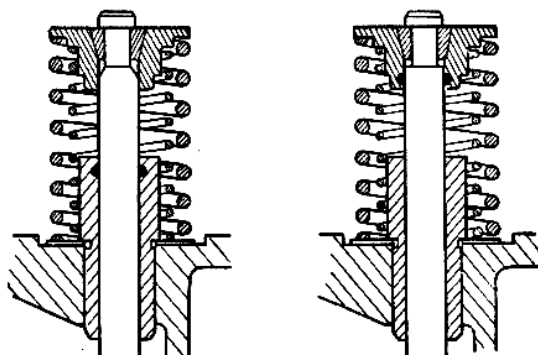
Note.—When fitting a replacement rocker or cam-follower, it is essential that the component be fitted with the special protective coating of grease still adhering.

1. Fit new bushes in the rockers and followers as necessary and drill through the 1/16 in. (1,58 mm) oil feed hole. The bush must be a *light drive fit* in the rocker or follower and a *sliding fit* on the shaft. Ream in position to .593 in. +.001 (15,081 mm + 0,025).
2. Replace shafts by inserting front shaft through the locating hole and assembling component parts in the following order: spring; R.H. rocker, washer; R.H. cam-follower; L.H. cam-follower; washer; L.H. rocker; spring.
3. Repeat for rear shaft, ensuring that, with both shafts in position, the oil feed holes in the rocker shafts are facing towards the cylinder block. The front of each shaft is marked 'F'.
4. Fit the plugs and fibre washer; for tappet adjustment see Operation A/54.

Inlet valves

Operation A/50

1. Cut the valve seats (in cylinder head) to $30^\circ + \frac{1}{4}$ only when necessary; normally they require cutting only at every second or third decarbonising operation.
2. Face the valves to $30^\circ - \frac{1}{4}$ and lap into their respective seats.
3. Wash each valve, seat, port and guide in paraffin.
4. Locate each valve into their respective guides and, using compressor Part No. 276102, fit the spring assemblies, caps and split cones. A new 'O' ring seal must be fitted to each guide.



Later seal Fig. A-21

Early seal

To fit new guides

5. Remove the guide with a drift, Part No. 263051.
6. Press in the new guide, and ream to .3448 in. — .0005 (8,757 mm — 0,012).
7. Repeat items 1-4, noting that the seat must be ground in the event of a new guide being fitted.

Cylinder head and rocker gear

Operation A/52

1. Smear the joint face of cylinder block and cylinder head gasket with engine oil, then fit the gasket and cylinder head to cylinder block.
2. Locate head and gasket with the securing bolts, fitting all bolts except those which also secure the rocker shaft pedestals, but do not tighten at this stage.
3. Insert the push-rods into their original position, through cylinder head and locate in the cam-followers.
4. Fit new bushes in the rockers as necessary. The bush must be a *light drive fit* in the rocker and a *sliding fit* on the shaft. Press a new bush in with its shoulder on the same side as the rocker pad; drill through the oil feed holes—7/64 in. (2,77 mm) to the push-rod and 1/16 in. (1,58 mm) in the top of the rocker. Ream in position to .005 in. +.001 (12,7 mm + 0,025).

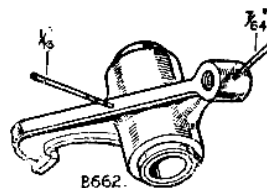
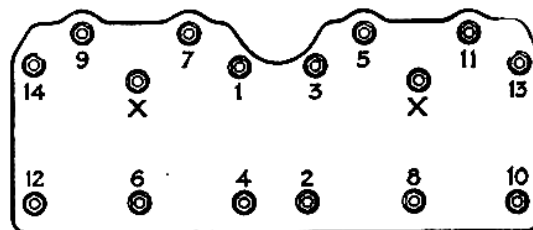


Fig. A-22—
Drilling oil feed holes

5. Fit the component parts to the rocker shafts in the following order: Rear bracket (located by set screw); spring; R.H. rocker; bracket; L.H. rocker; two brackets; spring; R.H. rocker; bracket; L.H. rocker; spring; front bracket.
6. Fit the rocker shaft to the cylinder head. When in position, the oil feed holes in the rocker shaft must face the push-rods. Tighten all the bolts down in the manner illustrated by Fig. A-23: $\frac{7}{8}$ in. bolts to 50 lb./ft. (7 mKg); $\frac{3}{4}$ in. bolts to 30 lb./ft. (4 mKg).



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Fig. A-23—

Order of tightening cylinder head bolts. Those marked X also secure the rocker shaft.

Tappet adjustment**Operation A/54**

The exhaust tappets may be set with the engine hot or cold.

The inlet tappets should be set with the engine at running temperature.

1. Set the valve receiving attention fully open by engaging the starting handle and turning the engine, then rotate the engine one complete revolution, to bring the tappet on the back of the cam.

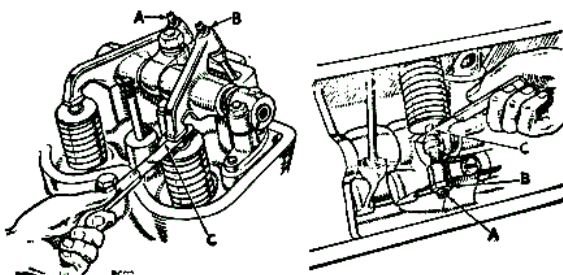


Fig. A-24—Tappet adjustment

A—Tappet adjusting screw B—Locknut
C—Feeler gauge

2. Slacken the tappet locknut and using a feeler gauge, rotate the adjusting screw to give the correct clearance .010 in. (0,25 mm) inlet and .012 in. (0,30 mm) exhaust, bearing down on the screw to take up all the clearance at the push-rod ends.

Tighten the locknut.

3. Repeat for the remaining tappets.

Chain wheels, timing chain, adjuster and valve timing**Operation A/56**

1. Fit the crankshaft chain wheel on to shaft and key.
2. Turn the crankshaft in direction of rotation until the E.P. mark on the flywheel is in line with the timing pointer.
3. Replace the camshaft chainwheel and key (do not secure at this stage), rotate the camshaft and set No. 1 exhaust tappet at .010 in. (0,254 mm).
4. If removed, refit the pawl pivot pin, pawl and spring.
5. Fit dial test indicator and bracket, Part No. 262751, so that the "fully open" position of No. 1 exhaust valve can be ascertained in the following manner:—

- (a) Turn the camshaft in direction of rotation until the lobe of cam has nearly opened the valve fully, then stop rotation and mark the chain wheel and timing case to record the position.

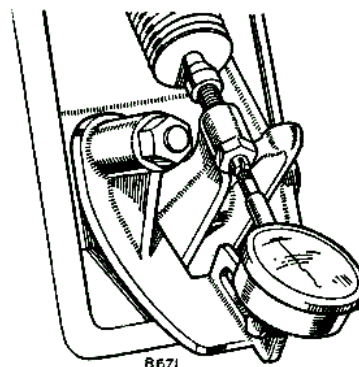


Fig. A-25—Checking exhaust valve fully open position

- (b) Note the reading on dial test indicator, then continue to turn the chain wheel slowly in direction of rotation until the needle has again reached the same position.
- (c) Mark the chain wheel at a point opposite to the mark on timing case and make a third mark on the chain wheel, exactly midway between those made previously.
- (d) Turn the camshaft against direction of rotation until the third mark is in line with that on timing casing, whereon the valve should be fully open.

Fit the timing chain with "no slack" on the driving side. It may be necessary to remove and re-position the camshaft chain wheel to obtain this "no slack" condition on the driving side when the flywheel and camshaft are correctly positioned. The camshaft chain wheel is provided with three irregularly spaced keyways to facilitate accurate timing.

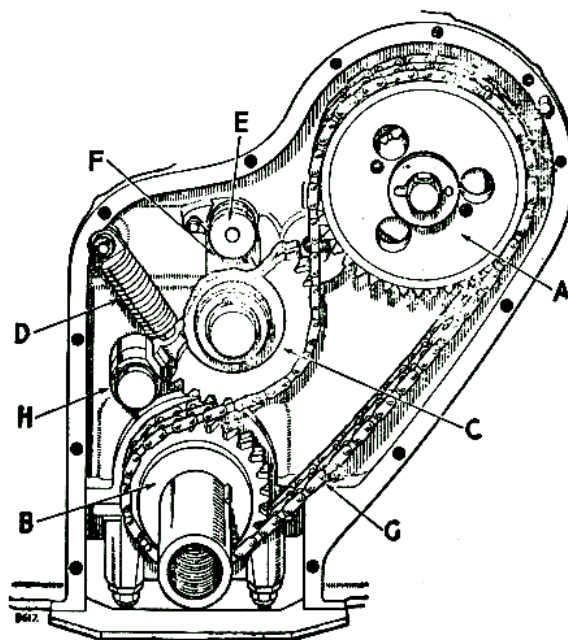


Fig. A-26—Timing chain and tensioner

A—Camshaft chain wheel E—Pawl
B—Crankshaft chain wheel F—Ratchet
C—Jockey pulley G—Timing chain (driving side)
D—Hydraulic tensioner H—Jockey pulley arm

6. Fit the jockey pulley arm to its locating spindle.
7. Assemble the hydraulic tensioner, compress and retain the spring with clip, Part No. 262748, and fit complete assembly to its locating spindle. Position the ball-end in its seat on the pulley arm, holding the ratchet pawl clear, and push arm upwards to the extent of its travel. Remove the special clip and fit jockey wheel.
8. Release the pulley arm and allow jockey wheel to take up slack in the timing chain.
9. Check the timing by rotating the engine and correct if necessary, by moving the camshaft chain wheel to one of the other key-ways.
10. Finally, secure the tensioner with a split pin and plain washer, secure the jockey wheel with a circlip and secure the camshaft chainwheel by locating the lock washer in one of the vacant key-ways and bending over the tag. Fit the oil thrower to the crankshaft noting that, correctly located, it curves away from the chain.

Water pump and front cover Operation A/58

1. Renew the joint washer and smear with a light grease.
2. Fit front cover to block (two locating dowels) and secure with bolts.
3. For details of assembly procedure for water pump, refer to Section L.
4. Fit new joint washer, smear with light grease and offer assembly to cylinder block, complete with copper tube and rubber joint ring in recess on top of water pump.
5. Locate securing bolts and tighten.
6. Fit thermostat housing complete with thermostat, outlet pipe, inlet elbow and joint washer, to cylinder head, taking care not to dislodge the copper and rubber washer.

Vibration damper Operation A/60

1. If stripped, examine the flywheel bush. Renew if necessary, noting that it should be a press fit in the flywheel and an easy fit on the driving flange.
2. When reassembling the damper, discard any shims which may have been previously fitted. These have been found to be unnecessary. Tighten the screws fully.
3. Mount the unit on a suitable mandrel, using a slave location key and rotate on centres. Adjust the run-out on the front face by tightening the screws at the point where a dial test indicator gives a minus reading. Secure the screws by staking.

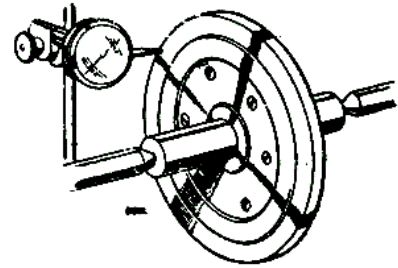


Fig. A-27—Checking vibration damper run-out

4. Balance statically, using putty or similar material. Weigh the putty and drill balancing holes in the flywheel. *Note:* A hole $\frac{3}{8}$ in. (9,52 mm) dia. x $\frac{1}{4}$ in. (6,35 mm) deep represents $1\frac{1}{2}$ grams.

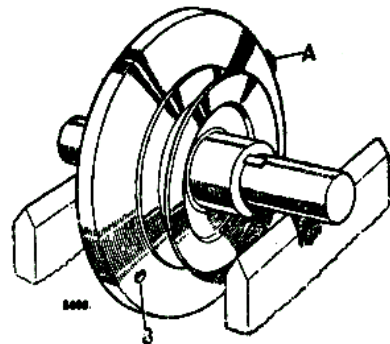


Fig. A-28—Balancing vibration damper
A—Putty B—Balancing hole

5. Refit damper on crankshaft, securing with a lock washer and starting dog. Tighten the starting dog, using spanner Part No. 263055.

Oil pump

Operation A/62

1. For details of assembly procedure for oil pump, refer to Section AO.
2. With the gauze oil strainer secured in position, offer the pump up to the engine.

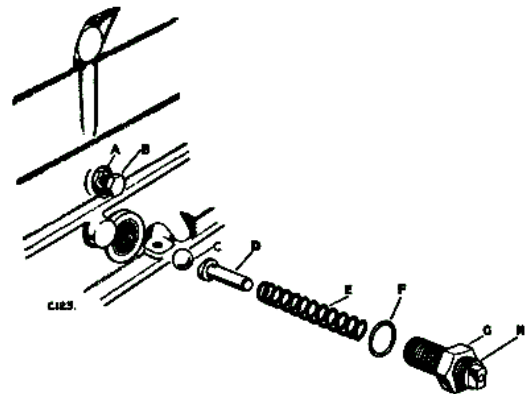


Fig. A-29—Oil pressure relief valve

- | | |
|---------------------------|--------------------------------|
| A—Locknut, | E—Spring |
| B—Locating screw—oil pump | F—Washer |
| C—Ball | G—Locknut |
| D—Plunger | H—Adjusting screw—oil pressure |

3. Fit the pump locating screw and locknut.
4. Fit the relief valve assembly. Do not tighten the locknut at this stage.
5. Refer to Section AO for details of oil pressure adjustment.

Distributor and ignition timing

Operation A/64

1. Rotate the engine in running direction until the F.A. 15° mark (1948-53 models) or the F.A. 10° mark (1954-58 models) on the flywheel is in line with the pointer, with both valves on No. 1 cylinder closed.
2. Fit the oil pump drive shaft so that when fully engaged in oil pump, the broad segment of driving spigot will be nearest to No. 3 exhaust port. The crankshaft may have to be rotated slightly to allow engagement of driving shaft in oil pump, and when this is necessary, item 1 must be repeated.
3. Secure the distributor housing in position with the hollow oil feed bolt, then fit distributor drive shaft.
4. Locate a cork washer in recess in top of distributor housing.
5. Check the distributor contact breaker clearance and adjust if necessary, .014 to .016 in. (0,35 to 0,40 mm). Set the octane selector so that the fourth line from the L.H. side of the calibrated slide is against the face of distributor body casting.
6. Rotate the distributor spindle until the rotor is at the firing point for No. 1 cylinder. The broad side of the driving spigot should be towards No. 3 exhaust port and vacuum unit facing forward when the distributor is located.
7. Mount distributor and secure to distributor housing.
8. Slacken the pinch bolt at the base of the distributor body; rotate the distributor bodily in the opposite direction to the arrow on the rotor arm, until the contact breaker points are just opening with the fibre cam follower on the leading side of the cam; retighten the pinch bolt.

Checking with 12 volt timing lamp

- (a) Connect a lead between the distributor L.T. terminal and the centre pole of the bulb; earth the bulb body.

(b) Rotate the distributor; the bulb will glow exactly when the points begin to open.

9. Adjust as required by slackening the pinch bolt and turning the distributor bodily, or for fine adjustments, by means of the vernier screw.

Externals

1. Fit the oil filter complete and joint washer.
2. Fit the exhaust rocker cover and joint washer.
3. Fit the oil feed pipe, gallery to cylinder head.
4. Fit the exhaust and inlet manifolds, and joint washers.
5. Fit the dynamo and starter motor; adjust the dynamo belt tension to allow the belt to move $\frac{1}{8}$ to $\frac{3}{8}$ in. (12 to 19 mm) when pressed by thumb between the crankshaft and water pump pulleys.
6. If removed, refit heater pipes, etc., to cylinder head.
7. Fit the inlet rocker cover and joint washer.
8. Fit the sparking plugs, covers and rubber sealing rings, and connect plug leads to distributor.
9. Fit the carburetter, and connect vacuum pipe between carburetter and distributor, connect fuel feed pipe from pump. Connect the accelerator linkage to the carburetter.
10. Fit the oil sump, noting rubber seal, packing strip and three distance pieces at rear.
11. Fit the dipstick and tube.

Engine, to refit

Operation A/66

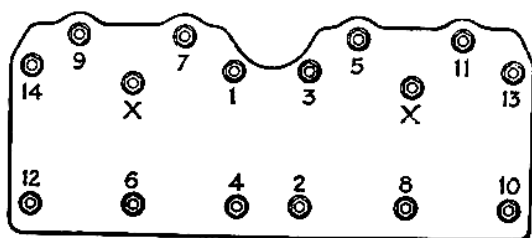
1. Reverse removal procedure—fit new mounting rubbers if necessary. Refill with lubricating oil, 10 imperial pints (5,5 litres), and coolant, 17 imperial pints (9,75 litres).
2. See Section M for details of carburetter adjustments.
3. See Section AO for details of oil pressure adjustment.
4. Check for oil and coolant leaks—rectify as necessary.

MAINTENANCE PROCEDURE**Removing cylinder head Operation A/68**

1. If necessary, remove the spare wheel from the bonnet panel.
2. Remove the bonnet panel.
3. Remove the radiator cap; drain off coolant.
4. Disconnect the battery leads.
5. Remove the air cleaner. Section M.
6. Disconnect the throttle return spring, throttle linkage (at a ball joint), the mixture control (at the carburetter and clamp) and hand throttle control (if fitted) at the lever and clamp. If fitted, remove the engine governor. Section T.
7. Disconnect: Oil feed pipe from the cylinder head; petrol pipe at the carburetter; mixture control switch wire (at rear of cylinder head); H.T. wire from the coil; L.T. wire from the distributor.
8. Remove the distributor vacuum pipe.
9. Pull off the plug covers and detach the distributor cap. Remove the sparking plugs.
10. Disconnect the top water hose at the radiator.
11. Release the dipstick tube bracket.
12. Remove the inlet rocker cover.
13. Remove the inlet rocker shaft complete. *Note:* The $\frac{3}{8}$ in. nuts (spanner size) have $\frac{7}{16}$ in. threads. Lift out the push rods.
14. Remove the distributor complete with clamp.
15. Remove the cylinder head complete, together with the rubber seal between the water pump and thermostat housing, which should be preserved.

Fitting cylinder head Operation A/70

1. Reverse the removal procedure.
2. Renew all joint washers.
3. Pull down the cylinder head bolts evenly to the correct tension in the order shown in Fig. A-29.



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Fig. A-30—Order of tightening cylinder head bolts
Those marked X also secure the rocker shaft.

4. Carry out ignition timing. Operation A/64.

5. Adjust the tappet clearances. Exhaust .012 in. (0,30 mm) and inlet .010 in. (0,25 mm). Operation A/54.

6. Run the engine for a few minutes and check for leaks.

Decarbonising, valve grinding and lapping Operation A/72

1. Remove the cylinder head and inlet rocker shaft. Operation A/68.
2. Remove the valves. Operations A/14 (inlet), A/16 (exhaust).
3. Remove the carbon from the cylinder head face and ports, using a blunt scraper. Do not use a wire brush or sharp tools. On no account must the cylinder head be sandblasted.
4. Remove the carbon from the cylinder block combustion chambers, exhaust ports and piston tops, using a blunt scraper.
5. Clean out the small water holes on the right-hand side of the cylinder block and head faces.
6. Renew valve guides or seats as necessary. Operations A/46 and A/50. Grind in the valves.
7. Check and clean the sparking plugs.
8. Refit the cylinder head. Operation A/70.
9. Carry out ignition timing. Operation A/64.
10. Adjust the tappet clearances—exhaust .012 in. (0,30 mm) and inlet .010 in. (0,25 mm). Operation A/54.
11. Run the engine for a few minutes and check for leaks.

Tappet adjustment Operation A/74

1. Remove the rocker covers. The exhaust tappets may be set either hot or cold. The inlet valves should be set with the engine at running temperature.
2. Engage the starting handle and set the tappet clearance by the method described in Operation A/54. Exhaust .012 in. (0,30 mm) and inlet .010 in. (0,25 mm).

Rocker gear removal Operation A/76

1. Remove the rocker covers.
2. To remove the inlet rocker gear, see Operation A/68, items 1, 2, 12 and 13.
3. To remove the exhaust rocker gear, see Operation A/18. *Note:* It is not necessary to remove the oil pump drive shaft.

Rocker gear fitment Operation A/78

1. Reverse removal procedure and set tappet clearance as directed in Operation A/54. Exhaust .012 in. (0,30 mm) and inlet .010 in. (0,25 mm).

Timing chain renewal **Operation A/80**

1. Remove bonnet top.
2. Remove the radiator. Section L.
3. Pivot the dynamo inwards and remove the fan belt.
4. Unscrew the starting dog and remove the damper.
5. Remove the front cover and mark the camshaft and crankshaft chain wheels, then mark the casing opposite these marks.
6. Release the pawl from the ratchet, compress the tensioner spring by lifting the jockey pulley arm as far as possible, then fit clip, Part No. 262748, over the tensioner.
7. Remove the jockey pulley; remove the driving chain and discard.
8. With the marks on chain wheels and casing aligned, fit the new chain with "no slack" on the driving side.
9. Fit the pulley arm and jockey wheel and check that the exhaust valve of No. 1 cylinder is fully open when the timing pointer is in line with the E.P. mark on the flywheel. See Operation A/56.
10. Complete the assembly by reversing the removal procedure.

Piston and connecting rod removal.**Operation A/82**

1. Remove cylinder head. Operation A/68.
2. Drain the oil from the sump. Jack the front end of vehicle up, and position suitable stands beneath the chassis side members.
3. Remove sump carefully to avoid damage to the joint washer. Remove the connecting rod caps, bearings and bolts.
4. Push each connecting rod up and turn to engage the slots at the bottom of the cylinder bore. Remove the circlips; withdraw the gudgeon pin, using extractor Part No. 263052; remove the piston.
5. Lower each connecting rod, turning the crankshaft as necessary to effect withdrawal.

Piston and connecting rod—fitment**Operation A/84**

1. Reverse the removal procedure, using tool Part No. 263053 to refit the gudgeon pins, noting that when cold and dry, the gudgeon pin should be an *easy sliding fit* in the connecting rod and should have a *slight interference fit* in both piston bores, i.e. so that it can be pressed in by hand but will not fall out under its own weight.

2. Fit the connecting rods with the oil spray hole on the opposite side to the camshaft. Tighten the nuts to 30 lb/ft. (4 mKg) on 1948-53 models and to 40 lb/ft. (5,5 mKg) on 1954-58 models.
3. Refit sump and joint washer. Refit the cylinder head, Operation A/70.
4. Refill with oil.

External oil filter, 1955-58 models—removal
Operation A/86

1. Jack the front end of vehicle up and position suitable stands beneath the side members. Place a drip tray under the filter.
2. Remove the securing bolts and withdraw the filter complete.

External oil filter, 1955-58 models—fitment
Operation A/88

1. Fit a new gasket between the filter head and cylinder block, then reverse removal procedure.

External oil filter element, 1955-58 models—renewal
Operation A/90

1. See item 1 of Operation A/86.
2. Unscrew the bolt at base of container, then remove the element and container complete.
3. Discard the old element and the large rubber sealing ring from filter head.
4. Wash the container thoroughly in paraffin or petrol, fit the new element and rubber sealing ring, ensure that all the sealing washers are in position, and that the container is correctly located in the top cover. Tighten securing bolts in base of container.

External oil filter, to renew, 1948-54 models

1. Disconnect the inlet and outlet pipes from the filter.
2. Slacken the four set bolts securing the filter mounting bracket and clip to the cylinder block; withdraw and discard the filter.
3. Fit the new filter by reversing this procedure, and refill the engine with one of the recommended lubricants.
4. Run the engine for five minutes and inspect and rectify any oil leaks.
5. Check the engine oil level and top up as necessary.

DEFECT LOCATION

(Symptom, Cause and Remedy)

A—ENGINE FAILS TO START

1. Incorrect starting procedure—*See Instruction Manual.*
2. Starter motor speed too low—*Check battery and connections.*
3. Faulty ignition system—*Section P.*
4. Water or dirt in fuel system—*Section M.*
5. Carburetter flooding—*Section M.*
6. Defective fuel pump—*Section M.*
7. Defective starter motor—*Section P.*
8. Starter pinion jammed in flywheel—*Rotate starter shaft with spanner to free pinion.*
9. Starter pinion not engaging—*Clean drive sleeve and pinion with paraffin.*

B—ENGINE STALLS.

1. Low idling speed—*Section M.*
2. Faulty sparking plugs—*Rectify.*
3. Faulty coil or condenser—*Renew.*
4. Faulty distributor points—*Rectify or renew. Section P.*
5. Incorrect tappet clearance—*Adjust.*
6. Incorrect mixture—*Adjust carburetter. Section M.*
7. Foreign matter in fuel system—*Section M.*

C—LACK OF POWER

1. Poor compression—*If the compression is appreciably less than the correct figure, (Page A-16) the piston rings or valves are faulty. Low pressure in adjoining cylinders indicates a faulty cylinder head gasket.*
2. Badly seating valves—*Rectify or renew.*
3. Faulty exhaust silencer—*Renew.*
4. Incorrect ignition timing—*Rectify.*
5. Leaks or restrictions in fuel system—*Section M.*
6. Faulty sparking plugs—*Rectify.*
7. Clutch slip—*Section B.*
8. Excessive carbon deposit—*Decarbonise.*
9. Brakes binding—*Section H.*
10. Faulty coil, condenser or battery—*Section P.*

D—ENGINE RUNS ERRATICALLY

1. Faulty electrical connections—*Rectify.*
2. Defective sparking plugs—*Rectify.*
3. Low battery charge—*Recharge battery. Section P.*
4. Defective distributor—*Rectify.*
5. Foreign matter in fuel system—*Section M.*
6. Faulty fuel pump—*Section M.*
7. Sticking valves—*Rectify or renew.*
8. Incorrect tappet clearance—*Adjust.*
9. Defective valve springs—*Renew.*
10. Incorrect ignition timing—*Rectify.*
11. Worn valve guides or valves—*Renew.*
12. Faulty cylinder head gasket—*Renew.*
13. Damaged exhaust system—*Rectify or renew.*

E—ENGINE STARTS, BUT STOPS IMMEDIATELY.

1. Faulty electrical connections—*Rectify low tension circuit.*
2. Foreign matter in fuel system—*Section M.*
3. Faulty fuel pump—*Section M.*
4. Low fuel level in tank—*Replenish.*

F—ENGINE FAILS TO IDLE

1. Incorrect carburetter setting—*Section M.*
2. Faulty fuel pump—*Section M.*
3. See defect D, 7-12.
4. See defect D, 1-4.

G—ENGINE MISFIRES ON ACCELERATION

1. Distributor points incorrectly set—*Rectify. Section P.*
2. Faulty coil or condenser—*Renew.*
3. Faulty sparking plug—*Rectify.*
4. Faulty carburetter—*Section M.*

H—ENGINE KNOCKS

1. Ignition timing advanced—*Adjust.*
2. Excessive carbon deposit—*Decarbonise.*
3. Incorrect carburetter setting—*Section M.*
4. Unsuitable fuel—*Adjust octane selector.*
5. Worn pistons or bearings—*Renew.*
6. Distributor advance mechanism faulty—*Rectify. Section P.*
7. Defective sparking plugs—*Rectify or renew.*
8. Incorrect tappet clearance—*Adjust.*
9. Incorrect valve timing—*Adjust.*

J—ENGINE BACKFIRES

1. Ignition defect—*Section P.*
2. Carburetter defect—*Section M.*
3. Incorrect valve timing—*Adjust.*
4. Incorrect tappet clearance—*Adjust.*
5. Sticking valve—*Rectify.*
6. Weak valve springs—*Renew.*
7. Badly seating valves—*Rectify or renew.*
8. Excessively worn valve stems and guides—*Renew.*
9. Loose timing chain—*Rectify tensioner.*
10. Excessive carbon deposit—*Decarbonise.*

K—BURNED VALVES

1. Insufficient tappet clearance—*Adjust.*
2. Sticking valves—*Rectify.*
3. Weak valve springs—*Renew.*
4. Excessive deposit on valve seats—*Re-cut.*
5. Distorted valves—*Renew.*

L—NOISY VALVE MECHANISM

1. Excessive tappet clearance—*Adjust.*
2. Sticking valves—*Rectify.*
3. Weak valve springs—*Renew.*
4. Faulty valve mechanism—*Renew worn parts.*

M—MAIN BEARING RATTLE

1. Low oil pressure—*See N.*
2. Excessive bearing clearance—*Renew bearings; grind crankshaft.*
3. Burnt-out bearings—*Renew.*
4. Loose bearing caps—*Tighten.*

N—LOW OIL PRESSURE

1. Thin or diluted oil—*Refill with correct oil.*
2. Low oil level—*Replenish.*
3. Choked pump intake filter—*Clean.*
4. Faulty release valve—*Rectify.*
5. Excessive bearing clearance—*Rectify.*
6. Excessive camshaft bearing clearance—*Rectify.*
7. Loose or restricted oil line—*Rectify.*

GENERAL DATA

Capacity (piston displacement)		Maximum torque, 1948-51	
1948-51 models	.... 1,595 cc (97.34 cu.in.)	models	.... 80 lb/ft. (11 mKg) at 2,000 r.p.m.
Capacity (piston displacement)		Maximum torque, 1952-58	
1952-58 models	.... 1,997 cc (121.9 cu.in.)	models	.... 101 lb/ft. (14 mKg) 1,500 r.p.m.
Number of cylinders	.... 4	Firing order	.... 1—3—4—2
Bore, 1948-51 models	.... 69,5 mm (2.736 in.)	Compression pressure (at starter motor cranking speed, i.e., 300 r.p.m. with engine hot and carburetter butterfly fully open)	.... 125 lb/sq.in. 8,8 kg/cm ²
Bore, 1952-58 models	.... 77,8 mm (3.063 in.)		
Stroke	.... 105 mm (4.134 in.)		
Compression ratio	.... 6.9-1		
B.H.P.	.... 52 at 4,000 r.p.m.		

DETAIL DATA

Camshaft		Maximum permissible run-out on flywheel face	.... .005 in. (0,12 mm)
Journal diameter	.... .874 in.—.0005	Maximum refacing depth	.... .030 in. (0,75 mm)
Clearance in bearing	.... .001 to .002 in. (0,025 to 0,050 mm)	Minimum thickness after grinding:	
End-float	.... .003 to .005 in. (0,075 to 0,12 mm)	88 models, 1956-58	.... 1.204 in. (30,5 mm)
Camshaft bearings		Other models, 1948-56	.... 1.047 in. (26,5 mm)
Type	.... Split Mazak die casting	Markings:	
Internal diameter	.... .876 in.—.001	T.D.C.	.... When opposite pointer, No. 1 piston is at top dead centre
Connecting rods		E.P.	.... When opposite pointer, No. 1 exhaust valve should be fully open. 114° before T.D.C.
Bearing fit on crankpin	.... .001 to .0025 in. (.025 to 0,063 mm)	F.A. 15°, 1948-53 models	.... When opposite pointer, indicates firing point of No. 1 cylinder
Bearing nip	.... .002 to .004 in. (0,05 to 0,10 mm)	F.A. 10°, 1954-58 models	.... When opposite pointer, indicates firing point of No. 1 cylinder.
End-float at big-end	.... .009 to .013 in. (0,23 to 0,33 mm)	Primary pinion bush	
Gudgeon pin bush fit in small end	.... .001 to .002 in. (0,025 to 0,050 mm) interference	Fit in flywheel	.... .001 to .003 in. (0,025 to 0,075 mm) interference
Gudgeon pin bush—internal diameter—reamed in position	.... .8755 in.—.0005 (22,187 mm—0,0127)	Internal diameter—reamed in position	.... .878 in. (22,3 mm)
Fit of gudgeon pin in bush	.... .0003 to .0005 in. (0,0075 to 0,0127 mm) clearance	Fit of shaft in bush	.... .003 to .004 in. (0,075 to 0,10 mm) clearance
Crankshaft		Gudgeon pin	
Journal diameter	.... 2.005 in. (50,80 mm)	Fit in piston (selective assembly)	.... Zero to .0003 in. (zero to 0,0075 mm) interference
Crankpin diameter	.... 1.875 in. (47,52 mm)	Fit in connecting rod bush (selective assembly)	.... .0003 to .0005 in. (0,0075 to 0,0127 mm) clearance
End-float	.... .002 to .006 (0,05 to 0,15 mm)	Main bearings	
Regrind sizes:		Clearance on crankshaft journal	.... .001 to .002 in. (0,025 to 0,05 mm)
Undersize	Journal dia. Crankpin dia.	Bearing fit	.... .001 to .002 in. (0,025 to 0,05 mm)
.010 in.	1.990 in. 1.865 in.		
.020 in.	1.980 in. 1.855 in.		
.030 in.	1.970 in. 1.845 in.		
.040 in.	1.960 in. 1.835 in.		
Flywheel			
Number of teeth	.... 97		
Thickness at pressure face	.... 1.094 in. (27,6 mm)		

Pistons

Type	Light alloy, tin plated
Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin	.0012 to .0017 in. (0,030 to 0,043 mm)
Clearance in bore, measured at top of skirt at right angles to gudgeon pin	.0022 to .0027 in. (0,055 to 0,068 mm)
Gudgeon pin bore, early models	.6872 in. + .0002 in. (17,45 mm + 0,005)
Gudgeon pin bore, late models	.8747 in. + .0002 (22,21 mm + 0,005)

Piston rings

Compression (2)	
Type	Taper periphery
Gap in bore	.015 to .020 in. (0,38 to 0,50 mm)
Clearance in groove	.0005 to .002 in. (0,012 to 0,05 mm)
Scraper ring (upper) Early models only	
Type	Stepped
Gap in bore	.012 to .017 in. (0,3 to 0,4 mm)
Clearance in groove	.0005 to .002 in. (0,012 to 0,05 mm)
Scraper ring (lower)	
Type	Slotted, H section
Gap in bore	.012 to .017 in. (0,3 to 0,4 mm)
Clearance in groove	.0005 to .002 in. (0,012 to 0,05 mm)

Rocker gear

Rockers and cam followers:		
	Inlet	Exhaust
Reamed bore	.500 in. + .001 (12,7 mm + 0,025)	.593 in. + .001 (15,081 mm + 0,025)
Clearance on shaft	.001 to .002 in. (0,025 to 0,050 mm)	.001 to .003 in. (0,025 to 0,075 mm)

Tappet clearance

Exhaust, engine hot or cold	.012 in. (0,30 mm)
Inlet, engine at running temperature	.010 in. (0,25 mm)

Timing chain tensioner

Driving chain	
Type	Endless roller, pre-stretched
Diameter of rollers	$\frac{1}{4}$ in. (6,35 mm)
Chain tensioner spring	
Free length	4.200 in.
Length in position	1.937 in.
Load in position	15 $\frac{1}{2}$ lb \pm $\frac{1}{2}$ (7 Kg \pm $\frac{1}{2}$)
Hydraulic chain tensioner	
Inlet valve lifts at	4 to 12 lb/sq.in. (0,30 to 0,80 Kg/cm ²)

Thrust bearings, crankshaft

Type	Semi-circular, steel backed, tin plated
Thickness	.093 in.—.002 (2,36 mm — 0,05)
Oversizes	.0025 in., .005 in., .0075 in. and .010 in.

Torque loadings

Connecting rod bolts	40 lb/ft. (5,5 mKg)
Cylinder head bolts:	
7/16 in. B.S.F.	50 lb/ft. (7 mKg)
3/8 in. B.S.F.	30 lb/ft. (4 mKg)
Main bearing bolts	80 lb/ft. (11 mKg)
Flywheel securing bolts	70 lb/ft. (9,7 mKg)

Valves

Inlet valve	
Diameter (stem)	.343 in.—.001
Face angle	30°— $\frac{1}{4}$
Exhaust valve	
Diameter	.343 in.—.001
Face angle	45°— $\frac{1}{4}$

Valve seat—inlet

Type	Integral
Angle	30° + $\frac{1}{4}$

Valve seat—exhaust

Type	Removable insert
Angle	45° + $\frac{1}{4}$
Fit in cylinder block	.005 in. to .007 in. (0,12 to 0,17 mm) interference

Fit of inlet and exhaust

valves in guides	.002 to .003 in. (0,05 to 0,08 mm) clearance
------------------	--

Valve guides

Length—inlet	1.968 in.—.016
Length—exhaust	2.250 in.—.016
Reamed bore	.3448 in. + .0005 (8,757 mm + 0,012)

Valve springs

Free length, inner	.... 1.817 in. (46,0 mm)
Free length, outer	.... 1.845 in. (46,8 mm)
Compressed length, inner	.... 1.469 in. (36,3 mm)
Compressed length, outer	.... 1.625 in. (41,2 mm)
Pressure, valve closed, inner	.... 10 lb. $\pm \frac{1}{2}$ (4,5 kg $\pm \frac{1}{2}$)
Pressure, valve closed, outer	.... 32.8 lb. ± 1 (14,8 kg $\pm \frac{1}{2}$)
Pressure, valve open, inner	.... 17.9 lb. ± 1 (8,1 kg $\pm \frac{1}{2}$)
Pressure, valve open, outer	.... 74.0 lbs. ± 1 (33,5 kg $\pm \frac{1}{2}$)

Valve timing

Inlet opens	.... 9° B.T.D.C.
closes	.... 45° A.B.D.C.
peak	.... 83° B.B.D.C.
Exhaust opens	.... 42° B.B.D.C.
closes	.... 16° A.T.D.C.
peak	.... 66° A.B.D.C.

Vibration damper

Fit of bush in flywheel	.002 to .004 in. (0,05 to 0,10 mm) interference
Clearance of bush or driving flange	.... .005 to .007 in. (0,12 to 0,17 mm)
Run-out on front face	.005 in. (0,12 mm) maximum
Permissible out-of- balance 3 grams

Section A – ENGINE – DIESEL MODELS

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ENGINE REMOVAL AND DISMANTLING PROCEDURE

Removing engine Operation A/402

1. If fitted remove the spare wheel from bonnet.
2. Disconnect the bonnet support stay and remove the bonnet.
3. Disconnect the hose from inlet manifold, unscrew the securing wing nut and lift the air cleaner and hose clear.
4. Disconnect the battery leads and remove the L.H. battery.
5. Drain the coolant from system (one tap at bottom L.H. side of radiator and one tap at L.H. side of cylinder block).
6. Disconnect the side lamp leads at each side of the grille panel assembly and the front lamp harness from the junction box at R.H. side of scuttle, then pull the wiring clear to front of engine.
7. Detach the top hose at radiator header tank and the bottom hose from water pump inlet.
8. Remove the fan blades.
9. Remove the bolts securing the grille panel to front cross member and front wings.
10. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle. Remove the L.H. battery support.
11. Loosen the bolts securing the intermediate to front exhaust pipe and disconnect the exhaust pipe from exhaust manifold.
12. Disconnect the heater pipes (if fitted) at the engine side of bulkhead.
13. Disconnect the wiring from starter motor, dynamo, oil pressure warning switch and glow-plug lead at resistance on bulkhead.
14. Disconnect the fuel inlet and outlet pipes from fuel lift pump and injection pump, then disconnect the three pipes joined at scuttle, lower R.H. side.
15. Remove the accelerator control rod, then the cut-off control cable from the steady bracket on engine and from the lever on injection pump.
16. Fit the engine sling to the support brackets at front and rear of cylinder head and with suitable lifting tackle just take the strain.
17. Remove the front floor and gearbox cover.
18. Support the gearbox assembly with a jack or packing blocks.
19. Remove the clutch slave cylinder bracket from the flywheel housing and pull back the complete assembly as far as possible.
20. Remove the remaining nuts and washers securing the gearbox to the flywheel housing.
21. Remove the bolts from engine front support brackets, allow the engine to move forward and thus clear the gearbox input shaft. Ensure that

the speedometer cable, etc., and all wires are clear, then hoist the engine gently from the vehicle.

22. Drain oil from sump.
23. Bolt the engine to a suitable stand.

DISMANTLING ENGINE

Externals Operation A/404

1. Disconnect the fuel spill gallery pipe from injectors and remove the fuel feed pipes— injection pump to injectors.
2. Remove the securing straps, then withdraw the injectors and seating washers. Make sure the small steel washer is also removed from out of the orifice in the cylinder head.
3. Release the accelerator pull-off spring and remove the injection pump; disconnect the wiring, then remove heater plugs carefully to avoid damage to element.
4. Remove the inlet and exhaust manifolds, then the starter, fan belt and dynamo.
5. Disconnect the heater pipes and water tap from cylinder head if fitted. Remove the fuel filter from mounting bracket at R.H. front of engine.
6. The rearmost tappet chamber cover and fuel lift pump may be removed as one unit; the foremost tappet chamber cover and oil filler pipe may also be removed together.
7. Remove the external full-flow oil filter complete with oil pressure warning switch.
8. Disconnect the oil feed pipe—gallery to cylinder head and the hose, thermostat to water pump casing.
9. Drain the oil and remove the sump.

Oil pump Operation A/406

1. Remove the securing bolts and withdraw the pump assembly.
2. Withdraw the driving shaft from the pump upper casing.
3. Unscrew the securing nut and remove the filter gauze assembly.

Note.—See Section AO for oil pump strip and assembly.

Vertical drive shaft gear Operation A/408

1. Lift the drive shaft gear and external bush assembly clear, with a pair of snipe-nosed pliers, after removing the locating screw from the external filter adaptor joint face. The split bush may be removed by tapping to release the dowels. Do not remove the aluminium plug in the gear unless absolutely necessary. A new plug must be fitted if the old one has been removed.

Vibration damper Operation A/410

1. Remove the starting nut and tab washer, then withdraw the vibration damper assembly from crankshaft.

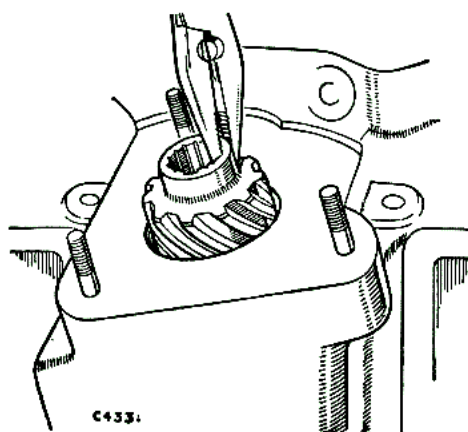


Fig. A-401—Removing the vertical drive shaft gears

2. Unscrew the set bolts securing the back plate to flywheel, withdraw the back plate, rubber discs and shims. Extract the bushes from flywheel and back plate if necessary.

Water pump and front cover

Operation A/412

1. Remove the front cover and water pump assembly. For overhaul of water pump, see Section L.

Timing chain tensioner and chain wheels

Operation A/414

1. Remove the ratchet securing bolt and withdraw the ratchet and spring. Compress the chain tensioner spring and unscrew the lower fixing bolts and remove the chain tensioner assembly. Lift off the timing chain and remove the chain wheels.
2. The screwed plug and ball may be removed from the piston if necessary and the piston pressed from its housing if unduly worn.
3. The tensioner cylinder and bush must be renewed complete if the bush is unduly worn.
4. The bushes in idler wheel and ratchet arm should also be removed if worn beyond reasonable limits.

Rocker gear and cylinder head

Operation A/416

1. Remove the rocker gear cover, unscrew the bolts securing the rocker shaft support brackets, and lift the rocker gear assembly complete from the cylinder head.
2. Unscrew the rocker cover securing studs from the centre and end support brackets and the locating set bolts from the intermediate support brackets. Remove the component parts from the rocker shafts but retain the items in their correct relative positions.

3. Withdraw the push rods and insert them in a piece of cardboard pre-pierced and marked.
4. Remove the cover and joint washer, then lift out the thermostat.
5. Loosen the securing bolts evenly and lift the cylinder head clear.
6. Using a valve spring compressing tool, Part No. 276102, remove the valve assemblies.
7. If necessary remove the hot plugs by inserting a copper drift through the injector aperture, then tap evenly and gently around the inside of hot plug. Avoid using a hammer if possible and thus minimise the possibility of damage. The push rod tubes may also be removed if necessary by drifting them out, using tool Part No. 274399.
8. Drift the valve guides from the cylinder head using tool, Part No. 274401 (exhaust) and 274400 (inlet). Remove and scrap the seals.

Tappet guide, roller and tappet

Operation A/418

1. Remove the locating bolts from R.H. side of cylinder block and lift out the brass tappets. With a piece of bent wire remove the rollers; then remove the tappet guide.
The guide, roller and tappet are marked to ensure correct refitment. The rollers have a chamfer on their front face inside diameter.

Camshaft removal

Operation A/420

1. Remove the camshaft front thrust plate, then withdraw the camshaft.

Flywheel

Operation A/422

1. Remove the clutch assembly, then the flywheel securing bolts and withdraw the flywheel. The primary pinion bush may be extracted if necessary.

Pistons, connecting rods and liners

Operation A/424

1. Turn the crankshaft until the pistons of numbers 1 and 4 cylinders are at B.D.C. Remove the big end bolt securing nuts of numbers 1 and 4 connecting rods, then withdraw the piston and connecting rod assemblies from the top of cylinder block.
Retain the bearing shells in pairs, preferably taped together on the crankpins from which they were removed, until ready for inspection. Repeat for numbers 2 and 3 assemblies.
Remove the piston rings, gudgeon pin retaining circlips and press out the gudgeon pins; if necessary remove the small end bushes from connecting rods.

2. After marking the top with a scribe to ensure correct refitment, the liners may be withdrawn by hand and the sealing rings removed from the crankcase end of cylinder block bores.

Note: Ensure that the component parts are retained in their correct relative positions.

Crankshaft, main bearings and rear bearing seal Operation A/426

1. Remove the main bearing caps, lift the crankshaft clear and place in a suitable stand.

Retain the shell bearings in pairs adjacent to the journal from which they were removed.

2. The rear bearing seal halves may be removed from the cylinder block and bearing cap.

Camshaft bearing removal Operation A/427

Note: When new camshaft bearings are to be fitted, the front and front intermediate bearings must be removed and new ones fitted before removing the rear bearings. See Items 1 to 5 of Operation A/428 for bearing fitment.

2. Unscrew the $3\frac{1}{2}$ in. (88,9 mm.) long stud from the joint face at front of cylinder block.
3. Drift the front camshaft bearing in to the foremost tappet chamber using tool, Part No. 274388, then withdraw the bearing from the chamber aperture.

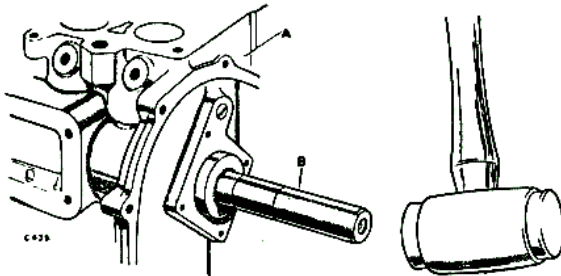


Fig. A-402—Outer camshaft bearing removal
A—Cylinder block. B—Drift.

The front intermediate bearing is removed by drifting it into the fuel injection pump drive chamber, using the same tool, but it must be collapsed before withdrawing from the drive aperture as illustrated by Fig. A-403.

Note: The inner bearing should be positioned at the innermost lower side of the chamber, before inserting a suitable bar which should then be tapped lightly against the bearing. Care must be taken to avoid damage to the machined faces in the chamber.

4. Fit new front and front intermediate bearings, Items 1 to 5 Operation A/428, before removing the rear bearings by drifting them, using the same tools and method employed when removing the foremost bearings.

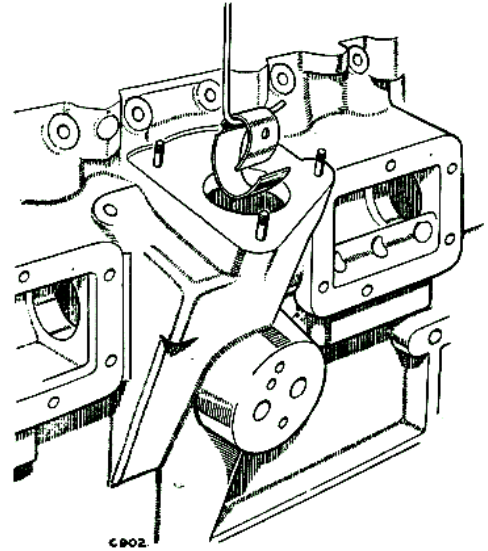


Fig. A-403—Inner camshaft bearing removal

ENGINE ASSEMBLY

Camshaft bearings Operation A/428

When replacing camshafts it should be noted that $2\frac{1}{4}$ litre petrol engine camshafts are marked "Petrol" between No. 1 and No. 2 cam lobes. This is to differentiate between Diesel camshafts which are similar in all respects other than the positioning of the cam lobes.

Note: When new camshaft bearings are to be fitted, the front and front intermediate bearings must be removed and new ones fitted before removing the two rearmost bearings. See Items 2 to 4 inclusive of Operation A/420 for bearing removal procedure.

1. Fit a guide tool, Part No. 274385, into the two old rearmost bearings with the part of flange marked "TOP" uppermost, then insert three end cover set bolts loosely for location purposes. Position a new bearing on to the handle end of bearing fitting bar, Part No. 274382, and locate by means of the peg and semi-circular cut-out, then slide a spacer, Part No. 274383, on to the fitting bar and engage the locating shoulder
2. Place a new bearing on spigot, Part No. 274384, and position it inside the foremost tappet chamber with the bearing nearest the front intermediate housing.

Insert the bearing fitting bar into the front bearing housing and feed the spigot on to the bar; withdraw the spigot handle. Turn the

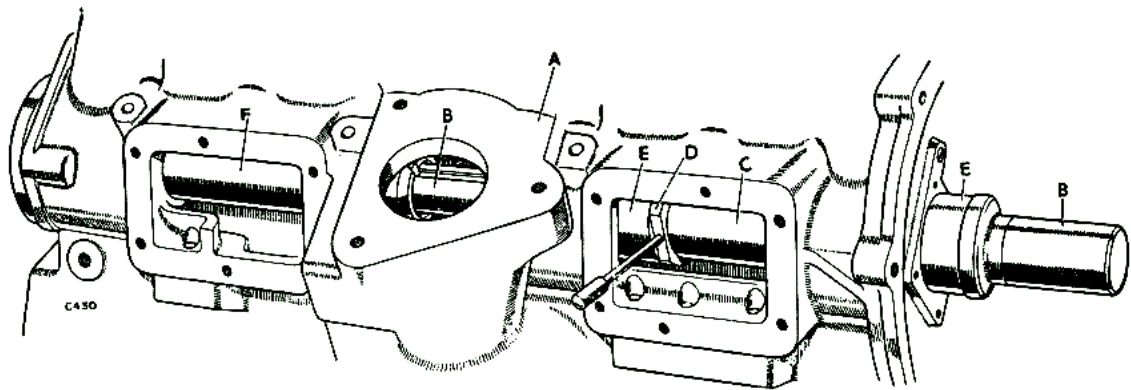


Fig. A-404—Fitting camshaft front bearings

A—Cylinder block. C—Spacer.
B—Bearing fitting bar. D—Spigot.
E—New bearings. F—Guide tube.

- spigot to engage the locating shoulder in the spacer, then press the fitting bar inward, turning as necessary to engage the bar slot with the peg in guide tube.
3. When the fitting bar has been pressed in as far as possible by hand, ensure that all locating points are properly engaged, then drive the bearings into position with a hide-faced hammer. Remove the bearing fitting tools and check the oil holes for alignment. Remove the two rearmost bearings—Item 4, Operation A/420.
 4. Fit new camshaft rear bearings in the same manner as for front bearing fitment, but remove the spacer from fitting bar and use guide tool, Part No. 274386, instead of the guide tube used when fitting front bearings.
 5. Locate a guide plug, Part No. 274394, in the front new camshaft bearing and locate, using the end-plate screws. Do not tighten these screws until the reamer, Part No. 274389, is put into position and the guide collar immediately in front of the cutter is entered into the rearmost bearing, which is first to be cut. This precaution is to ensure correct alignment of the reamer.

Before commencing the reamering operation it is necessary to turn the engine block to a vertical position, i.e. front end facing downwards, in order that the weight of the reamer will assist in the cutting operation. As each bearing is cut the reamer should be held steady by the operator whilst an assistant, using a high pressure air line, blows away the white metal cuttings, before allowing the reamer to enter the next bearing.

After the rearmost and the two intermediate bearings have been cut, remove the guide plug Part No. 274394, before cutting the foremost bearing. Remove the reamer handle and carefully remove the reamer, turning it in the same direction as for cutting. Care must be taken to prevent the reamer damaging the foremost bearing as the reamer is removed.

Note: No lubricant is necessary for the reamering operation, best results are obtained when the bearings are cut dry.

Remove the plugs from the ends of oil gallery passage and clean the gallery and oil feed passages to camshaft and crankshaft bearings, using compressed air. Refit the plugs flush with the face of the cylinder block and lock in position.

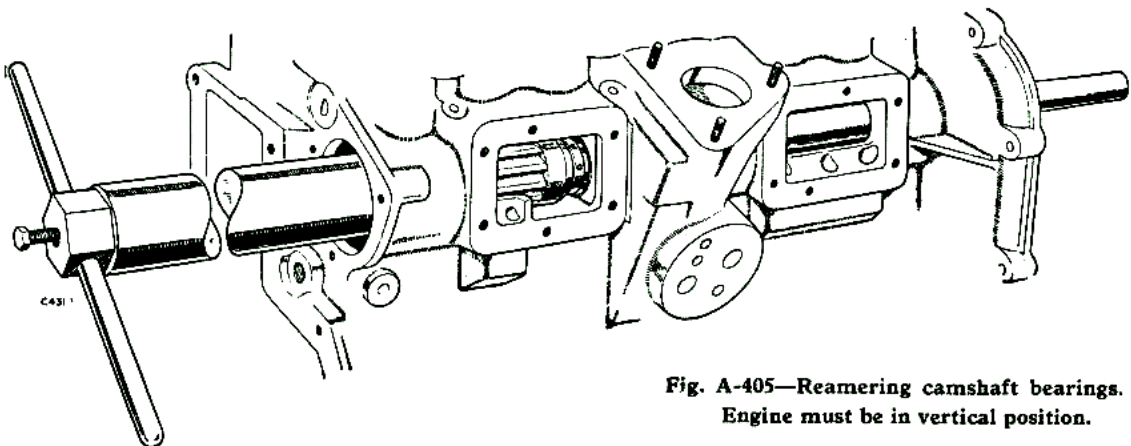


Fig. A-405—Reamering camshaft bearings.
Engine must be in vertical position.

Crankshaft, main bearings and seal**Operation A/430**

Note: Crankshafts considered unserviceable because of wear on the journals must not under any circumstances be reconditioned, and no undersize main bearings are supplied.

It is most important, therefore, that when a Diesel crankshaft becomes unserviceable it should be scrapped out, and damaged to ensure that it cannot be subsequently reconditioned. A new crankshaft of the latest type must be fitted.

1. To check that the bearing caps have not been filed, first assemble the caps without bearing shells to the crankcase, ensuring that they are correctly located by means of the dowels. Tighten both securing bolts for each cap, then slacken one bolt of each pair right off. There should be no clearance at the joint face.

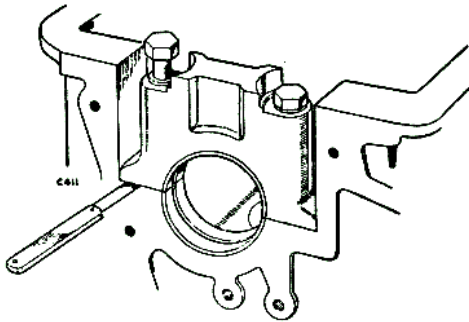


Fig. A-406—Checking main bearing nip

Check the main bearing nip as follows —

Remove the bearing caps and fit the bearing shells, locating by means of the tags. Tighten the caps down and slacken off one bolt of each pair. Check the bearing nip, as illustrated in Fig. A-406, ensuring that the clearance does not exceed .004 to .006 in. (0,10 to 0,15 mm). The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.

2. When the bearing nip has been checked, remove the caps and bearing shell bottom halves. Position a standard size thrust bearing at each side of centre bearing shell—top half, and fit the crankshaft.
3. Refit the bearing shell bottom halves and bearing caps. Tighten the securing bolts evenly and check each bearing in turn for correct clearance. The crankshaft should resist rotation when a feeler paper, .0025 in. (0,06 mm) thick, is placed between any one bearing shell and crankshaft journal, and turn freely by hand when the feeler paper is removed. Adjust by selective assembly of bearing shells.

4. Mount a dial test indicator, then check and note the crankshaft end-float reading which should be .002 to .006 in. (0,050 to 0,15 mm).
5. Remove the bearing caps, bottom half shells and crankshaft.
6. To the rear main bearing cap fit neoprene seals in recess at each side, and on the rear face fit the lower half of crankshaft rear bearing seal.

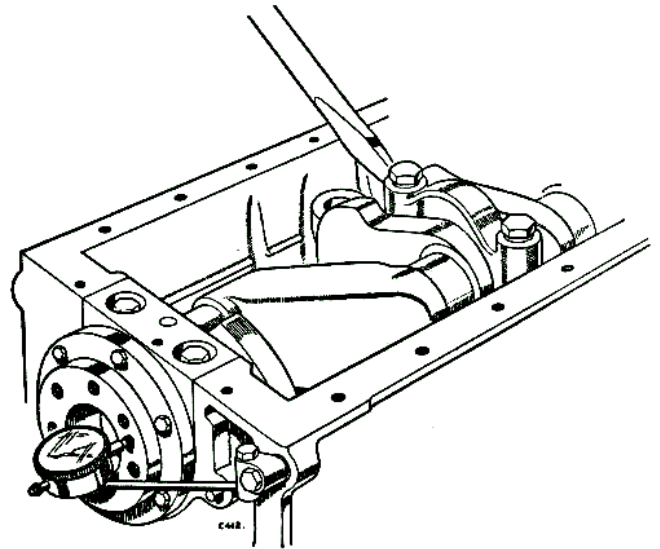


Fig. A-407—Checking crankshaft end-float

7. Fit the top half of crankshaft rear bearing oil seal to the crankcase. Lubricate bearing face with Silicone MS4 Compound.
8. If the crankshaft end-float reading, obtained in Item 4, was not within the limits, fit suitable oversize thrust bearings. The variation of thrust bearing thickness at each side must not exceed .003 in. (0,07 mm) to ensure that the crankshaft remains centralised.

Note: It will be found advantageous to carry out Items 5, 6 and 7 of Operation A/434 relating to connecting rods at this stage.

9. Lubricate the crankshaft journals, main bearing shells and thrust bearings, then refit crankshaft. Fitment of the rear main bearing cap, with side seals in position, will be facilitated by using a lead tool (Part No. 270304) fitted to the sump studs adjacent to rear bearing cap aperture. See Fig. A-408.

Smear bearing face of crankshaft rear bearing oil seal with Silicone MS4 Compound.

It will be found advantageous to cut a slight lead on to the bottom edges of side seals as this will prevent them from folding under the cap during fitment, thus causing an oil leak due to the cap not seating properly. Lubricate seals with Silicone MS4 Compound.

Crankshaft, main bearings and seal**Operation A/430**

Note: Crankshafts considered unserviceable because of wear on the journals must not under any circumstances be reconditioned, and no undersize main bearings are supplied.

It is most important, therefore, that when a Diesel crankshaft becomes unserviceable it should be scrapped out, and damaged to ensure that it cannot be subsequently reconditioned. A new crankshaft of the latest type must be fitted.

1. To check that the bearing caps have not been filed, first assemble the caps without bearing shells to the crankcase, ensuring that they are correctly located by means of the dowels. Tighten both securing bolts for each cap, then slacken one bolt of each pair right off. There should be no clearance at the joint face.

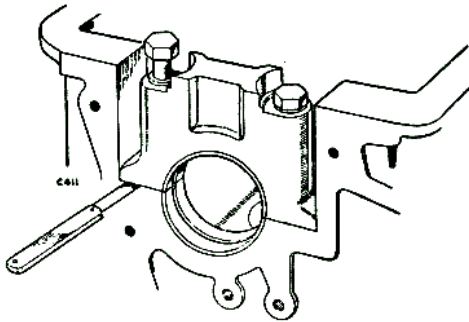


Fig. A-406—Checking main bearing nip

Check the main bearing nip as follows —

Remove the bearing caps and fit the bearing shells, locating by means of the tags. Tighten the caps down and slacken off one bolt of each pair. Check the bearing nip, as illustrated in Fig. A-406, ensuring that the clearance does not exceed .004 to .006 in. (0,10 to 0,15 mm). The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.

2. When the bearing nip has been checked, remove the caps and bearing shell bottom halves. Position a standard size thrust bearing at each side of centre bearing shell—top half, and fit the crankshaft.
3. Refit the bearing shell bottom halves and bearing caps. Tighten the securing bolts evenly and check each bearing in turn for correct clearance. The crankshaft should resist rotation when a feeler paper, .0025 in. (0,06 mm) thick, is placed between any one bearing shell and crankshaft journal, and turn freely by hand when the feeler paper is removed. Adjust by selective assembly of bearing shells.

4. Mount a dial test indicator, then check and note the crankshaft end-float reading which should be .002 to .006 in. (0,050 to 0,15 mm).
5. Remove the bearing caps, bottom half shells and crankshaft.
6. To the rear main bearing cap fit neoprene seals in recess at each side, and on the rear face fit the lower half of crankshaft rear bearing seal.

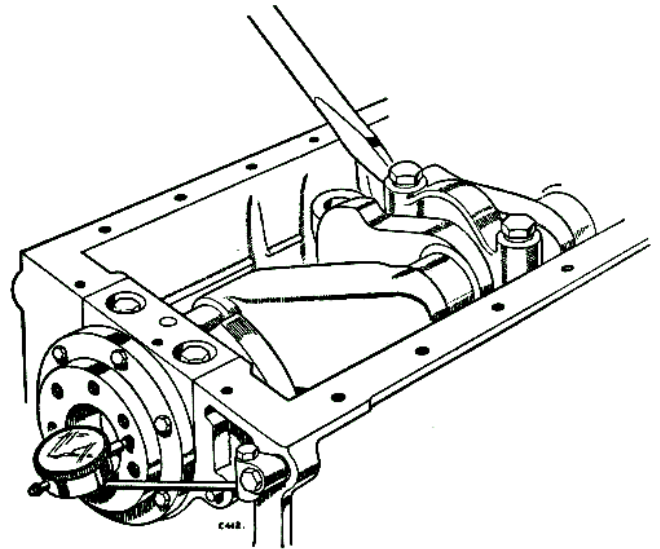


Fig. A-407—Checking crankshaft end-float

7. Fit the top half of crankshaft rear bearing oil seal to the crankcase. Lubricate bearing face with Silicone MS4 Compound.
8. If the crankshaft end-float reading, obtained in Item 4, was not within the limits, fit suitable oversize thrust bearings. The variation of thrust bearing thickness at each side must not exceed .003 in. (0,07 mm) to ensure that the crankshaft remains centralised.

Note: It will be found advantageous to carry out Items 5, 6 and 7 of Operation A/434 relating to connecting rods at this stage.

9. Lubricate the crankshaft journals, main bearing shells and thrust bearings, then refit crankshaft. Fitment of the rear main bearing cap, with side seals in position, will be facilitated by using a lead tool (Part No. 270304) fitted to the sump studs adjacent to rear bearing cap aperture. See Fig. A-408.

Smear bearing face of crankshaft rear bearing oil seal with Silicone MS4 Compound.

It will be found advantageous to cut a slight lead on to the bottom edges of side seals as this will prevent them from folding under the cap during fitment, thus causing an oil leak due to the cap not seating properly. Lubricate seals with Silicone MS4 Compound.

Cylinder liners and seals Operation A/432

1. Smear the sealing ring grooves at the crankcase end of cylinder block bores, and the liner sealing rings, with Silicone MS4 Compound, then fit a ring to the upper and lower grooves of each bore.

Lightly coat the underside of the liner flange and the mating recess in the cylinder block with Hylomar SQ 32 M sealing compound, using a fairly stiff brush for application.

The coated joint faces may be allowed to dry thoroughly before assembly if desired, but a minimum drying time of ten minutes must be allowed.

A small hole is drilled through the cylinder block into the middle groove to provide evidence of coolant leakage past the top sealing ring.

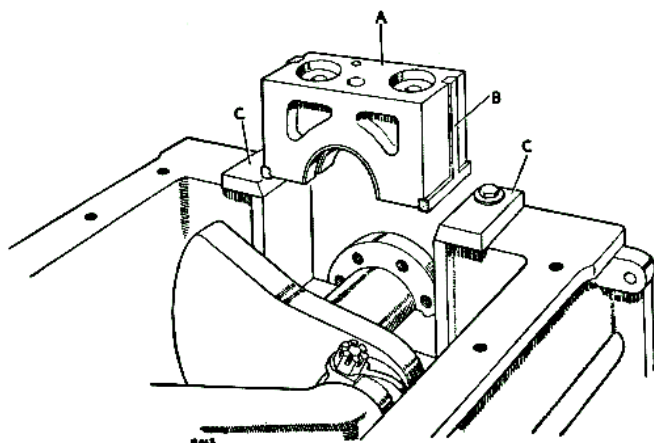


Fig. A-408—Fitting rear bearing cap and seal assembly
A—Bearing cap. B—Seal. C—Lead tool.

2. Press the liners into their respective bores by hand and align the marks made whilst dismantling.

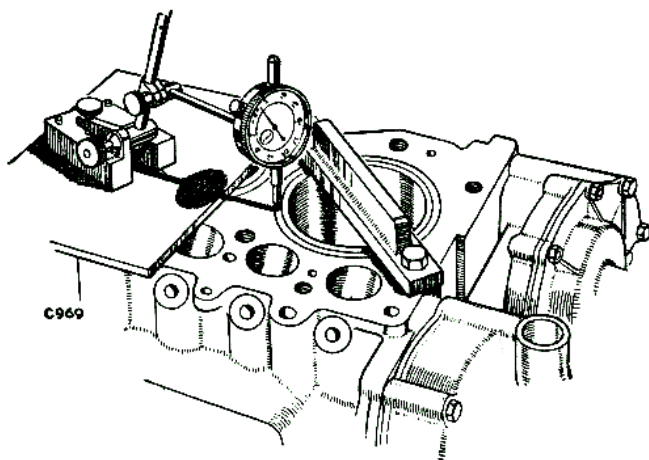


Fig. A-409—Checking cylinder liner extension

3. Clamp each liner in turn in the manner illustrated and tighten the securing bolts to 65 lb/ft. (8,9 Kg/m) torque. Mount a dial test indicator

and check that the outer edge of the cylinder liner is from .002 to .004 in. (0,050 to 0,10 mm) above the cylinder head joint face. See Fig. A-410. Adjust if necessary by removing liner and adding a suitable shim washer under the flange. Clamp and re-check liner as described above. Shim washers are available .002 in. (0,50 mm) and .004 in. (0,10 mm) thick.

Connecting rods Operation A/434

1. The oil hole in gudgeon pin bush is pre-drilled and care must be taken to ensure that the oil holes of bush and connecting rod will align when the bush is pressed into position. The gudgeon pin bushes should be a .001 to .002 in. (0,025 to 0,050 mm) interference fit in connecting rods. Ream the bush when fitted to connecting rod to allow a .0003 to .0005 in. (0,0076 to 0,0127 mm) gudgeon pin clearance. Ensure that correct alignment is maintained while reamering.

This fit is selected to give the smallest possible clearance consistent with a smooth revolving action.

2. Fit each connecting rod to a suitable test rig and check for twist and mal-alignment.
3. To check that the connecting rod and cap have not been filed:—

(a) Select the correct cap for each connecting rod, as denoted by the number stamped near the joint faces. This number also indicates the crankpin to which it must be fitted.

Assemble the connecting rods, less shell bearings, with corresponding numbers together.

- (b) Tighten the securing bolts, then slacken one of them right off and check that there is no clearance at the joint face.
- Check bearing nip as follows:—
- (c) Fit the bearing shells and tighten both securing bolts—slacken one bolt as before and check the nip with a feeler gauge; this should be .002 to .004 in. (0,050 to 0,10 mm).

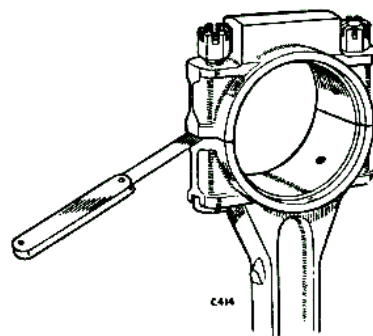


Fig. A-410—
Checking the big-end bearing nip

- (d) The nip can be corrected by selective assembly of the bearing shells; these are available in slightly varying thickness. Do not file the rod or cap.

Cylinder liners and seals Operation A/432

1. Smear the sealing ring grooves at the crankcase end of cylinder block bores, and the liner sealing rings, with Silicone MS4 Compound, then fit a ring to the upper and lower grooves of each bore.

Lightly coat the underside of the liner flange and the mating recess in the cylinder block with Hylomar SQ 32 M sealing compound, using a fairly stiff brush for application.

The coated joint faces may be allowed to dry thoroughly before assembly if desired, but a minimum drying time of ten minutes must be allowed.

A small hole is drilled through the cylinder block into the middle groove to provide evidence of coolant leakage past the top sealing ring.

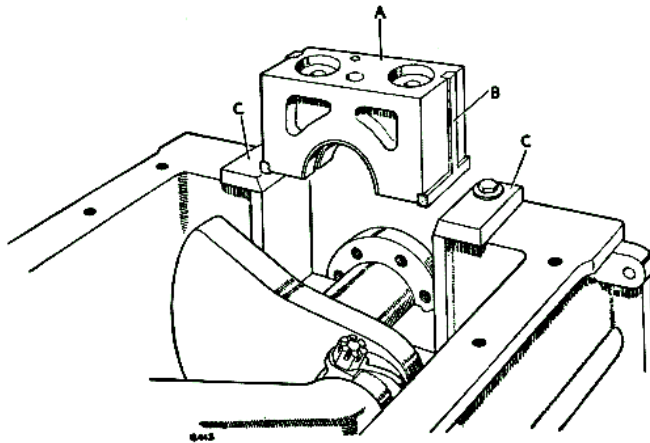


Fig. A-408—Fitting rear bearing cap and seal assembly
A—Bearing cap. B—Seal. C—Lead tool.

2. Press the liners into their respective bores by hand and align the marks made whilst dismantling.

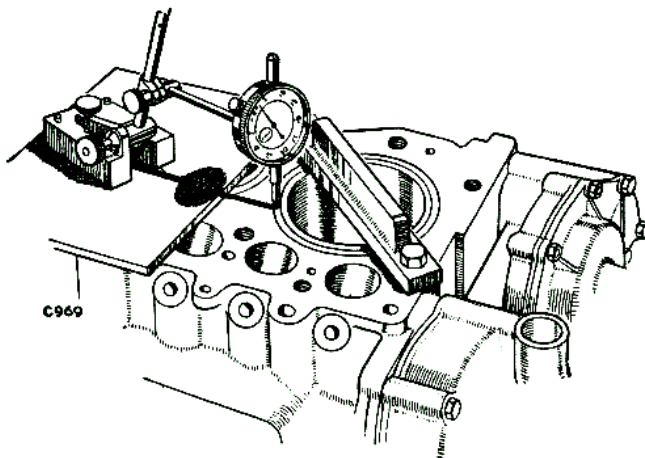


Fig. A-409—Checking cylinder liner extension

3. Clamp each liner in turn in the manner illustrated and tighten the securing bolts to 65 lb/ft. (8,9 Kg/m) torque. Mount a dial test indicator

and check that the outer edge of the cylinder liner is from .002 to .004 in. (0,050 to 0,10 mm) above the cylinder head joint face. See Fig. A-410. Adjust if necessary by removing liner and adding a suitable shim washer under the flange. Clamp and re-check liner as described above. Shim washers are available .002 in. (0,50 mm) and .004 in. (0,10 mm) thick.

Connecting rods Operation A/434

1. The oil hole in gudgeon pin bush is pre-drilled and care must be taken to ensure that the oil holes of bush and connecting rod will align when the bush is pressed into position. The gudgeon pin bushes should be a .001 to .002 in. (0,025 to 0,050 mm) interference fit in connecting rods. Ream the bush when fitted to connecting rod to allow a .0003 to .0005 in. (0,0076 to 0,0127 mm) gudgeon pin clearance. Ensure that correct alignment is maintained while reamering.

This fit is selected to give the smallest possible clearance consistent with a smooth revolving action.

2. Fit each connecting rod to a suitable test rig and check for twist and mal-alignment.
3. To check that the connecting rod and cap have not been filed:—
 - (a) Select the correct cap for each connecting rod, as denoted by the number stamped near the joint faces. This number also indicates the crankpin to which it must be fitted. Assemble the connecting rods, less shell bearings, with corresponding numbers together.
 - (b) Tighten the securing bolts, then slacken one of them right off and check that there is no clearance at the joint face.

Check bearing nip as follows:—

- (c) Fit the bearing shells and tighten both securing bolts—slacken one bolt as before and check the nip with a feeler gauge; this should be .002 to .004 in. (0,050 to 0,10 mm).

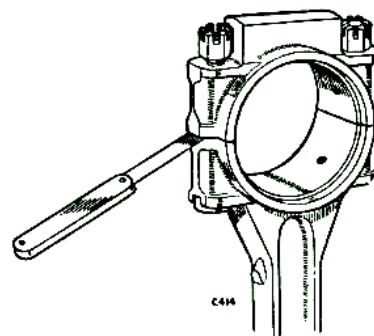


Fig. A-410—
Checking the big-end bearing nip

- (d) The nip can be corrected by selective assembly of the bearing shells; these are available in slightly varying thickness. Do not file the rod or cap.

4. Fit liner retainers (Part No. 274411) to joint face of cylinder block, then rotate assembly in the stand to bring crankshaft uppermost.
5. Assemble the big-end of each connecting rod to its respective crankpin, then check for correct clearance.

The connecting rod should resist rotation when a .0025 in. (0,0635 mm) shim paper is fitted between the crankpin and one-half of big-end bearing shell, then move freely by hand when the shim paper is removed. Adjust by selective assembly of bearing shells.

Bearing clearance should be .001 to .0025 in. (0,025 to 0,063 mm).

6. Check the connecting rod end-float on crankpin by inserting a feeler gauge between the end face of rod and the crankpin shoulder. End-float should be .007 to .011 in. (0,177 to 0,279 mm).
7. Remove the connecting rods from crankshaft, ensuring that the bearing shells are kept with the rods to which they were fitted.

Pistons

Operation A/436

1. When fitting pistons, the clearance in liner bore should be in accordance with the dimensions laid down in the Data Section. In the absence of suitably accurate measuring instruments, a long feeler, .004 in. (0,10 mm) thick, may be inserted in the thrust side of the liner bore, as illustrated in Fig. A-411, and the piston located crown downward. The piston should become a tight fit when the bottom of skirt enters the bore.

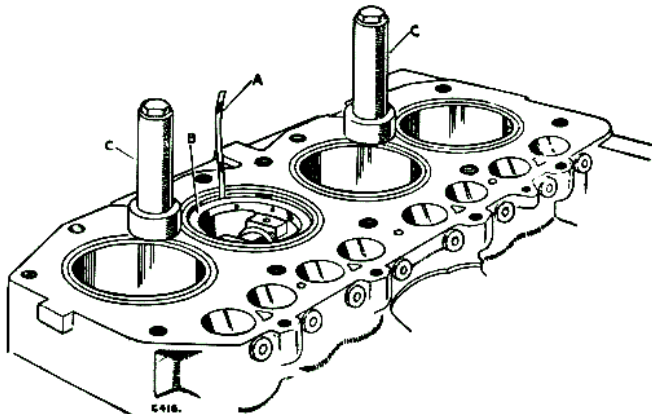


Fig. A-411—Checking piston clearance
A—Feeler gauge. B—Piston. C—Liner retainer.

2. The gudgeon pin, when cold and dry, should be a slight interference fit in both bores of the piston—see Data. It must be fitted by hand pressure but must not be able to fall out of either bore under its own weight.

Lubricate the gudgeon pin when the correct size has been selected for a particular piston, but do not fit and remove the pin from piston unnecessarily thereafter, or the slight interference fit may be lost.

3. Check the piston ring gaps in the liner bores, using an old piston as illustrated in Fig. A-412, to keep the rings square in the bore.

The second and third compression rings are bevel edged and must be fitted with the side marked "T" uppermost; the top chromium plated compression and the oil scraper ring has a square friction edge and may be fitted either way. Fit the piston rings and check the clearance in ring groove. See Data Section.

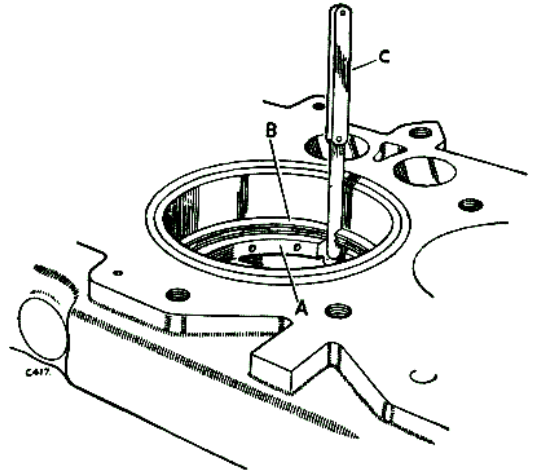


Fig. A-412—Checking a piston ring gap
A—Scrap piston. B—Piston ring. C—Feeler gauge.

Note: It will be seen that provision is made for the fitment of two oil scraper rings. The second groove is for service purposes only.

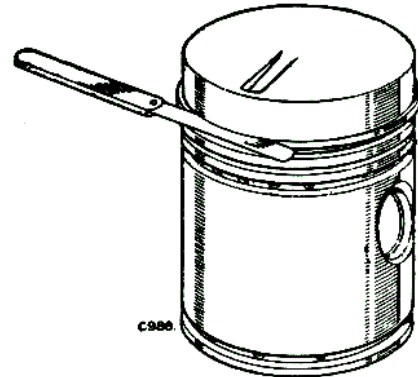


Fig. A-413—Checking ring clearance in groove

Pistons to connecting rods

4. Fit the connecting rod to the piston with the oil spray hole of rod on the same side as the swirl-inducing recess in piston crown. Lock the gudgeon pin in position with circlips.

Piston and connecting rod to cylinder block and crankshaft

Operation A/438

Note: See Items 1 to 6 of Operation A/434 inclusive for gudgeon pin bearing fitment and big-end shell bearing selection.

1. Turn the crankshaft until the crankpins relative to numbers 1 and 4 cylinders are at B.D.C. Insert the connecting rods and pistons for these cylinders from the top of cylinder block, with the oil spray hole in connecting rod and turbulence recess in piston towards the R.H. side of engine—toward the camshaft. Secure the big ends to crankpins, using new nuts and tightening to 35 lb/ft. (4,3 Kgs/m).
2. Repeat Item 1 for numbers 2 and 3 cylinders.

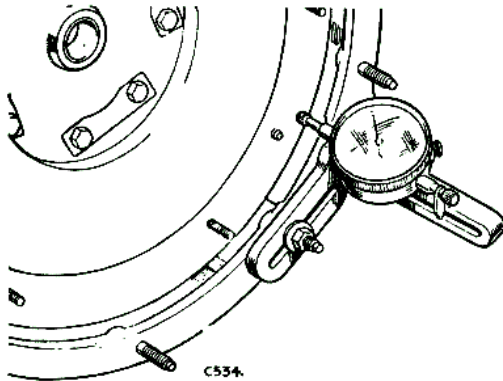


Fig. A-414—Checking run-out on flywheel face

Flywheel housing and flywheel

Operation A/440

1. Ensure that the oil seal is in good condition, then secure the flywheel housing to cylinder block.
2. Fit the flywheel and tighten the securing bolts to 50 lbs/ft. (6,9 Kgs/m) torque.
3. Check the run-out on flywheel face as illustrated by Fig. A-414. The run-out on flywheel face must not exceed .002 in. (0,050 mm).

Camshaft fitment

Operation A/442

Note: For replacement and line boring of camshaft bearing, see Items 1 to 5 of Operation A/428 inclusive.

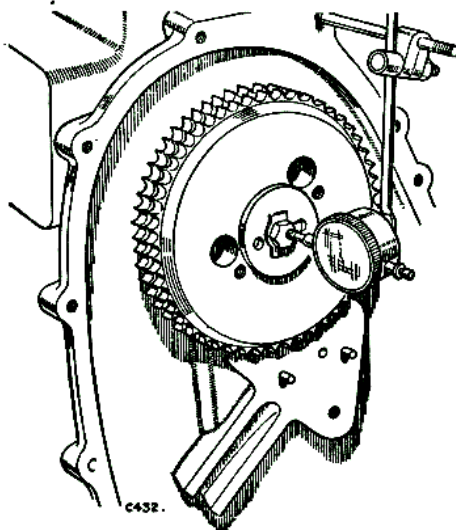


Fig. A-415—Checking camshaft end-float

1. Insert the camshaft—keyed end to extend at front of engine.
2. Fit the front thrust plate and secure the camshaft chain wheel but do not bend up the locking tab for securing bolt at this stage. Check the camshaft end-float with a dial test indicator as illustrated by Fig. A-415 and ensure that the reading is within .0025 to .0055 in. (0,063 to 0,139 mm). Adjust by selective assembly of the front thrust plate.

Tappet assembly and fitment

Operation A/444

1. Before fitting the tappet assembly into the block, thoroughly clean all parts and check that the tappet will move freely in the tappet guide when held in the hand and shaken up and down.

2. Fit tappet guides into the cylinder block, ensuring that the locating hole lines up with the hole in the cylinder block.

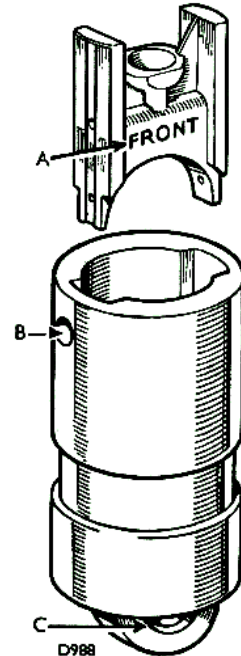


Fig. A-416—Tappet guide and roller

The tappet guides must not be too tight in the block or they may be damaged by insertion of the locating screw in cases when they are not properly aligned.

3. Gently insert the roller into the guide, with the chamfer to the front. Do not drop the roller, as it is easily damaged.
4. Fit tappet into the guide and locate on to the roller. The tappet is marked "Front" and must be facing the front of the guide.
5. Fit the tappet locating screws and washers; the locating screws must be screwed up with the fingers and then tightened; if they are not free, remove and investigate reason.
6. Lock the locating screws in pairs, using 20 s.w.g. iron wire.

Valve gear, hot plugs and thermostat to cylinder head

Operation A/446

1. Pull the inlet and exhaust valve guides into position, using tool Part No. 274406. Locate an "O" ring seal in each inlet and exhaust valve guide after the valves have been ground and lapped in.

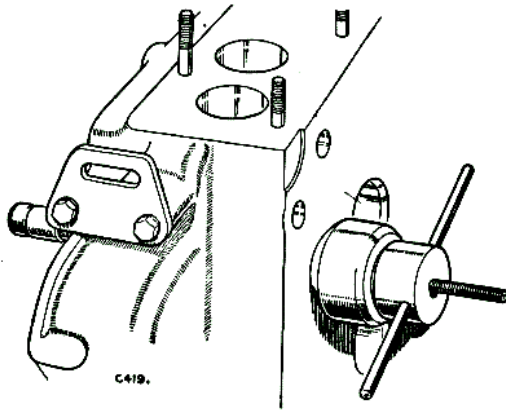


Fig. A-417—Fitting valve guides

2. If the push rod tubes were removed, new tubes complete with new sealing rings, smeared with Silicone M.S.4 Compound, should be pulled into position, using tool Part No. 274402. Ensure that the chamfers on tube and in cylinder head are in full contact and that the "flat" of tube is at right angles to a line drawn between the centre of push rod tube and centre of hot plug, as illustrated by Fig. A-418.

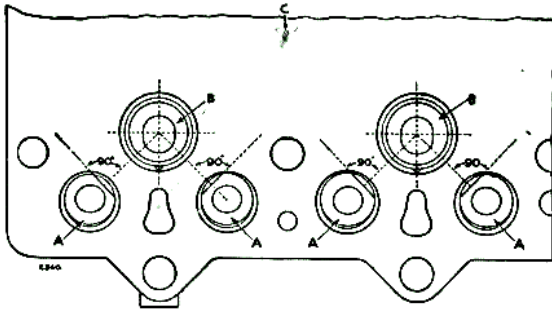


Fig. A-418—Correct position of push-rod tubes in relation to hot plugs
 A—Push rod tubes. B—Hot plug.
 C—Cylinder head inverted.

3. Fit the valves, springs, cups and split cotters, ensuring that the components are retained in their original sets and positions.
4. Test the thermostat before fitment to cylinder head, by immersing in hot water. Expansion should commence between 164°F and 173°F and be complete at 193°F.
 Insert the thermostat in the housing in cylinder head with rubber 'O' ring and fit the joint washer and cover.
5. If the hot plug and peg assemblies have been removed, these must now be replaced by tapping gently into position with a hide-faced hammer. When fitted they must be checked with a clock gauge to ensure that they do not protrude above the level of the cylinder head face more than .002 in. (0,050 mm) and are not recessed below the level of the cylinder head face more than .001 in. (0,025 mm).

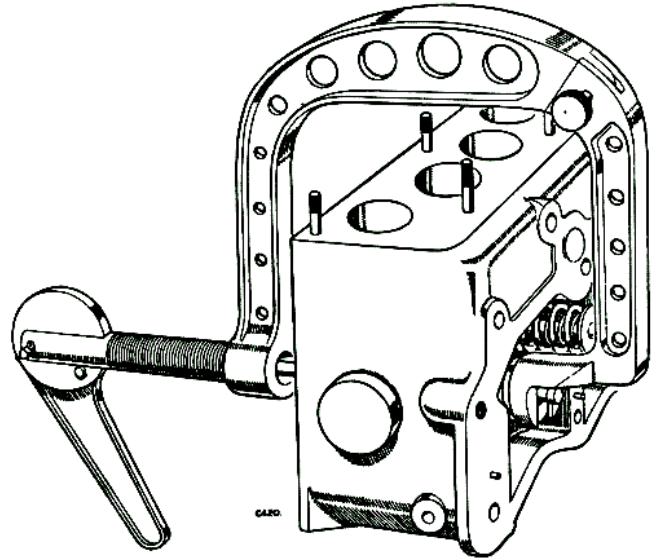


Fig. A-419—Compressing valve springs.

6. The fitment of wooden plugs in the injector nozzle apertures will be found advantageous at this stage.

Cylinder head and valves assembly to cylinder block

Operation A/448

When fitting the cylinder head, dummy studs ($\frac{1}{2}$ in. U.N.F. x 5 in. long) must be used to locate the gasket.

1. Smear the joint face of cylinder block and cylinder head gasket with engine oil, then fit the gasket and cylinder head assembly to cylinder block, using the two studs to facilitate alignment.

It is strongly recommended that the head should be fitted before fitment of the rocker shaft assembly, otherwise damage to the push rod seats may occur.

2. Locate head and gasket with the securing bolts, fitting all bolts except those which also secure the rocker shaft pedestals, but do not tighten at this stage.

Push rods

3. Insert the push rods into their original positions, through cylinder head and locate in the tappets.

Rocker shaft assembly

Operation A/450

1. If necessary, press new bushes into the rockers. The oil holes in the rocker bushes are pre-drilled and care must be taken to ensure that the oil holes of bush and rocker will align when pressed into position.
2. Reamer the bush to .530 in. +.001 (13,4 + 0,02 mm) to obtain the correct clearance. The reamer and rocker assembly must be held in such a manner as to ensure the correct alignment of the reamed hole.

3. Align the lubricated rocker shafts, with the bored ends together, and slide a support bracket on to each shaft. The locating hole in each bracket must be positioned immediately above the chamfered hole in shaft, 4.75 in. (120,65 mm) from the plugged end, and then secured with a locating screw and spring washer.
4. Assemble the remaining components with the plugged end of the shafts in the end brackets and the bored end of both shafts located in the centre bracket.
5. Fit the rocker cover securing studs to the rocker brackets.
6. Slacken off all tappet adjusting screws and offer the rocker assembly to cylinder head. Fit the bracket securing bolts, but do not tighten.
7. Tighten down the cylinder head bolts in the order indicated by Fig. A-420. The $\frac{1}{2}$ in. U.N.F. bolts, including those that also secure the rocker brackets must be pulled down to 75 lb/ft. (10,3 Kg/m) whilst the $\frac{5}{16}$ in. U.N.F. bolts securing the rocker brackets only are pulled down to 12-13 lb/ft. (1,6-1,7 Kg/m).

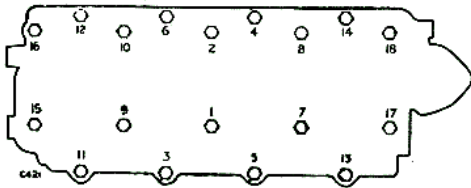


Fig. A-420—Order of tightening cylinder head bolts

8. It is important before rotating the camshaft to adjust all the tappets which are slack. Rotate the camshaft a quarter revolution at a time and after each movement adjust any tappets which are slack. When all excessive clearance has been eliminated adjust the tappets to the correct clearance.

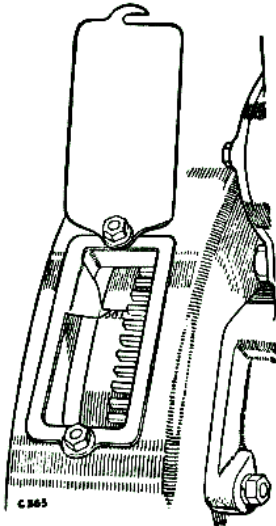


Fig. A-421—
Timing pointer

Chain wheels, timing chain, adjuster and valve timing Operation A/452

1. Fit the crankshaft chain wheel on to shaft and key.
2. Turn the crankshaft in direction of rotation until the E.P. mark on flywheel is in line with the timing pointer.
3. Fit a dial test indicator so that the "fully open" position of the valve can be ascertained in the following manner:—

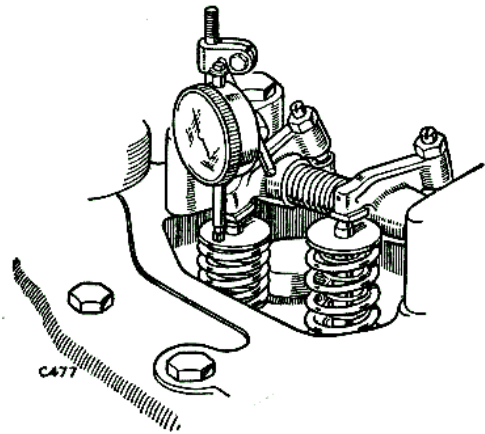


Fig. A-422—Checking exhaust valve "fully open" position

- (a) Turn the camshaft in direction of rotation until the lobe of cam has nearly opened the valve fully, then stop rotation and mark the chain wheel and timing casing to record the position.
 - (b) Note the reading on dial test indicator, then continue to turn the chain wheel slowly in direction of rotation until the needle has again reached the same position.
 - (c) Mark the chain wheel at a point opposite to the mark on timing casing and make a third mark on the chain wheel, exactly between those made previously.
 - (d) Turn the camshaft against direction of rotation until the third mark is in line with that on timing casing, whereon the valve should be fully open.
4. Fit the timing chain with "no slack" on the driving side. It may be necessary to remove and re-position the camshaft chain wheel to obtain this "no slack" condition on the driving side when the flywheel and camshaft are correctly positioned.
 5. Fit new bushes to the chain tensioner components as necessary; ensure that the fits and clearances are in accordance with those laid down in the Data Section. Position the ball in chain tensioner piston and secure with the retaining clip. Fit the compression spring over piston, locate the cylinder assembly and compress the spring. Place the idler wheel on

bearing arm and offer the assembly to the cylinder block, locating by means of the dowels. Screw the stepped bolt with ratchet and spring in position into cylinder block, then finally secure with two set bolts.

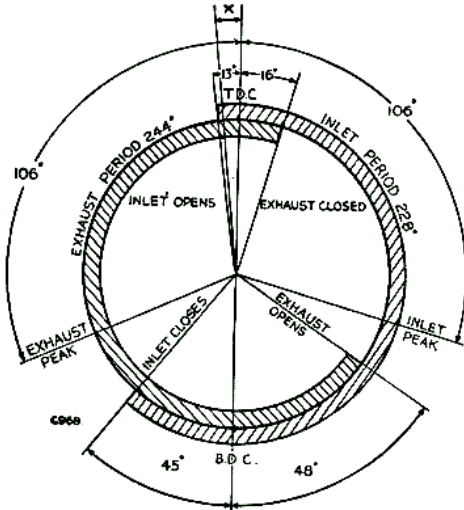


Fig. A-423—Timing diagram

X—Injection point is 17°

- Turn the flywheel against direction of rotation approx. 90° then slowly in direction of rotation, checking that the exhaust valve reaches the "fully open" position, as indicated by the dial

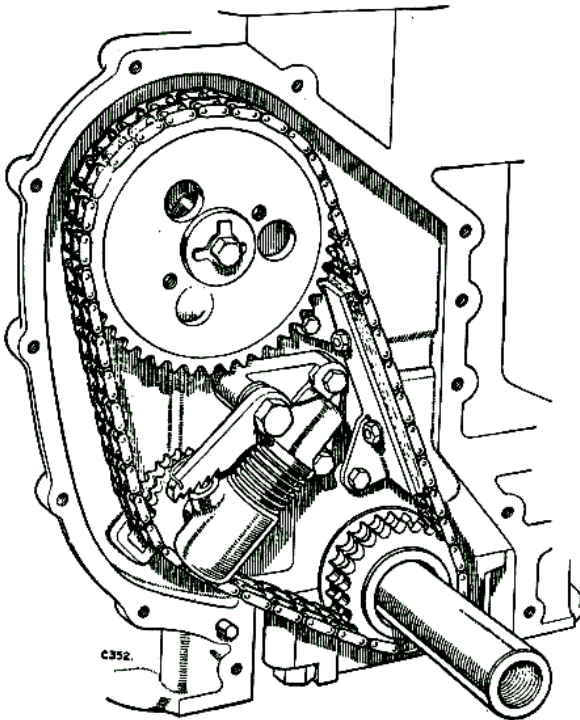


Fig. A-424—Timing gear arrangement.

test indicator, exactly when the "E.P." mark on flywheel is in line with the pointer on flywheel housing.

Adjust if necessary by means of the six irregularly spaced keyways in the timing chain wheel. This arrangement allows a variation of 2° between each position.

Lock the set bolt securing camshaft chain wheel when timing has been set satisfactorily.

- Secure the timing chain vibration damper to the front of cylinder block.

Tappet adjustment

Operation A/454

Two methods of setting the tappet clearance may be used, the first necessitates revolving the crankshaft 16 times approximately, and the second, two revolutions only.

1. Method 1

Turn the crankshaft in direction of rotation until the selected valve is fully open and then continue for a further revolution whereon the tappet concerned will be resting on the cam dwell. Adjust the tappet clearance to .010 in. (0,25 mm) with a feeler inserted between the rocker and valve stem.

Re-check clearance after tightening locknut. Repeat for each valve in turn.

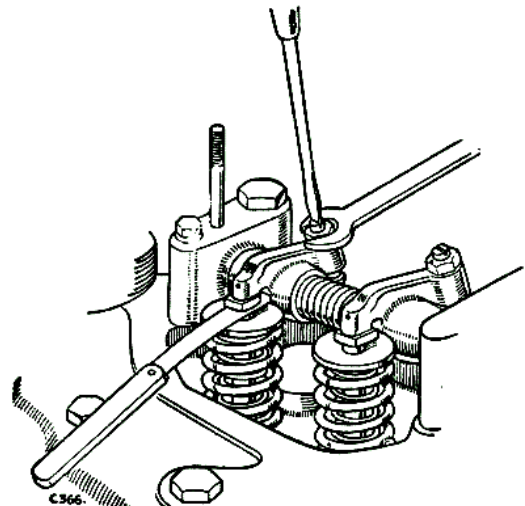


Fig. A-425—Adjusting tappets

2. Method 2

Turn the crankshaft in direction of rotation until number 8 valve (counting from front end of engine) is fully open. In this position the tappet for number 1 valve is on the dwell of its cam and the tappet clearance may be set with a .010 in. (0,25 mm) feeler inserted between the rocker and valve stem. Recheck the clearance after tightening the locknut.

The tappets should be set in the following order:

- Set No. 1 tappet with No. 8 valve fully open.
- Set No. 3 tappet with No. 6 valve fully open.
- Set No. 5 tappet with No. 4 valve fully open.
- Set No. 2 tappet with No. 7 valve fully open.
- Set No. 8 tappet with No. 1 valve fully open.
- Set No. 6 tappet with No. 3 valve fully open.
- Set No. 4 tappet with No. 5 valve fully open.
- Set No. 7 tappet with No. 2 valve fully open.

Water pump assembly and fitment to front cover

Operation A/456

1. See "Coolant System" for water pump assembly.
2. Renew the joint washer, then locate and secure the pump to front cover.

Front cover to cylinder block

Operation A/458

1. Examine the crankshaft oil seal and replace if necessary.
2. Position new joint washers and fit the front cover and water pump assembly to cylinder block.
3. Fit the water pump pulley to hub.

Vibration damper assembly and fitment

Operation A/460

1. If necessary renew the bushes in flywheel and backplate with an interference fit of .002 in. (0,05 mm) to .004 in. (0,10 mm).
2. Bolt the flywheel and backplate together, and reamer the bushes (ensuring that the bore is axially concentric) to allow a clearance fit on driving flange of .001 to .003 in. (0,025 to 0,076 mm).
3. Remove the securing bolts and withdraw the backplate from flywheel.
4. Fit a rubber disc to each side of the driving flange, mount the flywheel and backplate, with the arrows on backplate and flange aligned, then fit the set bolts and locking tabs. Discard any shims which may have been previously fitted, as these have been found to be unnecessary. Fit the securing bolts and tighten fully.

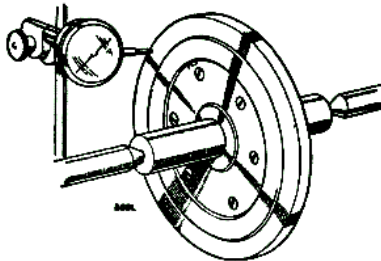


Fig. A-426—Checking vibration damper run-out

5. Mount the unit on a suitable mandrel and rotate between centres. Check the run-out with a

dial test indicator and adjust to within .005 in. (0,127 mm) by means of the securing bolts.

Finally bend up the locking tabs to secure the set bolts.

6. Locate the vibration damper on crankshaft and key, then secure with the starting dog and tab washer.

Vertical drive shaft gear assembly

Operation A/462

1. Fit the circlip to groove dividing the upper and lower internal splining and enter the tapered splined plug in the end furthest from gear teeth, small end first.
2. Drift the plug into the gear until it abuts on the circlip.
3. Lubricate the split bush and fit it to the gear with the reduced diameter nearest the teeth.

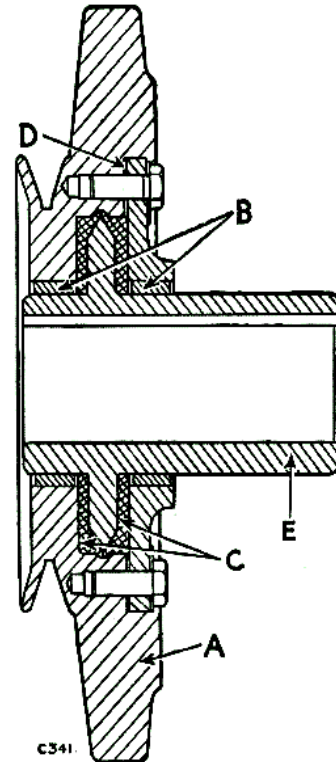


Fig. A-427—Sectioned view of vibration damper

- | | |
|------------------------|------------------|
| A—Flywheel and pulley. | D—Shims. |
| B—Bushes. | E—Driving flange |
| C—Rubber discs. | |

Injection pump timing

Operation A/464

1. A—Early engines.

On early engines the flywheel is marked SI.

- (i) Early, unmodified engines.

In order to time these engines correctly, turn the crankshaft in the direction of rotation, until the timing pointer is exactly in line with the SI mark, with both valves on No. 1 cylinder closed.

- (ii) Early engines with latest type pistons and early type hot plugs.

The injection pump timing for these engines must be altered to 17° B.T.D.C. Turn the crankshaft in the direction of rotation, until the timing pointer is .1 in. (2,5 mm) past the SI mark on the flywheel, with both valves on No. 1 cylinder closed.

- (iii) Early engines with latest type pistons and hot plugs.

The correct timing for these engines is 16° B.T.D.C.

Turn the crankshaft in the direction of rotation, until the timing pointer is .2 in. (5 mm) past the SI mark on the flywheel, with both valves on No. 1 cylinder closed.

B. Late engines.

On late engines the flywheel is marked 16° and 18° .

- (i) Late engines with latest type pistons and early type hot plugs.

The correct timing for these engines is 17° B.T.D.C.

Turn the crankshaft in the direction of rotation, until the timing pointer is exactly between the 16° and 18° mark on the flywheel, with both valves on No. 1 cylinder closed.

- (ii) Late engines with latest type pistons and hot plugs.

This type of engine must be timed at 16° B.T.D.C.

Turn the crankshaft until the timing pointer is exactly in line with the 16° mark on the flywheel, with both valves on No. 1 cylinder closed.

Note: Engines fitted with late type hot plugs are identified by a splash of red paint on the cylinder head.

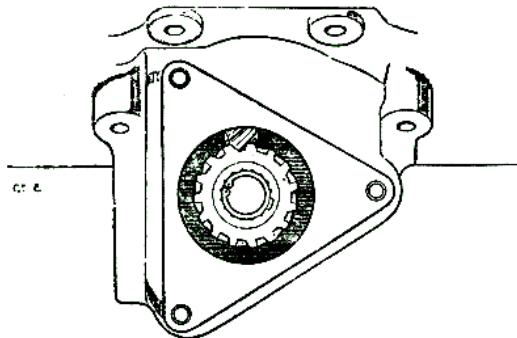


Fig. A-428—Driving gear in correct timing position

2. Insert the driving gear assembly for injection and oil pumps complete with split bushes, then mesh with camshaft gear so that when fully engaged, the master spline is approx. 20° from the centre line of engine (measured from front end) and the locating holes are correctly

aligned. Lock the driving gear assembly in position with a grub screw.

It is very important that the backlash in the vertical drive shaft is taken into account when timing the injection.

3. Remove the inspection cover from injection pump and rotate the spindle in direction of rotation until the line marked "A" on driving plate aligns with mark on timing ring.
4. Offer the pump to engine with the fuel inlet connection forward and engage in the splined drive.

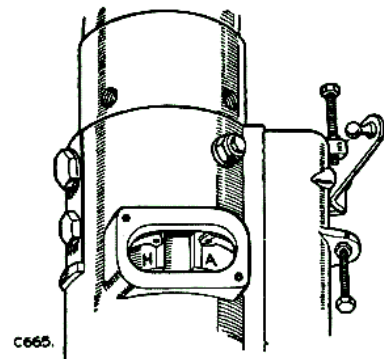


Fig. A-429—Distributor timing marks correctly aligned

Observe the markings through inspection aperture in injection pump side and make any final necessary adjustment by turning the pump body to align the timing marks.

Note 1:

It will be found advisable to use a mirror when checking markings.

Note 2:

It is very important that the injection pump is timed as accurately as possible. Two or three degrees retardation can cause excessive white smoke when starting from cold and running at light load. Two or three degrees advance can cause excessive black smoke at low speed, full load.

The timing must be checked by turning the engine until the timing marks on the pump are dead in line and then checking the timing marks on the flywheel. In this way any slight error is magnified by the 2 : 1 ratio of camshaft to crankshaft and the large diameter of the flywheel. An error of a given width on the pump markings will be 12 times that width if transferred to the flywheel.

5. Tighten pump down and re-check setting. Replace inspection cover on pump and flywheel housing.

Oil pump

Operation A/466

1. Insert the longer splined end of driving shaft into the pump and locate in the driving gear.
2. With the inlet port rearward, and the splined upper end of driving shaft aligned to the vertical drive gear, offer the pump to engine and secure in position.

3. Fit a tab locking washer and seal to the filter gauze and nut assembly. Screw the unit into the pump inlet port and position the filter square with sump bottom; lock in position.

Note: No provision is made for oil pressure adjustment.

Externals

1. Fit the lubricating oil filter assembly and joint washer.
2. Secure the breather pipe and oil filler assembly over the forward tappet chamber aperture, and steady bracket to top of cylinder block.
3. Mount and secure the fuel lift pump and cover plate assembly over the rear tappet chamber aperture.
4. Mount and secure the fuel oil filter assembly.
5. Fit the starter motor.
6. Fit the dynamo driving belt and adjust the tension to allow the belt to move $\frac{1}{8}$ to $\frac{1}{16}$ in. (8 to 11 mm) when pressed by thumb between the camshaft and water pump pulleys.
7. Connect the oil feed pipe and pressure gauge assembly between cylinder head and cylinder block rear end.
8. Secure the coolant pipe to thermostat and water pump casings.
9. Position the joint washer and fit the rocker and valve gear cover.
10. Fit the oil sump.
11. Smear new injector copper joint washers with grease and fit one to each injector. Insert a new corrugated sealing washer into each injector nozzle recess in cylinder head, with the raised portion upward, then locate the injector nozzles; do not tighten the clamping straps fully at this stage.

Note: Ensure that the bottom steel washer (corrugated) is replaced correctly, when refitting injectors. See Fig. A-430.

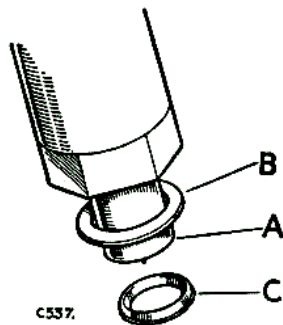


Fig. A-430—Position of injection nozzle washers
A—Nozzle B—Copper washer C—Steel washer

Note: For injector assembly and check, see Section M.

12. Connect the injector pipes to the injector pump. Turn the injectors to align with the pipes and connect.
Do not overtighten the clamping strap.

13. Fit the heater plugs to cylinder head and tighten.

Engine, to refit

Operation A/468

1. Reverse removal procedure—fit new mounting rubbers if necessary. Refill with lubricating oil, 11 pints (6 litres) and coolant, 17 pints (9,75 litres).
2. See Section M, Fuel Section, for method of priming injection pump, then Section Q for resetting controls and slow-running adjustment procedure.
3. Check for oil and water leaks—rectify as necessary.

Note:

At all times when the diesel engine is running, it is necessary to ensure that the oil bath air cleaner is fastened securely in the vertical position.

If adjustments are made with the engine running and the oil bath cleaner balanced on top of the engine, it is possible, should the cleaner tip to one side, for oil to be drawn into the intake manifold and hence into the engine, where it will act as a fuel and cause the engine to overspeed out of control and serious damage may result.

Should it be necessary to run the engine with the air cleaner out of the normal position, the rubber hose should be disconnected from the inlet manifold and the whole oil bath removed from the vehicle.

MAINTENANCE PROCEDURE

Removing cylinder head Operation A/470

1. Open the tap at base of radiator and drain the coolant from this point only.
2. Disconnect the horn leads at the snap connectors adjacent to horn; ensure that the rubber insulators are left fitted to the main harness and thus avoid the danger of "shorting".
3. Remove the pin securing stay to bonnet and lift the bonnet clear of vehicle.
4. Remove the air cleaner and flexible air intake pipe complete.
5. Unscrew the dome nuts securing rocker cover and lift the cover clear.
6. Remove the rocker pedestal securing bolts, then pressing the extreme end pedestals towards the centre of rocker shaft, lift the complete rocker assembly clear.
7. Withdraw the push rods but ensure that they are retained in correct order for refitment.
8. Disconnect the pipes from main fuel filter; the pipe—"filter to injection pump"—must be removed completely to prevent distortion.
9. Remove the bolts securing filter to support bracket at engine, detach the heater plug earth lead and withdraw the filter.
10. Disconnect the fuel "bleed back" pipe from injection nozzle and from union nut on main fuel return pipe.

11. Remove the fuel pipes— injection pump to injection nozzle.
12. Fit aluminium caps to the injection pump outlet unions, to the fuel lift pump outlet, to fuel return pipe union and to the injection nozzle inlet and outlet unions.
13. Remove the injection nozzle securing straps and withdraw the nozzle assemblies.
14. Disconnect the leads and remove the heater plugs.
15. Remove the top coolant hose and the thermostat by-pass hose.
16. Disconnect the oil-feed pipe from rear of cylinder head—R.H. side—and the front exhaust pipe from exhaust manifold.
17. Loosen the cylinder head bolts evenly, then remove them completely and lift the head clear.
18. Remove the inlet and exhaust manifolds if necessary.

Fitting cylinder head Operation A/472

1. Reverse the removal procedure.

When fitting the cylinder head, dummy studs ($\frac{1}{2}$ in. U.N.F. x 5 in. long) must be used to locate the gasket. If this procedure is not adopted there is danger of the gasket being nipped on the liner spigot.

Make sure the injector washers are fitted correctly. See Fig. A-430.

2. Renew all joint washers.
3. Pull down the cylinder head bolts evenly to the correct tension in the order shown in Fig. A-431.

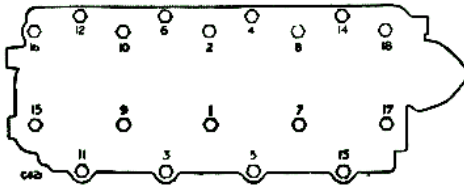


Fig. A-431—Order of tightening cylinder head bolts.
 $\frac{1}{4}$ in. bolts to 75 lb/ft. (10,3 Kg/m).
 $\frac{3}{8}$ in. bolts to 12 to 13 lb/ft. (1,6 to 1,7 Kg/m).

4. Adjust tappet clearances to .010 in. (0,25 mm)—Operation A-454.
5. Refill radiator.
6. Prime the fuel system. See Section M.
7. Run the engine and check for leaks.
8. It is important that the cylinder head bolts are retightened to the torque figures above after 30 minutes' running.

Decarbonising, valve grinding and lapping Operation A/474

1. Remove the cylinder head—Operation A/470.
2. Using valve spring compressing tool, part number 276102, remove the valves, valve springs and retaining collets.

Position each valve with its springs and collets together and chalk mark the bench to ensure refitment to the guide from which they were removed.

Inner and outer valve springs are a selected interference fit and must not be interchanged.

3. Remove the carbon from the cylinder head, face, and ports, then from the piston crown and swirl-controlling recess, using a blunt scraper.
4. Examine the valves and valve guides for wear and renew as necessary. The guides may be drifted out using tools, part number 274400 inlet and 274401 exhaust, and new ones fitted with tool, part number 274406. See Fig. A-417—Page A-46.
5. Reface the valves to $45^\circ - \frac{1}{4}^\circ$ and lap them into their seats.

Use the valve seat re-cutting tools (part number 274413 inlet and 274414 exhaust) only when necessary and then remove the minimum amount of metal.

6. Wash the valves, seats and ports thoroughly with paraffin and wipe dry with a non-furry rag. Fit a new rubber seal to each guide.
7. Refit the valves, springs and collets, then pour paraffin into each port and check the valve seats for tightness.

Tappet adjustment Operation A/476

1. Disconnect the rubber air intake hose from the induction manifold and from air cleaner.
2. Remove the rocker gear cover.
3. Engage the starting handle and set the tappet clearance to .010 in. (0,25 mm) by either of the methods described under "Tappet adjustment" on Page A-48.
4. Replace the cover and rubber hose.

Rocker gear removal Operation A/478

1. See Items 2 to 6 of Operation A/470.

Rocker gear fitment Operation A/480

1. Reverse removal procedure and set tappet clearance to .010 in. (0,25 mm) as directed under "Tappet adjustment", Page A-48.

Timing chain renewal Operation A/482

1. Lift off bonnet top—Items 2 and 3 of Operation A/470.
2. Remove the radiator—Section L.
3. Pivot the dynamo inwards and remove the fan belt.
4. Unscrew the starting nut and withdraw the vibration damper.
5. Remove the front cover and water pump assembly.

6. Mark the camshaft and crankshaft chainwheels and mark the casing opposite these marks, then remove the timing chain tensioner and timing chain. Discard the old chain.
7. With the marks on chain wheels and casing aligned, fit the new chain with no "slack" on the driving side.
8. Refit the chain tensioner.
9. The timing should be checked to ensure that the exhaust valve of No. 1 cylinder is fully open when the timing pointer is in line with the E.P. mark on the flywheel.
10. Refit the front cover, vibration damper, fan belt, radiator and bonnet top by reversing removal procedure.
11. Refill radiator—17 pints (10,0 litres).

Piston and connecting rod—removal**Operation A/488**

1. Drain the oil from sump.
2. Remove the cylinder head—Operation A/470, and fit liner retainers, Part No. 274411.
3. Jack the front end of vehicle up and position suitable stands beneath the chassis side-members.
4. Remove the sump carefully to avoid damage to the joint washer.
5. Turn the crankshaft to bring the connecting rod concerned to B.D.C., then remove the connecting rod cap and push the rod and piston upward to remove.

Piston and connecting rod fitment**Operation A/490**

1. With the crankpin at B.D.C., insert the connecting rod and piston assembly from the top of cylinder block with the oil spray hole in connecting rod and turbulence recess in piston towards the R.H. side of engine (nearest the camshaft).
2. Fit new connecting rod cap nuts and tighten to 35 lb./ft. (4,8 Kgs/m) torque.
3. Refit the sump and joint washer.
4. Replace the cylinder head—Operation A/472.
5. Refill with oil—11 pints (6 litres).

Cylinder liner replacement Operation A/492

1. Remove the cylinder head—Operation A/470.
2. Remove piston and connecting rod—Operation A/488.

3. Cover the oil hole in crankpin with masking tape or some similar material to prevent the entry of foreign matter to the crankshaft oilways.
4. Press the liner upward and then withdraw it from the top of cylinder bore.
5. Clean the liner bore spigot at top of cylinder block and the area inside the block immediately surrounding the lower liner bore. Remove and discard the two sealing rings from the grooves at lower bore, wipe the grooves clean and ensure that the small hole drilled through the L.H. side of cylinder block into the middle groove, is clear.
6. Smear the top and bottom grooves and two new sealing rings with Silicone Compound M.S.4, then fit the rings to the top and bottom grooves.
7. Apply a small amount of Silicone Compound M.S.4 to the outer walls of liner and refit to cylinder block.
8. Check the liner extension above cylinder block joint face in the manner instructed by Items 2 and 3 of Operation A/432.
9. Refit the piston and connecting rod—Operation A/490.

External oil filter—removal Operation A/494

1. Jack the front end of vehicle up and position suitable stands beneath the side members. Place a drip tray under the filter.
2. Disconnect the lead at oil pressure switch on filter head.
3. Remove the securing bolts and withdraw the filter complete.

External oil filter—fitment Operation A/496

1. Fit a new gasket between the filter head and cylinder block then reverse removal procedure.

External oil filter element—renewal**Operation A/498**

1. See Item 1 of Operation A/494.
2. Unscrew the bolt at base of container, then remove the element and container complete.
3. Discard the old element and the large rubber sealing ring from filter head.
4. Wash the container thoroughly in paraffin, fit the new element and rubber sealing ring, then replace the container.

DEFECT LOCATION

(Symptom, Cause and Remedy)

A—ENGINE FAILS TO START.

1. Incorrect starting procedure—*See Instruction Manual.*
2. Starter motor unserviceable—*Section P.*
3. Batteries in low state of charge—*Remove and charge.*
4. Heater plug circuit broken—*Section P.*
5. Foreign matter in fuel system—*Section M.*
6. Supply of fuel to injection nozzles restricted—*Section M.*
7. Insufficient compression—*Check tappet clearance, cylinder head for tightness, cylinder head gasket, valve seats, valve springs, pistons, piston rings and liners for wear.*
8. Injection nozzles setting incorrect—*Reset—Section M.*
9. Injection nozzle auxiliary spray hole blocked—*Clean—Section M.*

B—ENGINE STALLS.

1. Slow-running incorrectly adjusted.—*See Section Q.*
2. Incorrect tappet clearance—*Adjust.*
3. Injection nozzle setting incorrect—*Reset—Section M.*
4. Injection nozzle auxiliary spray hole blocked—*Clean—Section M.*
5. Insufficient compression—*See item 7 of "A" above.*

C—REDUCED POWER AND ROUGH RUNNING.

1. Broken valve spring—*Renew.*
2. Incorrect tappet clearance—*Reset.*
3. Burnt valve—*Renew, reset tappet clearance and tighten injection nozzles.*
4. Broken piston rings—*Renew damaged parts as necessary.*
5. Compression uneven—*See Item 7 of "A" above.*
6. Injection nozzles burnt—nozzle valve seating badly—*Service—Section M.*
7. Incorrectly timed injection pump—*Check and adjust.*
8. Fuel supply restricted—*Clean filters—Section M.*
9. Injection nozzles improperly tightened—*Check sealing washer and re-tighten.*
10. Fuel pumps not delivering properly—*Section M*

D—ENGINE OVERHEATING.

1. Defective coolant system—*See "Defect Location"—Section L.*
2. Defective lubrication system—*See "Defect Location"—Section AO.*
3. Defective injection nozzles—*See "Defect Location"—Section M.*
4. Incorrect injection pump timing—*Check and adjust.*
5. Restricted fuel supply—*Section M.*

E—LOW OIL PRESSURE.

1. Defective lubrication system—*See "Defect Location"—Section AO.*

F—BLACK SMOKE ISSUES FROM EXHAUST

1. Defective fuel injection nozzle—*Section M.*
2. Injection pump incorrectly timed—*Check and adjust.*

G—WHITE VAPOUR ISSUES FROM EXHAUST.

1. Coolant leaking into combustion chamber—*Ascertain cause.*

Note:—Do not confuse with the issue of vapour immediately after starting and caused by condensation in the exhaust pipe.

GENERAL DATA

Capacity (piston displacement)	2,052 cc.	B.M.E.P.	105 lbs/sq.in. (7,382 Kg/cm ²) at 2,000 R.P.M.
Number of cylinders	4	Maximum torque	87 lbs/ft. (12,00 Kg/m) at 2,000 R.P.M.
Bore	3.375 in. (85,725 mm)	Firing order	1 - 3 - 4 - 2
Stroke	3.5 in. (88,9 mm)	Piston speed at 3,500 R.P.M.	2,040 ft./min.
Compression ratio	22.5 to 1		
B.H.P.	52 at 3,500 R.P.M.		

DETAIL DATA

Camshaft

Journal diameter	1.842 in.—.001 (26,70 mm—0,02)
Clearance in bearing....	.001 to .002 in. (0,02 to 0,05 mm)
End-float ....	.0025 to .0055 in. (0,06 to 0,14 mm)
Cam lift—inlet ....	.262 in. (6,65 mm)
Cam lift—exhaust ....	.279 in. (7,10 mm)

Camshaft bearings

Type	Split—steel backed, white metal lined
Internal diameter (line reamed in position)	1.843 in.+.0005 (46,812 mm+0,012)

Connecting rods

Bearing fit on crankpin	.001 to .0025 in. (0,02 to 0,06 mm) clearance
Bearing nip ....	.002 to .004 in. (0,05 to 0,10 mm)
End-float at big end ....	.007 to .011 in. (0,177 to 0,280 mm)
Gudgeon pin bush fit in small end ....	.001 to .002 in. (0,02 to 0,05 mm) interference
Gudgeon pin bush internal diameter—reamed in position	1.1875 in.+.0005 (31,87 mm+0,012)
Fit of gudgeon pin in bush ....	.0003 to .0005 in. (0,007 mm to 0,012) clearance

Crankshaft

Journal diameter	2.5 in.—.001 (63,5 mm—0,021)
Crankpin diameter	2.126 in.—.001 (54 mm—0,02)
End-float (controlled by thrust washers at centre bearing) ....	.002 to .006 in. (0,05 to 0,15 mm)

Flywheel

Number of teeth	100
Thickness at pressure face	1.375 in.—.015 (85,725 mm—0,39)
Maximum permissible run-out on flywheel face ....	.002 in. (0,05 mm)
Maximum refacing depth ....	.030 in. (0,76 mm)
Minimum thickness after grinding	1.330 in. (33,5 mm)

Markings

T.D.C.	When opposite pointer, No. 1 piston is at top dead centre
E.P.	When opposite pointer, No. 1 exhaust valve should be fully open
SI, 17° or 16°.	When opposite pointer, See Pages A-49 and 50 for details start of injection is indicated.
Primary pinion bush	
Fit in flywheel ....	.001 to .003 in. (0,02 to 0,083 mm) interference
Internal diameter—reamed in position	.875 in.+.002 (22,237 mm+0,0510)
Fit of shaft in bush	.001 to .0035 in. (0,02 to 0,08 mm) clearance

Gudgeon pin

Fit in piston	Zero to .0002 in. (0,005 mm) interference
Fit in connecting rod bush ....	.0003 to .0005 in. (0,076 to 0,127 mm) clearance

Injection pump

Type Distributor, self-governing

Injection takes place.... SI, 17° or 16°. See pages A-49 and 50 for details

Injector

Type C.A.V. Pintaux

Size BDNO/SP6209

Liners

Internal diameter 3.375 in. +.001
(85,725 mm +0,02)

Fit in cylinder block

Top—upper005 to .015 in. (0,13 to 0,38 mm) clearance

Top—lower001 to .003 in. (0,02 to 0,08 mm) clearance

Bottom001 to .003 in. (0,02 to 0,08 mm) clearance

Main bearings**Clearance on crankshaft**

journal001 to .0025 in. (0,02 to 0,06 mm)

Bearing nip004 to .006 in. (0,10 to 0,15 mm)

Push rod tubes

Fit in cylinder head0005 to .002 in. (0,01 to 0,051 mm) interference on large diameter. Full contact fit at chamfered edges of tube and cylinder head.

Oil pump assembly

Type Spur gear

Drive By splined shaft from camshaft gear

End-float of gears002 to .005 in. (0,02 to 0,12 mm)

Radial clearance of gears0005 to .002 in. (0,012 to 0,05 mm)

Backlash of gears004 to .008 in. (0,10 to 0,20 mm)

Oil pressure, engine warm at 2,000 R.P.M

.... 50 to 60 lbs/sq.in. (3,515 to 4,220 Kgs/cm²)

Relief valve spring

Free length 2.840 in. (52,93 mm)

Length in position under a load of 10 lbs. (4,53 Kg) 2.45 in. (61,23 mm)

Pistons

Type Light alloy, with recess in crown

Clearance in liner bore, measured at bottom of skirt at right angles to gudgeon pin004 to .005 in. (0,10 to 0,12 mm)

Fit of gudgeon pin in piston Zero to .0002 in. (0,005 mm) interference

Gudgeon pin bore 1.187 in. +.002 (47,57 mm +0,05)

Piston rings**Compression No. 1**

Type Square friction edge—chromium plated

Gap in liner bore010 to .015 in. (0,25 to 0,38 mm)

Clearance in groove0025 to .0035 in. (0,063 to 0,089 mm)

Compression—Nos. 2 and 3

Type Bevelled friction edge. Marked 'T' on upper side.

Gap in liner bore010 to .015 in. (0,25 to 0,38 mm)

Clearance in groove0025 to .0035 in. (0,063 to 0,089 mm)

Scraper No. 4

Type Slotted, square friction edge, double landed

Gap in liner bore010 to .015 in. (0,25 to 0,38 mm)

Clearance in groove0025 to .0035 in. (0,063 to 0,089 mm)

Rocker gear

Bush internal diameter (reamed in position)530 + .001 in. (13,4 + 0,02 mm)

Shaft clearance in rocker bush001 to .002 in. (0,02 to 0,04 mm)

Tappet clearance010 in. (0,25 mm) hot or cold

Timing chain tensioner

Fit of bush in cylinder003 to .005 in. (0,07 to 0,12 mm) interference

Fit of bush in idler wheel001 to .003 in. (0,02 to 0,07 mm) interference

Fit of idler wheel on stub shaft001 to .003 in. (0,02 to 0,07 mm) clearance

Fit of piston in cylinder bush0005 to .001 in. (0,01 to 0,02 mm) clearance

Thrust bearings, crankshaft

Type	.....	Semi-circular, steel back, tin plated on friction surface
Standard size, total thickness	.....	.093 in.—.002 (2,362 mm—0,05)
Oversizes	.....	.0025 in. (0,06 mm) .005 in. (0,12 mm) .0075 in. (0,18 mm) .010 in. (0,25 mm)

Torque loadings

Connecting rod bolts	35 lb/ft. (4,84 Kg/m)
Cylinder head ($\frac{1}{4}$ in. U.N.F.)	75 lb/ft. (10,3 Kg/m)
Main bearing bolts ($\frac{9}{16}$ in. U.N.F.)	85 lb/ft. (11,75 Kg/m)
Rocker shaft support bracket bolts ($\frac{5}{16}$ in. U.N.F.)	12 to 13 lb/ft. (1,6 to 1,7 Kg/m)
Flywheel securing bolts	50 lb/ft. (6,91 Kg/m)

Valves

Inlet valve	
Diameter (stem)	.311 in.—.001 (7,92 mm—0,02)
Face angle	45°— $\frac{1}{4}$
Exhaust valve	
Diameter (stem)	.343 in.—.001 (8,71 mm—0,02)
Face angle	45°— $\frac{1}{4}$
Fit of inlet and exhaust valves in guides	.0005 to .003 in. (0,01 to 0,07 mm) clearance
Valve seat	
Seat angle (inlet and exhaust)	45° + $\frac{1}{4}$

Valve springs—inlet

Inner	
Length—free	1.61 in. (40,89 mm)
Length under 17.5 lbs. (7,9 Kgs) load	1.383 in. (35,12 mm)
Outer	
Length—free	1.768 in. (44,90 mm)
Length under 46 lbs. (21 Kgs) load	1.508 in. (38,30 mm)

Valve springs—exhaust

Inner	
Length—free	1.61 in. (40,9 mm)
Length under 18.5 lbs. (8,37 Kgs) load	1.372 in. (34,8 mm)
Outer	
Length—free	1.768 in. (44,9 mm)
Length under 48 lbs. (21,76 Kgs) load	1.497 in. (38,0 mm)

Valve timing

Inlet opens	13° B.T.D.C.
Inlet closes	45° A.B.D.C.
Inlet peak	106° A.T.D.C.
Exhaust opens	48° B.B.D.C.
Exhaust closes	16° A.T.D.C.
Exhaust peak	106° B.T.D.C.

Vertical drive shaft gear

Backlash	.006 to .010 in. (0,1524 to 0,254 mm)
Internal diameter of bush	1.00 in. +.001 (25,4 mm + 0,02)
Fit of gear in bush	.001 to .003 in. (0,02 to 0,07 mm) clearance

Vibration damper

Fit of bushes in fly- wheel and back plate	.002 to .004 in. (0,05 to 0,10 mm)
Internal diameter of bushes (reamed in position)	1.917 in. + .001 (47,70 mm + 0,02)
Fit of bushes on driv- ing flange	.001 to .003 in. (0,02 to 0,07 mm) clearance
Maximum permissible run-out of flywheel	.002 in. (0,05 mm)

