

no particles of white metal are left anywhere in the lubricating system. Inject a small amount of clean thin engine oil into the crankshaft oilways before replacing.

The installation of the main bearings is a reversal of the dismantling procedure but note the following points:

The two halves of the main bearing shells are different; the half with the oil hole is fitted into the crankcase.

When replacing the main bearing caps check the running clearance (Fig. A.8). Apply engine oil freely and finally tighten the main bearing nuts to a torque of 84 lb. ft. (11.5 kg. m.) and lock with new split pins.

## Section A.6

### REMOVING AND REPLACING THE ROCKER GEAR

Carry out the operations numbered 1 to 4 in Section A.21.

Unscrew the two cap nuts and lift off the rocker cover. Take care not to damage the gasket unless a new one is to be fitted.

Slacken all the rocker adjusting screws until all pressure is relieved from each of the valve springs.

Release the set bolts securing the rocker brackets to the cylinder head and remove the rocker assembly complete.

To dismantle the rocker shaft assembly remove the bolt which is located in the rear intermediate bracket and which secures the rocker shaft in position. Withdraw the shaft, threading off the rockers and distance collars.

Dismantle the relief valve, fitted to the front rocker shaft bracket, and remove the blanking plug from the rear bracket (Section A.7).

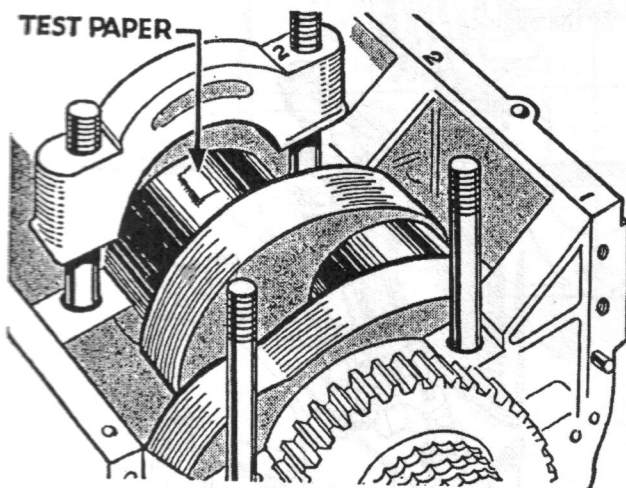


Fig. A.8

Using feeler paper to check the crankshaft main bearing clearance as detailed in Section A.5

Clean the rocker shaft, rockers, and brackets; inspect for wear on the shaft and rockers.

Remove the blanking screws at the ends of the shaft and blow out the oilways and holes in the shaft, rockers, and the front and rear brackets.

Assemble the rocker shaft assembly ready to refit to the cylinder head. The distance pieces are assembled as shown in Fig. A.12 and the shaft must be located by the set bolt in the rear intermediate bracket.

Fit the oil relief valve to the front bracket and the blanking plug to the rear bracket, using a new copper lock washer in each case.

Refit the rocker cover, ensuring that the gasket is in good condition, and secure in position with the two cap nuts. Check for oil leaks after running the engine for a short while.

## Section A.7

### ROCKER GEAR RELIEF VALVE

Oil to the rocker gear is fed at a reduced pressure to that delivered to the remainder of the engine; the pressure is controlled by a separate relief valve assembly mounted on the front rocker bracket. The surplus oil relieved from the oil feed at this point is directed down one of the push-rod tunnels, where it drains back into the sump.

To remove the relief valve assembly first remove the rocker cover as detailed in Section A.6.

Release the tab washer and unscrew the valve body complete from the rocker bracket, thus releasing the drain pipe and the two banjo washers.

Remove the valve body plug and withdraw the spring, spring seat, and relief valve ball.

Clean all the dismantled parts thoroughly.

Examine the valve seat and the ball for wear. The seat should be perfectly smooth and the ball free from scores. Renew the ball and valve body if there is any possibility of leakage past the valve.

Check the valve spring; it should be renewed if the length is below that given in 'GENERAL DATA'.

Insert the ball, spring seat, and spring into the valve body; ensure that the spring and seat fit squarely onto the ball.

Replace the plug, fitting a new copper gasket and copper tab washer. The tab washer is positioned against the plug head.

Fit the valve body to the rocker bracket, using new copper gaskets each side of the banjo and with the drain pipe directed down the push-rod tunnel.

Screw up securely and lock the tab washer over the banjo and plug head.

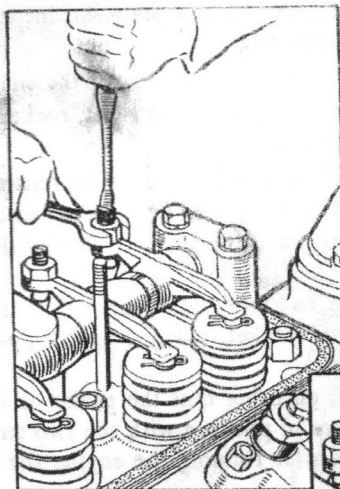


Fig. A.9  
Valve and rocker  
adjustment

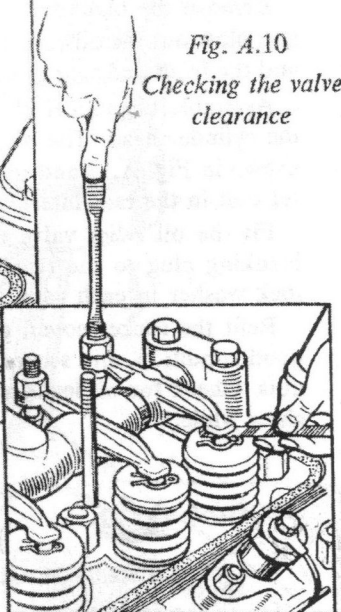


Fig. A.10  
Checking the valve  
clearance

## Section A.8

### ROCKER CLEARANCES

The clearance between the ends of the valve stems and the heads of the valve rockers must be adjusted before running the engine after valve reconditioning and again after warming the engine. The clearance must also be checked periodically during service (see 'MAINTENANCE ATTENTION').

Remove the valve gear cover and check and adjust the clearances in the following sequence:

No. 1 valve (ex.) with No. 5 valve fully open.

No. 4	"	(in.)	"	"	No. 5	"	"	"
"	2	"	(in.)	"	"	4	"	"
"	3	"	(ex.)	"	"	4	"	"
"	5	"	(ex.)	"	"	4	"	"
"	6	"	(in.)	"	"	4	"	"

Crank the engine with the starting handle and note when No. 5 valve is fully open.

Check the clearance of valves Nos. 1 and 4, which will be fully closed (see Fig. A.10).

To adjust the clearance release the rocker adjusting screw by slackening off the locknut while holding the adjusting screw against rotation with a screwdriver (see Fig. A.9). Interpose a .013 in. (.33 mm.) feeler gauge between the valve stem and rocker. Screw down the adjusting screw to allow the feeler gauge to have a light 'drag-through' clearance and re-lock effectively, but do not use undue force.

Again check the clearance to make sure that the setting has not been altered by the locking process.

Crank the engine until No. 4 valve is fully open and check the clearance of valves Nos. 2, 3, 5, and 6 in the manner already described.

Replace the valve gear cover and ensure that the joint gasket is in good condition and provides an oiltight joint.

## Section A.9

### REMOVING AND REPLACING THE CYLINDER HEAD ASSEMBLY

It is possible to remove the cylinder head assembly without removing the engine from the tractor mounting. Warm the engine by allowing it to run lightly for a few minutes and then stop the engine.

Carry out the operations numbered 1 to 4 in Section A.21.

Drain the cooling system (Section C.6).

Remove the two suction pipes between the governor and throttle unit (venturi).

Disconnect the hose from the water outlet pipe and the by-pass hose from the thermostat housing.

Disconnect the exhaust pipe from the manifold flange by removing the three nuts.

Remove the exhaust manifold from the left-hand side of the cylinder head.

Remove the fuel feed pipes connected between the injectors and the pump.

Remove the leak-off pipe between No. 1 injector and the air vent union on the fuel filter.

Disconnect the leak-off unions from the injectors and remove the leak-off pipe by disconnecting it at the rear of the engine.

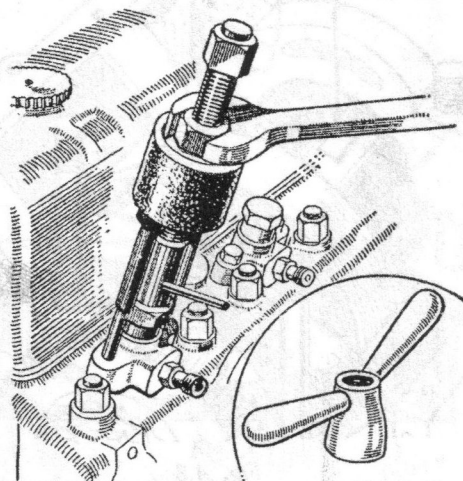


Fig. A.11

Using the injector withdrawing tool 18G491



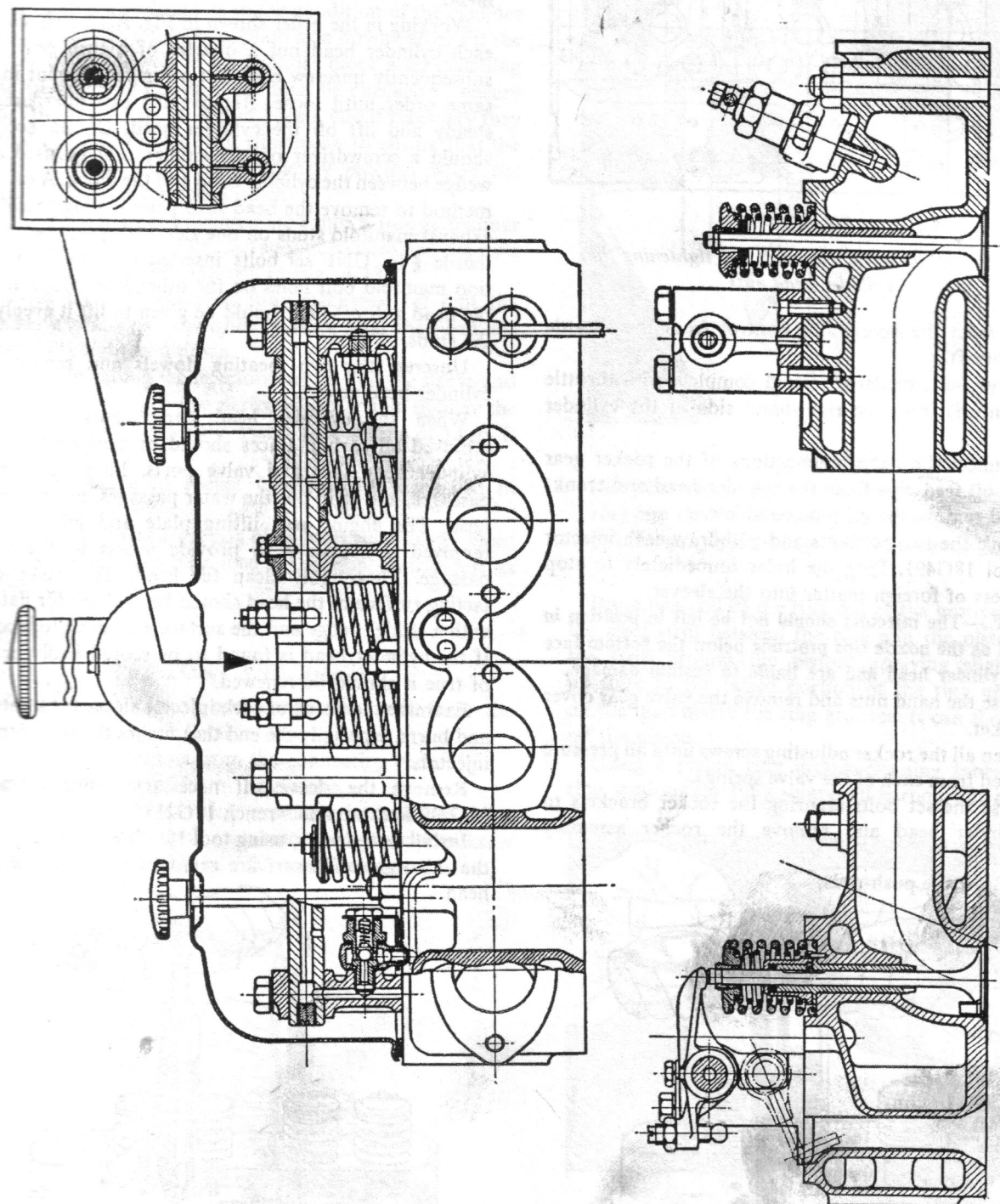


Fig. A.12

The valve and rocker gear, showing the assembly of the rockers and distance pieces. A sectioned view of the cylinder head through an inlet port and valve is illustrated on the left, and on the right a sectioned view of an exhaust port and valve

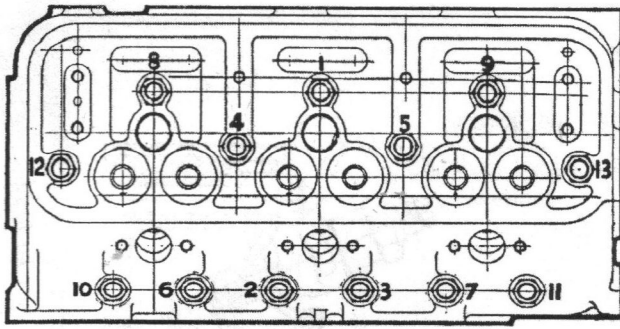


Fig. A.13

*The correct order of loosening and tightening the cylinder head nuts*

Disconnect the accelerator control from the throttle unit (venturi).

Remove the air inlet manifold complete with throttle unit (venturi) from the right-hand side of the cylinder head.

Disconnect the banjo connections of the rocker gear external oil feed pipe from the cylinder head and crankcase, and remove the oil pipe complete.

Remove the two set bolts and withdraw each injector with tool 18G491. Plug the holes immediately to stop the ingress of foreign matter into the sleeves.

**NOTE.**—The injectors should not be left in position in the head as the nozzle tips protrude below the bottom face of the cylinder head and are liable to sustain damage.

Release the hand nuts and remove the valve gear cover and gasket.

Slacken all the rocker adjusting screws until all pressure is released from each of the valve springs.

Release the set bolts securing the rocker brackets to the cylinder head and remove the rocker assembly complete.

Withdraw the push-rods.

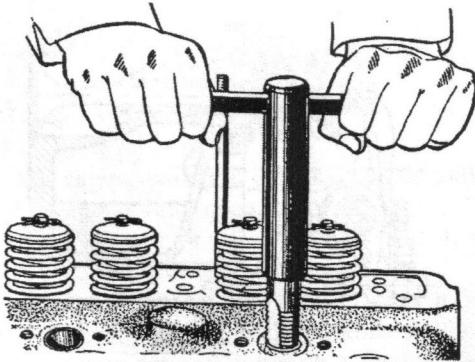


Fig. A.14

*Using tap and wrench 18G213A for injector sleeve extraction. The tap cuts an internal thread on the injector sleeve before the insertion of extractor 18G213*

**NOTE.**—The push-rods should be suitably marked, preferably with tags denoting the number of the cylinder and valve to which each belongs, to ensure correct replacement.

Working in the order shown in Fig. A.13, first slacken each cylinder head nut a quarter of a turn only, and subsequently unscrew each nut a further amount in the same order until loose. Remove the fuel filter bracket steady and lift off the cylinder head. On no account should a screwdriver or any similar tool be used as a wedge between the cylinder head and the block. A suitable method to remove the head is to place a sling round the exhaust manifold studs on one side and round two high-tensile  $\frac{3}{8}$  in. UNF set bolts inserted into the air induction manifold bolt holes on the other side. When lifting the head a direct pull should be given to lift it evenly up the studs.

Unscrew the two locating dowels and remove the cylinder head gasket.

When the cylinder head components have been removed all carbon traces should be scraped from the cylinder head face and valve ports. Blow out the oil passages, and swill out the water passages, using a water hose. The engine rear lifting plate and joint can be removed if necessary to provide access to the water passage. Thoroughly clean the head. The gasket-contacting surface of the head should be checked for flatness with a straight-edge and the surface examined for scores. If the cylinder head is found to be scored badly or out of true it should be renewed.

Examine the inside of each injector sleeve for scratches and burrs, especially the end that makes the seal with the injector.

Remove the sleeves, if necessary, using extractor 18G213 and tap and wrench 18G213A.

Install new sleeves, using tool 18G213B, after ensuring that all traces of swarf are removed from the cylinder head.

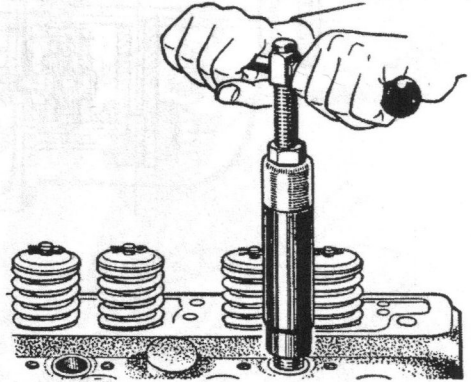


Fig. A.15

*The extractor 18G213, which is of robust construction, is screwed into the internal threads which have been cut in the injector sleeve by tool 18G213A*

The installation of the cylinder head assembly is a reversal of the dismantling procedure, but note the following points:

If there is any doubt as to the condition of the cylinder head gasket fit a new one, plain side downwards. Fit the two locating dowels to the cylinder block after installing the gasket. The dowel holes must be checked to ensure that they are  $\frac{5}{8}$  in. (7.94 mm.) deep, and if necessary they must be drilled out to this dimension to ensure that the cylinder head gasket is completely pinched when the cylinder head is tightened down.

For tightening the cylinder stud nuts a torque spanner set to 100 lb. ft. (13.8 kg. m.) should be used and the nuts tightened in the order shown in Fig. A.13.

With the rocker screws fully slackened off refit the rocker assembly to the cylinder head after the head has been fully tightened down.

When installing the injectors ensure that the sleeve and the injector surface are perfectly clean and tighten the injector securing set bolts evenly to a torque of 12 lb. ft (1.6 kg. m.).

Set the valve to rocker clearances as described in Section A.8.

When the installation has been completed finally bleed the fuel system as described in Section D and test as directed.

## Section A.10

### PISTONS AND RINGS

Remove the pistons and connecting rods from the engine as detailed in Section A.5.

Remove the pistons from the connecting rods.

Remove the rings from the pistons.

If no special piston ring expander is available use a piece of thin steel such as a smoothly ground hacksaw blade or a disused .020 in. (.50 mm.) feeler gauge.

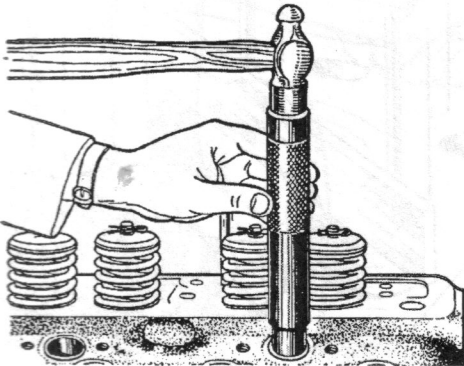


Fig. A.16

*The use of injector sleeve replacer 18G213B will minimize the possibility of damage when driving a new sleeve into the cylinder head*

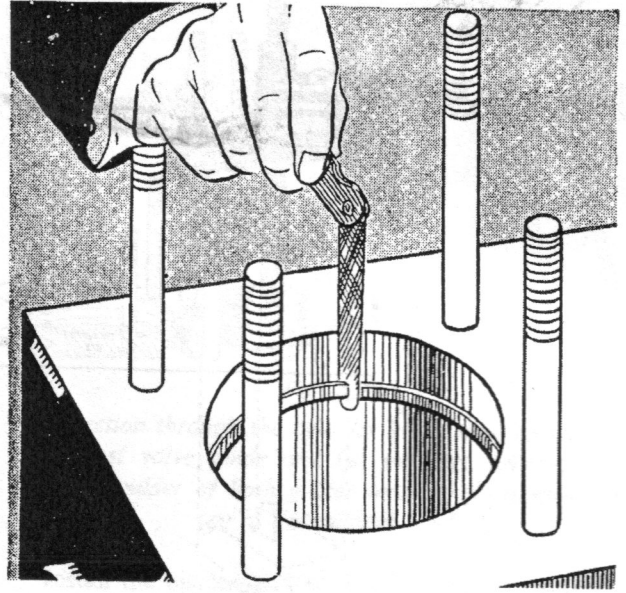


Fig. A.17

*The piston ring gap may be checked by inserting the ring into the cylinder bore, and checking the gap with a feeler gauge, providing the bores are not badly worn*

Raise one end of the ring out of the groove and insert the steel strip between the ring and the piston. Rotate the strip around the piston, applying slight upward pressure to the raised portion of the ring until it rests on the land above the ring grooves. It can then be eased off the piston.

Using a piston ring groove-cleaning tool or an old ring section, carefully scrape all carbon out of the ring

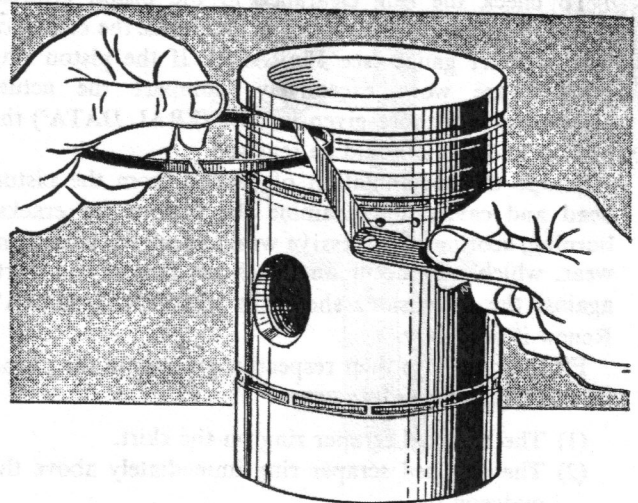


Fig. A.18

*Checking the piston ring groove clearance*



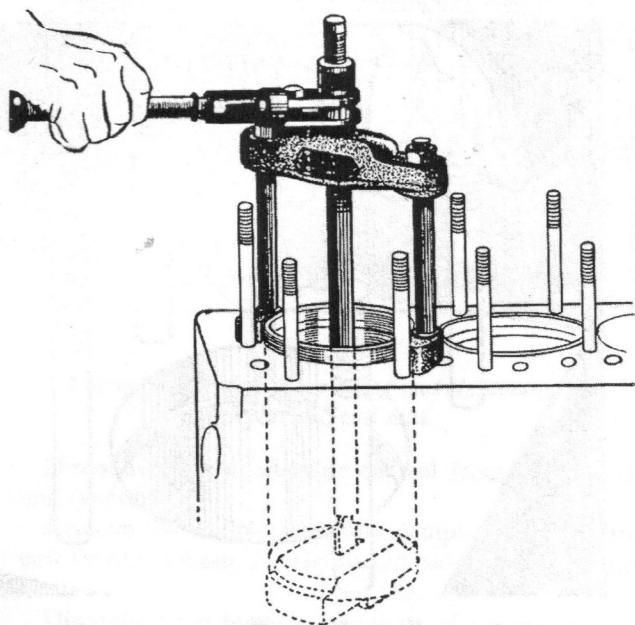


Fig. A.19

*Using extractor 18G227A to withdraw a cylinder liner*

grooves of the pistons. Clean the carbon out of the oil holes in the piston scraper ring grooves.

Piston rings should have a gap clearance of .011 to .016 in. (.279 to .406 mm.) when installed in the cylinder bores. If new rings are being installed or to check the gaps of the old rings insert the ring part way in the bore, using the top of the piston. The ring will then be square with the axis of the bore to check the gap clearance, as shown in Fig. A.17. The cylinder bores must not be badly worn or a false measurement will be taken.

To check the ring clearance in the piston grooves install the rings in the pistons and determine the clearance with a feeler gauge (see Fig. A.18). If the piston ring grooves are worn excessively (compare the actual clearances with those given in 'GENERAL DATA') the pistons and rings should be renewed.

Scrape the accumulation of carbon from the piston head and cavity and examine the pistons for cracks, burning, scoring, or excessive wear; check for maximum wear, which may occur on the thrust face of the skirt, against the dimensions shown in 'GENERAL DATA'. Renew if necessary.

Fit the rings into their respective grooves in the piston in the following order:

- (1) The oxidized scraper ring on the skirt.
- (2) The oxidized scraper ring immediately above the gudgeon pin.
- (3) The tapered periphery compression ring in the third groove—fit with the 'T' towards the crown of the piston.

(4) The tapered periphery compression ring in the second groove—fit with the 'T' towards the crown of the piston.

(6) The chromium compression ring in the top groove.

Fit the pistons to the connecting rods and install them to the instructions given in Section A.5.

## Section A.11

### GUDGEON PINS

The gudgeon pins are a running fit in phosphor-bronze bushes in the connecting rod little-ends and are a hard hand-push fit in the piston.

Check the gudgeon pin fit in the connecting rod little-end bush against the specification given in 'GENERAL DATA'. The old bush should be pressed out if worn. When pressing in a new little-end bush ensure to line the oil hole in the bush with the hole in the top of the connecting rod. One edge of the connecting rod little-end bore is countersunk to facilitate the pressing in of the bush. Replacement bushes are finished to size and reaming is not necessary. On no account must the gudgeon pin bosses and connecting rod bush be reamed out oversize, as oversize gudgeon pins are not supplied or permitted.

The gudgeon pin should be a hard hand-push fit in the piston at 68° F. (20° C.).

## Section A.12

### CYLINDER LINERS AND BORES

Remove the cylinder head (Section A.9) and pistons and connecting rods (Section A.5).

Inspect the liner bores for wear, ovality, and scores; for maximum wear check just below the position where

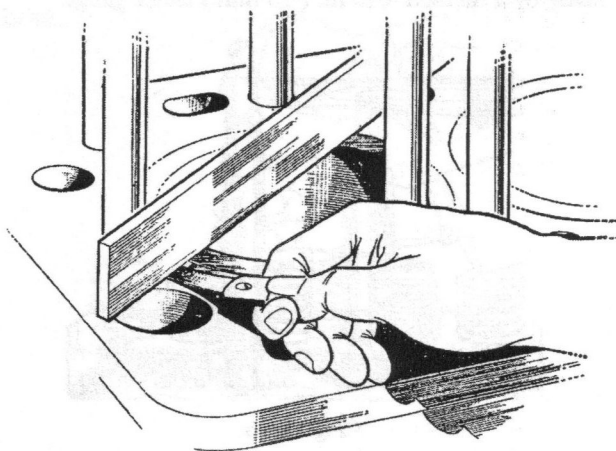


Fig. A.20

*After fitting, check the standing height of the liner from the face of the block*

the top compression ring reaches T.D.C. If the diameter of the bores is worn by as much as .010 in. (.254 mm.) or beyond, new liners and pistons should be fitted. New liners are supplied to standard finished size.

Inspect for water leaks at the top and bottom of the liners; remove the liners and renew the rubber sealing rings if any leak is apparent at the bottom.

Using extractor 18G227A, withdraw the liners from the cylinder block.

When the liner has been removed it is essential that the rubber sealing ring is renewed.

Inspect the locating shoulder for the liners in the top of the cylinder block for signs of burrs or rust accumulation. Clean and smooth off the shoulder and mating surface. Do not remove any metal, otherwise a water leak is liable to occur when the new liner is fitted.

Thoroughly clean out the sealing ring groove in the cylinder block.

Insert the new liner and press fully into position until the flange of the liner butts against the shoulder of the block. Place a piece of wood across the top of the liner and, using double hand pressure, press the liner fully home. Check the standing height of the liners from the face of the block, which should be .002 in. (.051 mm.) to .005 in. (.127 mm.) and fit shims (available in .003 or .005 in. [.076 or .127 mm.] sizes) under the flange to obtain this height if necessary.

Withdraw the liner and install a new sealing ring into the groove in the bottom of the block.

Apply a smear of petroleum jelly to the surface of the ring to prevent any possibility of the ring being dislodged or damaged when refitting the liner.

Refit the liner, ensuring that the correct number of shims, if any, are fitted beneath the liner flange.

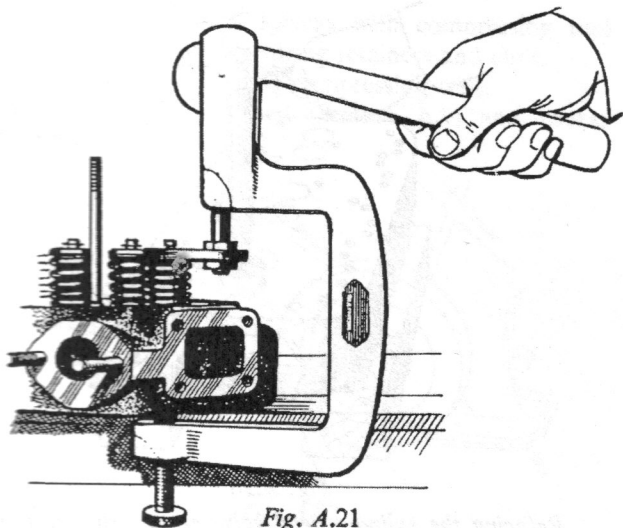


Fig. A.21

Make use of valve spring compressor 18G106 when removing the valves

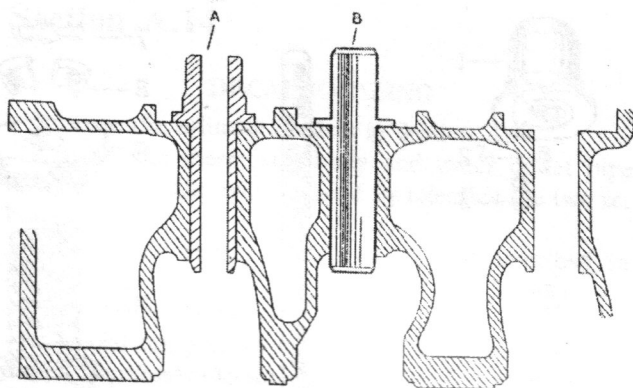


Fig. A.22

A section through the cylinder head, showing (A) an exhaust valve guide and (B) an inlet valve guide. The shoulder of both guides must be flush with the top of the cylinder block

Install the pistons and connecting rods as detailed in Section A.5.

Refit the cylinder head as in Section A.9.

## Section A.13

### VALVES, GUIDES, AND SPRINGS

Remove the cylinder head as detailed in Section A.9.

Remove the rocker assembly as detailed in Section A.6.

To remove the exhaust valves compress each valve spring, using tool 18G106, and remove the spring clip and the two split cones. Release the compressing tool,

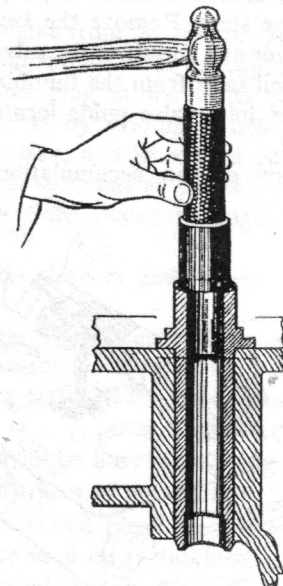


Fig. A.23

Valve guide tool 18G228 may be used to remove and refit inlet and exhaust valves

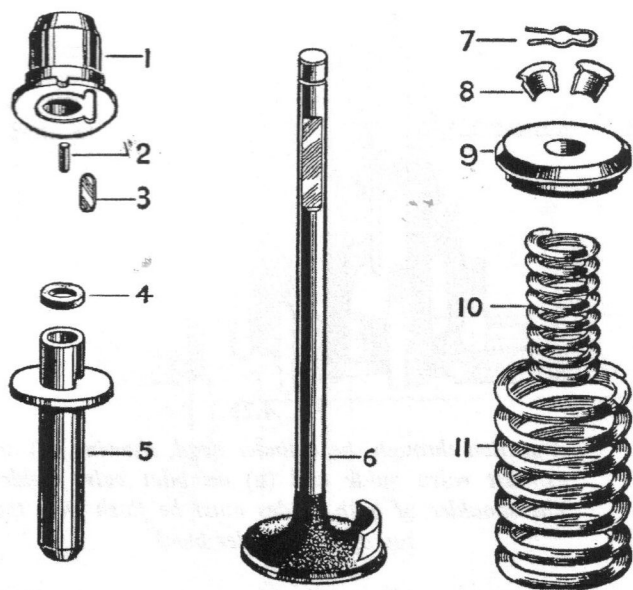


Fig. A.24

*The inlet valve components*

- |                  |                         |
|------------------|-------------------------|
| 1. Thimble.      | 7. Spring clip.         |
| 2. Locating peg. | 8. Split cones.         |
| 3. Key.          | 9. Valve spring collar. |
| 4. Oil seal.     | 10. Inner valve spring. |
| 5. Valve guide.  | 11. Outer valve spring. |
| 6. Valve.        |                         |

thus releasing the valve spring collar, oil seal and retainer, valve springs, and valve.

To remove the inlet valves remove the springs in the manner described in the preceding paragraph. Lift each valve thimble clear of its locating peg and withdraw it from the valve stem. Remove the key from the slot in each valve guide and withdraw the valves from the guides. Remove the oil seals from the thimbles.

Remove the inlet valve guide locating pegs from the cylinder head.

Remove any carbon accumulation from the valve

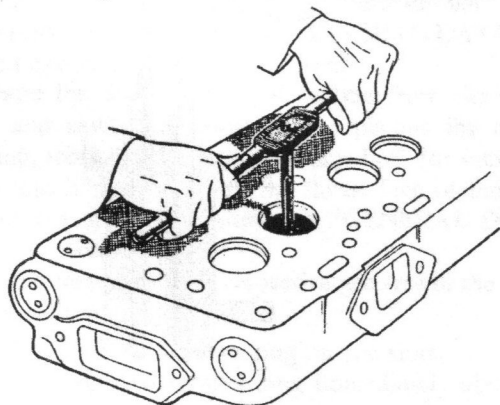


Fig. A.25

*After fitting new valve guides ream in position, using reamer 18G229*

guides; this can be accomplished by dipping the valve stem in petrol or paraffin and moving it up and down in the guide until it is free. If excessive wear is disclosed the guides should be renewed. The guides can be removed by using tool 18G228.

Exhaust valve guides are made with a shoulder and they should be pressed into the correct ports (see Fig. A.22) until the shoulder is flush against the top face of the cylinder head. Ream in position  $\cdot 3460$  to  $\cdot 3465$  in. ( $8\cdot 788$  to  $8\cdot 801$  mm.), using reamer 18G229.

To fit a new inlet valve guide, which is also made with a shoulder, line up the locating peg slot in the guide with the locating peg hole in the cylinder head and press the guide into the correct inlet port until the shoulder is flush against the top face of the cylinder head. Tap the locating peg into position in the cylinder head. Ream the guide in position  $\cdot 3460$  to  $\cdot 3465$  in. ( $8\cdot 788$  to  $8\cdot 801$  mm.), using reamer 18G229.

Later valve guides, which are identified by a groove situated at the top of the guide on its outer diameter, are pre-finished and do not require reaming.

Remove all carbon accumulation from the valves and thoroughly clean them. Inspect the valve faces and seats; if they are slightly pitted or rough they should be ground in in the usual manner, using a fine grinding compound. Badly pitted or distorted valve faces and seats must not be ground together as excessively wide seats are liable to result.

In such cases the valves must be reground and the seats refaced true with the valve guide, using cutters 18G28 (inlet) and 18G174 (exhaust), pilot 18G230, and handle 18G27, removing as little metal as possible. Finally grind in, using fine grinding paste.

When the valves and seats are perfectly smooth and even all round, with no traces of pitting, wash away all

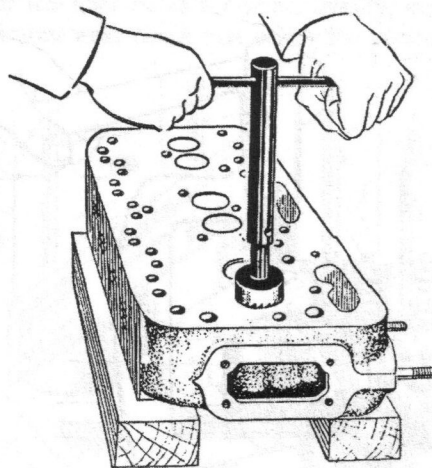


Fig. A.26

*Refacing the cylinder head valve seats, using cutters 18G28 (inlet), 18G174 (exhaust), pilot 18G230, and handle 18G27G*



traces of grinding compound from the seats, ports, and valve guides, using petrol.

Seatings can be checked by using a spot of marking blue on the valve face and turning the valve about one turn on its seat; the marking should be completely reproduced on the valve seat.

With the valves held in position by their springs, ensure that the top faces of the valve heads are flush with the cylinder head face or 'stand-down' to a depth not greater than .010 in. (.254 mm.).

It is most important to remember that operational efficiency of the compression-ignition engine depends largely on the maintenance of good compression, therefore contact between the valve face and seatings must be perfect.

Broken or weak valve springs should be renewed. They should be tested for 'rate' and free length with the figures given under 'GENERAL DATA'. If the springs are below the given free height by more than  $\frac{1}{8}$  in. (3 mm.) they should be renewed. At the same time test the ends of the springs for squareness with the axis. If the ends vary by more than .015 in. (.38 mm.) the springs should be renewed.

Replace the valves in the cylinder head in their original positions. The inlet valves must be positioned so that the small flat at the top of the valve stem diametrically opposite the valve shroud faces the valve guide locating peg. Fit the keys into the valve guide slots and place the thimbles over the valve stems, engaging the locating pegs and locking the keys in position.

Fit a new oil seal to each valve; on the exhaust valves they must be fitted with the chamfered side facing downwards.

Replace the inner and outer valve springs and the valve spring collars.

Compress the valve springs with compressing tool 18G106 and replace the spring retainers and clips.

Release the valve spring compressing tool.

Refit the cylinder head (Section A.9) and rocker assembly (Section A.6).

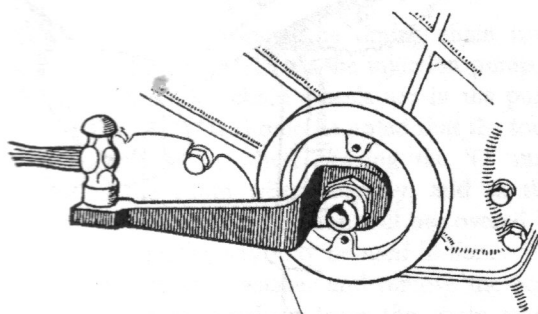


Fig. A.27

*Removing the starting handle jaw nut with special spanner 18G97*

## Section A.14

### DECARBONIZING

Remove the cylinder-head as in Section A.9.

Remove the thermostat body and water outlet pipe complete from the cylinder head by releasing the two set bolts.

Remove the rocker shaft assembly as described in Section A.6.

Remove the valves as in Section A.13.

If special equipment is not available for decarbonizing it will be necessary to scrape the carbon deposit from the piston crowns, cylinder block, and cylinder head, using a blunt scraper.

A ring of carbon should be left round the periphery of the piston crown and the ring of carbon round the top of the cylinder bore should not be disturbed. To facilitate this an old piston ring can be sprung into the bore so that it rests on top of the piston crown.

Thoroughly clean all the dismantled parts and remove all traces of grinding compound and carbon from the cylinder head, valve ports, and surrounds, using paraffin (kerosene) or petrol (gasoline).

Fit a new cylinder head gasket when replacing the head if the old is damaged or otherwise unserviceable.

Refit the valves, rocker shaft assembly, and cylinder head as described in the sections mentioned above.

## Section A.15

### CYLINDER BLOCK

Remove the engine from the tractor (Section A.21).

Remove all components from the engine.

If an expansion plug in the water gallery requires renewing remove it by drilling a hole in its centre, inserting a steel spike, and levering it out.

Scrape as much sediment as possible from the water space and gallery in the block; thoroughly swill out with a water hose.

Clean all gasket surfaces and inspect for cracks and scores.

Check the seating for the cylinder liners in the block; remove any corrosion and burrs. Do not remove any metal, otherwise a water leak is liable to occur when the liner is installed.

Clean out the cylinder liner sealing ring grooves in the block; remove all traces of the old ring.

If any of the screwed plugs are removed new joint washers should be used on replacement.

Check the camshaft bearing bores.

Install all studs, unions, and screwed plugs, etc. If new studs are being installed the tapped holes in the block should be cleaned out and the stud threads coated with

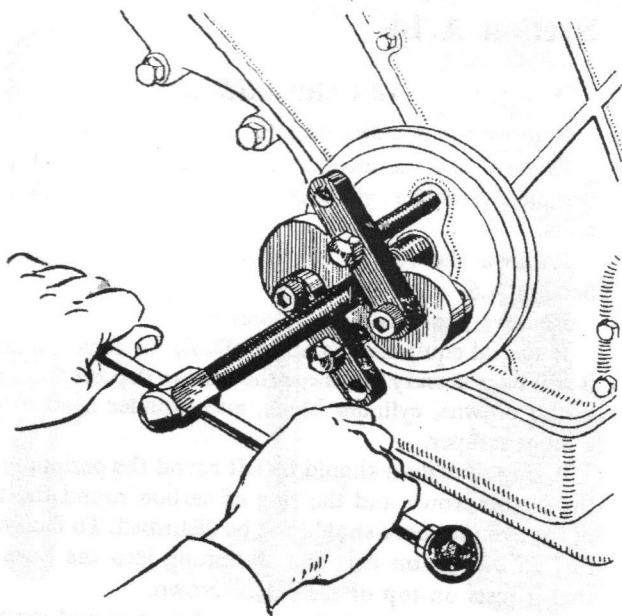


Fig. A.28

*Remover 18G231 with adaptors 18G231A are used to withdraw the fan pulley*

sealing compound. The excess sealing compound which will be forced out must be completely removed from the cylinder block face.

When installing new expansion plugs coat the edge of the plug with sealing compound and insert the plug with the convex side outside. A carefully aimed blow at the centre of the plug with a small hammer or with a blunt punch interposed will expand the plug sufficiently to make a watertight joint. If too heavy a blow is used the plug will be useless and must be replaced by another new one.

## Section A.16

### TIMING CHAIN COVER

To obtain access to the timing chain case cover drain the cooling system and remove the radiator case and block as described in Section C.7.

Take the weight of the engine at the front, preferably with a sling. Do not jack up directly under the sump.

Disconnect the front mountings from the engine front support bracket.

Remove the dynamo and belt (Section N.3).

Remove the starting handle jaw nut, using tool 18G97, and withdraw the fan pulley, using remover 18G231 with adaptors 18G231A. Extract the pulley key from the crankshaft.

Release the bolts securing the engine front support to the chain case cover and remove the support.

Disconnect the Tractometer cable, when fitted, from the tachometer housing.

Release the set bolts securing the timing chain case cover to the engine and remove the front lifting bracket and the dynamo adjusting link support. Release the four set bolts securing the front of the sump to the underside of the chain case cover and slacken the remaining sump bolts one or two turns.

Remove the timing chain case cover complete with the oil seal housing, oil seals, and distance collar, taking care to avoid damaging the sump joint gasket. If this is damaged it should be renewed. Cover the open portion of the sump to prevent the ingress of foreign matter.

Thread the oil thrower off the crankshaft.

Examine the oil seals for wear. If the slightest damage is revealed, especially on the lips, renew by removing the seal housing from the casing and pressing out the old seals.

When refitting the oil seals in their housing the sealing lips must be facing away from each other, i.e. back to back; use a suitable assembly tool to avoid damage to the seals. From the front of the housing thread the distance piece, slow-tapered end foremost, through the oil seals, taking care not to damage the sealing lips.

Ensure that the timing case distance piece is refitted into the tapped hole below the chain guide bracket.

Replace the oil thrower with its bevelled face against the crankshaft chain wheel.

Replacement of the timing cover is a reversal of the removal instructions. Fit a new gasket between the case and cover.

Before fitting the timing case cover apply engine oil to the chain wheels and chain.

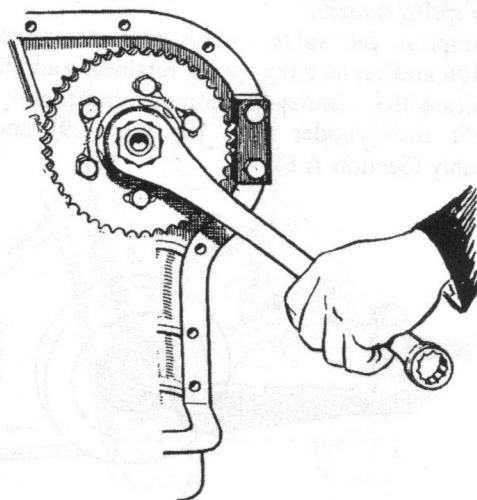


Fig. A.29

*Use locking plate 18G232 to hold the camshaft chain wheel when slackening or tightening the securing nut*

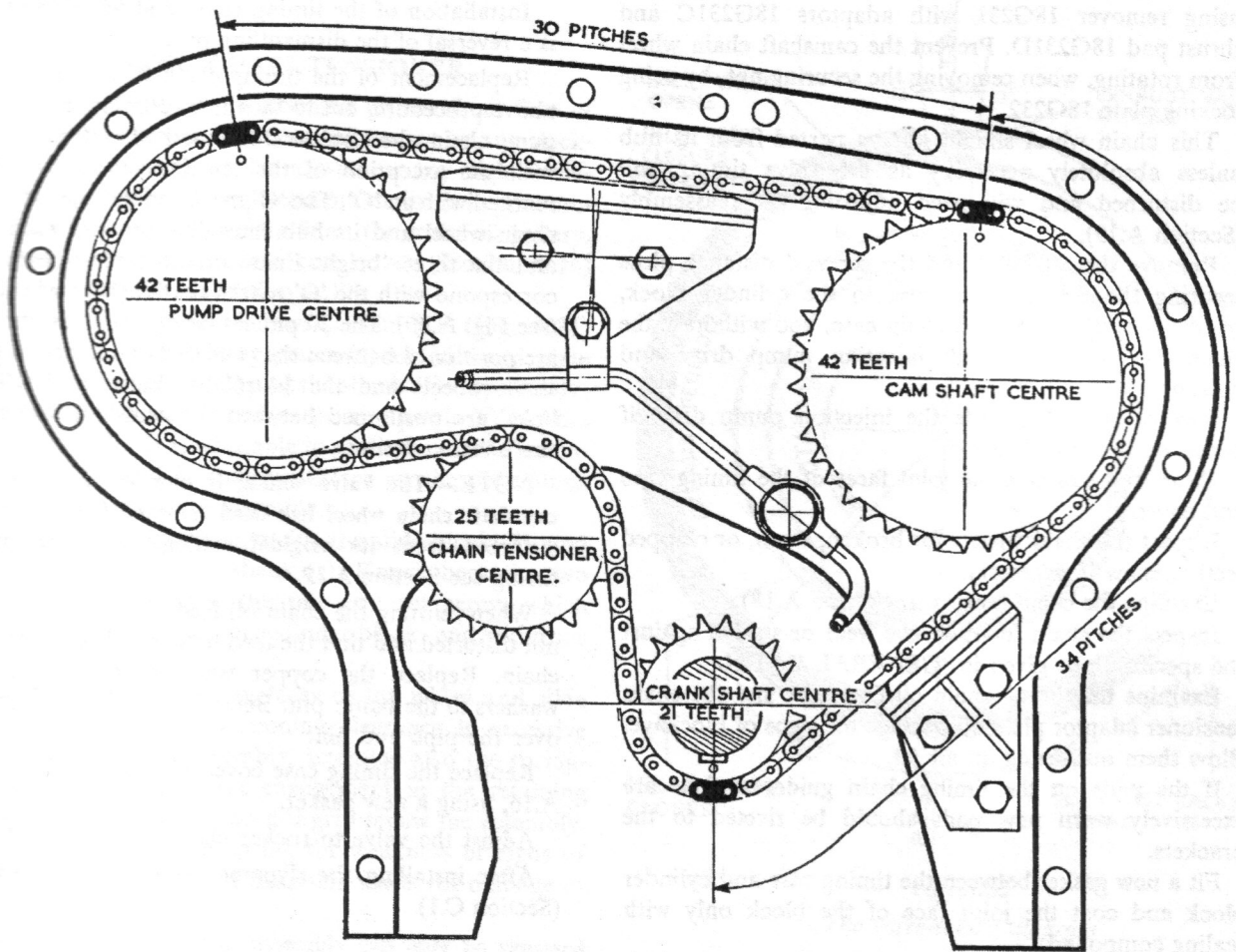


Fig. A.30

*The timing chain drive, showing the positions of the marked teeth and bright chain links to facilitate correct retiming*

## Section A.17

### TIMING CHAIN AND CASE

Remove the timing chain case cover as detailed in Section A.16.

To assist when replacing the timing chain turn the engine until the 'O' marks on the injection pump, camshaft, and crankshaft chain wheels are in the positions shown in Fig. A.30. It should be noted that the tooth on the crankshaft chain wheel bearing the 'O' mark is adjacent to the chain wheel keyway, and as the 'O' mark when in its correct position will be covered by the timing chain, the keyway may be used in lieu.

Press back the lock washer and remove the bolt and two copper sealing washers from the chain wheel oil feed pipe banjo-type union. Unscrew the three bolts with spring washers which secure the timing chain guide bracket and remove the oil feed pipe and the guide bracket.

Release the tension from the timing chain by squeezing together the chain tensioner pawl pins (see Fig. A.31) and pushing the tensioner chain wheel over as far as possible to compress the spring; wedge the chain wheel in this position by inserting special tool 18G241.

Cut the locking wires; remove the six set bolts securing the injection pump chain wheel and ease the chain wheel off its hub. Withdraw the injection pump chain wheel from the timing chain and lift the chain clear of the remaining chain wheels.

With the timing chain removed neither the crankshaft nor the camshaft may be rotated unless all the rocker adjusting screws are completely released to allow all the valves to be in the closed position. If the above is not carried out the valves will foul the tops of the pistons and cause serious damage.

To remove the timing case first remove the remaining timing chain guide bracket and pad assembly.

Withdraw the camshaft chain wheel and hub complete,



using remover 18G231 with adaptors 18G231C and thrust pad 18G231D. Prevent the camshaft chain wheel from rotating, when removing the securing nut, by using locking plate 18G232.

This chain wheel should not be parted from its hub unless absolutely necessary as the valve timing will be disturbed and will need adjusting on reassembly (Section A.19).

Remove the set bolts and the screwed distance piece securing the timing chain case to the cylinder block, release the sump from the chain case, and withdraw the chain case complete with injection pump drive and housing.

Remove and dismantle the injection pump drive if necessary (Section A.20).

Clean and examine the joint faces of the timing case and cover.

Inspect the chain wheels for broken, worn, or chipped teeth; renew if necessary.

Examine the chain tensioner (Section A.18).

Inspect the chain for excessive wear or stretch against the specifications given in 'GENERAL DATA'.

Examine the timing chain oil feed pipe and the chain tensioner adaptor plate oil passage for signs of blockage. Blow them out, using an air jet.

If the pads on the timing chain guide brackets are excessively worn new pads should be riveted to the brackets.

Fit a new gasket between the timing case and cylinder block and coat the joint face of the block only with sealing compound.

Installation of the timing chain and wheels and cover is a reversal of the dismantling procedure.

Replacement of the timing chain is a reversal of the above procedure, but to facilitate retiming, the injection pump chain wheel hub and one tooth of each chain wheel, with the exception of the tensioner chain wheel, are marked with an 'O'. The 'O' marks on the injection pump chain wheel and its hub must line up with each other and the three 'bright links' in the timing chain must correspond with the 'O' marks on the chain wheel teeth (see Fig. A.30). The 30 pitches between the 'bright links' are positioned between the camshaft and injection pump chain wheels and the 34 pitches between the 'bright links' are positioned between the camshaft and crankshaft chain wheels.

**NOTE.**—The valve timing is now correct unless the camshaft chain wheel has been removed from its hub or disturbed from its original setting. For checking the timing see Section A.19.

When refitting the chain oil feed pipe ensure that it is not distorted and that the feed holes are directly over the chain. Replace the copper washers and new locking washers to the banjo pin. Bend the locking washer tabs over the pipe and pin.

Replace the timing case cover as described in Section A.16, using a new gasket.

Adjust the valve to rocker clearance (Section A.8).

After installing the dynamo adjust the belt tension (Section C.1).

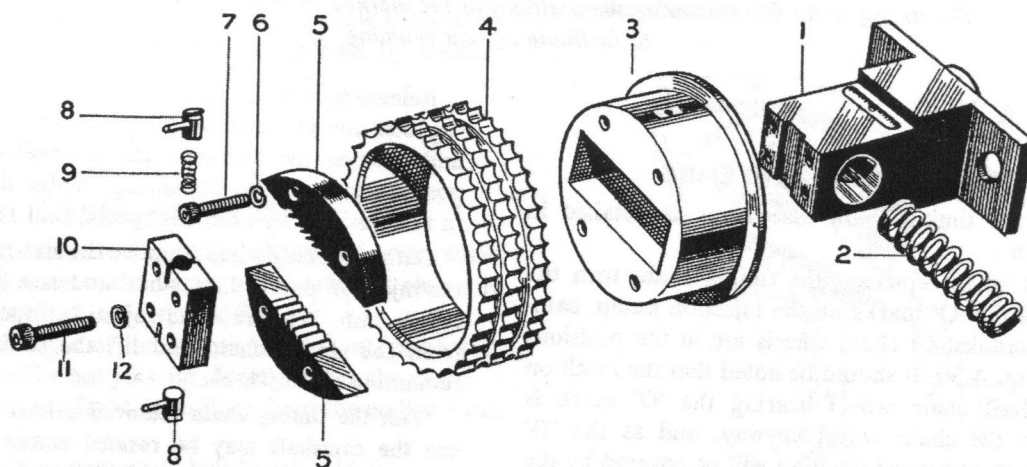


Fig. A.31

*The automatic chain tensioner components*

- |                    |                      |  |
|--------------------|----------------------|--|
| 1. Shank.          | 5. Retaining plates. | 9. Pawl spring.                        |
| 2. Tension spring. | 6. Spring washer.    | 10. End plate.                         |
| 3. Slide block.    | 7. Allen screw.      | 11. Allen screws (end plate to shank). |
| 4. Chain wheel.    | 8. Pawls.            | 12. Spring washer for screw.           |

## Section A.18

## TIMING CHAIN TENSIONER

The chain tensioner is mounted on the front face of the cylinder block and automatically takes up any slackness of the timing chain due to wear or any slight variation in the length of a replacement chain. It is pressure-lubricated through a drilling from the main oil gallery.

Remove the timing chain case cover (Section A.16) and the timing chain (Section A.17).

Unscrew the eight set screws (7) and (11) (Fig. A.31) which secure the retaining plates (5) and the end plate (10) to the slide block (3) and the shank (1) respectively; care must be taken not to lose the two pawls (8) and the pawl spring (9). It is advisable to mark one of the retaining plates (5) and its mating surface on the slide block (3) to ensure correct reassembly.

Withdraw the chain wheel (4), the slide block (3), and the spring (2) from the shank (1). Knock back the two lock washers, unscrew the nut and set screw which secure the shank (1) to the cylinder block, and withdraw the shank.

Examine the bearing surfaces of the wheel and slide block for wear. If the running clearance is excessive renew the tensioner assembly. Examine also the spring-loaded pawls for correct engagement in the retaining plate serrations. If they do not grip renew the assembly.

Examine the tension spring for weakness or signs of fracture, also the teeth of the chain wheel for damage or signs of excessive wear.

**NOTE.**—The tensioner assembly can only be renewed as a complete unit when any component part is worn or damaged.

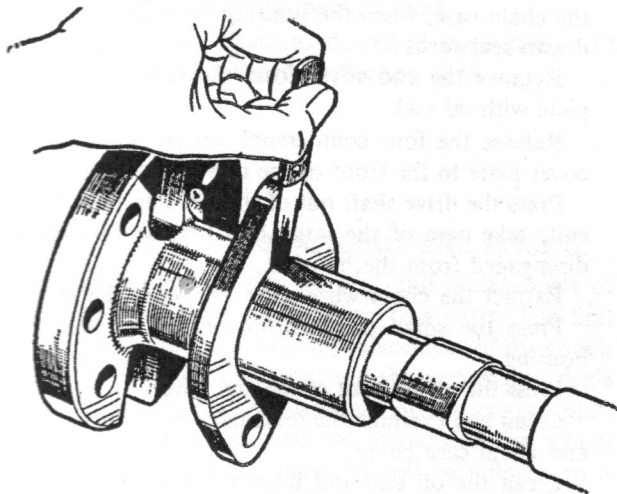


Fig. A.32

Check with a feeler gauge the camshaft end-float, which should not exceed .012 in. (.305 mm.)

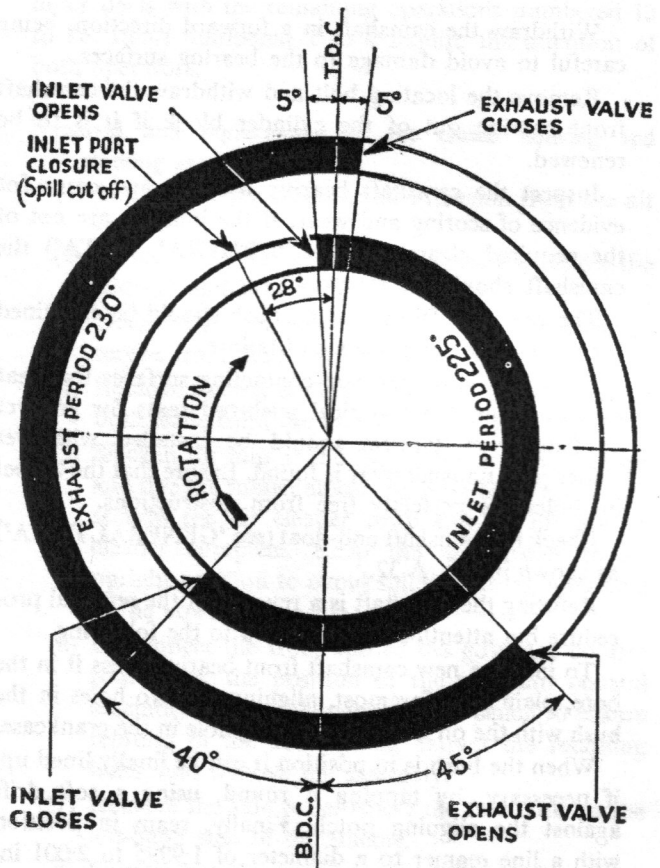


Fig. A.33

The valve-timing diagram

Reassembly is a reversal of the above procedure, but it is most important that the retaining plates (5) and the pawls (8) are fitted correctly, that is with the teeth of the ratchets facing in the direction shown in Fig. A.31, otherwise the restraint mechanism becomes inoperative.

## Section A.19

## REMOVING AND REPLACING THE CAMSHAFT

(Engine with Chain Drive)

Remove the radiator and case (Section C.7).

Remove the timing chain case cover and chain; withdraw the camshaft chain wheel and hub complete (Section A.17). It is not necessary to remove the chain case.

Remove the rocker gear cover, slacken the rocker arm adjusting screws fully, and withdraw the push-rods.

Remove the tappet and push-rod cover.

Remove the tappets.

Remove the fuel lift pump (Section D.4).

Remove the camshaft thrust plate.

Withdraw the camshaft in a forward direction, being careful to avoid damage to the bearing surfaces.

Remove the locating bolt and withdraw the camshaft front bearing out of the cylinder block if it is to be renewed.

Inspect the camshaft bearing journals and cams for evidence of scoring and wear. If the journals are not of the required clearances (see 'GENERAL DATA') the camshaft should be renewed.

The camshaft front bearing bush should be examined for scores, pits, or evidence of failure.

Examine the tappet cam-contacting surfaces for wear or scores and the spherical push-rod seats for grooves or flats. New tappets should be installed whenever evidence of unusual wear is found. Ensure that the tappet oil holes are perfectly free from obstructions.

Check the camshaft end-float (see 'GENERAL DATA') as shown in Fig. A.32.

Refitting the camshaft is a reversal of the removal procedure but attention must be paid to the following.

To install a new camshaft front bearing press it in the bore, plain edge foremost, aligning the two holes in the bush with the oil hole and locating hole in the crankcase.

When the bush is in position it can be finally lined up, if necessary, by tapping it round, using a soft drift against the aligning notch. Finally, ream in position with a line reamer to a diameter of 1.9995 to 2.001 in. (50.787 to 50.825 mm.) and fit the locating bolt.

Lubricate the journals before installing the camshaft.

Install the camshaft thrust plate with the polished side against the camshaft front journal.

If the camshaft chain wheel has been removed or disturbed on the hub during servicing retiming of the valves will be necessary and can be carried out as follows.

Line the 'O' mark on the chain wheel with the 'O' mark on the hub; secure the chain wheel with the six set bolts but do not lock them at this stage. Secure the hub to the camshaft and lock the centre securing nut when fully tightened. Replace the timing chain as described in Section A.17. Adjust the rocker to push-rod clearances as described in Section A.8. Obtain access to the rim of the flywheel so that the timing marks can be seen. (Remove the clutch inspection cover on the left-hand side of the tractor forward of the clutch pedal.) When the mark 'T.D.C.' is in line with the timing pointer No. 1 piston is at T.D.C. (If the engine is out of the vehicle note that the flywheel markings will be at 90° to the vertical position. A degree plate will be of assistance.)

Determine the exact point at which No. 1 exhaust valve closes. A clock gauge mounted on the exhaust manifold front studs with its indicator on the valve collar will facilitate this operation. The flywheel should now be at 5° A.T.D.C.

If the timing in accordance with these instructions and the valve-timing diagram (Fig. A.33) is incorrect, slacken the six set bolts securing the camshaft chain wheel to its hub and turn the flywheel until the T.D.C. mark is at 5° A.T.D.C. Always turn the flywheel in the direction of rotation of the engine. When a new timing chain is being fitted it is advisable to set the flywheel T.D.C. mark at 2° A.T.D.C. in order to allow for a slight stretching of the chain.

When the exact valve timing is obtained tighten and wire up the camshaft chain wheel set bolts.

Bleed the fuel system, as described in Section D, after the fuel pipe connections are made.

## Section A.20

### INJECTION PUMP DRIVE (Engine with Chain Drive)

Remove the timing chain case cover (Section A.16).

Remove the timing chain (Section A.17).

Remove the injection pump from its mounting bracket as described in Section D and remove the coupling and key from the drive shaft.

Refit the chain wheel (withdrawn during the removal of the timing chain) to its hub.

Release the tab washer and remove the nut from the front of the drive shaft. Locking plate 18G232 can be used to prevent the chain wheel revolving when unscrewing the nut.

Withdraw the chain wheel complete with hub from the drive shaft, using remover 18G231 with adaptors 18G231C and thrust pad 18G231E.

Remove the six set bolts securing the drive housing to the chain case, when the housing complete can be withdrawn rearwards.

Remove the end cover from the drive housing complete with oil seal.

Release the four countersunk set screws securing the cover-plate to the front of the drive housing.

Press the drive shaft out of the housing from the plain end; take care of the large ball bearing as it becomes disengaged from the housing.

Extract the chain wheel hub key from the shaft.

Press the small ball bearing out of the rear of the housing.

Press the oil seal out of the end cover.

Clean and examine the joint faces of the drive housing and chain case cover.

Clean the oil seal and inspect for wear and damage. If the slightest damage is revealed, especially on the lip, the seal must be renewed.

Inspect the chain wheel for broken, worn, or chipped teeth; renew if necessary.



Inspect the ball bearings for signs of pits or scores. To dislodge solid particles remaining in the bearing tap the bearings sharply on a block of wood and immerse them in paraffin, spinning them slowly. Renew any bearings that are worn. Coat the bearings in engine oil and wrap them in a clean cloth until required for re-assembly.

Press the large ball bearing into the front of the housing.

Fit the cover-plate over the front of the housing, using new countersunk set screws; peen them over when fully tightened.

Fit the chain wheel hub key to the front of the drive shaft and insert the shaft into the housing with the shoulder against the ball bearing.

With the shaft held in this position, press on the rear ball bearing fully against its abutment shoulder.

Press the oil seal into the end cover, with the lip of the seal towards the open end of the cover.

Thread the oil seal and cover over the drive shaft; take particular care when engaging the lip of the seal over the shaft—it must not be damaged in any way or oil leakage will occur. Lightly smear the joint faces with a sealant compound and secure the end cover with the four set bolts.

Inject a liberal amount of engine oil into the housing for initial lubrication of the bearings until the engine oil is circulated.

Lightly smear the joint face of the chain case with a sealing compound and assemble the drive housing to the rear of the chain case, using a new joint gasket between the mating surfaces. Secure in position with the six set bolts.

Refit the injection pump (Section D.8).

Install the timing chain as described in Section A.17 and the chain case cover as in Section A.16.

## Section A.21

### REMOVING AND REPLACING THE ENGINE

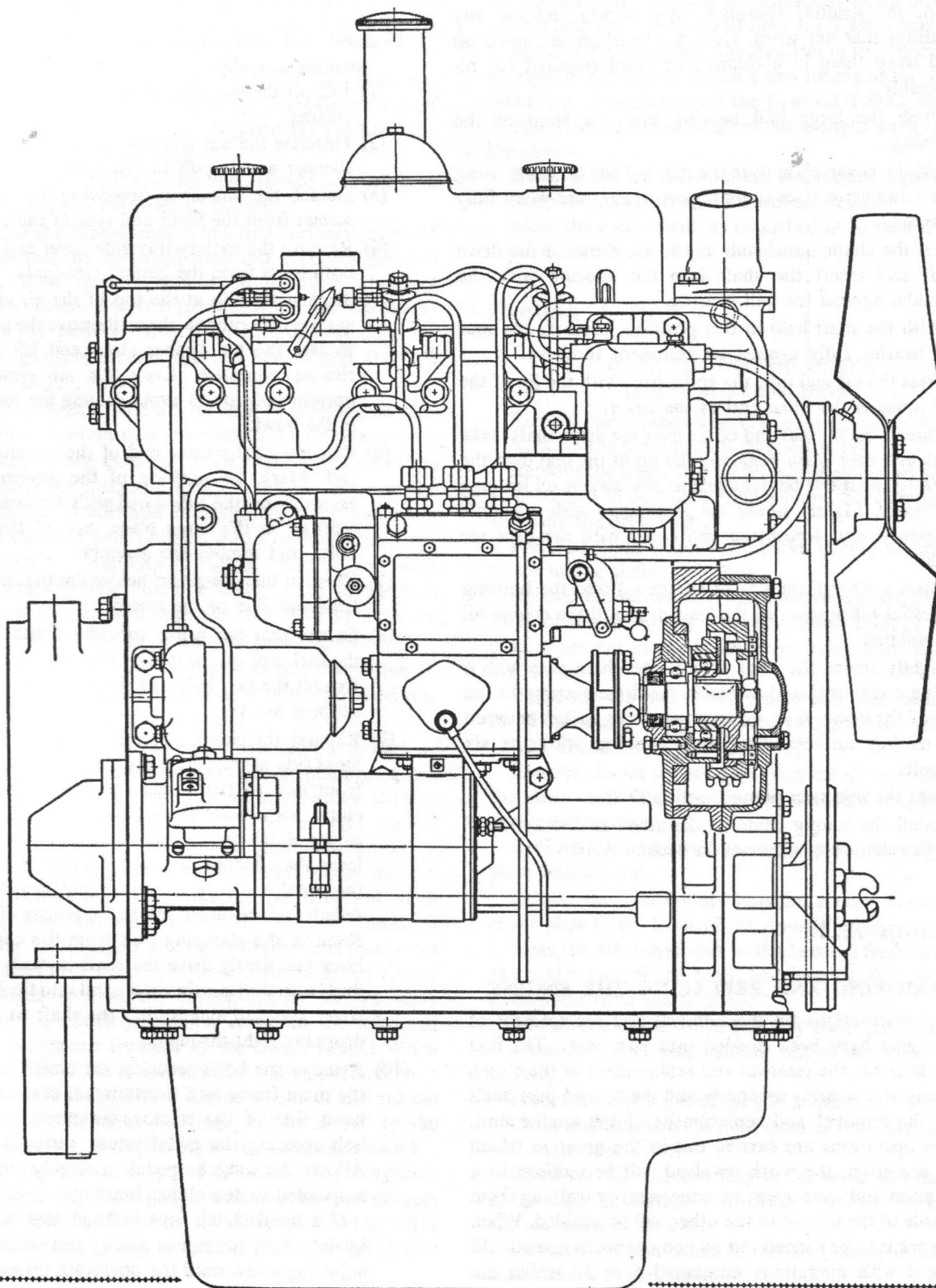
The instructions on the removal and replacement of the engine have been divided into two parts. The first part describes the removal and replacement of the clutch housing and steering assembly and the second part deals with the removal and replacement of the engine unit. If the operations are carried out in the order in which they are given, the work involved will be reduced to a minimum and time spent in unnecessarily walking from one side of the tractor to the other will be avoided. When the work is to be carried out by two operators one should proceed with operations numbered 5 to 12 whilst the

other deals with the remaining operations numbered 13 to 26. Items numbered 1 to 4 require the attention of both operators.

### Removal and replacement of the clutch housing and steering assembly

- (1) Lift off the pre-cleaner and extension from the air cleaner.
- (2) Unscrew the nut and bolt from the clip below the silencer and lift off the silencer.
- (3) Detach the bonnet by removing the two securing screws from the front and rear of the bonnet.
- (4) Remove the battery tray side cover and disconnect both leads from the battery terminals.
- (5) Slacken the clip at the top of the air cleaner pipe and free the rubber elbow. Remove the screw which secures the air cleaner strap and lift off the air cleaner complete. Keep the air cleaner in an upright position to avoid spilling the oil contained in the bowl.
- (6) Disconnect the front end of the governor control rod. Mark the position of the governor control assembly on the side panel with a pencil to ensure refitting in the same place, extract the retaining bolts, and remove the assembly.
- (7) Remove the side panel below the fuel tank on the left-hand side of the tractor.
- (8) Ensure that the tap is turned off and disconnect the fuel pipe on the delivery side of the filter bowl. Extract the two bolts securing the filter unit to the support bracket.
- (9) Remove the clutch inspection cover from the left-hand side of the clutch housing and disconnect the front end of the clutch operating rod from the clutch withdrawal shaft. Scribe a mark on the face of the clutch pedal lever and the end of the pedal lever shaft before removal to assist in positioning the pedal correctly on reassembly, thus facilitating re-entry of the pinch-bolt in the groove of the shaft. Remove the clamping bolt from the clutch pedal lever and gently drive the shaft inwards until it is flush with the boss. Insert a hand into the inspection cover aperture and behind the shaft to prevent it dropping right through.
- (10) Remove the bolts securing the clutch housing to the main frame and transmission case on the left-hand side of the tractor, commencing with the bolt securing the pedal return spring anchorage. Allow the clutch pedal assembly to remain suspended in the clutch housing.  
If a hand clutch unit is fitted this is removed by detaching the return spring and slackening the adjusting screw until the operating spring and cup

## THE UNIVERSAL THREE ENGINE—INJECTION PUMP DRIVE



can be removed. Disconnect the operating rod fork from the withdrawal shaft, remove the circlip from the right-hand side of the pedal shaft, and drive the shaft through the casing from the right.

- (11) Disconnect the oil pressure gauge pipe from the union on the cylinder block situated below the drain tap.

- (12) Disconnect the leads to the dynamo and remove the cable and clip from under the tappet cover bolt.

The following operations are carried out from the right-hand side of the tractor:

- (13) Disconnect both wires from the starter motor pilot switch.
- (14) Disconnect from the solenoid the starter motor wire.
- (15) On tractors fitted with electric lighting disconnect the headlamp wiring from the snap connector.
- (16) Disconnect the cable from the stop control lever on the injection pump.
- (17) Disconnect from the bell-crank lever the throttle linkage connected between it and the venturi lever.
- (18) Disconnect the injector spill-off pipe from the return pipe to the fuel tank.
- (19) Unscrew the nuts and remove the starter solenoid from the battery box.
- (20) Four bolts secure the battery box to the clutch housing; remove the bolts and detach the box.
- (21) Remove the six screws securing the right-hand panel below the fuel tank. **NOTE.—The two bottom screws securing either tank panel each have one spring and one plain washer, the remaining screws each having one spring washer only.** Extract the clevis pin securing the starter control rod to the lever on the starter motor and withdraw the

side panel complete with the starter control assembly.

- (22) Scribe a mark across the steering drop-arm lever and shaft to ensure correct alignment on reassembly and then remove the drop-arm clamping bolt. Withdraw the drop-arm from the shaft.
- (23) Remove from the right-hand side the six bolts securing the clutch housing to the main frame and transmission casing.
- (24) When electric lighting is fitted disconnect both wires from the lighting switch on the instrument panel.
- (25) Lift one end of the rubber sealing strip between the flywheel housing and the clutch housing and peel the strip out.
- (26) Place a rope sling beneath the fuel tank support brackets. Pack with rag to prevent abrasions and lift off the assembly. Ensure that the fuel pipe is not caught up and that the instrument panel and fuel filter bowl are not damaged when the assembly is lowered to the ground.

Replacement of the clutch housing and steering assembly is carried out in the reverse order to the removal procedure.

## Removal and replacement of the engine unit

- (27) Drain the cooling system from the left-hand side by opening the tap at the base of the radiator and the tap on the cylinder block. (If the engine is to be dismantled after removal drain the oil by removing the plug in the left-hand side of the engine sump.)
- (28) Remove the four bolts holding the radiator case to the support brackets and lift off the radiator case.
- (29) Take out the split pin securing the front end of the radiator shutter control, if fitted, and remove the control complete. Slacken the clips securing the top and bottom water hoses and free the hoses. Remove the radiator stay securing bolt. Take out the split pins and remove the nuts and bolts securing the radiator block to the support brackets. Lift off the radiator block and leave in an upright position in a safe place. (Flush out the radiator block with clean running water on removal from the tractor.)
- (30) Remove the locking wire and withdraw the clevis pin from the transmission driving sleeve. Slide the sleeve forward along the shaft.
- (31) Extract the two retaining spring clips and remove the release bearing from the withdrawal shaft.
- (32) Remove the four bolts securing the engine in position and arrange a suitable sling from the two lifting brackets provided on the engine. Take care to prevent the sump drain plug from fouling the main frame as the engine is lifted.

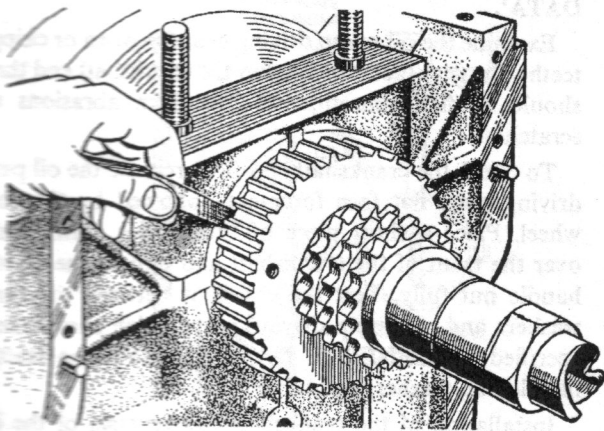


Fig. A.34

*Insert a feeler gauge between the thrust washers and the oil pump driving gear to check the crankshaft end float*



Make sure that the dowels are in position over the main bearing studs before refitting the caps.

The two halves of the main bearing shells are different; the half with the oil hole is fitted into the crankcase.

If the top half of the crankshaft rear oil seal cover has been removed a new gasket should be fitted after coating the crankcase joint face with sealing compound. The cover must be centralized round the return thread of the crankshaft; a clearance of  $\cdot0070$  to  $\cdot0085$  in. ( $\cdot178$  to  $\cdot216$  mm.) all round should be maintained between the thread and the cover. The flat surface of the bottom half of the cover must be perfectly level with the crankcase surface to which the sump is mounted.

## Section A.23

### REMOVING AND REPLACING THE FLYWHEEL

Remove the clutch as detailed in Section E.2.

Extract the locking wire and bolts securing the flywheel to the crankshaft flange.

Withdraw the flywheel from the locating dowels, using two  $\frac{3}{8}$  in. UNF. bolts screwed into the two withdrawal holes provided. Take care to use bolts with the correct thread; the flywheel bolts will not fit.

If the starter ring requires attention see Section A.24.

Examine the flywheel face for excessive or uneven wear and renew if necessary.

The flywheel dowels must be renewed if they are loose or burred.

To reinstall the flywheel and starter ring place it against the crankshaft flange with the locating dowels in position. The dowels are offset diagonally to ensure correct positioning of the flywheel timing marks with the pistons.

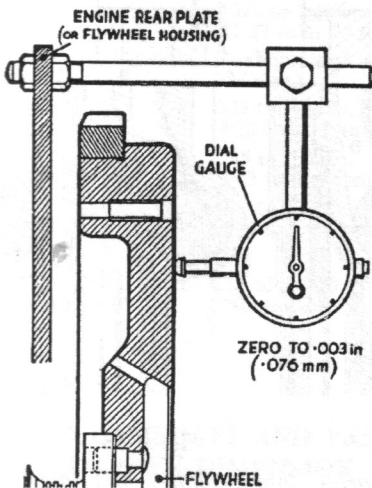


Fig. A.36

*Use a dial gauge to check that the flywheel alignment is within limits*

Insert the set bolts and tighten in diagonal sequence to a torque of 100 lb. ft. (13.8 kg. m.).

Check the alignment of the flywheel by installing a dial test indicator to the flywheel housing so that the indicator button rides on the clutch face of the flywheel (Fig. A.36).

Crank the engine slowly to determine the amount of misalignment. This should not exceed  $\cdot003$  in. ( $\cdot076$  mm.), as registered on the dial when the engine is turned through one complete revolution.

Finally, lock the securing bolts in position with new locking wire and remove the dial test indicator.

## Section A.24

### FLYWHEEL STARTER RING

Remove the flywheel from the engine as described in Section A.23.

Examine the teeth on the starter ring for damage and wear. The land on the engagement face of the teeth should be  $\cdot062$  to  $\cdot072$  in. (1.57 to 1.83 mm.) wide; if this land has worn away or the face is badly burred the ring or flywheel assembly should be renewed.

**NOTE.**—The fitting of a new starter ring requires careful heat treatment to obtain an even and correct temperature of the ring, therefore the instructions given below should be closely followed.

Remove the old starter ring from the flywheel flange.

New starter rings are marked with a strip of temperature-indicating-colour paint and this changes from its initial grey-blue colour to buff at a temperature of  $275^{\circ}\text{C}$ . ( $527^{\circ}\text{F}$ .).

Ensure that the bore of the new starter ring and its mating surface on the flywheel are perfectly clean and free from burrs.

The starter ring must not be heated above a temperature of  $350^{\circ}\text{C}$ . ( $662^{\circ}\text{F}$ .) maximum for shrinking onto the flywheel, otherwise the temper of the wheel will be adversely affected.

Place the new starter ring on a steel plate over a large gas-ring and heat up uniformly until the temperature-indicating paint changes to a buff colour.

If a thermostatically controlled furnace is available it should be heated to the required temperature of  $275^{\circ}\text{C}$ . ( $527^{\circ}\text{F}$ .) and then the starter ring placed inside and left for 10 to 15 minutes to allow for uniform heating.

Place the heated starter ring squarely on the flywheel, bore chamfer foremost. The expansion will allow the ring to be readily fitted, without force, by using a piece of hardwood placed across the ring and pressing or lightly tapping it until it is hard against its register.

When the starter ring is cold the 'shrink' fit will be permanently established and no further treatment is necessary.

Refit the flywheel as detailed in Section A.23.

## Section A.25

### ALTERNATIVE OIL FILTER

A Vokes engine oil filter is now being fitted to some OEC (3-cylinder) and OEA (4-cylinder) engines as an alternative to the Purolator filter.

Although the two filters are interchangeable as complete units the filter elements are not and it is important therefore that the correct element is fitted when a replacement is required.

Filter element part numbers are as follows: Purolator 8G2300, Vokes 17H1784.

## Section A.26

### FLYWHEEL BEARING MODIFICATION

Commencing at Engine No. 25TA/B/D6039, tractors fitted with independent power take-off have the stem wheel bush in the flywheel replaced by a single-row, rigid ball journal bearing (Part No. BMK411).

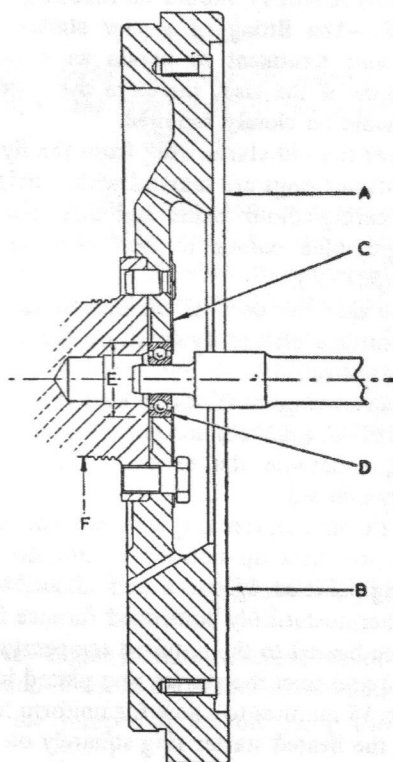


Fig. A.37

A2634A

- A. Flywheel AMK2730 (3.4-litre engine).
- B. Flywheel AMK2729 (2.55-litre engine).
- C. Bearing locating plate AMK2721.
- D. Bearing BMK411.
- E. Machining dimension 1.5618 to 1.5623 in. (39.685 to 39.697 mm.) diameter.
- F. Crankshaft.

The bearing can be fitted to earlier tractors if the bush bore diameter in the flywheel is increased to 1.5618 to 1.5623 in. (39.685 to 39.697 mm.) diameter (see Fig. A.37).

Before fitting, pack the bearing with Duckham's L.B. 10 Grease and insert a small amount in the hole in the end of the crankshaft.

The bearing must be tapped squarely into the bore in the flywheel until the bearing outer race is flush with the face of the flywheel that butts against the crankshaft. Ensure that all traces of excess grease are removed from the clutch side of the bearing after fitting.

Refit the flywheel to the engine as detailed in Section A.23, fitting the bearing locating plate (Part No. AMK2721) on the clutch side of the flywheel beneath the flywheel securing bolts.

## Section A.27

### MODIFIED CYLINDER LINER

An improved cylinder liner has been introduced on both three- and four-cylinder tractor engines.

The new liner, illustrated at (C) in Fig. A.38, is interchangeable with earlier types, preferably in sets, although single replacements may be fitted, provided the latest-type gasket is also fitted.

Fitting instructions for the modified liner remain as detailed in Section A.12, but care must be taken when checking the standing height that the measurements are taken at the points indicated by the arrows in Fig. A.38.

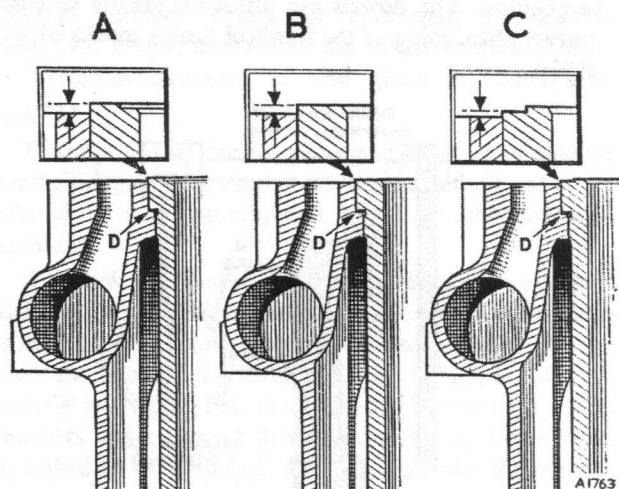


Fig. A.38

*The early-, intermediate-, and latest-type cylinder liners, indicated by (A), (B), and (C) respectively. The twin arrows indicate the standing height clearance and (D) the adjusting shims*

## Section A.28

### VALVE SEAT INSERTS

Should the valve seating become so badly worn or pitted that the normal workshop cutting and refacing tools cannot restore them to their original standard of efficiency, special valve seat inserts can be fitted. To fit

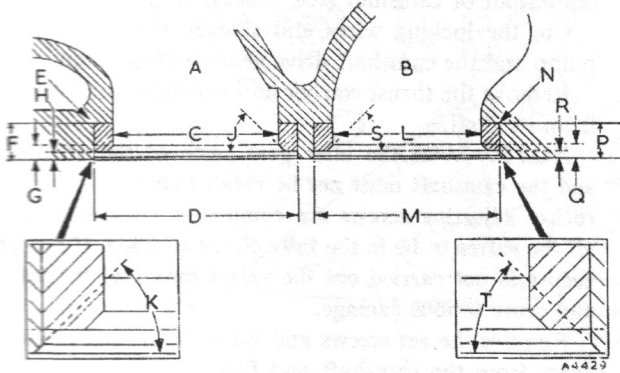


Fig. A.39

Valve seat machining dimensions

the inserts machine the seating in the cylinder head to the dimensions given in Fig. A.39 and press in the inserts, which have an interference fit of .002 to .004 in. (.051 to .102 mm.). Finally, grind or machine the seatings to the dimensions given in Fig. A.39, ensuring that the throat of the valve seat blends into the throat in the cylinder head. Normal valve grinding may be necessary to ensure efficient valve sealing.

See also Section AA.8.

Inlet (A)	Exhaust (B)
C. Nominal diameter 1.450 in. (36.8 mm.).	L. Nominal diameter 1.290 in. (32.75 mm.).
D. 1.775 to 1.776 in. (45.076 to 45.102 mm.).	M. 1.625 to 1.626 in. (41.27 to 41.30 mm.).
E. Maximum radius .015 in. (.38 mm.).	N. Maximum radius .015 in. (.38 mm.).
F. .325 to .328 in. (8.25 to 8.33 mm.).	P. .325 to .328 in. (8.25 to 8.33 mm.).
G. .135 to .140 in. (3.43 to 3.56 mm.).	Q. .135 to .140 in. (3.43 to 3.56 mm.).
H. .070 to .080 in. (1.78 to 2.03 mm.).	R. .070 to .080 in. (1.78 to 2.03 mm.).
J. 45°.	S. 45°.
K. Chamfer .020 to .030 in. (.508 to .762 mm.) at 45°.	T. Chamfer .020 to .030 in. (.508 to .762 mm.) at 45°.

## Section A.29

### MODIFIED CAMSHAFT AND VALVE STAND-DOWN DIMENSION

A camshaft having improved cam profiles and giving different valve lift characteristics was introduced on OEC engines at Engine No. 9435.

The valve stand-down (see Section A.13, page A.19) is increased to .020 to .030 in. (.508 to .762 mm.). For standardization purposes all Factory-reconditioned engines will, in future, have the valves fitted to the increased stand-down dimension, although they may not necessarily be fitted with the modified camshaft.

The modified camshaft, which has a  $\frac{3}{32}$  in. (2.38 mm.) wide shoulder machined on its threaded end for identification purposes, may be used as a replacement for the early-type camshaft, in which case the valve seats must be carefully recut to give the increased valve stand-down, using the valve seat cutting tools listed on page A.32.

In addition, the depth of each inlet port counterbore, as measured from the cylinder head joint face, must be checked and, if found to be less than .668 in. (17 mm.), must be recut to this dimension.

See also Section A.28.

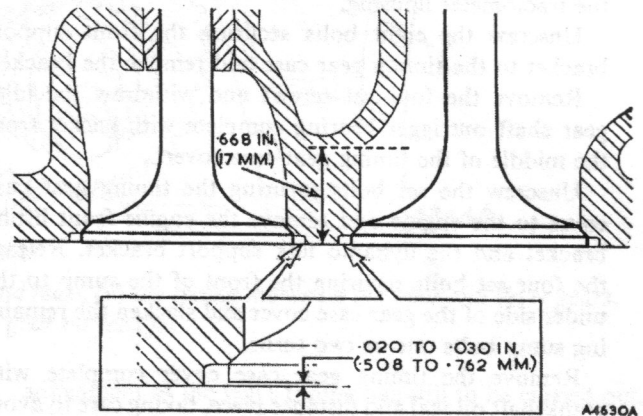


Fig. A.40

When fitting a modified camshaft to early engines recut, if necessary, the depth of each inlet port counterbore to the above dimension and fit the valves with their tops standing down below the cylinder head joint face as shown inset

## Section A.30

### GEAR DRIVE FOR CAMSHAFT AND F.I. PUMP

From Engine No. OEC14063 the chain drive for the camshaft and fuel injection pump is replaced by a train of helical gears.

The gears are lubricated by an oil feed jet screwed into a connecting passage from the front of the main oil gallery. From this passage oil is fed to the idler gear shaft to lubricate the idler gear bearing.

Where previous instructions are affected by the change to gear drive, revised instructions will be found in Sections A.31, A.32, A.33, and A.34.



## Section A.31

### REMOVING AND REPLACING THE TIMING GEAR CASE COVER

(Engine with Gear Drive)

To obtain access to the timing gear case cover drain the cooling system and remove the radiator case and block as described in Section C.7.

Disconnect the front mountings from the engine front support bracket.

Remove the dynamo and belt (Section N.3).

Press back the lock washer and unscrew the nut from the end of the crankshaft, using spanner 18G564.

Withdraw the crankshaft pulley, using remover 18G231 and adaptor 18G231A, and extract the pulley key from the end of the crankshaft.

Disconnect the tractometer cable, when fitted, from the tractometer housing.

Unscrew the eight bolts securing the front support bracket to the timing gear case and remove the bracket.

Remove the four set screws and withdraw the idler gear shaft outrigger bearing complete with gasket from the middle of the timing gear case cover.

Unscrew the set bolts securing the timing gear case cover to the engine and remove the engine front lifting bracket and the dynamo link support bracket. Release the four set bolts securing the front of the sump to the under side of the gear case cover and slacken the remaining sump bolts one or two turns.

Remove the timing gear case cover complete with crankshaft oil seal and distance piece, taking care to avoid damage to the sump joint washer. The gear case cover is located at its lower end on the gear case by two dowels.

Before replacing the gear case cover examine the joint faces of both the case and cover. Clean off any particles of old joint gasket which may adhere to the cover and ensure that no burrs are evident. Inspect the crankshaft oil seal for wear and renew it if the lips of the seal show the slightest signs of damage. Ensure that the crankshaft distance piece is free from burrs and scratches where the oil seal lips contact.

Replacement of the gear case cover is a reversal of the removal procedure. Fit a new joint gasket between the gear case and cover and do not use jointing compound.

## Section A.32

### REMOVING AND REPLACING THE TIMING GEARS AND CASE

(Engine with Gear Drive)

Remove the timing gear case cover (Section A.31).

Slacken all the fuel injector securing bolts to relieve the compression when cranking the engine.

If the timing gears only are to be renewed, refit the crankshaft nut and rotate the crankshaft with spanner 18G564 until No. 1 piston is at T.D.C. after completing its compression stroke. The timing marks on the crankshaft and camshaft gears (see Fig. A.41) are now positioned correctly for reassembly. This will enable the new gears to be fitted without the necessity of rotating the crankshaft or camshaft (see 'NOTE' below).

Cut the locking wires and slacken the fuel injection pump and the camshaft drive gear securing screws.

Remove the thrust washer and withdraw the idler gear from its shaft.

**NOTE.**—With the idler gear removed the crankshaft and the camshaft must not be rotated unless all the valve rocker adjusting screws are completely released to allow all the valves to be in the fully closed position. If this procedure is not carried out the valves may foul the pistons and cause serious damage.

Remove the set screws and washers and withdraw the gears from the camshaft and fuel injection pump drive hubs.

Withdraw the oil pump driving gear and the crankshaft gear, using remover 18G231 and adaptor 18G231B.

If the timing gears are not to be renewed the camshaft and fuel injection pump drive gears should be withdrawn complete with drive hubs. The camshaft drive gear hub must be withdrawn before the timing case can be removed.

Press back the lock washers and unscrew the camshaft and fuel injection pump drive shaft nuts. This should be carried out before the idler gear is withdrawn.

Withdraw the camshaft drive gear and hubs complete, using remover 18G231 with adaptor 18G231C and thrust pad 18G231D. The fuel injection pump drive gear and hub is withdrawn complete, in the same manner, but using thrust pad 18G 231E to protect the end of the drive shaft.

Remove the fuel injection pump (see Section D.8). Remove the idler gear shaft, which has a left-hand thread, and unscrew and remove the timing gear oil feed jet and copper sealing washer.

Unscrew and remove the six set bolts securing the timing gear case and withdraw the case, located on the front of the crankcase and cylinder block by three dowels, complete with the fuel injection pump drive and adaptor housing.

Remove and dismantle the fuel injection pump drive if necessary as described in Section A.33.

Inspect the timing gears for broken, worn, or chipped teeth, and renew if necessary.

Clean out the oilway in the idler gear shaft and check the shaft for wear. Blow clear the timing gear oil jet with compressed air.

Check the idler gear bush and the thrust washer for wear against the dimensions given in 'GENERAL

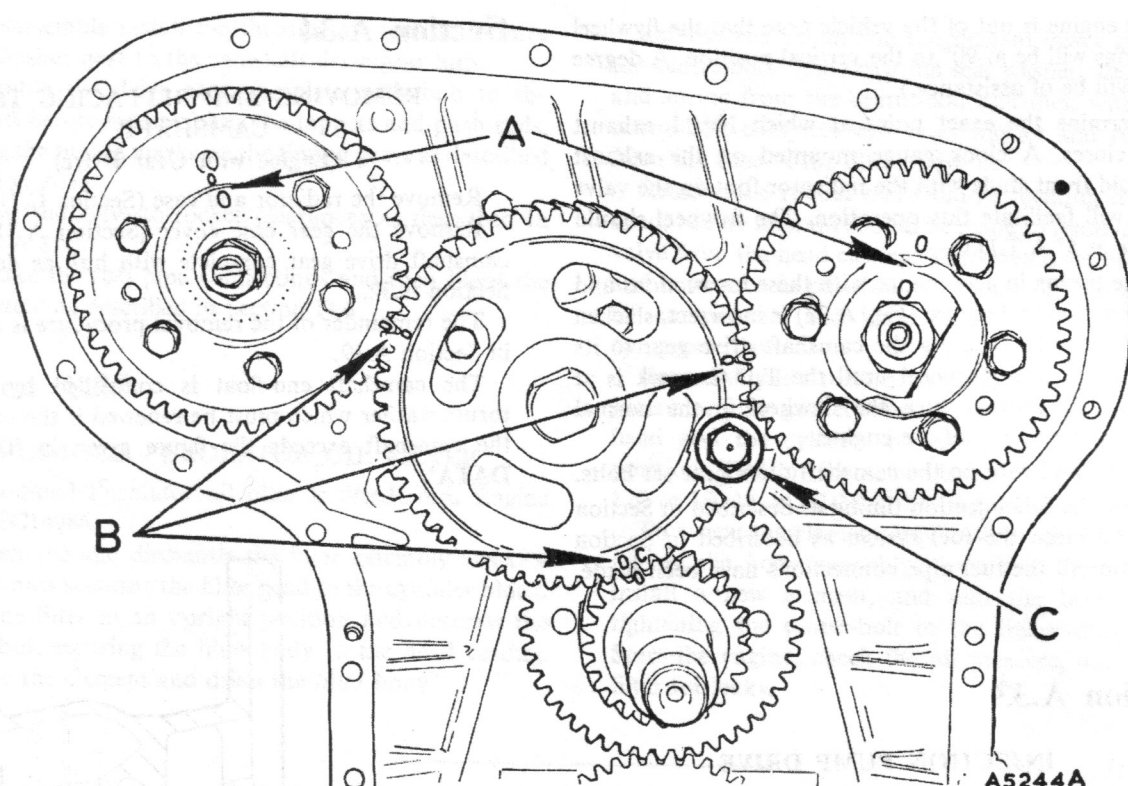


Fig. A.41

*Timing gears, showing (A) the 'O' marks of the drive gears and hubs, (B) the timing marks on the idler and drive gears, and (C) the timing gear oil feed jet*

**DATA'**. New bushes must be finished to size, using broaching tool 18G683 (see '**GENERAL DATA**'), after pressing them into the idler gear.

Replacement of the timing gears and case is a reversal of the removal instructions, but the following points should be noted.

Fit a new gasket between the timing gear case and the cylinder block, coating the joint face of the cylinder block with sealing compound.

Do not overtighten the idler gear shaft; sufficient to retain the shaft in position is all that is necessary.

To facilitate retiming, one tooth on each gear, with the exception of the idler gear, is marked with an 'O' or drill dimple (see Fig. A.41). The corresponding teeth on the idler gear which mesh with the marked teeth on the camshaft and fuel injection pump drive gears are each identified with an 'O' mark or drill dimple to ensure correct timing relationship between these components.

Assemble the fuel injection pump drive gear to its hub, lining up the timing mark on the face of the gear with the timing mark on the face of the hub. Tighten and wire-lock the securing bolts. In a similar manner assemble the camshaft drive gear to its hub, lining up the timing marks, but do not lock the securing bolts at this stage as final

adjustment of the valve timing has still to be carried out.

If necessary, after first ensuring that the valve rocker adjusting screws are fully released, rotate the crankshaft to position No. 1 piston at T.D.C. after completing its compression stroke.

The tooth with the timing mark on the crankshaft gear will now be between 11 and 12 o'clock (see Fig. A.41).

Rotate the camshaft to position the gear tooth with the timing mark between 8 and 9 o'clock and then turn the fuel injection pump drive gear so that its tooth with the timing mark is between 3 and 4 o'clock (see Fig. A.31).

Fit the idler gear to its shaft with the marked teeth on the idler gear engaging the corresponding teeth on the drive gears as illustrated in Fig. A.41.

Fit the idler gear thrust washer with the oil groove in the washer next to the gear.

Final adjustment of the valve timing must now be carried out as follows.

Adjust the rocker to push-rod clearances as described in Section A.8. Obtain access to the rim of the flywheel so that the timing marks can be seen. (Remove the clutch inspection cover on the left-hand side of the tractor forward of the clutch pedal.) When the mark 'T.D.C.' is in line with the timing pointer, No. 1 piston is at T.D.C.

(If the engine is out of the vehicle note that the flywheel markings will be at 90° to the vertical position. A degree plate will be of assistance.)

Determine the exact point at which No. 1 exhaust valve closes. A clock gauge mounted on the exhaust manifold front studs with the indicator foot on the valve collar will facilitate this operation. The flywheel should now be at 5° A.T.D.C.

If the timing in accordance with these instructions and the valve-timing diagram (Fig. A.33) is incorrect, slacken the six set bolts securing the camshaft drive gear to its hub and turn the flywheel until the T.D.C. mark is at 5° A.T.D.C. Always turn the flywheel in the normal direction of rotation of the engine.

Tighten and wire up the camshaft drive gear set bolts.

Check the fuel injection timing as described in Section D.8, and bleed the fuel system as described in Section D.6, after all the fuel pipe connections have been made.

## Section A.33

### INJECTION PUMP DRIVE

(Engine with Gear Drive)

Remove the timing gear case cover (Section A.31).

Slacken the fuel injector securing bolts to relieve the compression and ease the cranking of the engine.

Refit the crankshaft nut and rotate the crankshaft, using spanner 18G564 until No. 1 piston is at T.D.C. after completing its compression stroke.

The timing marks on the crankshaft and camshaft drive gears will now be correctly positioned for reassembly.

Remove the injection pump as described in Section D.8 and remove the coupling and key from the shaft.

Press back the lock washer and unscrew the nut securing the fuel injection pump drive gear hub to the drive shaft.

Withdraw the idler gear and thrust washer from its shaft and, using remover 18G231, adaptor 18G231C, and thrust pad 18G231E, withdraw the drive gear complete with hub from the fuel injection pump drive shaft.

**NOTE.**—With the idler gear removed, neither the camshaft nor the crankshaft must be rotated unless all the valve rocker adjusting screws are completely released to allow all the valves to be in the closed position. If the above procedure is not carried out the valves will foul the tops of the pistons and cause serious damage.

The remainder of the instructions are as detailed in Section A.20, excepting that gear wheel should, of course, be read in place of chain wheel.

## Section A.34

### REMOVING AND REPLACING THE CAMSHAFT

(Engine with Gear Drive)

Remove the radiator and case (Section C.7).

Remove the gear case cover (Section A.31) and the camshaft drive gear complete with hub as described in Section A.32.

The remainder of the removal procedure is as detailed in Section A.19.

The camshaft end-float is controlled by a bronze thrust washer which must be renewed if the end-float of the camshaft exceeds the figure given in 'GENERAL DATA'.

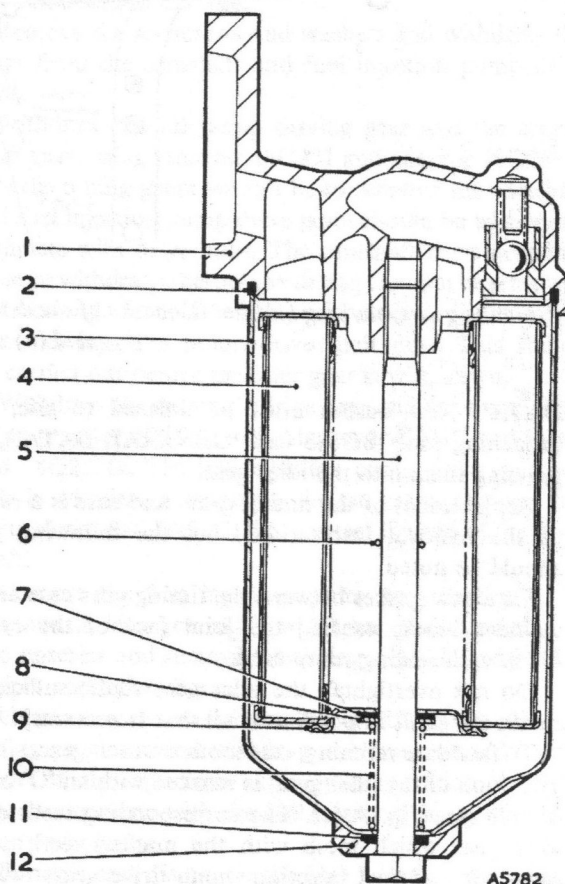


Fig. A.42

*A section through the Purolator oil filter*

- |                             |                                   |
|-----------------------------|-----------------------------------|
| 1. Head and valve assembly. | 7. Seal—centre-bolt.              |
| 2. Seal—head.               | 8. Washer—centre-bolt seal.       |
| 3. Sump.                    | 9. Element guide.                 |
| 4. Element.                 | 10. Spring—centre-bolt.           |
| 5. Centre-bolt.             | 11. 'O' suction seal—centre-bolt. |
| 6. Circlip—centre-bolt.     | 12. Collar—centre-bolt.           |



To reassemble install the thrust plate with its bronze thrust washer next to the camshaft drive gear hub.

Assemble the drive gear complete with hub to the camshaft before reassembling the tappets and push-rods, aligning the timing marks on the timing gears as described in Section A.32.

Adjust the valve-to-rocker clearances as described in Section A.8.

Remake the fuel pipe connections and then bleed the fuel system as described in Section D.6.

## Section A.35

### MODIFIED PUROLATOR OIL FILTER

A modified Purolator oil filter is fitted from Engine No. OEC14986.

To remove and dismantle the filter assembly unscrew the two nuts securing the filter head to the cylinder block. Hold the filter in an upright position and unscrew the centre-bolt securing the filter body to the head casting. Remove the element and drain the filter body.

Remove the circlip and the element lower guide from the centre-bolt. Withdraw the seal washer, steel washer, and spring from the centre-bolt and then withdraw the centre-bolt complete with steel washer and rubber seal from the base of the filter body.

Remove the rubber seal from its location in the filter head, but no attempt should be made to remove the relief valve from the head casting. The valve is set on assembly and is secured in position by peening. Thoroughly clean all components and blow out the oil passages with compressed air.

Reassembly is a reversal of the dismantling procedure. Fit a new joint gasket between the joint faces of the filter head and the cylinder block and secure the filter in position. Tighten the centre-bolt to a torque figure of 120 to 180 lb. in. (1.38 to 2.07 kg. m.).

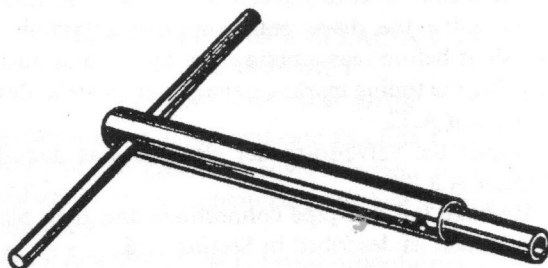
To renew the element only unscrew the centre-bolt to release the body assembly, drain and clean the body, install a new element, and refit the body assembly, tightening the centre-bolt to the figure quoted above. Start the engine, check the oil pressure, and check the filter for leaks.

(For 'SERVICE TOOLS' see page A.36)

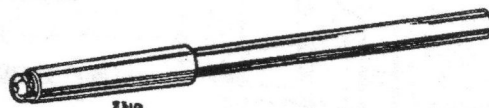
## SERVICE TOOLS

**18G27. Valve Seat Cutter and Pilot Handle**

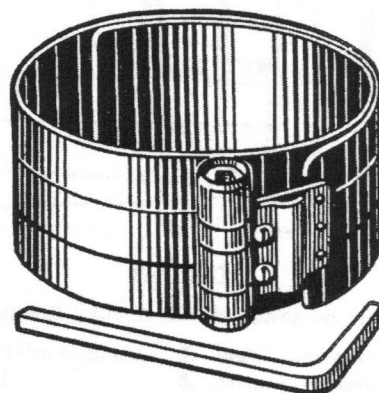
The use of these tools will save lengthy and wasteful grinding when valve seats are pitted, and are designed to cut the 45° seats accurately and parallel with the valve guides.

**18G27****18G28. Valve Seat Finishing Cutter (Inlet)****18G28A. Valve Seat Glaze Breaker (Inlet)****18G28B. Valve Seat Narrowing Cutter—Top (Inlet)****18G28C. Valve Seat Narrowing Cutter—Bottom (Inlet)****18G174. Valve Seat Finishing Cutter (Exhaust)****18G174A. Valve Seat Glaze Breaker (Exhaust)****18G174B. Valve Seat Narrowing Cutter—Top (Exhaust)****18G174C. Valve Seat Narrowing Cutter — Bottom (Exhaust)****18G28 and 18G174****18G230. Valve Seat Cutter Pilot****18G27. Valve Seat Cutter and Pilot Handle****18G27B. Fibre Box—Valve Seat Cutters**

These tools will save lengthy and wasteful grinding when valve seats are pitted, and are designed to cut the 45° seats accurately and concentric with the valve guides. The narrowing cutters are used to maintain the seats at their correct width as given under 'GENERAL DATA'.

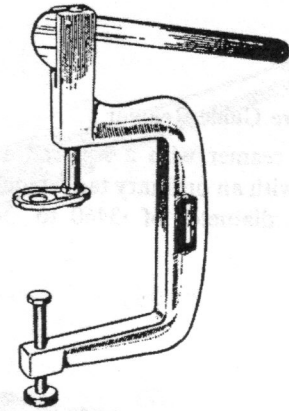
**18G230****18G55A. Piston Ring Compressor**

A clamping device which retains the piston rings and enables the piston to enter the cylinder bore with a minimum of pressure.

**18G55A**

## 18G106. Valve Spring Compressor

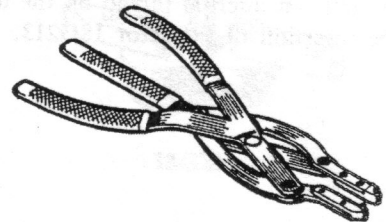
This tool is designed with a cam and lever action and makes for extremely rapid removal and replacement of valves, maintaining the springs in correct alignment.



18G106

## 18G214A. Circlip Pliers

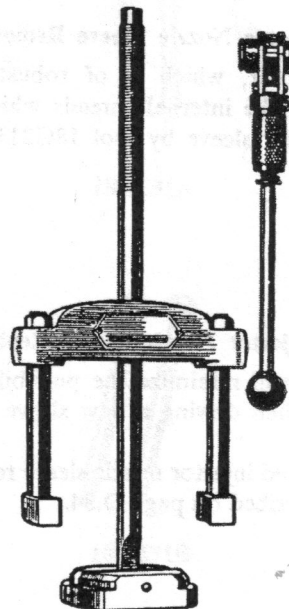
These circlip pliers are universal, i.e. they can be used for either expanding or contracting a circlip. The pliers are fitted with hardened-steel bits which are interchangeable, depending on the type of circlip.



18G214A

## 18G227A. Cylinder Liner Remover

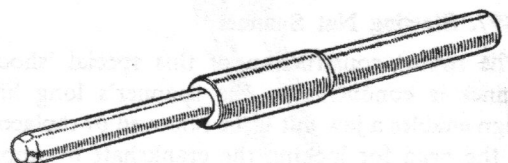
This tool will remove the cylinder liners with or without the crankshaft in position. The extractor plate and the bottom of the centre screw is pivoted and weighted so that it readily engages on the lower end of the liner. The ratchet handle facilitates its use in a confined space.



18G227A

## 18G228. Valve Guide Remover

This tool enables the valve guides to be driven out, or driven into position, without danger of damage either to the valve guides or to the cylinder head.



18G228

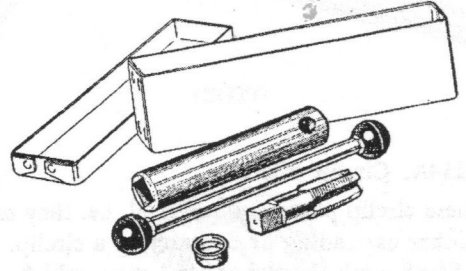


**18G229. Valve Guide Reamer**

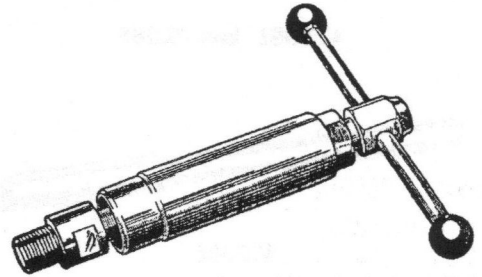
A straight reamer with a squared end which enables it to be used with an ordinary tap wrench. To ream guides to a finished diameter of .3460 to .3465 in. (8.788 to 8.801 mm.).

**18G229****18G213A. Injector Nozzle Sleeve Tap and Wrench**

The tap cuts an internal thread on the injector sleeve before the insertion of extractor 18G213.

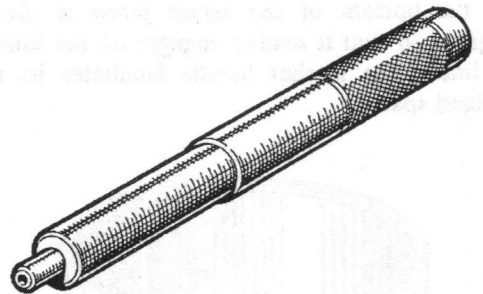
**18G213A****18G213. Injector Nozzle Sleeve Remover**

The extractor, which is of robust construction, is screwed into the internal threads which have been cut on the injector sleeve by tool 18G213A.

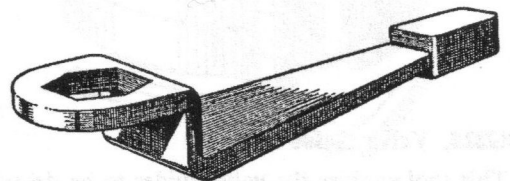
**18G213****18G213B. Injector Nozzle Sleeve Replacer**

This tool will minimize the possibility of damage to the sleeve when driving a new sleeve into the cylinder head.

An improved injector nozzle sleeve replacer is 18G561, which is described on page D.34.

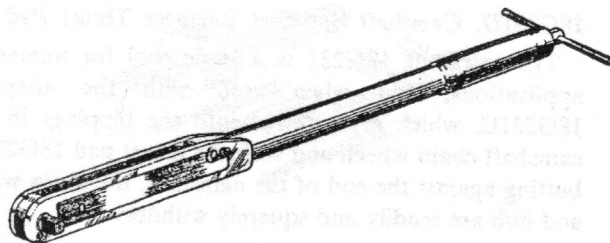
**18G213B****18G97. Starting Nut Spanner**

The robust construction of this special 'shock-type' spanner is conducive to the spanner's long life. The design enables a jaw nut to be removed or replaced without the need for locking the crankshaft by improvised means, which may cause damage to components.

**18G97**

## 18G372. Torque Wrench

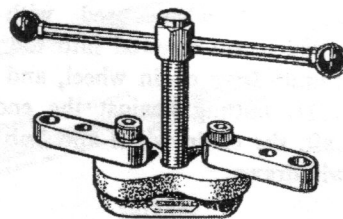
A universal torque spanner for use with standard sockets. This tool is essential if the recommended maximum torque for various studs is not to be exceeded.



18G372

## 18G231. Gear and Pulley Remover (basic tool)

This basic tool, with a variety of adaptors, can be used to cover a wide range of operations.



18G231

### 18G231A. Crankshaft Pulley Remover Adaptors

Application: Crankshaft pulley removing.

The extractor 18G231 is a basic tool for numerous applications, and when used with the adaptors 18G231A, which are screwed into the tappings in the crankshaft pulley, the pulley is readily and squarely withdrawn.

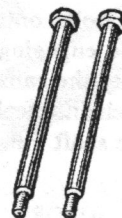


18G231A

### 18G231B. Oil Pump Driving Gear Remover Adaptors

Application: Oil pump driving gear removing.

The extractor 18G231 is a basic tool for numerous applications, and when used with the adaptors 18G231B, which are screwed into the tappings in the crankshaft oil pump driving gear, the chain wheel and gear are readily and squarely withdrawn.

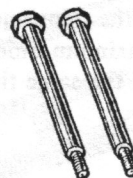


18G231B

### 18G231C. Sprocket Gear Remover Adaptors

Application: Camshaft or injection pump chain wheel removing.

The extractor 18G231 is a basic tool for numerous applications, and when used with the adaptors 18G231C, which are screwed into the tappings in the camshaft or injection pump drive chain wheel, the chain wheel and hub are readily and squarely withdrawn.



18G231C

**18G231D. Camshaft Sprocket Remover Thrust Pad**

The extractor 18G231 is a basic tool for numerous applications, and when used with the adaptors 18G231C, which are screwed into the tappings in the camshaft chain wheel, and with the thrust pad 18G231D butting against the end of the camshaft, the chain wheel and hub are readily and squarely withdrawn.

**18G231D****18G231E. Fuel Injection Pump Sprocket Remover Thrust Pad**

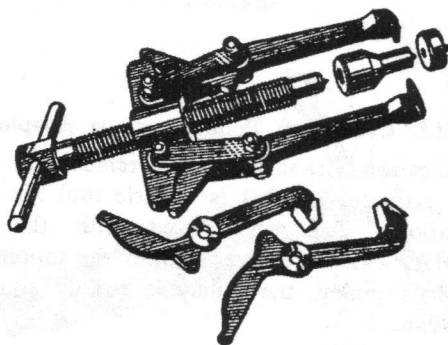
The extractor 18G231 is a basic tool for numerous applications, and when used with the adaptors 18G231C, which are screwed into the tappings in the injection pump drive chain wheel, and with the thrust pad 18G231E butting against the end of the pump driving shaft, the chain wheel and hub are readily and squarely withdrawn.

**18G231E****18G2. Crankshaft Gear, Pulley, and Propeller Shaft Flange Remover**

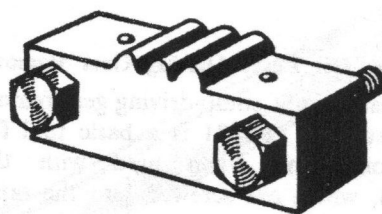
Application: Oil pump driven gear removing.

**18G231E. Fuel Injection Pump Shaft Thrust Pad**

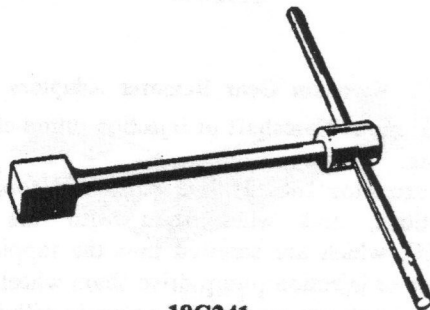
The extractor 18G2, when used with the thrust pad 18G231E butting against the oil pump spindle, will readily and squarely withdraw the gear off the oil pump spindle.

**18G2****18G232. Camshaft Sprocket Locking Fixture**

The plate 18G232 bolts onto the timing case, with the teeth of the plate engaging the teeth of the chain wheel, and locks either the camshaft chain wheel or the injection pump drive chain wheel to facilitate the removal or replacement of the shaft nut.

**18G232****18G241. Timing Chain Tensioner Positioning Tool**

This tool holds the tensioner sprocket in such a position that the maximum amount of slackness in the chain is available, at the same time leaving the operator with both hands free.

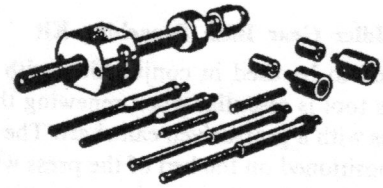
**18G241**



## Gg1491. Injector Nozzle Extractor

This nozzle remover, with its two sets of adaptors, will effectively remove the tightest nozzle without damage.

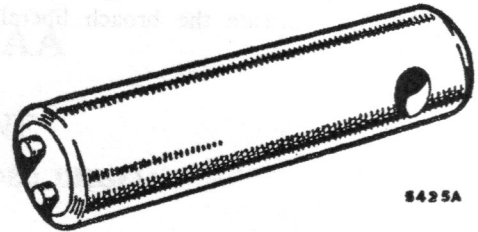
It can be used with the engine in or out of the tractor.



18G491

## 18G544. Oil Gallery Plug Tool

The oil gallery plugs may easily be removed and replaced with the aid of this tool.

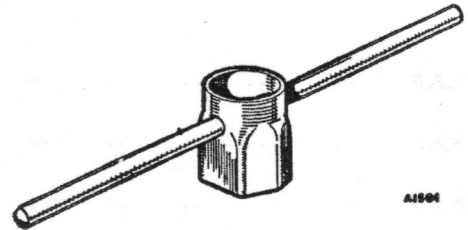


842 5A

18G544

## 18G564. Crankshaft Pulley Nut Spanner and Tommy-bar

The box spanner is essential when it is necessary to turn engines over to check rocker clearances or for timing purposes.

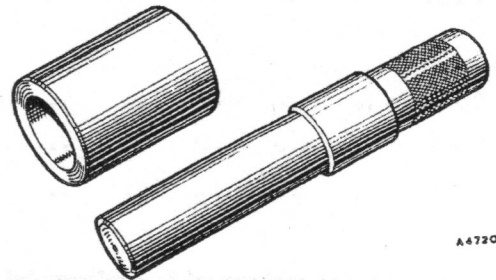


A1801

18G564

## 18G616. Connecting Rod Bush Remover and Replacer

Used in conjunction with a press, this tool will ensure removal and replacement of the wrapped-type bush without damage or distortion.

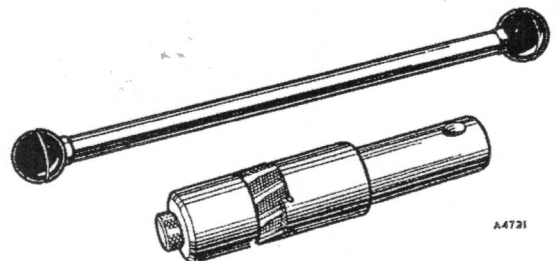


A4720

18G616

## 18G615. Connecting Rod Bush Reamer

For use on the wrapped-type bush which requires reaming after assembly.

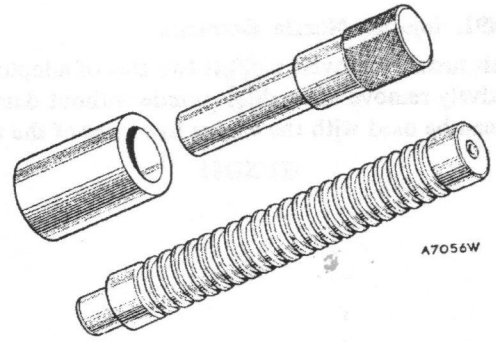


A4721

18G615

**18G683. Idler Gear Bush Broaching Kit**

Designed to be used in conjunction with a workshop press, this tool is essential when renewing the idler bush on engines with a gear-driven camshaft. The tool support must be positioned on the bed of the press with the larger bore uppermost for the pressing-out operation. When pressing in and broaching a new bush, the support must be placed on the bed of the press with its lipped end uppermost. This will ensure that the bush is installed with its ends equidistant from the sides of the gear. Immediately before broaching, lubricate the broach liberally with clean paraffin (kerosene).

**18G683**

## SECTION AA

### THE ENGINE

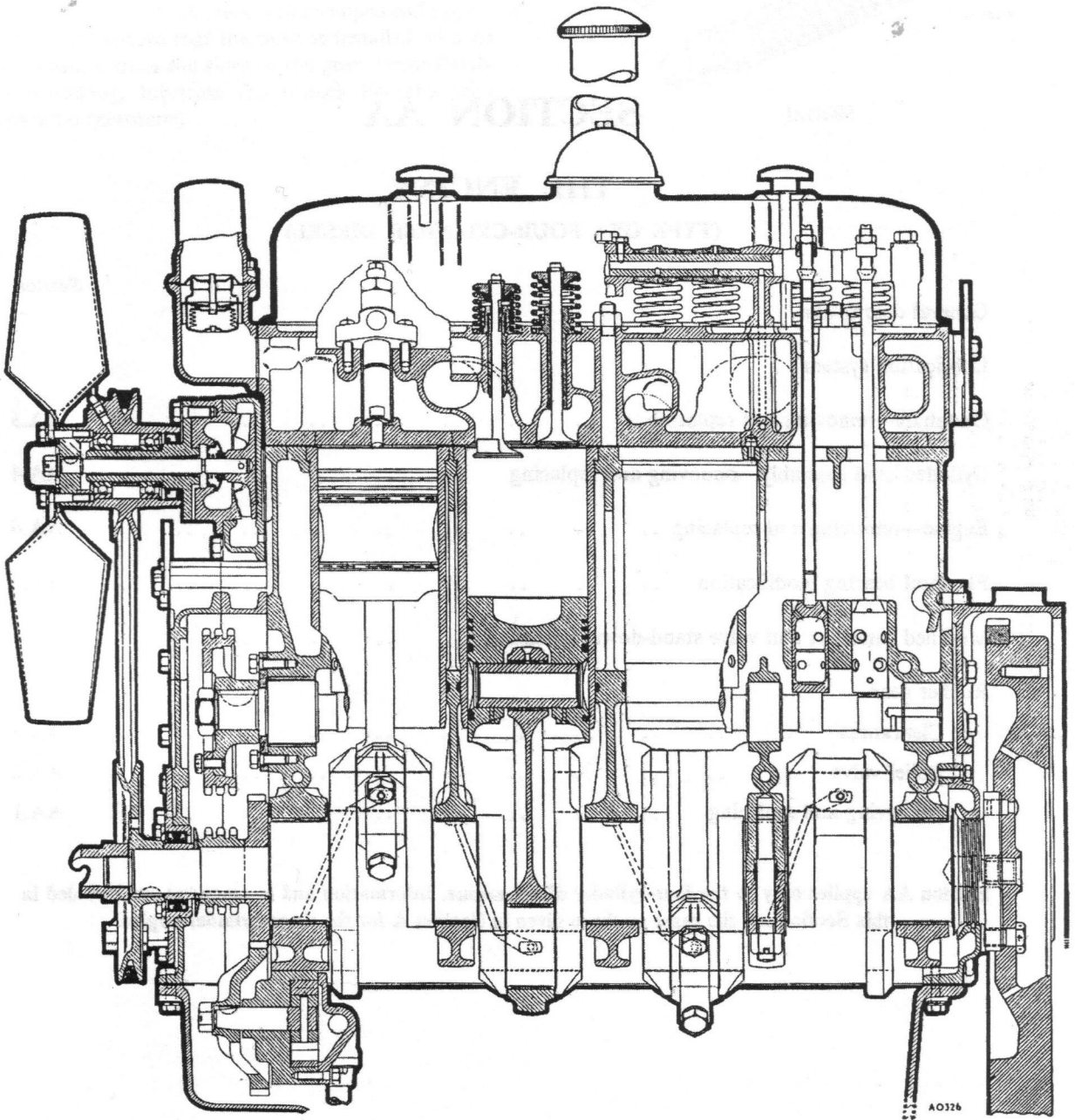
(TYPE OEA FOUR-CYLINDER DIESEL)

	<i>Section</i>
General description	
Lubrication system	
Camshaft—removing and replacing .. .. .	AA.5
Cylinder head assembly—removing and replacing .. .. .	AA.4
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Rocker gear	
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Relief valve .. .. .	AA.2
Removing and replacing .. .. .	AA.1

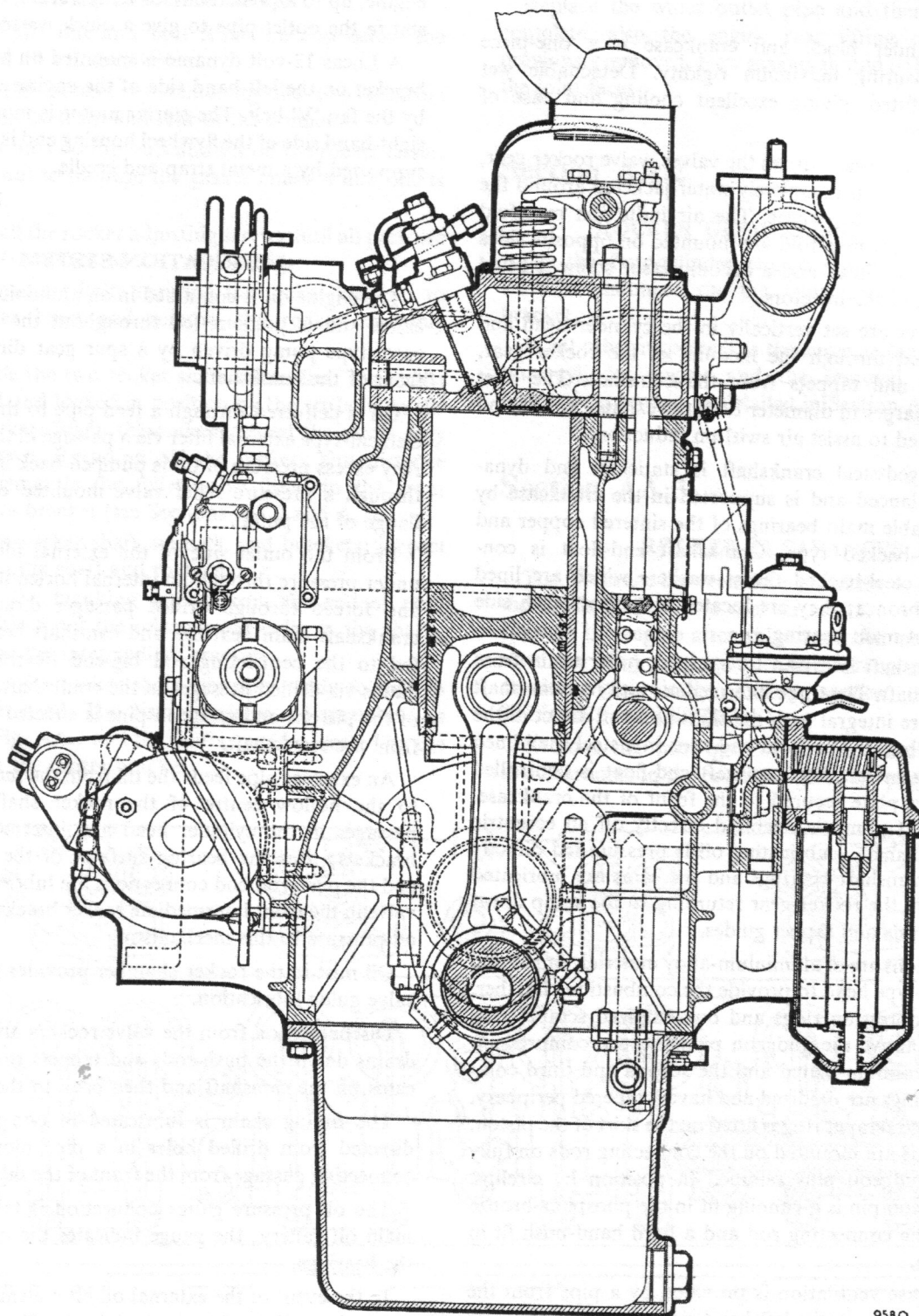
**Section AA applies only to the four-cylinder diesel engine. Information and instructions not included in this Section are the same as those given in Section A for the three-cylinder engine**



## THE NUFFIELD UNIVERSAL FOUR ENGINE LONGITUDINAL SECTION



# THE NUFFIELD UNIVERSAL FOUR ENGINE TRANSVERSE SECTION



9580

## GENERAL DESCRIPTION

The B.M.C. type OEA compression-ignition engine is a four-cylinder direct-injection type having a capacity of 3.4 litres.

The cylinder block and crankcase is a one-piece casting, ensuring maximum rigidity. Detachable wet liners are fitted, giving excellent cooling and ease of maintenance.

The cylinder head carries the valves, valve rocker gear, and injectors; it is completely water-jacketed around the ports and injector sleeves. The air induction manifold and the exhaust manifold are mounted on opposite sides of the cylinder head and a decompressor screw is fitted below each of the injectors.

The valves are set vertically in the cylinder head and are operated through the medium of the rocker gear, push-rods, and tappets from the camshaft. The inlet valves are larger in diameter than the exhaust valves and are shrouded to assist air swirl on induction.

The forged-steel crankshaft is statically and dynamically balanced and is supported in the crankcase by five renewable main bearings of the sintered copper and lead, steel-backed type. Crankshaft end-float is controlled by steel-backed thrust washers which are lined with lead-bronze; they are located in recesses each side of the front main bearing.

The camshaft is driven by a triplex roller chain from the crankshaft. The three intermediate and rear camshaft bearings are integral with the shaft and run direct in the crankcase bores. The front end runs in a steel shell lined with white metal. The camshaft end-float is controlled by a thrust plate secured to the front of the crankcase. The fuel lift pump is operated directly off an eccentric on the camshaft. Lubricating oil is pressure-fed directly onto the camshaft bearings and the cams are lubricated by oil from the rocker gear returning to the sump down the push-rods and tappet guides.

The pistons are of aluminium-alloy material, employing the cavity-type head to provide the combustion chamber. Three compression rings and one oxidized scraper ring are fitted above the gudgeon pin. The top compression ring is chromium-plated and the second and third compression rings are oxidized and have a tapered periphery. An oxidized scraper ring is fitted on the skirt of the piston. The pistons are mounted on the connecting rods on fully floating gudgeon pins retained in position by circlips. The gudgeon pin is a running fit in the phosphor-bronze bush of the connecting rod and a hard hand-push fit in the piston.

Crankcase ventilation is provided by a pipe from the push-rod cover on the left-hand side of the engine.

The cooling system comprises a centrifugal pump and

two-bladed fan mounted on the front of the cylinder block and driven by a single 'V' belt from a pulley on the crankshaft. Water circulation is confined within the engine, up to a predetermined temperature, by a thermostat in the outlet pipe to give a quick warm up.

A Lucas 12-volt dynamo is mounted on an adjustable bracket on the left-hand side of the engine and is driven by the fan 'V' belt. The starter motor is mounted to the right-hand side of the flywheel housing and is additionally supported by a metal strap and cradle.

## LUBRICATION SYSTEM

The engine oil is contained in an aluminium-alloy cast sump and is pressure-fed throughout the engine by a rotor-type pump driven by a spur gear directly off the front of the crankshaft.

Oil is delivered through a feed pipe to the renewable-element-type external filter via a passage in the crankcase. Any excess pressure of oil is pumped back into the sump through a pressure relief valve mounted on the outlet flange of the pump.

From the outlet side of the external filter oil is fed under pressure through an internal horizontal oil gallery and forced through drilled passages directly into the crankshaft main bearings and camshaft bearings. Oil is fed to the connecting rod big-end bearings from the mains via drilled passages in the crankshaft. Lubrication of the pistons and gudgeon pins is effected by oil splash from the crankshaft.

An external pipe feeds the oil from the main oil gallery to the hollow centre of the rocker shaft via drilled passages in the cylinder head and intermediate rocker brackets; thus the bearing surfaces of the rocker arms and the push-rod end connections are lubricated. A relief valve in the front intermediate rocker bracket reduces the oil pressure to this mechanism.

Oil mist in the rocker chamber provides the necessary valve guide lubrication.

Discharged oil from the valve rockers and relief valve drains down the push-rods and tappets to lubricate the cams on the camshaft and then back to the sump.

The timing chain is lubricated in two places by oil directed from drilled holes in a pipe mounted over a connecting passage from the front of the main oil gallery.

The oil pressure gauge connection is taken from the main oil gallery; the gauge indicates the oil pressure at the bearings.

In the event of the external oil filter element becoming blocked a relief valve situated in the filter head allows unfiltered oil to be fed through the engine.



## Section AA.1

### REMOVING AND REPLACING THE ROCKER GEAR

Unscrew the nut and bolt from the clip below the silencer and lift off the silencer.

Detach the bonnet by removing the two securing screws from the front and rear of the bonnet.

Unscrew the two cap nuts and lift off the rocker cover. Take care not to damage the gasket unless a new one is to be fitted.

Slacken all the rocker adjusting screws until all pressure is relieved from each of the valve springs.

Release the set bolts securing the rocker brackets to the cylinder head and remove the rocker assembly complete.

Dismantle the two rocker shaft assemblies. The shafts are located and locked in position by the set bolts in the centre bracket. When these are removed the shafts may be withdrawn, threading off the rockers and distance collars. Dismantle the relief valve fitted to the front intermediate bracket (see Sections AA.2 and A.7).

Clean the rocker shaft, rockers, and brackets; inspect for wear on the shaft and rockers.

Remove the blanking screws from the end of each shaft and blow out the oilways and holes in the shafts, rockers, and the intermediate brackets.

Assemble the rocker shaft assembly ready to refit to the cylinder head. The distance pieces are assembled as shown in Fig. AA.1 and the shafts must be located by the set bolts in the centre bracket.

Fit the oil relief valve to the front intermediate bracket and the blanking plug to the rear intermediate bracket, using a new copper lock washer in each case.

Replace the water outlet pipe and thermostat body complete, also the engine rear lifting cover-plate if previously removed. New gaskets should be fitted between the joint faces.

## Section AA.2

### ROCKER GEAR RELIEF VALVE

On the four-cylinder engine the oil pressure relief valve is mounted on the front intermediate rocker bracket.

In all other respects it is the same as that fitted to the three-cylinder engine and the removal and refitting instructions remain as detailed in Section A.7.

## Section AA.3

### ROCKER CLEARANCES

The clearance between the ends of the valve stems and the heads of the valve rockers must be adjusted before running the engine after valve reconditioning and again after warming the engine. The clearance must also be checked periodically during service (see 'MAINTENANCE ATTENTION').

Remove the valve gear cover and check and adjust the clearances in the sequence given on page AA.6.

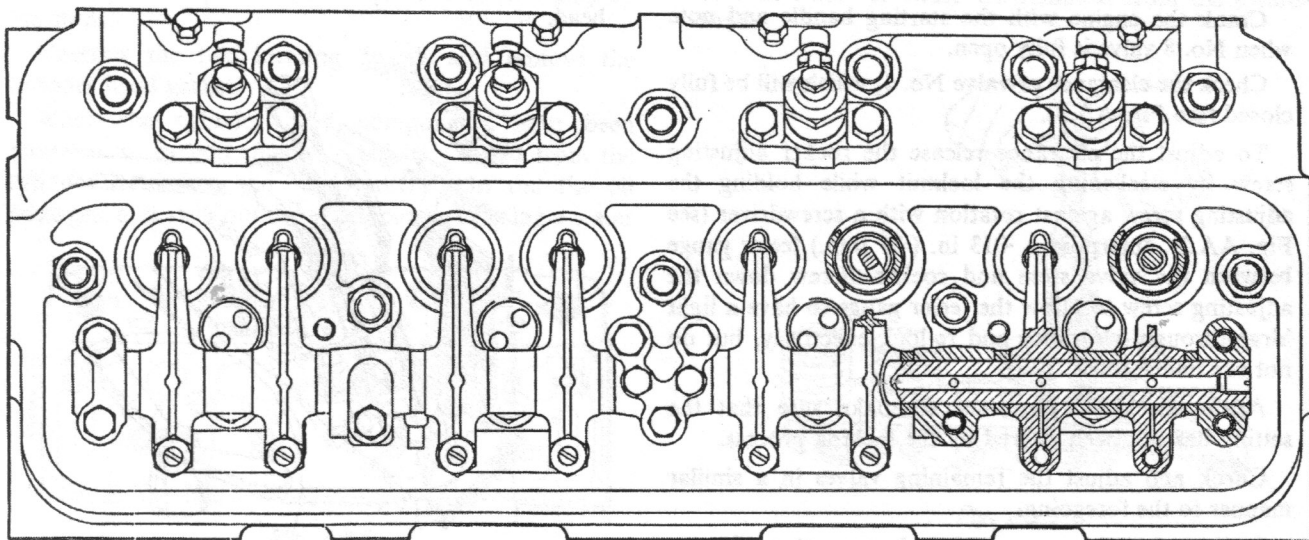


Fig. AA.1

*The valve and rocker gear, showing the assembly of the rockers and distance pieces*

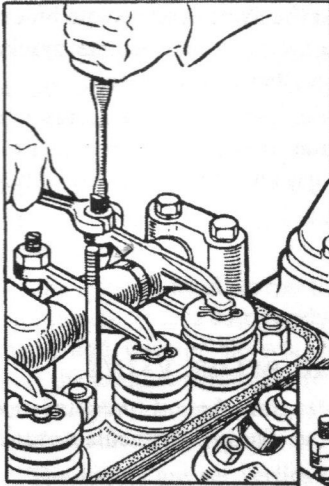
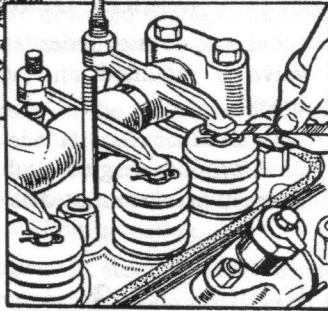


Fig. AA.2  
Checking the  
valve clearance

Fig. AA.3  
Valve and rocker  
adjustment



No. 1 valve (ex.) with No. 8 valve fully open

„ 3 „ (in.) „ „ 6 „ „ „	
„ 5 „ (ex.) „ „ 4 „ „ „	
„ 2 „ (in.) „ „ 7 „ „ „	
„ 8 „ (ex.) „ „ 1 „ „ „	
„ 6 „ (in.) „ „ 3 „ „ „	
„ 4 „ (ex.) „ „ 5 „ „ „	
„ 7 „ (in.) „ „ 2 „ „ „	

Crank the engine with the starting handle and note when No. 8 valve is fully open.

Check the clearance of valve No. 1, which will be fully closed (see Fig. AA.3).

To adjust the clearance release the rocker adjusting screw by slackening the locknut while holding the adjusting screw against rotation with a screwdriver (see Fig. AA.2). Interpose a .013 in. (.33 mm.) feeler gauge between the valve stem and rocker. Screw down the adjusting screw to allow the feeler gauge to have a light 'drag-through' clearance and re-lock effectively, but do not use undue force.

Again check the clearance to make sure that the setting has not been altered by the locking process.

Check and adjust the remaining valves in a similar manner to the foregoing.

Replace the valve gear cover and ensure that the joint gasket is in good condition and provides an oiltight joint.

## Section AA.4

### REMOVING AND REPLACING THE CYLINDER HEAD ASSEMBLY

It is possible to remove the cylinder head assembly without removing the engine from the tractor mounting. Warm the engine by allowing it to run lightly for a few minutes and then stop the engine.

Unscrew the nut and bolt from the clip below the silencer and lift off the silencer.

Detach the bonnet by removing the two securing screws from the front and rear of the bonnet.

Disconnect the leads from the battery terminals.

Drain the cooling system (Section C.6).

Remove the two suction pipes between the governor and throttle unit (venturi).

Disconnect the hose from the water outlet pipe and the by-pass hose from the thermostat housing.

Disconnect the exhaust pipe from the manifold flange by removing the three nuts.

Remove the exhaust manifold from the left-hand side of the cylinder head.

Remove the fuel feed pipes connected between the injectors and the pump.

Remove the leak-off pipe between No. 1 injector and the air vent union on the fuel filter.

Disconnect the leak-off unions from the injectors and remove the leak-off pipe by disconnecting it at the rear of the engine.

Disconnect the accelerator control from the throttle unit (venturi).

Remove the air inlet manifold complete with throttle unit (venturi) from the right-hand side of the cylinder head.

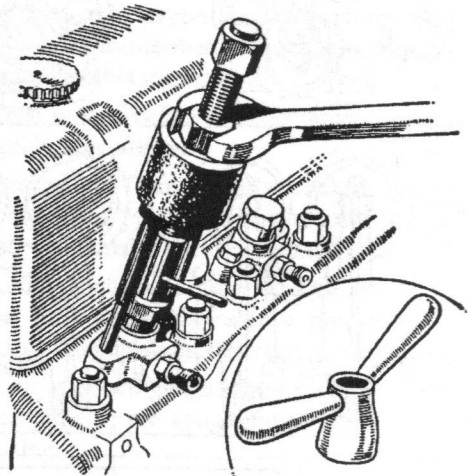


Fig. AA.4

Using the injector withdrawing tool 18G491

Disconnect the banjo connections of the rocker gear external oil feed pipe from the cylinder head and crankcase, and remove the oil pipe complete.

Remove the two set bolts and withdraw each injector with tool 18G491. Plug the holes immediately to stop the ingress of foreign matter into the sleeves.

**NOTE.**—The injectors should not be left in position in the head as the nozzle tips protrude below the bottom face of the cylinder head and are liable to sustain damage.

Release the hand nuts and remove the valve gear cover and gasket.

Slacken all the rocker adjusting screws until all pressure is released from each of the valve springs.

Release the set bolts securing the rocker brackets to the cylinder head and remove the rocker assembly complete.

Withdraw the push-rods.

**NOTE.**—The push-rods should be suitably marked, preferably with tags denoting the number of the cylinder and valve to which each belongs, to ensure correct replacement.

Working in the order shown in Fig. AA.5, first slacken each cylinder head nut a quarter of a turn only, and subsequently unscrew each nut a further amount in the same order until loose. Remove the fuel filter bracket steady and lift off the cylinder head. On no account should a screwdriver or any similar tool be used as a wedge between the cylinder head and the block. A suitable method to remove the head is to place a sling round the exhaust manifold studs on one side and round two high-tensile  $\frac{3}{8}$  in. UNF set bolts inserted into the air induction manifold bolt holes on the other side. When lifting the head a direct pull should be given to lift it evenly up the studs.

Unscrew the two locating dowels and remove the cylinder head gasket.

When the cylinder head components have been removed all carbon traces should be scraped from the cylinder head face and valve ports. Blow out the oil passages, and swill out the water passages, using a water

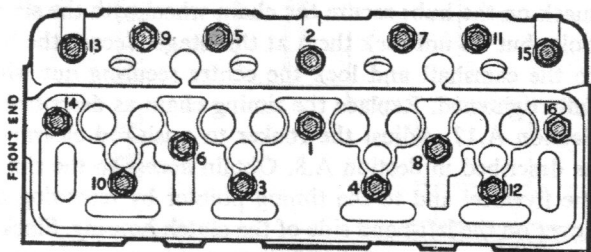


Fig. AA.5

The correct order of slackening and tightening the cylinder head nuts

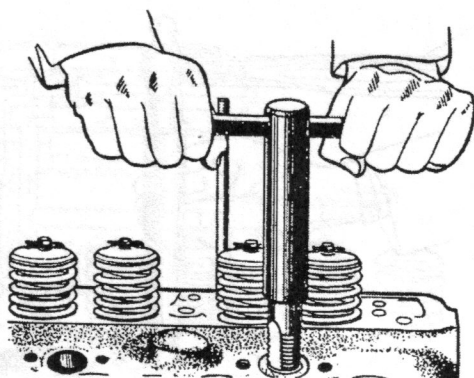


Fig. AA.6

Using tap and wrench 18G213A for injector sleeve extraction. The tap cuts an internal thread on the injector sleeve before the insertion of extractor 18G213

hose. The engine rear lifting plate and joint can be removed if necessary to provide access to the water passage. Thoroughly clean the head. The gasket-contacting surface of the head should be checked for flatness with a straight-edge and the surface examined for scores. If the cylinder head is found to be scored badly or out of true it should be renewed.

Examine the inside of each injector sleeve for scratches and burrs, especially the end that makes the seal with the injector.

Remove the sleeves, if necessary, using extractor 18G213 and tap and wrench 18G213A.

Install new sleeves, using tool 18G213B, after ensuring that all traces of swarf are removed from the cylinder head.

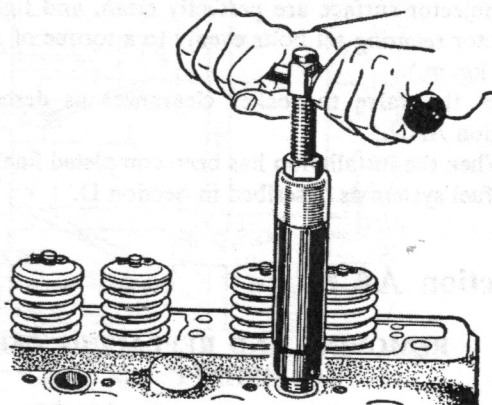


Fig. AA.7

The extractor 18G213, which is of robust construction, is screwed into the internal threads which have been cut in the injector sleeve by tool 18G213A



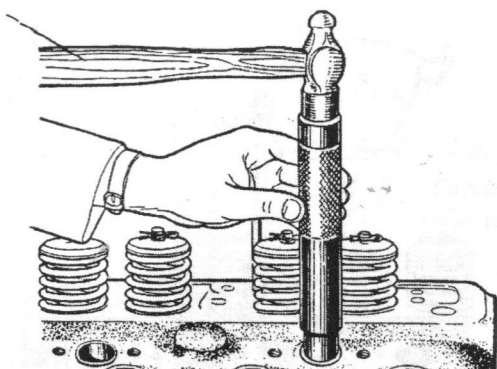


Fig. AA.8

*The use of injector sleeve replacer 18G213B will minimize the possibility of damage when driving a new sleeve into the cylinder head*

The installation of the cylinder head assembly is a reversal of the dismantling procedure, but note the following points:

If there is any doubt as to the condition of the cylinder head gasket fit a new one, plain side downwards. Coat both sides of the gasket with engine oil and fit the two locating dowels to the cylinder block after installing the gasket.

For tightening the cylinder stud nuts a torque spanner set to 100 lb. ft. (13.8 kg. m.) should be used and the nuts tightened in the order shown in Fig. AA.5.

With the rocker screws fully slackened off refit the rocker assembly to the cylinder head after the head has been fully tightened down.

Do not tighten down the intermediate rocker bracket securing bolts until the bolts securing the front, centre, and rear brackets are finally tightened.

When installing the injectors ensure that the sleeve and the injector surface are perfectly clean, and tighten the injector securing set bolts evenly to a torque of 12 lb. ft. (1.6 kg. m.).

Set the valve to rocker clearances as described in Section AA.3.

When the installation has been completed finally bleed the fuel system as described in Section D.

## Section AA.5

### REMOVING AND REPLACING THE CAMSHAFT

Remove the radiator and case (Section C.7).

Remove the timing chain case cover and chain; withdraw the camshaft chain wheel and hub complete (Section A.17). It is not necessary to remove the chain case.

Remove the rocker gear cover, slacken the rocker arm adjusting screws fully, and withdraw the push-rods.

Remove the tappet and push-rod cover.

Remove the tappets.

Remove the fuel lift pump (Section D).

Remove the camshaft thrust plate.

Withdraw the camshaft in a forward direction, being careful to avoid damage to the bearing surfaces.

Remove the locating bolt and withdraw the camshaft front bearing out of the cylinder block if it is to be renewed.

Inspect the camshaft bearing journals and cams for evidence of scoring and wear. If the journals are not of the required clearances (see 'GENERAL DATA') the camshaft should be renewed.

The camshaft front bearing bush should be examined for scores, pits, or evidence of failure.

Examine the tappet cam-contacting surfaces for wear or scores and the spherical push-rod seats for grooves or flats. New tappets should be installed whenever evidence of unusual wear is found. Ensure that the tappet oil holes are perfectly free from obstructions.

Check the camshaft end-float (see 'GENERAL DATA') as shown in Fig. A.32.

Refitting the camshaft is a reversal of the removal procedure but attention must be paid to the following:

To install a new camshaft front bearing press it in the bore, plain edge foremost, aligning the two holes in the bush with the oil hole and locating hole in the crankcase.

When the bush is in position it can be finally lined up, if necessary, by tapping it round, using a soft drift against the aligning notch. Finally, ream in position with a line reamer to a diameter of 1.9995 to 2.001 in. (50.787 to 50.825 mm.) and fit the locating bolt.

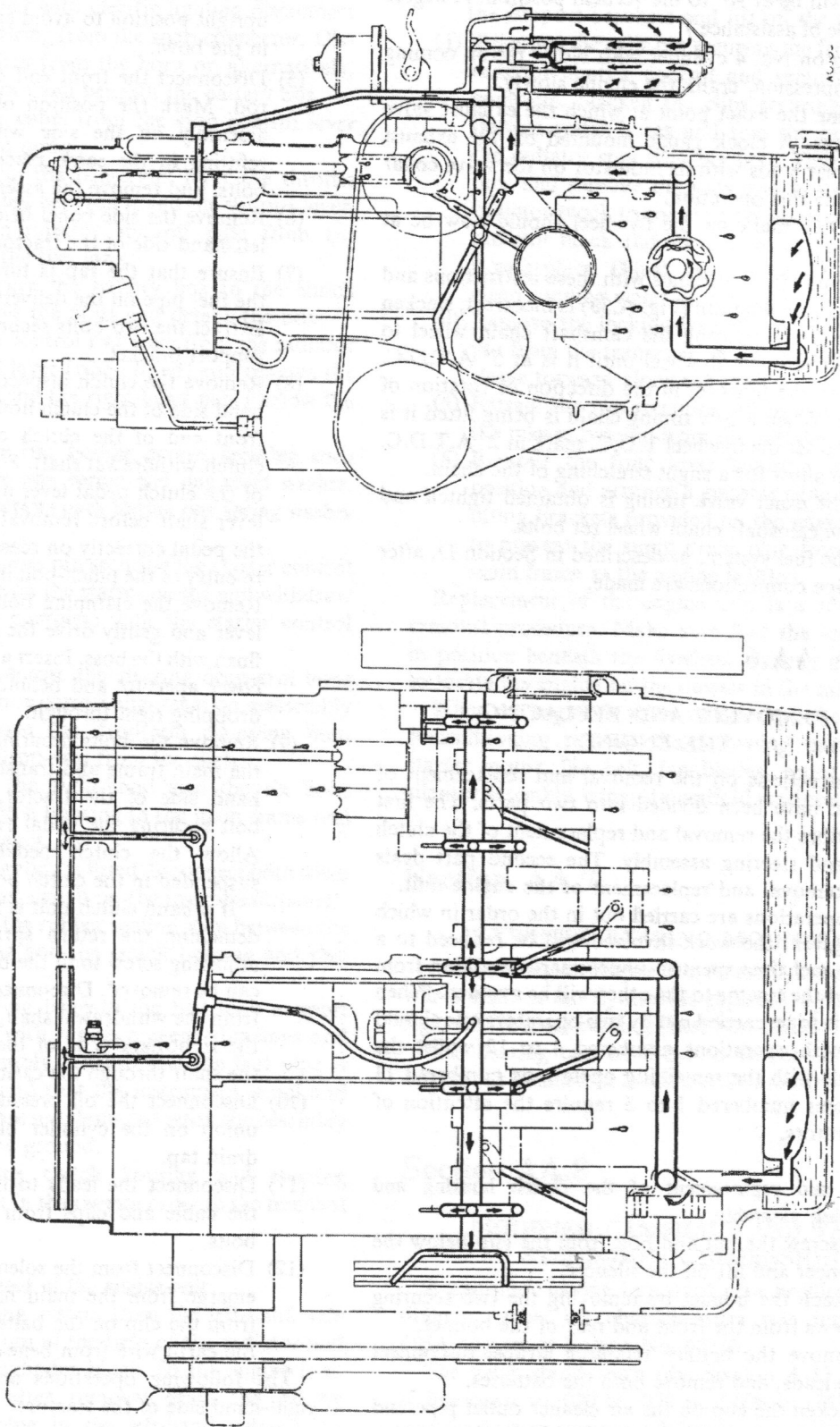
Lubricate the journals before installing the camshaft.

Install the camshaft thrust plate with the polished side against the camshaft front journal.

If the camshaft chain wheel has been removed or disturbed on the hub during servicing retiming of the valves will be necessary and can be carried out as follows:

Line the 'O' mark on the chain wheel with the 'O' mark on the hub; secure the chain wheel with the six set bolts but do not lock them at this stage. Secure the hub to the camshaft and lock the centre securing nut when fully tightened. Replace the timing chain as described in Section A.17. Adjust the rocker to push-rod clearances as described in Section A.8. Obtain access to the rim of the flywheel and to the timing pointer by removing the cover on the left-hand side of the clutch housing. Slacken the four decompression screws to enable the engine to be cranked over more easily. When the mark 'T.D.C.' is opposite the pointer Nos. 1 and 4 pistons are at T.D.C. (If the engine is out of the vehicle note that the flywheel

# THE NUFFIELD UNIVERSAL FOUR ENGINE—LUBRICATION SYSTEM



markings will be at 90° to the vertical position. A degree plate will be of assistance.)

Working on No. 4 cylinder with No. 1 piston coming up on compression, crank the engine slowly.

Determine the exact point at which the exhaust valve No. 8 closes. A clock gauge mounted on the exhaust manifold rear studs with its indicator on the valve collar will facilitate this operation.

The T.D.C. mark on the flywheel should now be at 5° A.T.D.C.

If the timing in accordance with these instructions and the valve-timing diagram (Fig. A.33) is incorrect, slacken the six set bolts securing the camshaft chain wheel to its hub and turn the flywheel until it is at 5° A.T.D.C. Always turn the flywheel in the direction of rotation of the engine. When a new timing chain is being fitted it is advisable to set the flywheel T.D.C. mark at 2° A.T.D.C. in order to allow for a slight stretching of the chain.

When the exact valve timing is obtained tighten and wire up the camshaft chain wheel set bolts.

Bleed the fuel system, as described in Section D, after the fuel pipe connections are made.

## Section AA.6

### REMOVING AND REPLACING THE ENGINE

The instructions on the removal and replacement of the engine have been divided into two parts. The first part describes the removal and replacement of the clutch housing and steering assembly. The second part deals with the removal and replacement of the engine unit.

If the operations are carried out in the order in which they are given, the work involved will be reduced to a minimum and time spent in unnecessarily walking from one side of the tractor to the other will be avoided. When the work is to be carried out by two operators one should proceed with operations numbered 4 to 12 whilst the other deals with the remaining operations numbered 13 to 25. Items numbered 1 to 5 require the attention of both operators.

#### Removal and replacement of the clutch housing and steering assembly

- (1) Unscrew the nut and bolt from the clip below the silencer and lift off the silencer.
- (2) Detach the bonnet by removing the two securing screws from the front and rear of the bonnet.
- (3) Remove the battery retaining straps, disconnect the leads, and remove both the batteries.
- (4) Slacken the clip on the air cleaner outlet pipe and remove the rubber elbow. Remove the screw which secures the air cleaner strap and lift off the air

cleaner complete. Keep the air cleaner in an upright position to avoid spilling the oil contained in the bowl.

- (5) Disconnect the front end of the governor control rod. Mark the position of the governor control assembly on the side with a pencil to ensure refitting in the same place, extract the retaining bolts, and remove the assembly.
  - (6) Remove the side panel below the fuel tank on the left-hand side of the tractor.
  - (7) Ensure that the tap is turned off and disconnect the fuel pipe on the delivery side of the filter bowl. Extract the two bolts securing the filter unit to the support bracket.
  - (8) Remove the clutch inspection cover from the left-hand side of the clutch housing and disconnect the front end of the clutch operating rod from the clutch withdrawal shaft. Scribe a mark on the face of the clutch pedal lever and the end of the pedal lever shaft before removal to assist in positioning the pedal correctly on reassembly, thus facilitating re-entry of the pinch-bolt in the groove of the shaft. Remove the clamping bolt from the clutch pedal lever and gently drive the shaft inwards until it is flush with the boss. Insert a hand into the inspection cover aperture and behind the shaft to prevent it dropping right through.
  - (9) Remove the bolts securing the clutch housing to the main frame and transmission case on the left-hand side of the tractor, commencing with the bolt securing the pedal return spring anchorage. Allow the clutch pedal assembly to remain suspended in the clutch housing.  
If a hand clutch unit is fitted this is removed by detaching the return spring and slackening the adjusting screw until the operating spring and cup can be removed. Disconnect the operating rod fork from the withdrawal shaft, remove the circlip from the right-hand side of the pedal shaft, and drive the shaft through the casing from the right.
  - (10) Disconnect the oil pressure gauge pipe from the union on the cylinder block situated below the drain tap.
  - (11) Disconnect the leads to the dynamo and remove the cable and clips from under the tappet cover bolts.
  - (12) Disconnect from the solenoid the two wires which emerge from the main harness and release them from the clip on the battery box. Disconnect also the earth wire from beneath the clip.
- The following operations are carried out from the right-hand side of the tractor:
- (13) Disconnect both wires from the starter motor pilot switch.



- (14) Disconnect the wire from the starter motor.
- (15) On tractors fitted with electric lighting disconnect the headlamp wiring from the snap connector. Disconnect the wires from the horn or, alternatively, remove the horn from beneath the battery box.
- (16) Disconnect the cable from the stop control lever on the injection pump.
- (17) Disconnect from the bell-crank lever the throttle linkage connected between it and the venturi lever.
- (18) Disconnect the injector spill-off pipe from the return pipe to the fuel tank.
- (19) Four bolts secure the battery box to the clutch housing; remove the bolts and detach the box.
- (20) Disconnect the control rod yoke from the radiator shutter control lever (when fitted) and remove the six screws securing the right-hand panel below the fuel tank.

**NOTE.**—The two bottom screws securing each tank panel have one spring and one plain washer, the remaining screws each having one spring washer only.

Extract the clevis pin securing the starter control rod to the lever on the starter motor and withdraw the side panel complete with the starter control assembly.

- (21) Scribe a mark across the steering drop-arm lever and shaft to ensure correct alignment on reassembly and then remove the drop-arm clamping bolt. Withdraw the drop-arm from the shaft.
- (22) Remove from the right-hand side the six bolts securing the clutch housing to the main frame and transmission casing.
- (23) When electric lighting is fitted disconnect both wires from the lighting switch on the instrument panel.
- (24) Lift one end of the rubber sealing strip between the flywheel housing and the clutch housing and peel the strip out.
- (25) Place a rope sling beneath the fuel tank support brackets. Pack with rag to prevent abrasions and lift off the assembly. Ensure that the fuel pipe is not caught up and that the instrument panel and fuel filter bowl are not damaged when the assembly is lowered to the ground.

Replacement of the clutch housing and steering assembly is carried out in the reverse order to the removal procedure.

#### **Removal and replacement of the engine unit**

- (1) Drain the cooling system from the left-hand side by opening the tap at the base of the radiator and the tap on the cylinder block. (If the engine is to be dismantled after removal drain the oil by removing the plug in the left-hand side of the engine sump.)

- (2) Remove the four bolts holding the radiator case to the support brackets and lift off the radiator case.
- (3) Take out the split pin securing the front end of the radiator shutter control and remove the control complete. Slacken the clips securing the top and bottom water hoses and free the hoses. Remove the radiator stay securing bolt. Take out the split pins and remove the nuts and bolts securing the radiator block to the support brackets. Lift off the radiator block and leave in an upright position in a safe place. (Flush out the radiator block with clean running water on removal from the tractor.)
- (4) Remove the locking wire and withdraw the clevis pin from the transmission driving sleeve. Slide the sleeve forward along the shaft.
- (5) Extract the two retaining spring clips and remove the release bearing from the withdrawal shaft.
- (6) Remove the four bolts securing the engine in position and arrange a suitable sling from the two lifting brackets provided on the engine. Take care to prevent the sump drain plug from fouling the main frame as the engine is lifted.

Replacement of the engine unit is a reversal of the removal procedure. Make sure that the sealing strip is in position beneath the flywheel housing and take care to locate the engine on the dowels in the main frame.

When an engine is to be returned to the Factory for reconditioning remove the following parts: dynamo, starter motor, fan belt, fan blades, water outlet pipe, silencer assembly, exhaust manifold, and clutch assembly.

## **Section AA.7**

### **FLYWHEEL BEARING MODIFICATION**

Commencing at Engine No. 34TA/B/D49850, the stem wheel bush in the flywheel is replaced by a single-row, rigid ball journal bearing (Part No. BMK411).

The bearing can be fitted to earlier tractors if the operations detailed in Section A.26 are carried out.

## **Section AA.8**

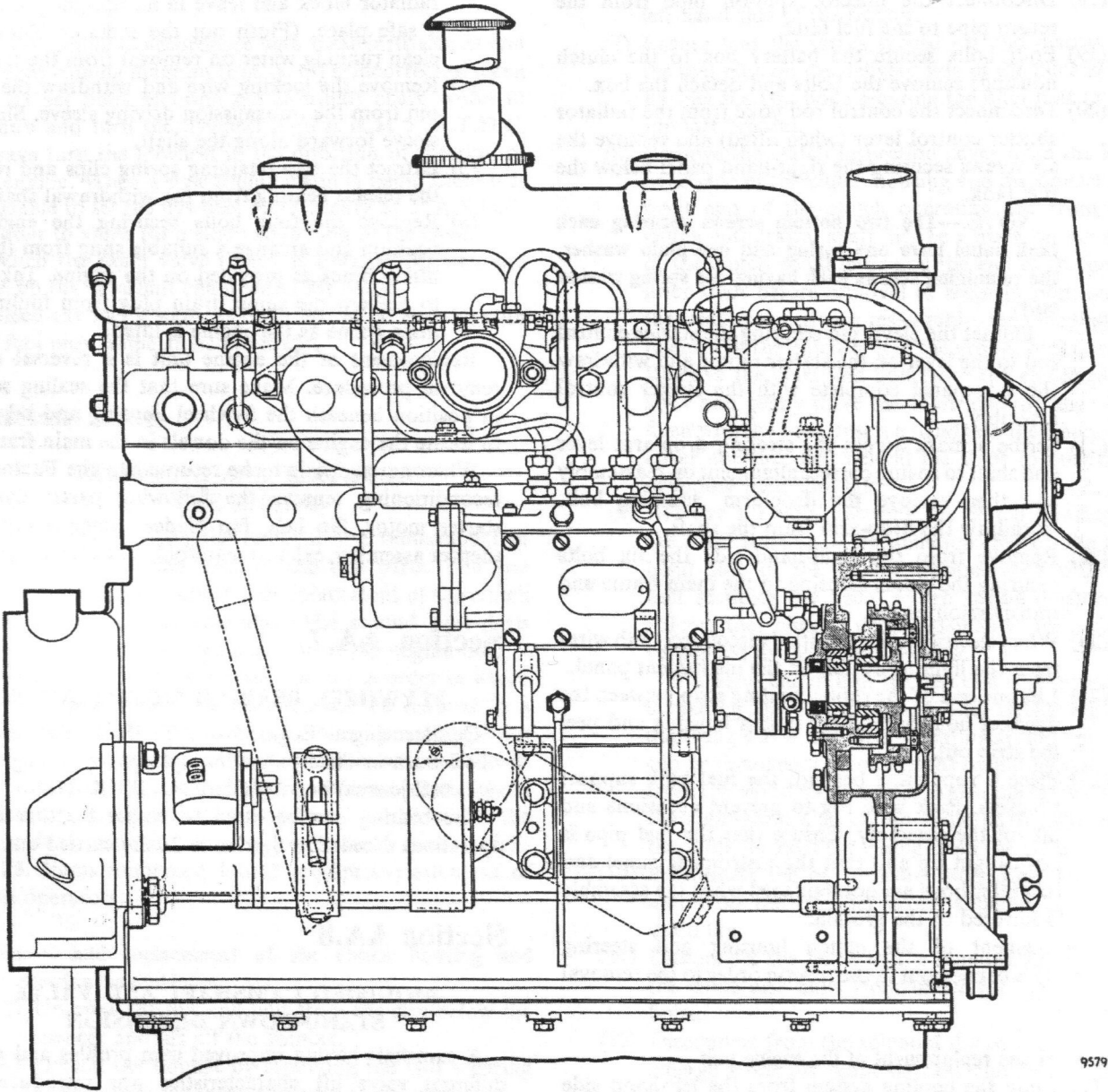
### **MODIFIED CAMSHAFT AND VALVE STAND-DOWN DIMENSION**

A camshaft having improved cam profiles and giving different valve lift characteristics was introduced on OEA engines at Engine No. 66336.

The valve stand-down (see Section A.13, page A.19) is increased to .020 to .030 in. (.508 to .762 mm.). For standardization purposes all Factory-reconditioned engines will, in future, have the valves fitted to the increased



## THE NUFFIELD UNIVERSAL FOUR ENGINE INJECTION PUMP DRIVE



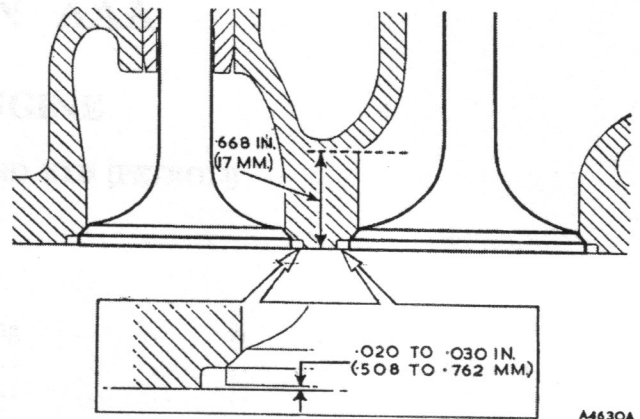
9579

stand-down dimension, although they may not necessarily be fitted with the modified camshaft.

The modified camshaft, which has a  $\frac{3}{32}$  in. (2.38 mm.) wide shoulder machined on its threaded end for identification purposes, may be used as a replacement for the early-type camshaft, in which case the valve seats must be carefully recut to give the increased valve stand-down, using the valve seat cutting tools listed on page A.32.

In addition, the depth of each inlet port counterbore, as measured from the cylinder head joint face, must be checked and, if found to be less than .668 in. (17 mm.), must be recut to this dimension.

See also Section A.28.



A4630A

Fig. AA.9

*When fitting a modified camshaft to early engines recut, if necessary, the depth of each inlet port counterbore to the above dimension and fit the valves with their tops standing down below the cylinder head joint face as shown inset*

## SECTION AAA

## THE ENGINE

(TYPES ETC [V.O.] AND ETD [PETROL])

	Section
General description	
Lubrication system	
Bearings—main and big-end—removing and replacing	AAA.9
Camshaft—removing and replacing	AAA.24
Carburetter—removing and replacing	AAA.15
Crankshaft	
Reground	AAA.31
Removing and replacing	AAA.30
Cylinder block	
Bores and piston sizes	AAA.14
Liners	AAA.32
Cylinder head—removing and replacing	AAA.10
Decarbonizing	AAA.19
Engine—removing and replacing	AAA.27
Flywheel	
Removing and replacing	AAA.28
Starter rings	AAA.29
Hot-spot gasket—fitting new (ETC)	AAA.33
Manifolds—removing and replacing	AAA.16
Oil filter—changing	AAA.6
Oil gallery—external	AAA.7
Oil pressure	AAA.8
Relief valve	AAA.5
Oil pump	
Dismantling and reassembling	AAA.4
Removing and replacing	AAA.3
Pistons and connecting rods	
Dismantling and reassembling	AAA.12
Removing and replacing	AAA.11
Rings—removing and replacing	AAA.13
Sump	
Draining	AAA.1
Removing and replacing	AAA.2
Tappets	
Adjusting	AAA.25
Guide blocks—removing and replacing	AAA.22
Timing chain cover, chains, and wheels	
Removing and replacing	AAA.23
Valves	
Grinding and testing seats	AAA.20
Guides—removing and replacing	AAA.21
Removing and replacing	AAA.18
Timing—checking	AAA.26
Water pump—removing and replacing	AAA.17

SEE PLATE FFF



## KEY TO THE ENGINE COMPONENTS

No.	Description	No.	Description	No.	Description
1.	Cylinder block assembly.	42.	Nut for stud.	93.	Valve.
2.	Stud for cylinder head.	43.	Spring washer.	94.	Cover.
3.	Stud for exhaust manifold.	51.	Oil seal cover.	95.	Element.
4.	Stud for tappet cover (long).	52.	Crankshaft—oil seal housing.	96.	Sealing ring (rubber).
5.	Gasket (front and rear).	53.	Main oil pipe assembly.	97.	Sump oil filter.
6.	Water jacket cover.	54.	Banjo pin.	98.	Valve spring.
7.	Joint for cover.	55.	Washer for pin.	99.	Centre-bolt.
8.	Screw—cover to block.	56.	Joint for centre and rear connections.	100.	Washer for bolt.
9.	Washer (copper and asbestos).	57.	Bolt for centre connection.	101.	Bolt—bracket to block.
10.	Cylinder drain blanking—plate.	58.	Lock plate.	102.	Spring washer for bolt.
11.	Joint for plate.	59.	Pipe assembly—pump to filter.	103.	Gasket.
12.	Water drain tap.	60.	Banjo pin.	104.	Bolt—water outlet pipe to head.
13.	Washer for drain tap (plain).	61.	Washer (fibre).	105.	Spring washer for bolt.
14.	Washer for drain tap (fibre).	62.	Gasket.	106.	Connection for top thermostat assembly.
15.	Bolt—plate to block.	63.	Oil filler body.	107.	Thermostat assembly housing.
16.	Spring washer.	64.	Tube assembly.	108.	Joint—connection to housing.
17.	Front tappet cover.	65.	Filler cap.	109.	Thermostat.
18.	Rear tappet cover.	66.	Cable for cap.	110.	Bolt—connection to housing.
19.	Joint for tappet covers.	67.	Oil level indicator rod.	111.	Spring washer for bolt.
20.	Wing nut for tappet covers.	68.	Bolt—body to block.	112.	Bolt—radiator top stay to housing.
21.	Nut for tappet covers (plain).	69.	Spring washer.	113.	Nut for bolt.
22.	Washer (fibre).	70.	Joint to block.	114.	Tube—water jacket to water pump.
23.	Tappet instruction plate.	71.	Oil filter assembly.	115.	Hose.
24.	Rivet for plate.	72.	Filter support bracket.	116.	Clip for hose.
25.	Sump.	73.	Joint—bracket to block.	117.	Stud for tappet covers.
26.	Joint—sump to block.	74.	Screw—filter to bracket.	118.	Plain washer.
26A.	Drain plug.	75.	Spring washer for screw.	119.	Nut for plain washer.
26B.	Gasket for plug.	76.	Dynamo bracket.	120.	Bolt—cover to case (short).
27.	Cylinder head.	78.	Spring washer for bolt.	121.	Bolt to timing case cover.
28.	Gasket for cylinder head.	79.	Dynamo adjusting link.	122.	Spring washer for bolt.
29.	Set screw.	80.	Fulcrum pin.	123.	Bolt—dynamo bracket to block.
30.	Lifting bracket (front and rear).	81.	Washer for fulcrum pin.	124.	Bolt—dynamo bracket to adaptor plate and block.
31.	Nut for cylinder head stud.	82.	Nut for fulcrum pin.	125.	Split pin for nut.
32.	Joint for filler tube.	83.	Hose—pipe to water pump.	126.	Bolt to block (long).
33.	Joint.	84.	Clip for hose.	127.	Spring washer for bolt.
34.	Timing gear—case.	85.	Pipe—radiator to water pump (bottom).	128.	Retaining plug.
35.	Timing case—cover.	86.	Cover-plate.	129.	Location plate.
36.	Bolt—cover to case (long).	87.	Water pipe.	130.	Washer.
37.	Nut for long bolt.	88.	Screw—pipe to cover.	131.	Spring.
38.	Bolt—case and cover to block.	89.	Spring washer for screw.	132.	Heat shield.
39.	Spring washer.	90.	Fume pipe hose.		
40.	Engine front support bracket.	91.	Dowel for timing case.		
41.	Stud—engine mounting bracket and case to block.	92.	Joint—timing case to block.		