INDUSTRIAL PRODUCTS SERVICE MANUAL FOR 2720 RANGE ENGINES

VOL. 3 –FUEL INJECTION EQUIPMENT

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INTRODUCTION

This Supplementary Workshop Manual covers testing and overhaul of the CAV Fuel Injection Equipment as fitted to the 2720 range of engines.

NOTE: Ford policy is one of continuous improvement and the right to change prices, specifications and equipment at any time without notice is reserved.

INJECTION PUMP AND INJECTOR IDENTIFICATION

Before starting work on a pump or injector, it is vital that it is identified correctly, so that the relevant repair and testing procedures can be followed easily.

Although all the injection pumps are basically the CAV Minimec type, they vary in detail specification according to the engine application. It it necessary to relate the pump to the engine on which it was fitted and to identify the type of governing used - refer to the 'Service Identification Plate' which is located on the engine rocker cover.

The engine type is stamped under 'Model' and the second letter stamped under 'Fuel System' identifies the governing as follows:

A. General Purpose (GP)

B. Class 'A'

C. Automotive

D. Combine Harvester

The CAV reference ('P') No. stamped on the injection pump identification plate, identifies the pump for testing and calibrating purposes.

In order to make the pump overhaul and testing procedures easier to follow, this manual refers to the various pumps either as 'Dover' or 'Dorset' types as shown in the following table (Fig. 1).

A chart for injector identification is shown on the following page (Fig. 2).

Engine/Governing	Pump Type
2722/GPI	Dover
2722/GPII	Dover
2722/Class A, 1500/1800	Dorset
2722/Automotive	Dover
2723/GPI	Dover
2723/Class A, 1500/1800	Dorset
2723/Automotive	Dover
2723/Combine Harvester	Dorset
2725/GPI	Dover
2725/GPII	Dover
2725/Class A, 1500/1800	Dorset
2725/Automotive	Dover
2725/Combine Harvester	Dorset
2726T/GP	Dover
2726T/Class A, 1500/1800	Dorset
2726T/Automotive	Dover
2726T/Marine*	Dover
2728T/Marine*	Dover

Fig. 1 - Injection Pump Identification

* Fitted with two-lead (insulated return) excess fuel solenoid.

NOTES: Automotive and Marine governing is very similar.

'Dorset' pumps are very similar to those fitted to 2710/2704ET engines but are fitted with different drive gears to suit the 2720 range timing gears which have straight cut teeth.

'Dover' pumps have an external oil pipe connecting to the oil filter head on the engine.

Engine/Governing	Ford Injector Part No.	CAV Injector Part No.	CAV Nozzle Part No.
2722/GPI	826F-9K546-DAB	LRB 6700807	6801018
2722/GPII	826F-9K546-DAB	LRB 6700807	6801018
2722/Class A, 1500/1800	826F-9K546-DAB	LRB 6700807	6801018
2722/Automotive	826F-9K546-DAB	LRB 6700807	6801018
2723/GPI	826F-9K546-DAB	LRB 6700807	6801018
2723/Class A, 1500/1800	826F-9K546-DAB	LRB 6700807	6801018
2723/Automotive	826F-9K546-DAB	LRB 6700807	6801018
2723/Combine Harvester	826F-9K546-DAB	LRB 6700807	6801018
2725/GPI	826F-9K546-DAB	LRB 6700807	6801018
2725/GPII	826F-9K546-DAB	LRB 6700807	6801018
2725/Class A, 1500/1800	826F-9K546-DAB	LRB 6700807	6801018
2725/Automotive	826F-9K546-DAB	LRB 6700807	6801018
2725/Combine Harvester	826F-9K546-DAB	LRB 6700807	6801018
2726T/GP	826F-9K546-HAA	LRB 6700805	6801016
2726T/Class A, 1500/1800	826F-9K546-HAA	LRB 6700805	6801016
2726T/Automotive	826F-9K546-HAA	LRB 6700805	6801016
2726T/Marine	826F-9K546-HAA	LRB 6700805	6801016
2728T/Marine	826F-9K546-HBA	LRB 6700806	6801017

Fig. 2 - Injector Identification

SPECIAL EQUIPMENT

Modern diesel engine fuel injection equipment is a specialised assembly of mechanical and hydraulic components. The working parts are manufactured to close limits and the running clearances are very fine. It is therefore essential that the overhaul procedures described in this manual are carried out only in working conditions of extreme cleanliness and orderliness. A dust free, well lit, purpose built 'Pump Room' must be provided with adequate floor space, benches and storage cupboards to accommodate all the special test machines and hand tools necessary to overhaul and adjust the injection equipment correctly. Fig. 3 shows a typical 'Pump Room' layout.

In some territories with extreme climatic conditions, air conditioning equipment may be necessary. A well planned layout will promote tidiness and efficiency.

Restrictions controlling the smoke level from diesel engined road vehicles have been a legal requirement in certain territories for many years. Regulations now prevailing within the E.E.C. place even stricter control on the smoke level.

To ensure that these regulations are met, closer control has been placed on the injection pump fuel delivery levels and tolerances.

Similarly, stricter control has been placed on test machine performance and special international standards have been published to ensure that the test machines are capable of testing injection pumps to meet the new regulations.
It is essential, in territories where smoke regulations are in operation, that the test machine manufacturer is consulted to ensure that the test machine to be used is of the correct type.

NOTE: The test machines and hand tools listed in this manual are the principle machines and tools necessary to carry out the overhaul and test procedures specified. A wide variety of additional tools and machines are available to further improve the efficiency of the pump room depending upon the volume of work. Details of these machines are available from the manufacturer.

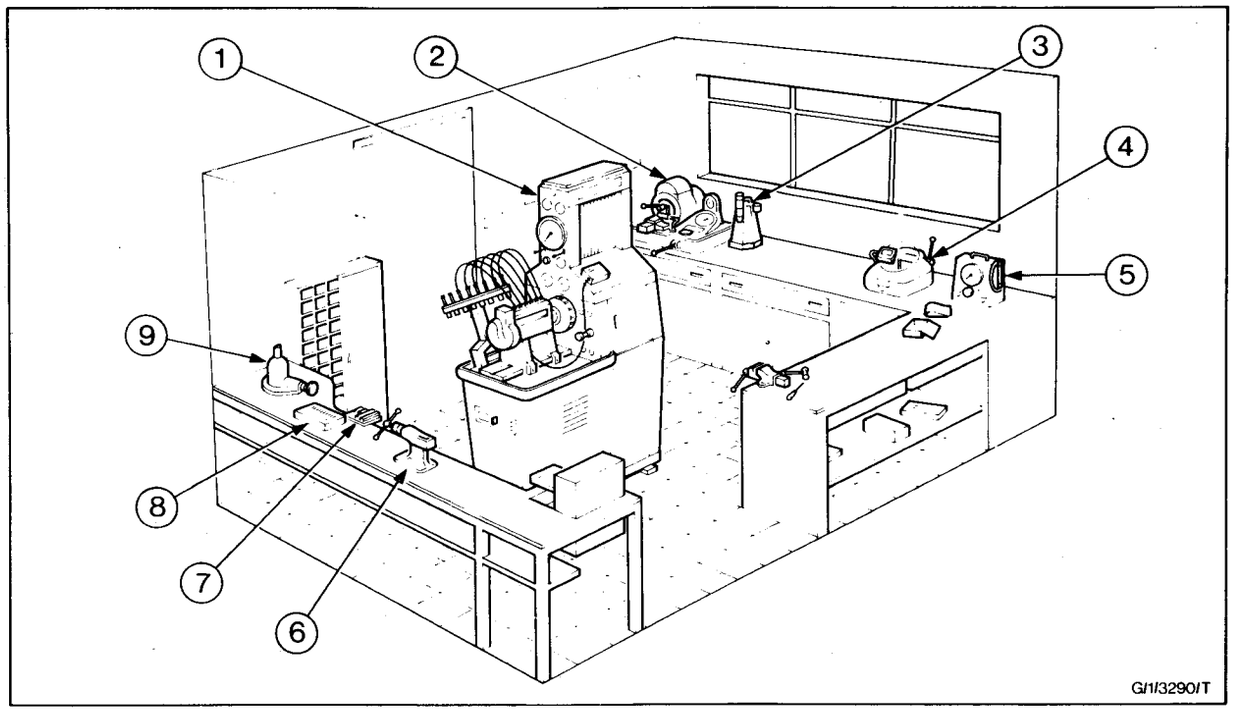


Fig. 3 - Typical Pump Room Layout
1. Test Stand (Series 800)
2. Nozzle Tester (Tool No. HH 601)
3. Nozzle Viewer (Tool No. HH 103)
4. Nozzle Cleaner (Tool No. HH 013)
5. Boost Control Test Rig (Tool No. HF 107)
6. Nipple Former
7. Injector Dismantling Jig (Tool No. HH 112)
8. Nozzle Cleaning Kit (Tool No. CT 9014)
9. Swivel Vice (Tool No. HM 910)

TEST MACHINES

Injection Pump Test Stand - see Fig. 4

The Hartridge Series 1100 Mk2 and the Series 800 test stands are recommended for testing all the injection pumps contained in this workshop manual. These machines have been devèloped by the manufacturer to meet ISO specifications.

The injection pump under test is mounted on the machine's test table and driven by an electric motor via a belt and pulley system providing stepless variable speed control.

Among the main facilities provided by the machine are means of measuring camshaft angular displacement and fuel spill cut-off for phasing; pump rotational speed and fuel delivery for calibration.

For a detailed description of this machine and the operating and servicing procedure, consult the manufacturer's manuals.

Boost Control Test Rig - see Fig. 5

When calibrating injection pumps from turbocharged engines or when carrying out the static test on the later type of boost control unit as fitted to the 'Dover' pumps, it is necessary to supply compressed air at an accurately measured pressure to the boost control unit on the pump.

The Hartridge test rig (TOOL NO. HF 107) comprises a pressure gauge, control valve and flowmeter mounted in a portable case with inlet and outlet air connections. The flowmeter is connected in circuit and is used to detect any air leaks in the boost control unit.

Injector Testing Machine - see Fig. 6

The Hartridge 'Testmaster' machine (TOOL NO. HH 601) is suitable for testing all the injectors contained in this workshop manual. The machine has a hand operated plunger pump that supplies test oil, via a connecting pipe, to the injector under test.

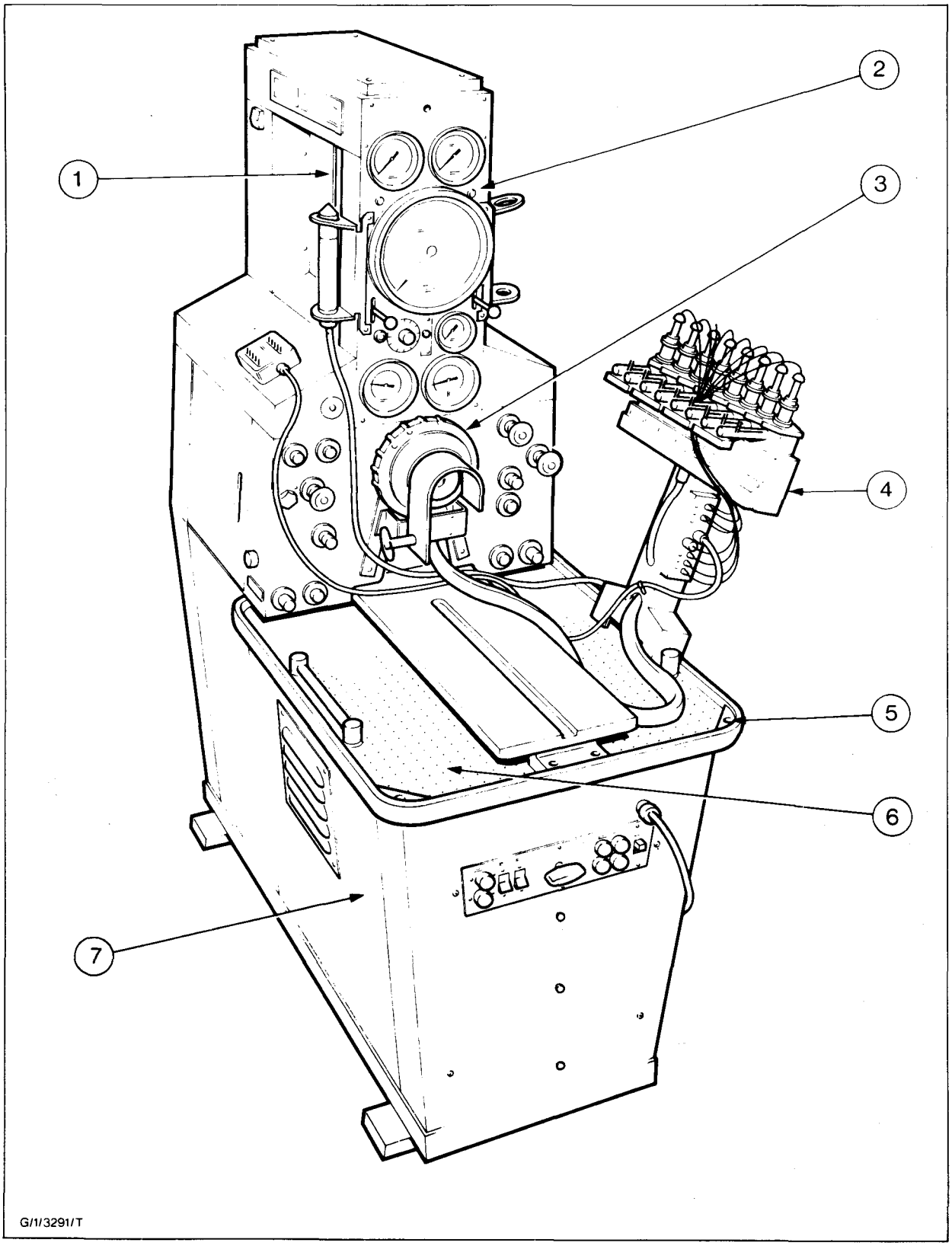


Fig. 4 - Hartridge Series 800 Test Stand
1. Fuel Delivery Graduates
2. Controls and Instruments
3. Phasing Ring
4. Injector Mount
5. Boost Control Test Rig Mounting Points
6. Drain Tray
7. Drive Motor

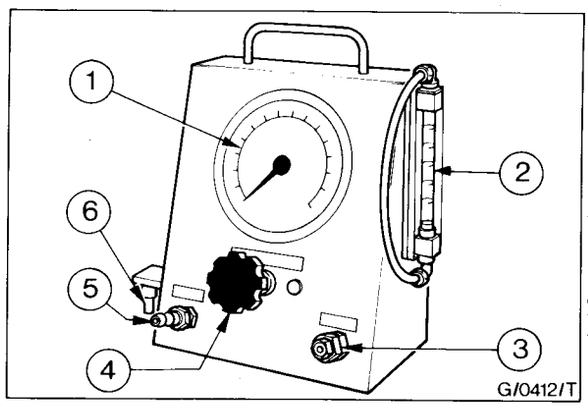


Fig. 5 - Boost Control Test Rig (Hartridge)
1. Pressure Gauge
2. Flowmeter
3. Outlet
4. Pressure Control Valve
5. Inlet
6. Mounting Bracket

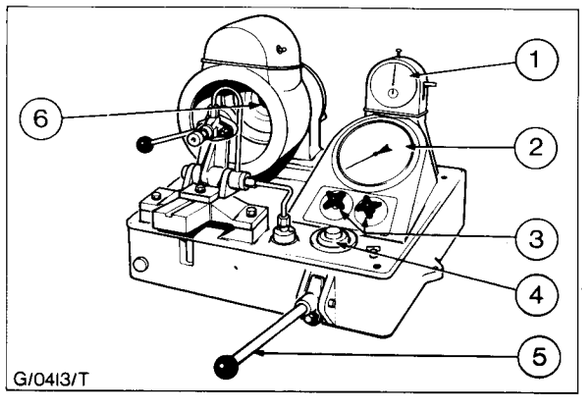


Fig. 6 - Nozzle Tester (Hartridge Testmaster)
1. Back Leakage Timer
2. Pressure Gauge
3. Pressure and Flow Control Valves
4. Paper Filter Element
5. Detachable Pump Handle
6. Spray Chamber

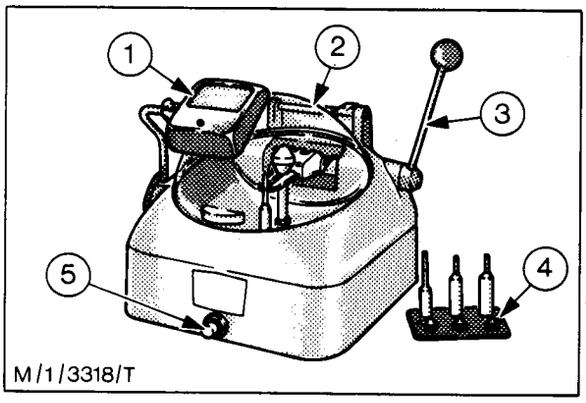


Fig. 7 - Nozzle Cleaner (Hartridge Multiclean)
1. Illuminated Magnifying Viewer
2. Domed Cover
3. Operating Lever
4. Nozzle Mounts
5. Illuminating Switch

A pressure gauge is provided to measure the pressure of the test oil supplied to the injector. The machine is equipped with two control valves, one to vary the quantity of test oil supplied to the injector or when closed to isolate the hand pump from the injector. The other valve is used to isolate the pressure gauge when testing the injector spray characteristics, thus protecting the gauge from violent needle fluctuations.

A spray chamber is provided with a motor driven extractor fan to collect and dispose of the discharged spray.

Injector Nozzle Cleaner - see Fig. 7

The Hartridge 'Multiclean' (TOOL NO. HH 013) combines oil and air cleaning for all injector nozzles in one operation, so that all the dirt, loose carbon and abrasives are removed quickly and easily.

The nozzle is mounted in the centre of the machine and the lever, operated after the domed transparent cover has been closed, clamps the nozzle in place and then releases firstly high pressure air and then cleaning oil through the nozzle, in both directions.

The machine has a filtered self contained oil supply, but requires an external pressurised air supply of 3,45 to 5,52 bar (50 to 80 lb/in^2).The cleaning operation is viewed though an illuminated magnifying viewer which allows close examination of the spray holes.

Nozzle Viewer - see Fig. 8

After a nozzle has been cleaned using the nozzle cleaner, it will require careful inspection to ensure that it is still serviceable. The Hartridge nozzle viewer (TOOL NO. HH 103) consists of a stand with an internal lamp which illuminates the component holders for inspection by microscopic and magnifying viewers. A separate viewing arrangement is provided for the nozzle and needle.

As an addition to the nozzle viewer, the 'Probelight' (TOOL NO. ANR 6) may also be used for close examination of both nozzle and needle.

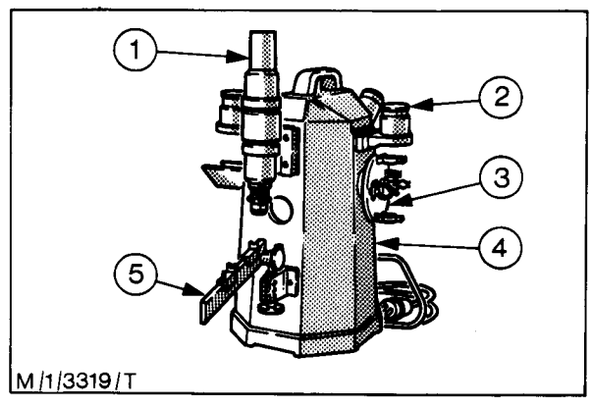
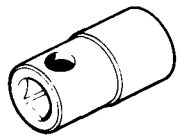
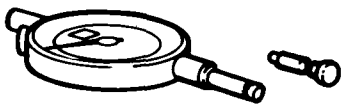
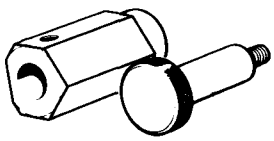
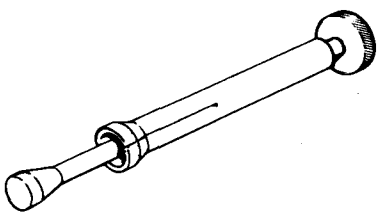
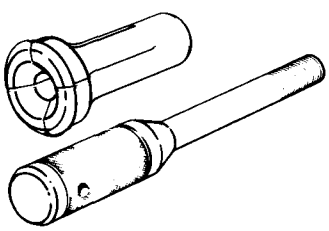
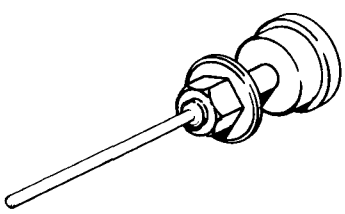
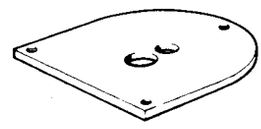
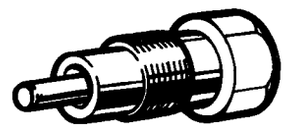
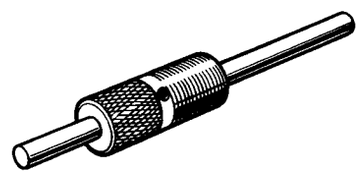
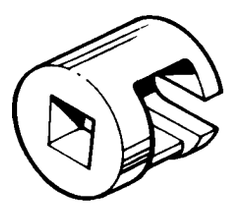
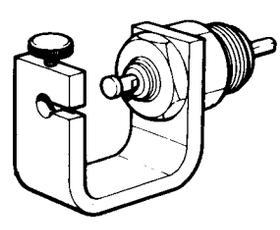
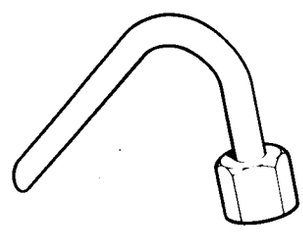


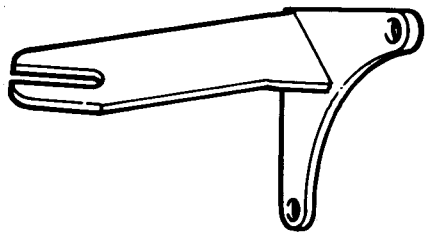
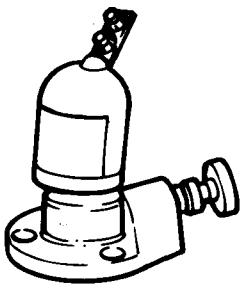
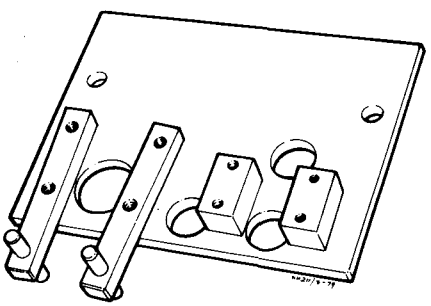
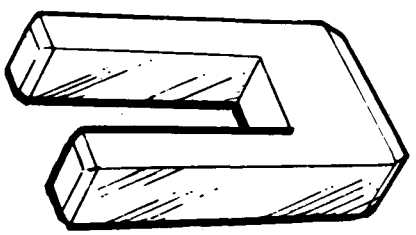
Fig. 8 - Nozzle Viewer (Hartridge)
1. Needle Microscope
2. Nozzle Viewer
3. Nozzle Holder
4. Light Projector
5. Needle Holder

SPECIAL TOOLS

Tool No.	Description	Identification
23 501 (CT 9054)	Delivery Valve Holder Remover/Installer	
CT 9017	Dial Indicator Gauge	
CT 9017-1	Camshaft Adaptor for Dial Gauge Mounting	
CT 9022	Delivery Valve Guide Remover	
CT 9050	Bearing Cup Remover	
CT 9051	Bearing Cup Installer	

Tool No.	Description	Identification
HM 927 *	Gauge Plate	
23 504	Timing Tool (Dorset)	
23 507	Timing Tool (Dover)	
CT 9009	Nozzle Nut Socket	
CT 9076 B	Plunger Head Clearance Gauge	
CT 9023	Pump Spill Pipe	

* = Tools available from L. Hartridge Ltd.

Tool No.	Description	Identification
HM 89558 *	Boost Control Unit Static Test Mounting Bracket	
HM 910 *	Swivel Vice (Hartridge Hydraclamp)	
HH 112 *	Injector Dismantling Jig	
7244-350 *	Adaptor for Jig HH 112	

* = Tools available from L. Hartridge Ltd.

TEST STAND MAINTENANCE STANDARDS

The test stands must be maintained according to the manufacturer's operating and servicing manuals. In particular, when testing Ford injection pumps, the following standards must be adhered to.

NOTE: Refer to the chart at the end of this section for the frequency at which test equipment checks should be carried out.

Master Injectors

The test stand must be equipped with standard Hartridge nozzle holders type BKB50SD533B fitted with type L166EP restricted lift nozzles. These master injectors are to be matched, steady flow checked sets, as tested and supplied by Leslie Hartridge Ltd.

The master injectors must be tested on initial installation and regularly thereafter for balance, opening pressure, back leak and seat dryness, as follows:

a) Select a new or overhauled standard injection pump for a naturally aspirated engine. Mount the pump on the test stand and connect all pipes and services. Run at 400 rpm until all the master injectors are functioning. Increase speed to approximately 800 rpm and run for at least 15 minutes to stabilise the injection pump and the master injectors.

b) Adjust one element on the pump to deliver 15cc for three consecutive readings at 800 rpm and 200 shots. Connect this element to each master injector in turn, using the same pipe and graduate throughout. Run at 800 rpm and collect 200 shots. For consistent results, allow 30 seconds in each case after each 200 shot delivery has ceased to allow the fuel to settle before taking a graduate reading at the bottom of the meniscus. Also allow 30 seconds in each case for the tube to drain after each reading. Take the mean of three consecutive readings from each injector. The variation between the highest and the lowest reading (the balance) must not exceed 0,2cc.

c) The master injectors should be removed and tested on a 'Testmaster' nozzle tester (TOOL NO. HM 601) as follows:

i) The opening pressure must be 177,32 to 179,34 bar (180,8 to 182,9 kg/cm^2; 2572 to 2601 lb/in^2).

ii) The back leak time must not be less than 10 seconds for a pressure drop of from 150 to 100 bar (153 to 102 kg/cm^2; 2175 to 1450 lb/in^2) at 20° to 30°C (68° to 86°F) test oil temperature.

iii) Seat dryness; the nozzle tip must be completely dry after one burst at the specified opening pressure.

After refitting the master injectors to the test stand the balance should be rechecked. There must be no leakage from any of the injector pipe unions at the injector or pump end, or from any of the cap nuts.

If the opening pressure is below specification, adjustment of the injector to restore the specified opening pressure is permissible. In a number of cases such readjustment of the opening pressure will also restore the specified balance. If, after pressure adjustment, the balance is still not to specification, a new or reconditioned set of master injectors must be obtained from the machine manufacturer. The master injectors may only be replaced in matched sets. Under no circumstances can master injectors be serviced to obtain balance by dismantling and cleaning other than by the machine manufacturer.

High Pressure Injector Pipes

The high pressure pipes must all have a bore of 2,0mm (0,079in), an outside diameter of 6,0mm (0,236in) and a length of 600mm (23,62in).

All new injector pipes must be cleaned, after bending and before fitting to the test stand, by oil flushing at a pressure of 10,3 bar (10,5 kg/cm^2; 150 lb/in^2).

The pipes must be flow checked at the same pressure into matched sets to a tolerance of 132 to 154 litres per hour (29 to 34 imperial gallons per hour). The pipes must be regularly checked for restricted ends or kinks. If any one pipe is defective, the complete set must be renewed.

Secondary Filters

Secondary (button) filter assemblies must be fitted to each master injector inlet adaptor. The assemblies comprise the adaptor (TF59835), the adaptor nipple (7008-220) and the filter (7008-221). New assemblies must be fitted regularly. Adaptors should be flushed before fitting new filters.

Dump Valve and Graduates

The deflectors fitted in the graduates to prevent aeration should be in position at all times during pump testing.

No leaks are permitted from the bottom of the graduates. The sealing of the graduate dump valve should be checked regularly as follows:

Fill the glass with 12cc of test oil. Allow to stand for 30 minutes. Check that the level has not dropped by more than 0,2cc. If the leakage rate is greater, remove the graduate, open the dump valve and remove the 'O' ring. Clean out the recess; examine the 'O' ring and renew it if necessary.

On replacing the graduate, ensure that the base rests on the calibrator base plate and rotate the graduate 360° to settle in the 'O' ring.

All graduates must be datum checked regularly for matched readings as follows:

Ensure that the bottom of the graduate rests on the calibrator base plate. Remove the top of the calibrator unit for access to the top of the graduates. Position a burette over each 0-24cc graduate in turn and tap off 8,0cc. Allow 15 seconds to settle and then take readings.

The line out balance between graduates must not exceed 0,1cc. Once the graduates are positioned and checked as above they must not be disturbed.

Pump Drive Coupling

The pump drive coupling flange must be a CR 400 series used with a rubber insert type C86565. There must be no rotational play of the coupling on the shaft, nor between the coupling due to worn rubber inserts. Ensure that the pump is aligned to the test bench shaft and that there is a minimum working end clearance on the rubber inserts of 5,0mm (0,20in).

Tachometer Check

With an injection pump set to a maximum fuelling of 10cc per 200 shots at 600 rpm fitted on the stand, set the index of the stand tachometer to 600, 1000, 1200 and 1500 rpm respectively.

Check these speeds with a digital tachometer for stands fitted with an electronic shot counter and optional transducer. Make an allowance for any error in excess of 1% of the reading.

Pressure Gauge Check

Install a master pressure gauge, tapping it into the pressure line adjacent to the stand pressure gauge. Set the pressure to 0,344 bar (0,351kg/cm^2; 5lb/in^2) and 0,552 bar (0,563kg/cm^2; 8lb/in^2) respectively on the master gauge.

Make an allowance for the difference between master and stand gauge.

Fig. 9 - Test Equipment Periodic Check Frequency

	After every 10 pumps	After every 50 pumps	After every 100 pumps	Monthly	After Graduate Breakage
Master Injectors		X			
High Pressure Injector Pipes	X				
Secondary Filters		X			
Dump Valve Seal				X	X
Graduate Matched Readings		X			X
Tachometer		X			
Pressure Gauge		X			
Shot Counter		X			
Temperature Gauge		X			
Supply Filter			X		

Shot Counter Check

For stands fitted with an electronic shot counter, check the shot accuracy with a digital counter.

Temperature Gauge Check

Check the accuracy of the temperature gauge with a thermo-couple applied at the sending point of the temperature gauge. Make an allowance for the difference between the thermocouple reading and the temperature gauge reading.

Supply Filter

The normal supply filter should be changed regularly. Every other time the filter is changed, the fuel tank should be drained, flushed with clean test oil and replenished with clean test oil.

TEST STAND OPERATING STANDARDS

For consistent fuel delivery readings in the graduated glasses always:

a) Drain the glasses for 30 seconds.

b) Allow 15 seconds settling time after collecting delivered fuel before reading the graduates.

c) Take graduate fuel readings from the bottom of the meniscus.

d) Measure fuel deliveries over 200 shots except where otherwise stated.

e) Observe but disregard the first 200 shot run.

Always determine the point of spill cut-off with the plunger rising, whether it be needed to measure the stroke to close the inlet port on number 1 element or to phase the remaining elements.

To avoid discrepancies of fuel level when draining the graduates, on no account must the dump valve operating lever be operated in quick succession (to and fro). The lever should be selected to the appropriate position and allowed to remain there until such time as the alternative position is required.

Leak-off drain pipes must be fitted to the master injector leak-off connection to enable the leak-off to be piped to the drain tray in the injector mount.

The test oil used in the test stand and in the injector test machine must conform to Ford specification SPM-99C-9105-A. Throughout the calibration procedure for injection pumps, the test oil temperature must be maintained at 40° to 45°C (104° to 113°F).

For all injector back leak testing the test oil in the test machine must be at a temperature of 16°C (60°F) - nominal pump room ambient temperature. If the ambient temperature is other than this value, the leak back times must be corrected in accordance with the chart in 'Specifications'.

The pressure of the test oil supplied to the fuel gallery of the injection pump under test must be maintained at 0,34 to 0,55 bar (0,35 to 0,56 kg/cm^2; 5 to 8 lb/in^2) unless stated otherwise in 'Specifications'.

On Dover pumps a self purging air valve must be fitted and a recirculating low pressure fuel feed system used during calibration.

To ensure that the fuel supply pipe from the test stand to the injection pump is adequate at all times, a steel braided supply pipe must be used (supplied by Leslie Hartridge Ltd.).

On no account must lubricating oil be allowed to contaminate the test fuel oil. To avoid this, any spillage of test oil onto the test stand drain trays should be passed to waste and not back into the test oil storage tank. To ensure this, the drain pipe between the stand drain tray and the test oil tank should be disconnected and reconnected to the drain tap at the rear of the stand.

When setting the fuel delivery and the governor, save time by making full use of the specified tolerance bands.

Stiffness or binding in any part of the pump or governor mechanism can result in incorrect or inconsistent fuelling and governor characteristics. During reassembly and testing it is important to check at each stage that the mechanism has free movement.

Terminology

The term 'Line Balance' is used in this manual and it refers to the difference in delivery from one line to another. It is controlled by the specified line balance tolerance. The 'overall spread' is a term sometimes used in service and has the same meaning.

The 'Master Fork' is that fork nearest to the end of the square section on the control rod. This fork is set in position first relative to the end of the square section. It forms a master setting position to which the other forks will be related.

The 'Master Element' or 'Master Line' is that element or line associated with the master fork and it is this element which is set initially to give the correct calibration delivery figure. The remaining elements are (in most cases) set relative to the master element and their delivery is controlled by the line balance.

The master element or fork for each pump is dependant on the pump configuration as follows:

Injection Pump No. of Cylinders	Master Element/Fork No.
4	4
6	6

The instruction 'Rotate the Pump Camshaft by Hand' in the testing procedure, implies rotation in the normal operating direction. Refer to specifications, if necessary, for the relevant pump on test.

The term 'Dwell Position' when used in connection with the tappets, means that position on the cam when the tappet is at the bottom of its stroke.

INJECTION PUMP TESTING

GENERAL INFORMATION

1. This procedure contains all the tests and adjustments necessary to prepare a new or overhauled pump ready for fitting to an engine. The procedure can also be used in full or in part to diagnose and correct faulty pumps which do not require a complete overhaul.

2. If a pump, other than an overhauled pump, is to be mounted on the test stand it must first be cleaned externally. Securely blank off all the apertures in the pump assembly and thoroughly clean and wash the outside of the pump in test oil.

3. Before using this test procedure, reference should be made to the 'Test Stand Maintenance' and 'Operating Standards' sections of the Manual. For all other information on test stand maintenance and operation, reference should be made to the test stand manufacturer's manuals.

4. To identify the pump to be tested, refer to the 'Injection Pump Identification Chart' on page 2. Also make a note of the pump reference ('P') No. so that the correct data in the 'Specifications' section is used when following the test procedures.

MOUNTING PUMP ON TEST STAND

1. Turn on the test stand test oil heating equipment and set the thermostat to the specified temperature.

a) On Dorset pumps, remove the drive gear.

b) Remove tappet chamber cover and retainers.

c) Where fitted, remove the delivery valve holder locking clamps.

d) Where fitted, remove the control rod buffer spring capnut, sealing washer and adjusting screw.

e) Remove the temporary blanking caps fitted over the apertures in the pump.

Boost Control Pumps

Where the pump has been overhauled immediately before testing, the boost control unit will not have been fitted. Overhauled pumps which have been stored before testing will have the boost control unit fitted loosely and it should be removed at this stage - refer to page 26 for removal procedure.

Pumps which have been in service and new pumps will require the side cover of the boost control unit to be removed - refer to page 26 for correct procedure. Secure the fuel control rod in the maximum fuel position.

All Pumps

2. Using the special mounting brackets and drive couplings available from the test stand manufacturer to suit each type of pump, mount the pump on the test stand and couple up the drive. (Fig. 10).

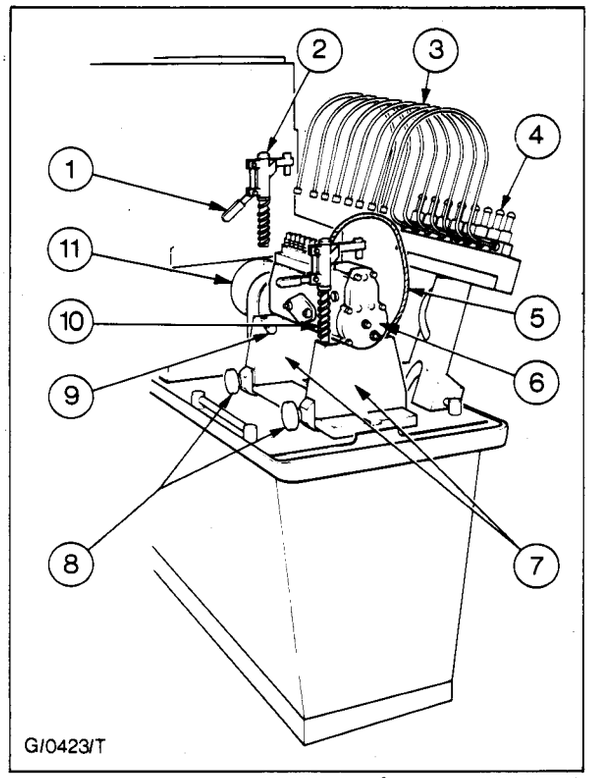


Fig. 10 - Injection Pump Mounted on Stand - 8 Cylinder Pump Illustrated

1. Locking Clamp Lever
2. Clamp Adjuster
3. Injector Pipes
4. Test Injectors
5. Fuel Supply Hose
6. Pump
7. Mounting Brackets
8. Clamps
9. Locking Pin
10. Mounting Clamp
11. Drive Coupling

CAUTION: DO NOT USE DORSET INJECTION PUMP DRIVE GEAR KEYS IN DOVER PUMPS AS THIS WILL SEVERELY DAMAGE THE DRIVE GEAR HUB.

3. Connect the test oil supply pipe(s) to the pump.

4. On pumps fitted with a solenoid operated excess fuel device, connect a variable 12 or 24 volt (as appropriate) switched d.c. electrical supply, equipped with a voltmeter, to the solenoid.

PHASING AND ADJUSTMENTS

Stroke to Close the Inlet Port

CAUTION: THE COMPONENTS FROM EACH ELEMENT MUST BE KEPT TOGETHER IN SETS AS THEY ARE REMOVED, AND MUST BE REFITTED TO THE ELEMENT FROM WHICH THEY WERE REMOVED.

1. Remove the delivery valve holder, the volume reducer, the delivery valve spring, the sealing washer and the delivery valve from number 1 element.

2. Screw the plunger head clearance gauge (TOOL NO. CT 9076 B) into number 1 line in the pump body and tighten securely (Fig. 11). Push the spindle of the tool down to ensure that it rests on the top of the plunger. Attach the dial indicator gauge (TOOL NO. CT 9017) to the plunger head clearance gauge (TOOL NO. CT 9076B) and clamp it in position with its spindle resting on the spindle of the other tool.

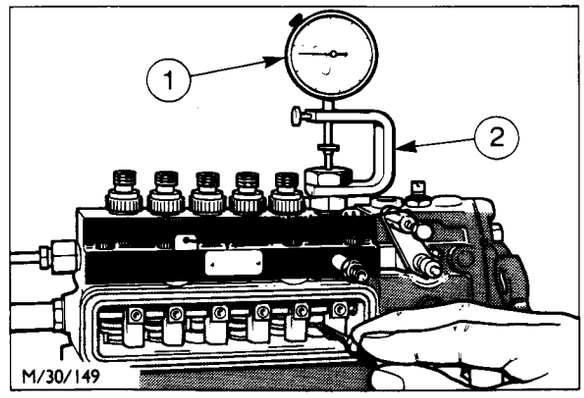


Fig. 11 - Measuring the Stroke to Close the Inlet Port
1. Dial Gauge 2. Plunger Head Clearance Gauge

3. Rotate the pump camshaft by hand until number 1 tappet is in the dwell position. Zero the dial gauge.

4. Turn on the test oil supply and adjust the pressure to 0,07 to 0,14 bar (1 to 2 lb/in^2). Set the governor control lever in the maximum speed position. Adjust the maximum fuel screw to position the control rod so that the master fork is approximately 10mm (0,4 in) from the control rod bush (an approximate preliminary setting for the maximum fuel position). Check that test oil is flowing steadily up past the 'flat' on the plunger head clearance tool spindle.

5. Rotate the pump camshaft slowly and smoothly, by hand, until the test oil ceases to flow from the flat on the tool spindle and stop turning the pump. This is the point of inlet port closure (spill cut-off). Note the dial gauge reading, which is the 'stroke to close the inlet port', for use later during the phasing procedure. Turn off the test oil supply.

NOTE: Element phasing can be carried out using either a low or high pressure test oil supply. The method used will depend largely on the facilities available on the test stand being used, particularly the type of master injector mounting.

Phasing and Adjustment

With number 1 element at the spill cut-off point, set the phasing ring on the test stand to 0° or a suitable multiple on the degree scale for the pump being tested (Fig. 12). The multiples are as follows :

4 cylinder pumps - 90°
6 cylinder pumps - 60°

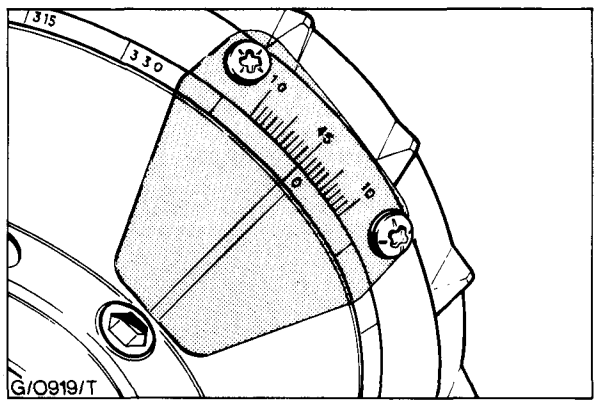


Fig. 12 - Setting the Phasing Ring

Low Pressure Phasing:

1. Remove the delivery valve holders, volume reducers, valve springs, sealing washers and delivery valves from the remaining elements.

2. Screw the delivery valve holders back into place and tighten them to the specified torque.

3. Screw spill pipes (TOOL NO. CT 9023) onto the top of the delivery valve holders.

4. Turn on the test oil supply and adjust the delivery until a steady flow runs from the spill pipes.

NOTE: There will be no flow from some of the elements whose tappet is up on the cam.

5. Rotate the pump camshaft slowly and smoothly, by hand, until the flow from the spill pipe changes to a slow drip on the next element in the engine firing order (Fig. 13). Observe and note the spill cut-off point reading on the phasing ring for use later.

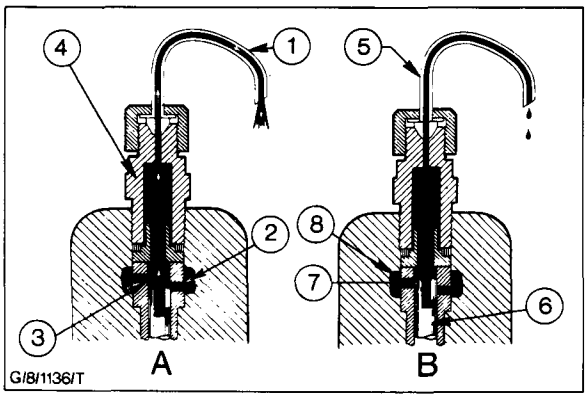


Fig. 13 - Spill Cut-Off Point
A. Full Flow from Spill Pipe
B. Flow Changes to Slow Drip

1. Spill Pipe
2. Fuel Gallery
3. Inlet Port Open
4. Delivery Valve Holder
5. Spill Pipe
6. Plunger
7. Inlet Port Closed
8. Fuel Gallery

6. Repeat this procedure to establish the point of spill cut-off for all the elements, one at a time, in the engine firing order. Turn off the test oil supply.

High Pressure Phasing:

1. Remove the plunger head clearance gauge (TOOL NO. CT 9076B) from number 1 element and replace the delivery valve components and holder. Tighten all the delivery valve holders to the specified torque using a socket (TOOL NO. 23 501).

2. Connect the injector pipes on the test stand to the delivery valve holders on the injection pump and tighten the union nuts to the specified torque.

3. Rotate the pump camshaft, by hand, until number 1 tappet is in the dwell position.

4. Open the high pressure phasing bleed valve on number 1 master injector (Fig. 14). Turn on the test oil supply and increase the pressure until a steady flow runs from the spill pipe.

5. Rotate the pump camshaft slowly and smoothly, by hand, until the flow from the spill pipe changes to a slow drip (spill cut-off). Stop rotating the pump. Check the phasing ring is reading zero and turn off the bleed valve.

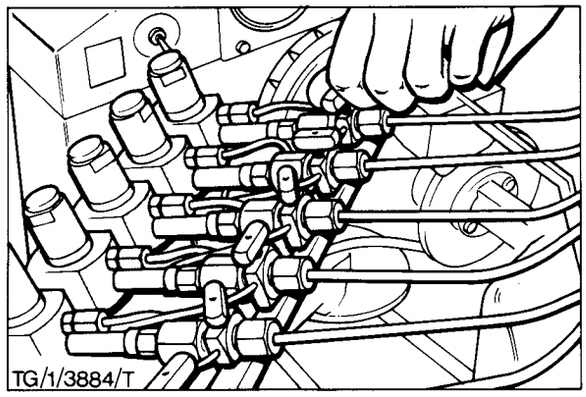


Fig. 14 - Opening the Bleed Valve

6. Open the bleed valve on the next master injector in the engine firing order. Rotate the pump camshaft until spill cut-off is reached and note the reading on the phasing ring scale.

7. Repeat this procedure to establish the spill cut-off point for the remaining elements. Turn off the test oil supply and the bleed valve on the last injector spilled.

Phasing Adjustment:

1. Compare the stroke to close the inlet port reading for number 1 element with the specified value for the injection pump. If the stroke is greater, the tappet phasing spacer will need to be changed for one that is thicker. If the stroke is less, it must be changed to one which is thinner.

2. If the phasing spacer of number 1 element is to be changed to adjust the stroke to close the inlet port, all the phasing spacers on the other elements must be adjusted by the same amount.

3. Compare the readings taken from the phasing ring and spill cut-off for the remaining elements with the nominal specified phase angle tolerance for the pump. If the phase angle for any element is not within the specified tolerance, it will be necessary to replace the phasing spacer in that element. For every half degree of angular correction, a 0,1mm (0,004in) adjustment to the phasing spacer is required. If the phase angle is too great, a thicker spacer is required and, if too small, a thinner spacer is required.

4. When calculating the spacer thickness for the remaining elements, add or subtract the adjustment made to number 1 spacer. Make a note of the spacers that will be required to adjust the phase angle of the remaining elements.

5. To change the phasing spacers, remove the pump from the test stand and partially dismantle it in order to remove the tappets. For details of this procedure, refer to the relevant 'overhaul' sections of this Manual.

6. After changing the spacers the pump must be reassembled and remounted on the test stand and the 'Stroke to Close the Inlet Port' on number 1 element and the 'Phasing' procedures repeated. It may be necessary to change the spacers and retest a number of times on a trial and error basis until the specified stroke to close and the phasing angles are obtained.

Master Fork Setting

Pumps other than Dover Types:

1. Check that the master fork is set at a distance of 0 to 1,0mm (0 to 0,04in) from the end of the square section of the control rod and that the locating screw is secured (Fig. 15).

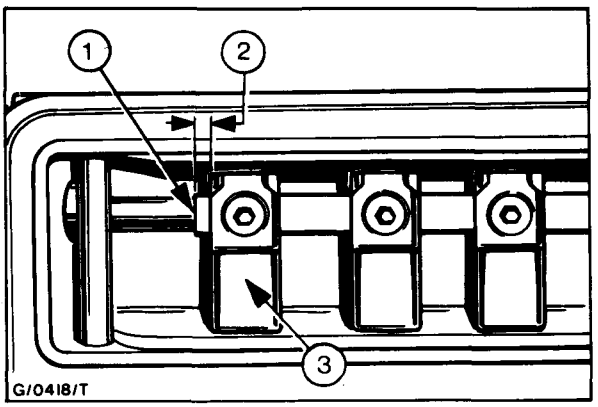


Fig. 15 - Master Fork Setting (Dorset)
1. End of Control Rod Square Section
2. Setting Dimension
3. Master Fork

Dover Type Pumps:

2. With the governor control lever in the maximum speed position, move the control rod into the excess fuel position by switching on the 12/24 volt DC electrical supply, set to maximum, wait 3 seconds and then switch off.

3. Using the method of spill cut-off as described under low and high pressure phasing, adjust the position of the master fork on the control rod so that the spill cut-off, with the control rod in the excess fuel position, is retarded by the specified angle relative to the spill cut-off, when the control rod is in the maximum fuel position.

NOTE: After this setting has been made, the master fork should not be more than 3mm (0,12in) from the end of the square section on the control rod.

All Pumps:

4. Tighten the fork locating screw to the specified torque.

5. Fill the pump with the specified quantity of lubricating oil for testing purposes.

CALIBRATION

'In Service' Checking

NOTE: See separate section (under Calibration) in Specifications for relevant figures.

1. Using the same general test conditions as for new and overhauled pumps, check the fuel delivery as follows:

a) On boost control pumps, set the boost pressure to the specified maximum.

b) Run the pump at the specified calibration lower checking speed and measure the fuel delivery. The fuel delivery at the master element and the line balance should be within the specified tolerance.

c) Run the pump at the specified calibration upper checking speed and measure the fuel delivery. The average fuel delivery from all elements should be equal to the 'actual' average fuel delivery from all elements at the lower checking speed, plus the specified increase. The line balance should also be within the tolerance specified for this speed.

d) On boost control pumps, set the boost pressure to zero and measure the fuel delivery at the lower checking speed. The average delivery should be within the specified tolerance.

2. If the fuel delivery is not within the specified tolerance but the pump is otherwise serviceable, it is permissible to adjust the fuel delivery to the specified value. For (b) and (c), use the maximum fuel adjusting screw (Fig. 16), and for (d) use the zero boost fuel adjusting screw in the boost control unit (Fig. 17).

NOTE: Instances have occured where marine craft powered by 2728T engines have failed to attain the planing mode due to the action of the boost control unit. A modification was introduced to overcome this situation and involved fitting a revised camplate and spring - see under the sub heading 'Boost Control Unit' under 'ASSEMBLY on page 39.

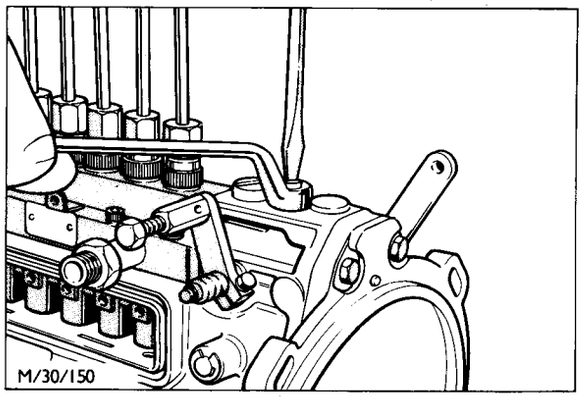


Fig. 16 - Setting the Maximum Fuel Adjusting Screw on a Naturally Aspirated Pump

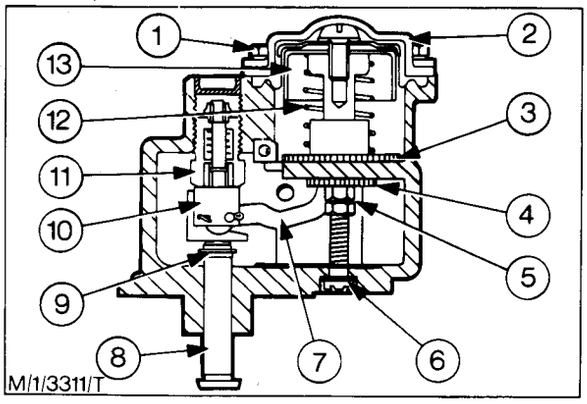


Fig. 17 - Boost Control Unit

1. Retaining Bolt
2. Air Inlet Cover
3. Fuel Adjusting Wheel (Intermediate Boost)
4. Fuel Adjusting Wheel (Zero Boost)
5. Locknut
6. Crosshead Screw
7. Camplate
8. Maximum Fuel Rod
9. 'E' Clip
10. Clevis
11. Maximum Fuel Screw (Max. Boost)
12. Spring
13. Piston and Diaphragm Assembly

New and Overhauled Pumps

All Pumps:

1. Secure the governor control lever in the maximum speed position, and on boost control pumps set the boost air pressure to the specified maximum.

2. Ensure that the test oil supply is turned on and the graduates dumping lever is in the open position.

3. Run the pump at approximately 400 rpm until all the master injectors are functioning. Increase the pump speed to approximately 800 rpm and run the pump at this speed for at least ten minutes to stabilise the pump and the master injectors.

4. Run the pump at the specified calibration setting speed and measure the delivery in the graduated glasses.

5. If necessary, set the maximum fuel adjusting screw for boost control pumps (Fig. 17) to bring the delivery from the master element within the specified tolerance and secure the locknut.

6. Run the pump at the specified calibration setting speed and measure the delivery in the graduated glasses.

7. Slacken the securing screws on the remaining control rod forks. Adjust the position of the forks on the control rod to bring the line balance of all the elements within the specified tolerance (Fig. 18). Move the forks towards the governor to increase delivery and away from the governor to decrease delivery. Tighten the securing screws.

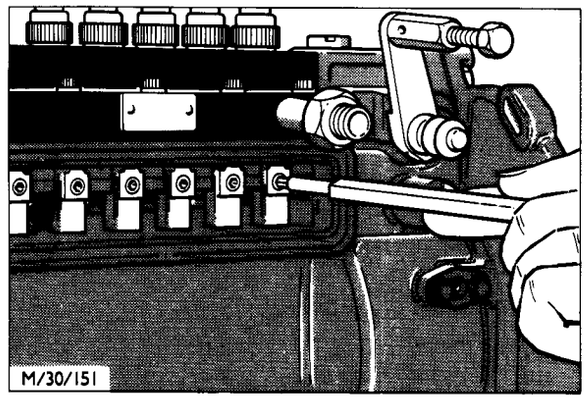


Fig. 18 - Adjusting the Control Forks

Fuel Delivery Curve Check

1. On pumps specified for a delivery curve check, run the pump at suitable speed increments in turn and measure the fuel delivery in the graduated glasses. Boost control pumps must have the boost air pressure set to the specified maximum.

2. Calculate the average delivery at each of the speeds and plot a graph of average delivery against pump speed. The delivery curve should fall within the specified tolerance band.

NOTES: If, after adjustment, the delivery curve is still not acceptable, it may be necessary to change some of the elements and/or the delivery valves to bring it within the specified band.

If any components are renewed the pump must be rephased and recalibrated.

Fuel Delivery at Zero Boost Pressure

1. Reduce the boost air pressure to zero. Run the pump at the specified zero boost pressure fuel delivery setting speed and measure the fuel delivery in the graduated glasses.

2. Adjust the zero boost fuel adjusting screw (Fig. 17) as necessary to bring the average fuel delivery from all the elements within the specified tolerance. Secure the stop screw with the locknut.

GOVERNOR SETTING

'In Service' Check

NOTE: See separate section (under Governor Setting) in Specifications for relevant figures.

All Pumps

1. On boost control pumps set the boost pressure to the specified maximum.

2. On pumps fitted with a control rod damper, the damper screw and spring must be removed.

3. With the governor control lever in the maximum speed position, run the pump at the specified upper checking speed. Measure the fuel delivery in the graduated glasses. If the fuel delivery is not as specified, adjust the maximum speed screw and remeasure the fuel delivery until the specified value is obtained. Secure the screw with the locknut.

4. Reduce speed by approximately 100 rpm and measure the fuel delivery. If the fuel delivery is not as specified (upper checking value), continue with small adjustments to speed followed by a fuel delivery check until the specified value is obtained. Note the speed necessary to obtain the specified fuel delivery.

5. Reduce speed to the specified lower checking value and:

a) On all Dorset pumps, check whether or not the control rod is hard against the maximum fuel stop. If the speed (as noted) to obtain the upper checking fuel delivery and/or the control rod is not hard against the maximum fuel stop, then the governor may require overhauling.

b) On all Dover pumps, measure the fuel delivery which should be within the specified tolerance. If the speed (as noted) to obtain the upper checking fuel delivery and/or the fuel delivery at this (lower checking) speed is not within the specified tolerance, then the governor may require overhauling.

6. On pumps where the control rod damper was removed and the pump does not require an overhaul, refit the damper spring, screw in the adjusting screw two or three threads and secure with the locknut. The final adjustment of the damper is made with the engine idling.

NOTE: If a 2726T or 2728T engine has shown an inclination to stop after reducing engine speed suddenly from full power to the idling speed position (undershoot stall), a modification can be carried out. This involves fitting a revised spring and spacer in the control rod damper unit, (Lucas/CAV Pt. Nos. 514177/10 and 512248). Also, in the case of 2728T engines, an additional interleaf governor spring, Lucas/CAV Pt No 503193 must be fitted between the existing two leaf springs. To compensate for the extra thickness, an 0,3mm shim must be removed from under the ramp.

When the injection pump fitted to a 2726T engine is equipped with the revised control rod damper spring and spacer the pump reference changes to P5488/2F from P5488/2E.

When the injection pump fitted to a 2728T engine is equipped with the revised control rod damper spring and spacer and the additional interleaf governor spring plus the revised boost control unit (refer to the note at the end of page 17), then the pump reference changes to P5525/2A from P5525/2.

New and Overhauled Pumps

1. Secure the governor control lever in the maximum speed position and run the pump at the specified governor setting speed. Adjust the maximum speed screw until the fuel delivery ceases, then tighten the adjusting screw locknut securely.

NOTE: In the following two governor checks the amount that the control rod must be clear of the stop for the check to be positive is only 0,1mm (0,004in). With experience it is possible to detect this by pushing the control rod against the stop, by hand. However, if any doubt exists, use a dial indicator mounted on the test stand bed with the spindle of the indicator against the side of one of the forks.

2. Reduce speed to the specified governor upper checking speed. Check that the control rod is not touching the maximum fuel stop by pushing the control rod towards the stop (i.e. towards the governor) and checking for movement.

3. Reduce the speed to the specified governor lower checking speed. Push the control rod again towards the governor but this time to check that the control rod is touching the maximum fuel stop.

EXCESS FUEL BAULKING DEVICE CHECK

NOTE: This does not apply to Dover pumps or Dorset pumps with external solenoid operated excess fuel devices.

1. Hold the governor control lever in the maximum speed position. Press in the excess fuel button and secure it in this position externally. Make sure the control rod has moved fully into excess fuel (the extreme position towards the governor). Move the governor control lever into the idle speed position to release the baulking device latch from the side of the excess fuel inner lever. Move the governor control lever back into the maximum speed position and secure it; this will place the baulking device latch on the control rod against the lobe of the excess fuel inner lever to hold the control rod in the baulk position.

2. Run the pump at the specified baulking device checking speed and measure the fuel delivery in the graduated glasses. The fuel delivery should be within the specified tolerance.

EXCESS FUEL DELIVERY CHECK

1. Secure the governor control lever in the maximum speed position and place the control rod in the excess fuel position as follows:

Pumps with solenoid operation - set the d.c. voltage regulator to zero, switch on and adjust the regulator to 7 volts (for pumps with a 12 volt electrical system) or 14 volts (for pumps with 24 volt systems). After 5 seconds switch off the supply by which time the control rod should have moved into the excess fuel position.

All other pumps - Press in the excess fuel button.

2. Make sure the control rod has moved fully into the excess fuel position.

3. Run the pump at the excess fuel checking speed and measure the fuel delivery in the graduated glasses. Check that the fuel delivery is within the specified tolerance.

START RETARD CHECK

All Pumps:
1. If the pump was low pressure phased, fit the spill pipes as described under 'Phasing'.

2. With the governor control lever in the maximum speed position, move the control rod into the excess fuel position as follows:

a) On solenoid operated excess fuel systems, switch on the 12/24 volt DC electrical supply set to maximum, wait 3 seconds and then switch off.

b) On manually operated excess fuel, press the excess fuel button.

3. Using the method of spill cut-off as described under low and high pressure 'Phasing', check that the spill cut-off for each element, with the control rod in the excess fuel position, is retarded by the specified angle relative to the spill cut-off with the control rod in the maximum fuel position.

4. If the pump was low pressure phased, remove the spill pipes and refit all the delivery valve components. Screw in the delivery valve holders and tighten to the specified torque. Connect the test stand injector pipes to the pump and tighten the union nuts to the specified torque.

IDLING SPEED DELIVERY CHECK

1. With the governor control lever in the idle speed position, run the pump at the specified idle fuel delivery setting speed and measure the fuel delivery in the graduated glasses.

2. Move the idle speed adjusting screw to bring the average delivery from all the elements to the specified value. Secure the adjusting screw with the locknut. Check the line balance which should not exceed the specified tolerance.

NOTE: This is a preliminary setting, the final setting of the idle screw is made on the engine when the idle speed is set to specification.

3. Where applicable, insert the control rod buffer spring into the buffer spring sleeve, screw in the adjusting screw two or three threads and secure lightly with the locknut.

NOTE: The control rod buffer spring is finally adjusted with the engine idling.

STOP CONTROL CHECK

1. With the governor control lever in the idle speed position, run the pump at the specified idle fuel delivery setting speed and observe that test oil is being delivered from the master injectors.

2. Move the stop control lever to the stop position and hold it there long enough to observe that delivery has ceased. Return the stop control lever rapidly to the run position and start a stop watch at the point when the lever actually reaches the run position. Measure the time lapse for delivery to restart, this time should be within the specified tolerance. Measure the actual delivery, this should be the same as previously set.

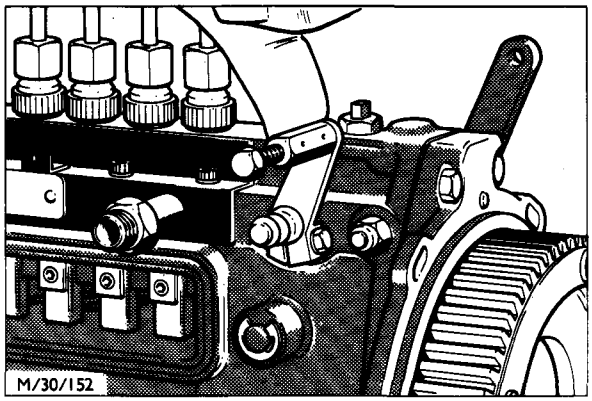


Fig. 19 - Stop Control Lever in the Stop Position

FUEL CUT-OFF CHECK

1. With the governor control lever in the idle speed position, run the pump at the specified fuel cut-off checking speed and measure the delivery in the graduated glasses. The fuel delivery should be within the specified tolerance.

INJECTION PUMP TIMING

CAUTION: DO NOT USE DORSET INJECTION PUMP DRIVE GEAR KEYS IN DOVER PUMPS AS THIS WILL SEVERELY DAMAGE THE DRIVE GEAR HUB.

1. Disconnect the injector pipes from the pump. Remove number 1 delivery valve holder, volume reducer, valve spring and the delivery valve. Refit the holder and tighten securely. Attach a spill pipe (TOOL NO. CT 9023) to number 1 delivery valve holder.

2. Slacken the pump mounting bracket(s) on the test stand bed and pull the pump back to disconnect the drive. Remove the pump test stand mounting bracket attached to the pump mounting flange if the pump was mounted by this method. Remove the drive coupling retaining nut and remove the coupling with a suitable puller.

Dorset Pumps

1. Remove the timing plug from the pump mounting flange. Assemble the drive gear to the pump camshaft and tighten the retaining nut to the specified torque.

2. Using the method described in the 'Phasing' section, set the camshaft at spill cut-off on number 1 element. Without disturbing the camshaft from this setting, screw the timing tool (TOOL NO. 23 504) into the aperture in the mounting plate and check that the spring loaded timing peg engages with the hole in the back of the drive gear (Fig. 20).

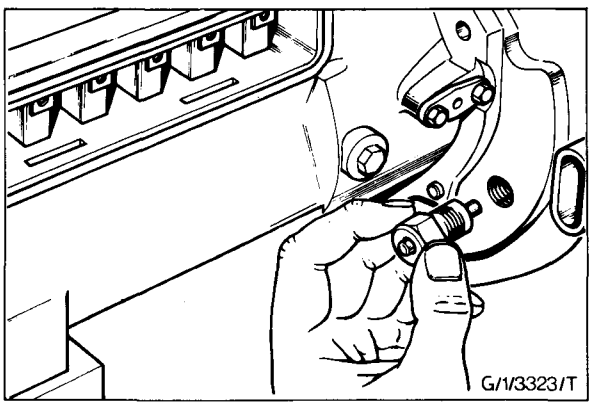


Fig. 20 - Fitting the Timing Tool to the Pump (Dorset)

It is permissible to rotate the gear backwards and forwards within the specified timing tolerance to engage the plunger.

3. If the plunger will not engage, a new gear must be fitted and timed as follows:

a) With the new gear assembled to the pump camshaft and number 1 element at spill cut-off, mark the back of the gear in line with the centre of the timing aperture in the mounting plate.

b) Remove the gear and drill a hole 4,7 to 4,8mm (0,185 to 0,189in) diameter and 9,5mm (0,37in) deep in the position marked on the gear.

c) Replace the new gear and check that the timing is correct.

4. Remove the timing tool, screw in the timing plug with a new sealing washer and tighten to the specified torque.

Dover Pumps

1. Remove the timing plug from the timing quadrant on the back of the front mounting flange (Fig. 21).

2. Using the method described in the 'Phasing' section, set the camshaft at spill cut-off on number 1 element. Without disturbing the camshaft from this setting, screw the timing tool (TOOL NO. 23 507) into the timing quadrant and move the quadrant backwards and forwards until the timing tool plunger engages with the hole in the back of the drive gear hub.

NOTE: An overhauled pump should be fitted with a new timing quadrant.

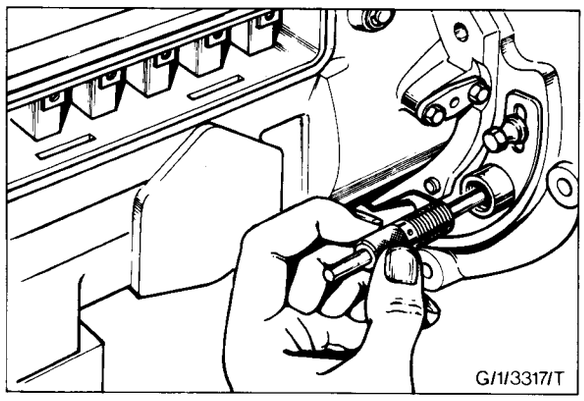


Fig. 21 - Fitting the Timing Tool to the Pump (Dover)

3. Tighten the two quadrant retaining bolts until the heads shear off. Remove the timing tool from the quadrant, screw in the timing plug and tighten securely.

All Pumps

1. Remove the spill pipe from number 1 line, remove the delivery valve holder, reassemble the delivery valve parts and tighten the holder to the specified torque using socket (TOOL NO. 23 501). Fit the delivery valve holder locking clamps and tighten the screws. Fit blanking caps over the delivery valve holder outlet unions.

2. Turn off the test stand test oil supply, disconnect the low pressure test oil supply pipes from the pump and fit blanking caps to the fuel connections on the pump.

3. As shown in Fig. 22, place the side cover retainers in position in the housing and secure with the lock bolts or spring retainers. Install a new sealing ring in the groove in the cambox and fit the side cover. Screw in the retaining bolts or screws and tighten to the specified torque.

4. Turbocharged pumps - Disconnect the boost air supply pipe and place a clean dust plug in the connector on the boost control unit. On Dover pumps, fit a new seal, replace the side cover and tighten the retaining shear bolt until the head shears off.

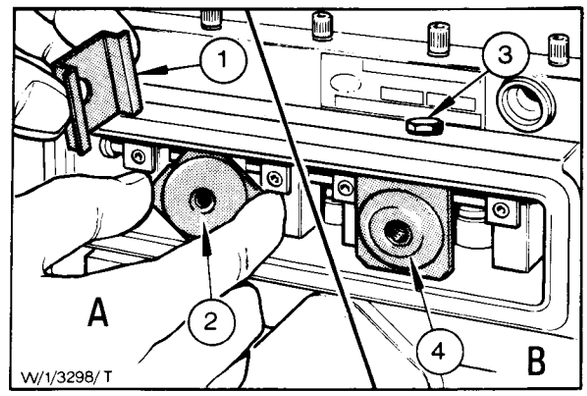


Fig. 22 - Fitting the Side Cover Retainers
A. Spring Clip Type
B. Grub Screw Type
1. Spring Clip
2. Retainer Plate
3. Grub Screw
4. Retainer Plate

5. Fit tamper proof sealing devices:

a) To the maximum fuel and maximum speed adjusting screws.

b) To the side cover (where drilled bolts are used).

c) To the side and top cover retaining bolt (boost control unit).

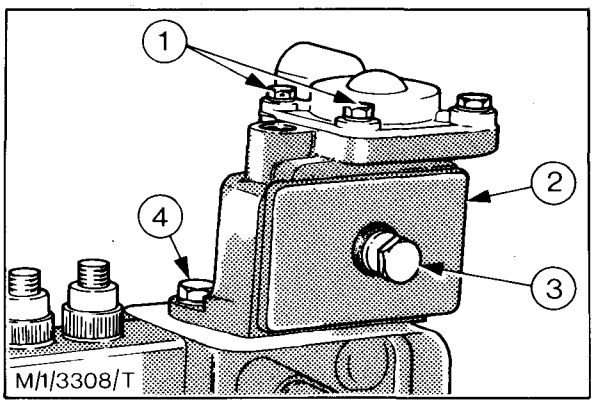


Fig. 23 - Boost Control Unit Installed
1. Inlet Cover Retaining Bolts
2. Side Cover
3. Shear Bolts
4. Retaining Bolt

INJECTION PUMP OVERHAUL

GENERAL INFORMATION

1. The overhaul procedures for all CAV Minimec type fuel injection pumps used on 2720 range engines are covered in this Section.

2. The procedures have been divided into two stages. The first covers the dismantling of the various pumps into their major sub-assemblies. The second stage covers the dismantling of each sub-assembly in detail. Following the detailed cleaning and inspection stage the sub-assemblies are each rebuilt and are then reassembled as a whole, ready for phasing and calibration.

3. Before starting a pump overhaul, ensure that a clean sectioned tray of suitable size is available to receive the components as they are removed.

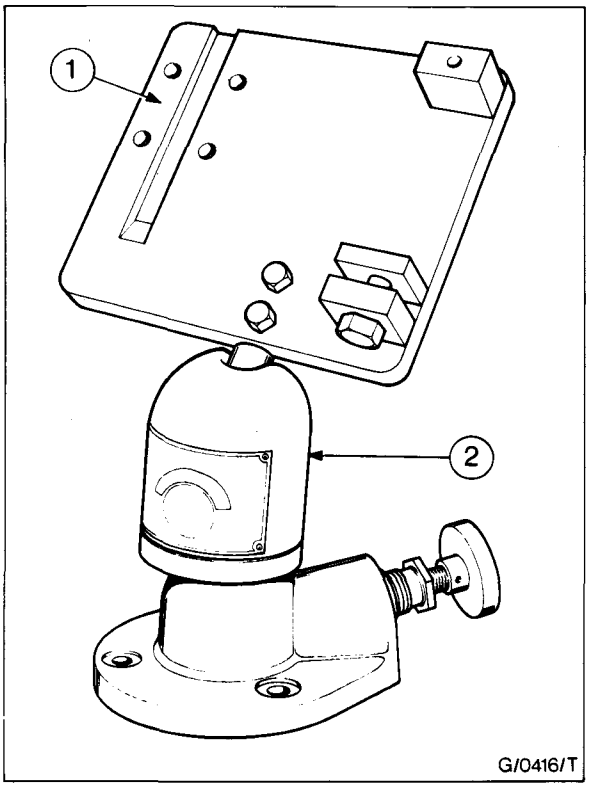


Fig. 24 - Swivel Vice
1. Typical Adaptor Plate
2. Swivel Vice - (Hydraclamp)

CAUTION: WHEN DISMANTLING AN INJECTION PUMP IT IS IMPERATIVE THAT ABSOLUTE CLEANLINESS IS OBSERVED. ANY FOREIGN MATTER ALLOWED TO ENTER A PUMP COULD CAUSE SERIOUS DAMAGE.

DISMANTLING THE PUMP

1. Seal all apertures and thoroughly clean the pump exterior in test fuel oil.

2. Remove all external tamperproof seals and wires.

3. Mount the pump on a swivel vice such as the Hartridge Hydraclamp (TOOL NO. HM 910) using the appropriate adaptor plate.

Ancillary Components

4. Remove the filler/level/drain plugs and drain all the oil from the cambox and governor housing. Refit the drain plugs loosely.

5. Undo the retaining nut and washer and remove the drive gear (Dorset) or drive hub (Dover) from the camshaft, using a suitable puller.

6. Remove the key from the keyway.

7. Remove the fuel gallery damper, if fitted (Fig. 25).

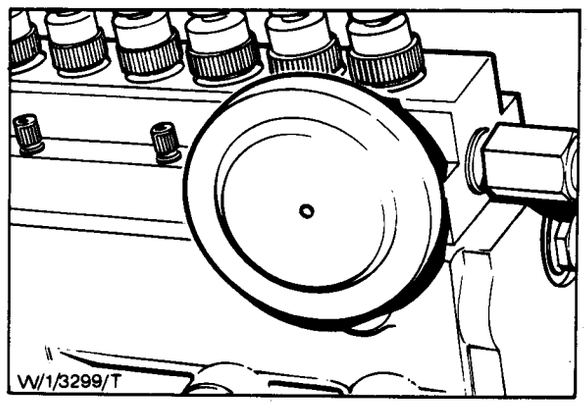


Fig. 25 - The Fuel Gallery Damper (Dover)

8. Slacken the fuel unions, bleed screws and blanking plugs in the pump body (where fitted).

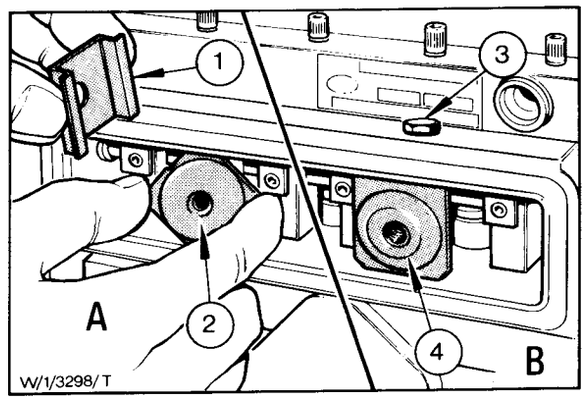


Fig. 27 - Side Cover Retainers
A. Spring Clip Type
1. Spring Clip
2. Removing the Plate
B. Grub Screw Type
3. Grub Screw
4. Retainer Plate

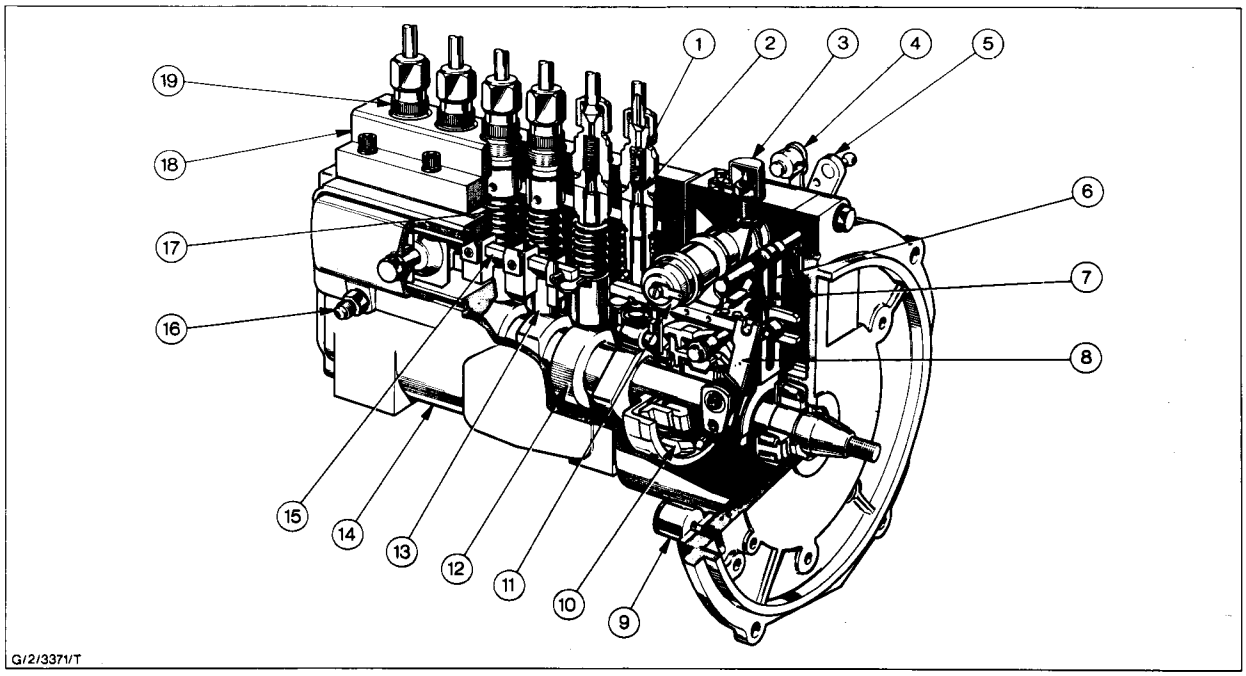


Fig. 26 - CAV Minimec Injection Pump - Dover Type

1. Volume Reducer
2. Delivery Valve
3. Maximum Fuel Screw
4. Stop Control Lever
5. Governor Control Lever
6. Governor Spring
7. Bias Spring
8. Rocking Lever
9. Timing Quadrant
10. Governor Weights
11. Excess Fuel Solenoid
12. Camshaft
13. Tappet
14. Cambox
15. Control Rod
16. Lubricating Oil Connection
17. Pumping Element
18. Pump Body
19. Delivery Valve Holder

9. Remove the delivery valve holder locking devices and slacken the holders using the socket (TOOL NO. 23 501).

10. Undo the side cover retaining screws or bolts and lift away the cover. Prise the seal from the groove in the cambox.

11. Remove the side cover retaining plates. Two different types of plate retainer are fitted; one is a spring clip fitted over the plate, the other is a grub screw inserted from above. With the retainers removed rotate the plates through 90° and lift them out (Fig. 27).

Boost Control Unit

12. File the boss of the retaining shear bolt flat and cut a slot in it (Fig. 28). Insert a screwdriver and unscrew the bolt. Remove the side cover and prise out the rubber seal. Discard the seal and retaining bolt.

13. Undo the single internal and two external retaining bolts and prise the boost control unit away from the governor housing. Discard the gasket.

Pump Body and Tappets

14. Remove the governor and stop control lever return springs (where fitted).

15. Slacken the Allen screws retaining the pump body, evenly and gradually, to release the tension on the plunger springs.

16. Remove the Allen screws and washers and lift away any brackets retained by the bolts.

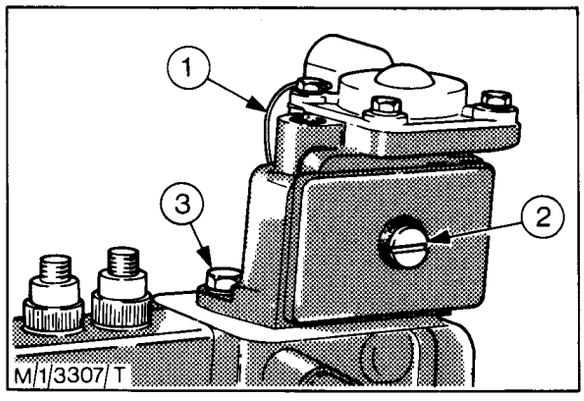


Fig. 28 - Boost Control Unit Removal
1. Sealing Wire
2. Side Cover Bolt Prepared for Removal
3. Retaining Bolt

17. Rotate the pump so that the tappet chamber aperture is facing downwards. Rotate the pump body away and downwards as illustrated in Fig. 29 so that the body and plunger assemblies are removed as one unit. As the pump body is rotated the plunger arms should automatically disengage from the control rod forks.

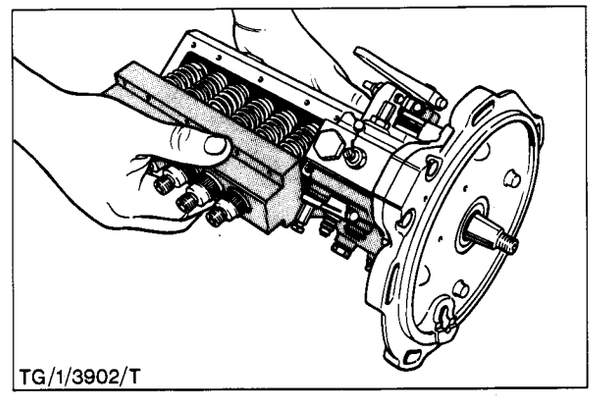


Fig. 29 - Removing the Pump Body

18. Place the complete sub-assembly to one side, with the plungers uppermost in the their original locations, for further dismantling.

CAUTION: ALL MATED COMPONENTS OF EACH PUMPING ELEMENT MUST BE KEPT TOGETHER TO ENSURE CORRECT REASSEMBLY OF THE PUMP.

19. Dover Pumps: On these pumps the tappets are retained by an 'E' shaped plate which fits between them. Remove the two long grubscrews inserted through the top face of the cambox and lift out the plate (Fig. 30).

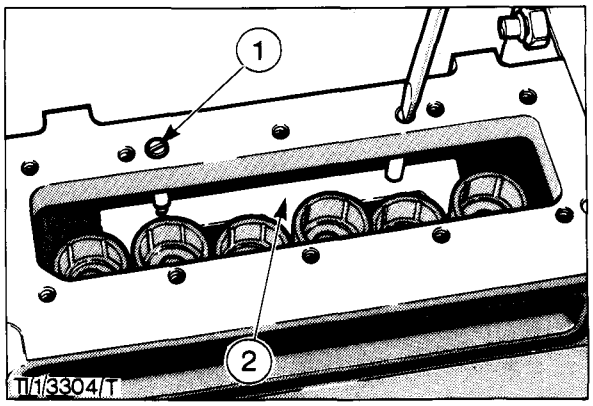


Fig. 30 - Removing the 'E' Plate (Dover)
1. Grub Screw 2. 'E' Plate

20. Remove the tappets from the cambox and place them in the sectioned tray in the correct order.

21. Dorset Pumps: Remove the tappet locating 'T' pieces from between the tappet bores (Fig. 31).

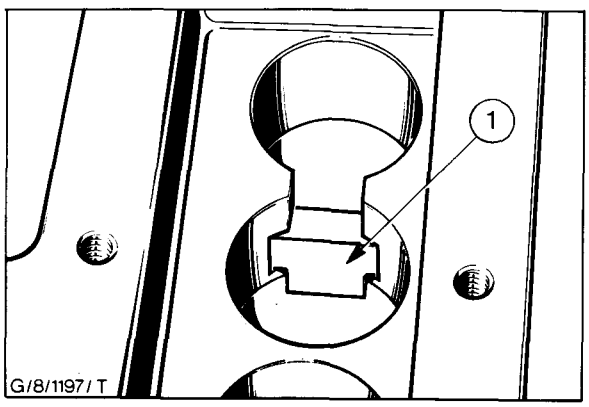


Fig. 31 - Tappet Locating 'T' Piece
1. 'T' Piece

22. Check the camshaft end float for reassembly purposes before removing the front mounting flange as follows:

23. Fit an adaptor (TOOL NO. CT 9017-1) to the threaded end of the camshaft and attach a dial gauge (TOOL NO. CT 9017) to the adaptor (Fig. 32).

24. Pack the joint between the dial gauge and adaptor where necessary to ensure the dial gauge anvil rests squarely on the surface of the mounting flange/drive hub housing.

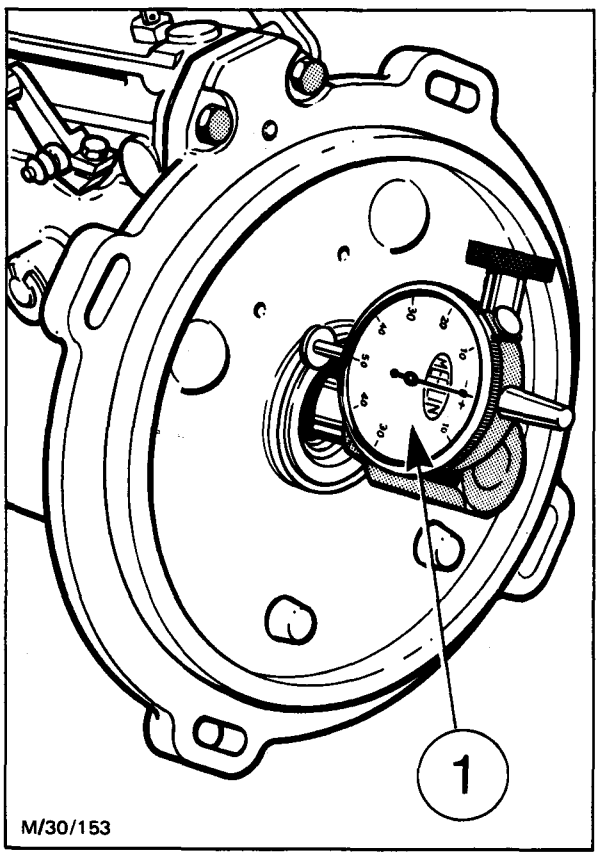


Fig. 32 - Measuring Camshaft End Float (York Pump Shown)
1. Dial Gauge

25. Pull the adaptor firmly away from the pump and zero the dial gauge. Push the adaptor firmly towards the pump and record the end float reading on the gauge.

26. Remove the dial gauge and adaptor.

27. Slacken the governor control lever and speed control stop quadrant pinch bolts and withdraw them both from the splined shaft.

28. Dorset pumps: Slacken the timing plug in the mounting flange.

29. Undo the front mounting flange retaining bolts and prise the flange away from the pump. Place it to one side for further dismantling and inspection. Discard the gasket.

Camshaft and Governor Assembly

30. Remove the dumb-bell shaped roller from the governor inner control lever (Fig. 33).

31. Dorset pumps: Remove the self locking nut on the end of the governor spring pivot shaft.

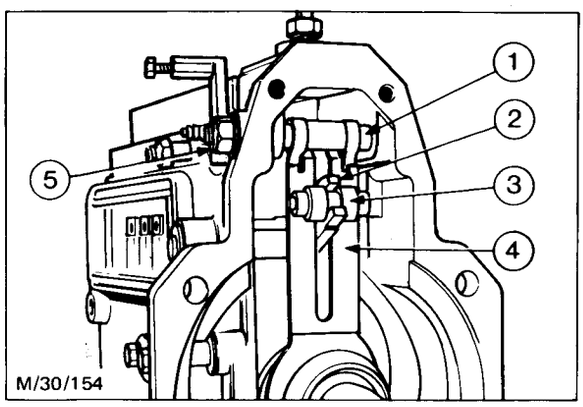


Fig. 33 - Governor Assembly (Dorset Shown)
1. Pivot Shaft
2. Governor Inner Control Lever
3. Dumb-bell Roller
4. Governor Spring
5. Self Locking Nut

32. Dover pumps: Undo the solenoid retaining collar bolts and remove the collar. Withdraw the solenoid from the housing and remove the spring from the shaft. Discard the 'O' ring fitted to the solenoid (Fig. 34).

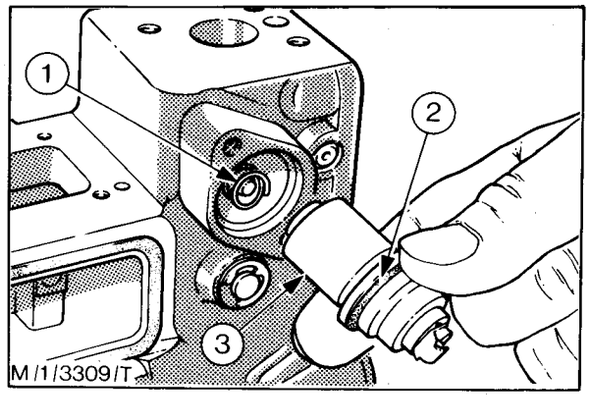


Fig. 34 - Removing the Excess Fuel Solenoid (Dover)
1. Spring
2. 'O' Ring
3. Solenoid

33. Dover pumps: Using a suitable soft metal drift, tap the governor spring pivot shaft out of the housing from the control lever side, while holding the governor spring.

34. Dorset pumps: Tap the threaded end of the governor spring pivot shaft into the housing and remove the shaft from the opposite side of the housing, while holding the governor spring.

35. Withdraw the governor spring assembly.

36. Remove the 'O' ring from the pivot shaft.

37. Undo the rocking lever pivot shaft retaining bolts.

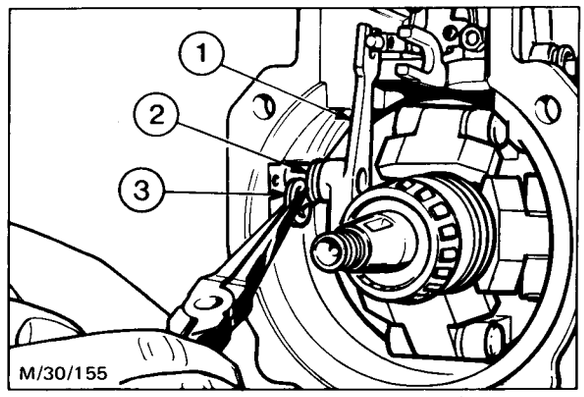


Fig. 35 - Rocking Lever Removal (Naturally Aspirated)
1. Rocking Lever
2. Washer
3. 'E' Clip

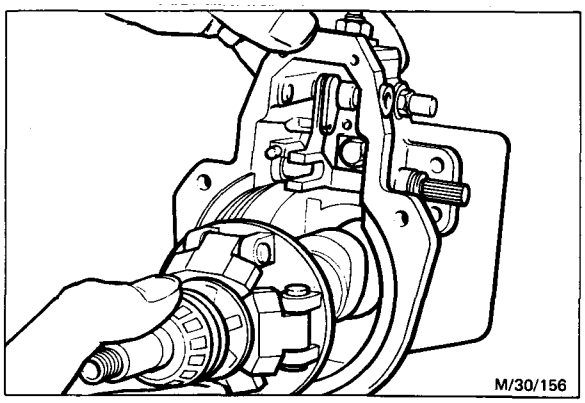


Fig. 36 - Removing the Camshaft (Dorset Shown)

38. *Turbocharged pumps:* Hold the two piece sprung rocking lever assembly and withdraw the pivot shaft. Remove the rocking lever assembly from the housing.

39. Naturally aspirated pumps: Withdraw the pivot shaft slightly for access to the retaining 'E' clip. Remove the 'E' clip and withdraw the pivot shaft, while holding the one piece rocking lever. Lift out the rocking lever and recover the thrust washer from the governor housing (Fig. 35).

40. Remove and discard the gasket from the pivot shaft, and the 'O' ring from the shaft bore.

41. Withdraw the camshaft and governor weights assembly from the cambox (Fig. 36). Place the complete assembly to one side for further dismantling and inspection.

DISMANTLING SUB-ASSEMBLIES

Boost Control Unit

1. Slacken the locknut securing the intermediate boost fuel adjusting wheel and unscrew the cross head screw from the bottom of the unit. Remove the adjusting wheel and locknut as the screw is removed. Discard the rubber washer (Fig. 37).

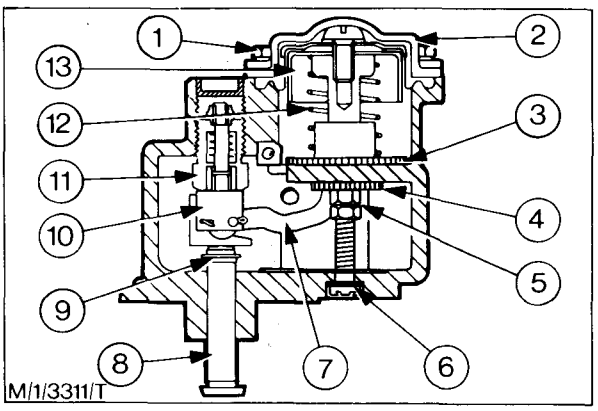


Fig. 37 - Boost Control Unit
1. Retaining Bolt
2. Air Inlet Cover
3. Fuel Adjusting Wheel (Intermediate Boost)
4. Fuel Adjusting Wheel (Zero Boost)
5. Locknut
6. Crosshead Screw
7. Camplate
8. Maximum Fuel Rod
9. 'E' Clip
10. Clevis
11. Maximum Fuel Screw (Maximum Boost)
12. Spring
13. Piston and Diaphragm Assembly

2. Remove the 'E' clip from the maximum fuel rod and slide the rod out of the housing.

3. Mark the relationship of the air inlet cover to the housing for reassembly. Undo the four retaining bolts and washers and lift the cover away separating it from the diaphragm.

4. Withdraw the split pin and clevis pin from the maximum fuel screw clevis. Depress the diaphragm and piston and remove the camplate assembly noting which way the two parts fit together for reassembly.

5. Remove the pin from the slotted end of the piston rod. Lift out the diaphragm, rod and spring assembly. Remove the spring.

6. Remove the Allen screw retaining the maximum fuel screw assembly (Fig. 38).

7. Unscrew and remove the maximum fuel screw assembly.

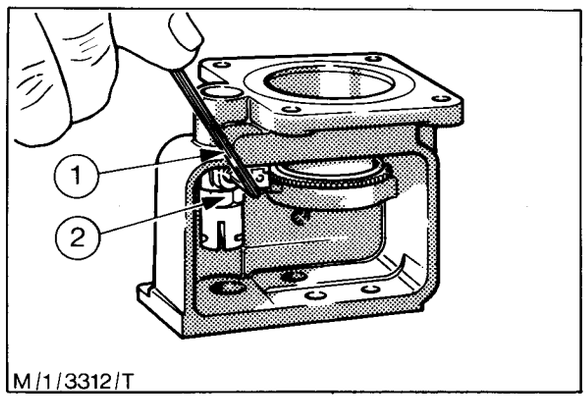


Fig. 38 - Removing the Maximum Fuel Screw Assembly
1. Allen Key
2. Maximum Fuel Screw

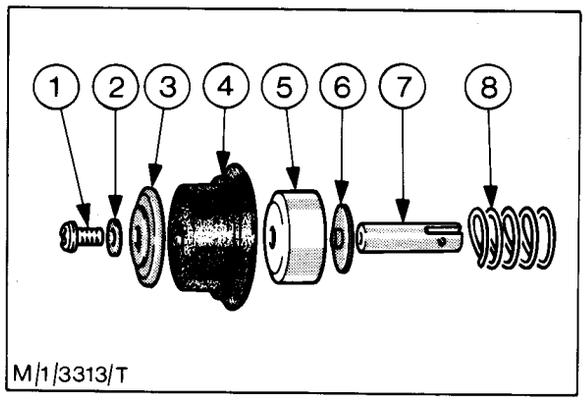


Fig. 39 - Piston and Diaphragm Assembly
1. Screw
2. Felt Washer
3. Retaining Plate
4. Diaphragm
5. Piston
6. Bottom Plate
7. Rod
8. Spring

8. Drive out the plug from the maximum fuel screw bore.

9. Unscrew and remove the knurled intermediate boost fuel adjusting wheel.

10. Unscrew the self locking nut and spring washer and separate the maximum fuel adjusting screw from the clevis pin.

11. Undo the crosshead screw in the top of the diaphragm/piston assembly and discard the washer. Separate the rod, bottom plate, piston, diaphragm and retaining plate (Fig. 39).

Pump Body and Tappets

NOTE: Ensure that a clean sectioned tray, with sufficient compartments for the pump being overhauled, is to hand before dismantling commences. All mated parts must be kept together for correct reassembly.

12. With the pump body inverted, withdraw the plunger, spring and spring seat assemblies, one at a time, from the barrels and place the components in the sectioned tray (Fig. 40).

13. Turn the pump body upright and unscrew the previously slackened delivery valve holders, one at a time. Extract the delivery valve spring and volume reducer from each valve holder and place the components in their respective compartment in the sectioned tray.

14. Extract the sealing washer, delivery valve, valve guide and 'O' ring from the pump body and place the components in the same compartment.

NOTE: Use extractor (TOOL NO. CT 9022) to facilitate the removal of delivery valve guides if required.

15. Invert the pump body and carefully tap out the barrels one at a time using a hide mallet. Place each barrel in its respective compartment as it is removed.

16. Remove all the previously slackened fuel unions, bleed screws and blanking plugs from the pump body where fitted.

17. Take each tappet assembly in turn from the tray and withdraw the pin followed by the bush and roller. Separate the bush and roller (Fig. 41).

18. Remove the circlip in the top of the tappet and lift out the phasing spacer.

19. Place the complete set of dismantled parts back in the correct compartment, in the tray.

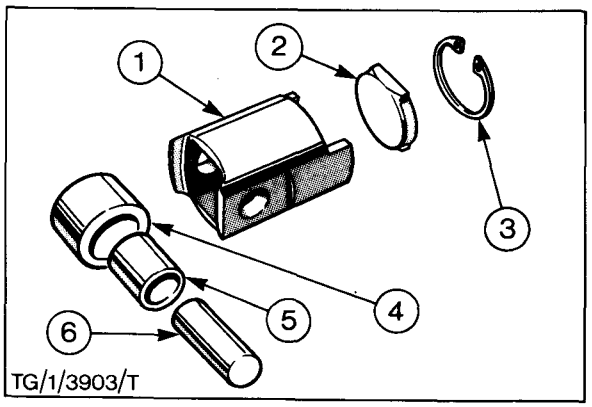


Fig. 41 - Tappet Assembly
1. Body
2. Phasing Spacer
3. Circlip
4. Roller
5. Bush
6. Pin

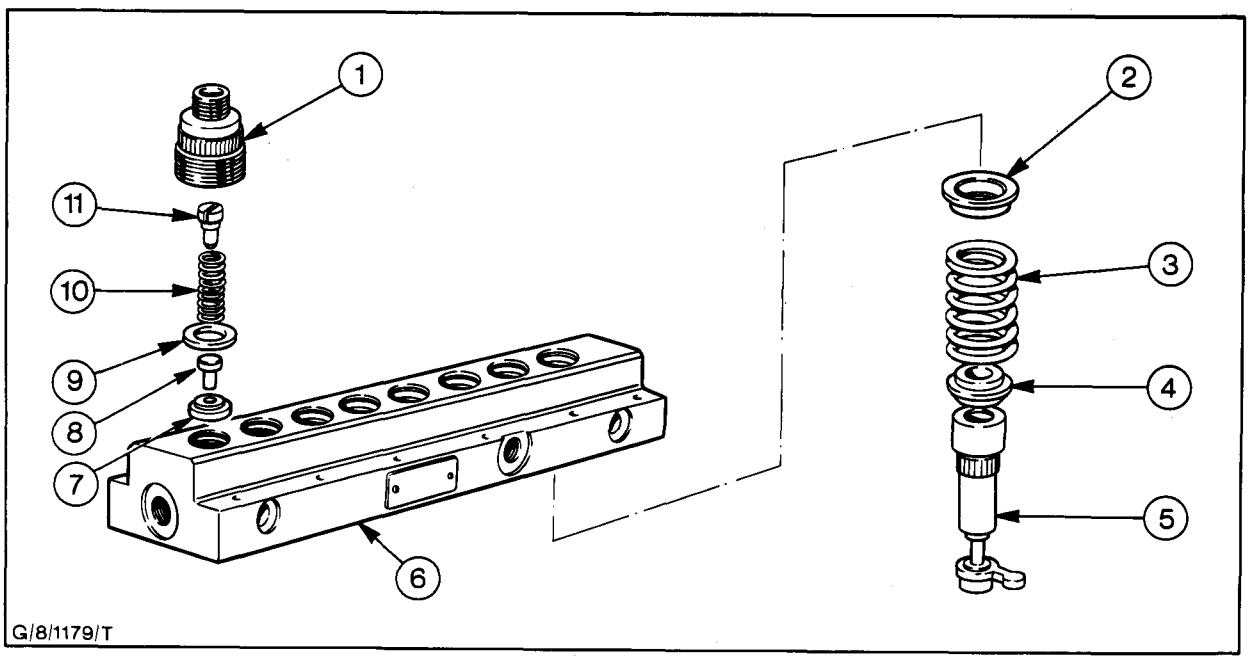


Fig. 40 - Pump Body
1. Delivery Valve Holder
2. Upper Spring Seat
3. Plunger Spring
4. Lower Spring Seat
5. Plunger and Barrel
6. Pump Body
7. Valve Guide
8. Valve
9. Sealing Washer
10. Delivery Valve Spring
11. Volume Reducer

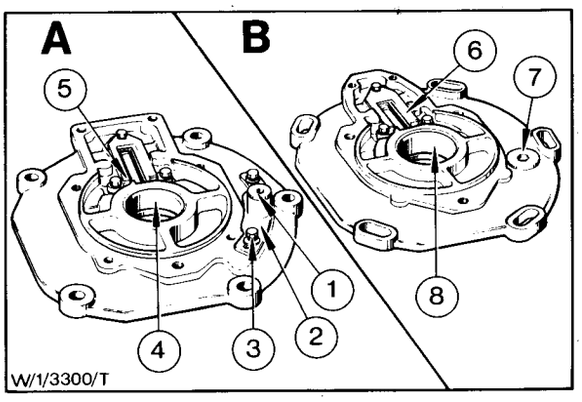


Fig. 42 - Front Mounting Flanges
A. Dover
B. Dorset
1. Timing Plug
2. Timing Quadrant
3. Shear Bolt
4. Bearing Cup
5. Governor Ramp
6. Governor Ramp
7. Timing Plug
8. Bearing Cup

Front Mounting Flange - see Fig. 42

20. Dorset pumps: Remove the slackened timing plug from the mounting flange/drive hub housing.

21. Dover pumps: Slacken the timing plug in the quadrant. Unscrew the shear bolts and remove the timing plate assembly.

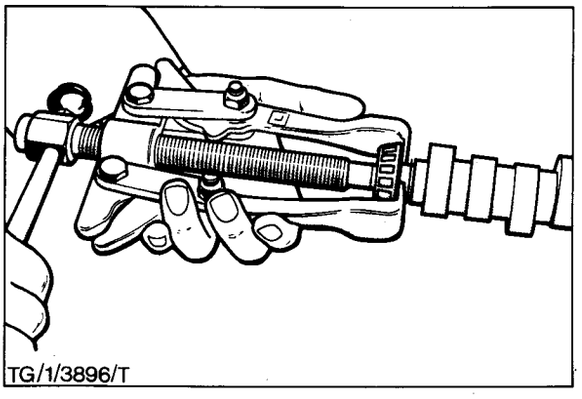


Fig. 43 - Removing a Camshaft Rear Bearing

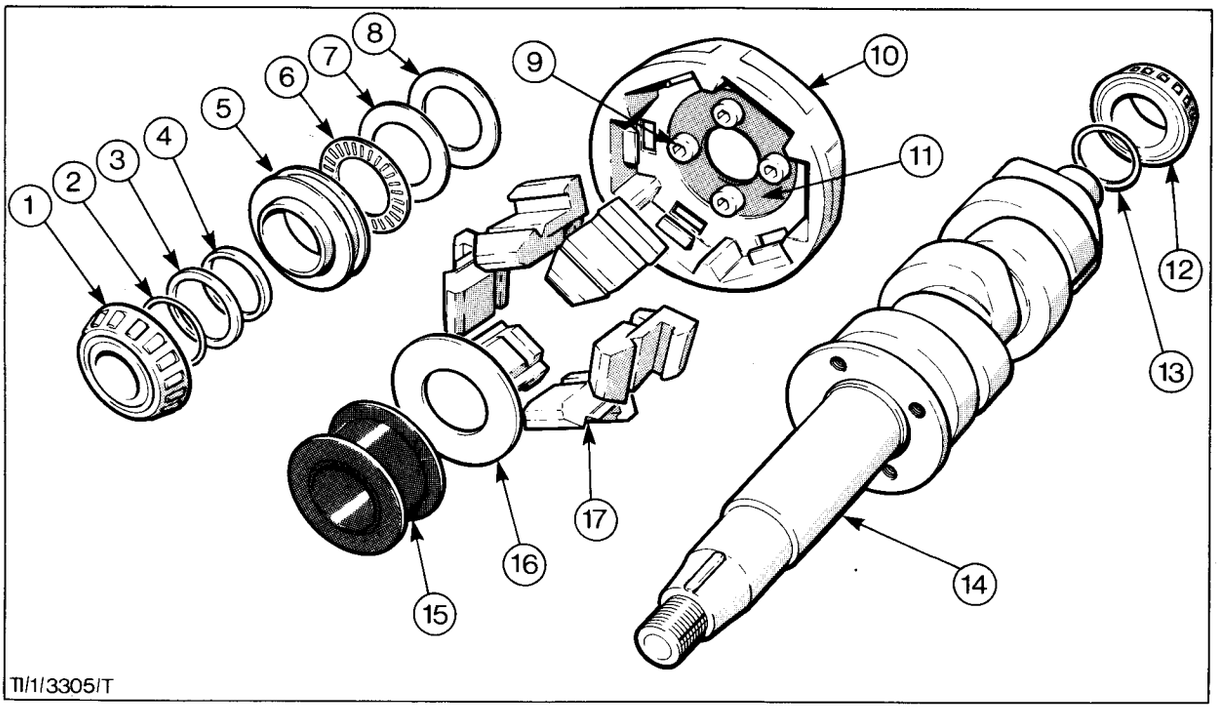


Fig. 44 - Camshaft and Governor Assembly Exploded (Dover)
1. Front Bearing
2. Shim
3. Stop Disc
4. Spacer Ring
5. Thrust Collar
6. Thrust Race
7. Thrust Washer
8. Thrust Washer
9. Retaining Screw
10. Governor Weight Cage
11. Retaining Plate
12. Rear Bearing
13. Shim
14. Camshaft
15. Thrust Sleeve
16. Thrust Washer
17. Governor Weights

22. Unscrew the governor ramp retaining bolts and lift away the ramp and any shims behind it.

23. Remove the oil seal from the front mounting flange.

24. Remove the front bearing cup from the front mounting flange using a puller with fine legs (TOOL NO. CT 9050).

Camshaft and Governor Weights

25. Using a suitable puller (Fig. 43), remove the front and rear camshaft bearings. Remove the shim packs behind the bearings and retain them for reassembly.

Dover Pumps

26. Slide the stop disc (where fitted) spacer ring, thrust collar and outer thrust race and two thrust washers off the camshaft (Fig. 44).

27. Withdraw the governor thrust sleeve from the shaft followed by another thrust washer.

28. Lift the governor weights out of the weight cage.

29. Undo the four socket head retaining screws and slide the weight cage and retaining plate off the camshaft.

Dorset Pumps

30. Slide the stop disc, spacer ring, thrust collar, thrust race and thrust sleeve off the camshaft (Fig. 45).

31. Knock back the tabs and remove the four governor weight assembly retaining bolts.

32. Slide the governor weights assembly off the camshaft.

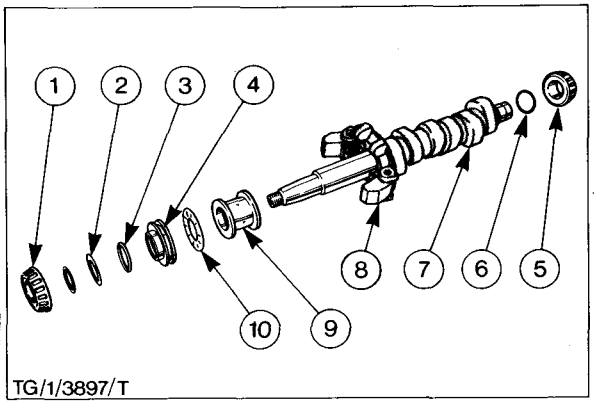


Fig. 45 - Camshaft and Governor Assembly (Dorset)
1. Roller Bearing
2. Stop Disc
3. Spacer Ring
4. Thrust Collar
5. Rear Bearing
6. Shims
7. Camshaft
8. Governor Weights
9. Thrust Sleeve
10. Thrust Race

Cambox and Controls

33. Slacken the governor inner control lever pinch bolt. Slide the lever along the shaft and remove the key (Fig. 46).

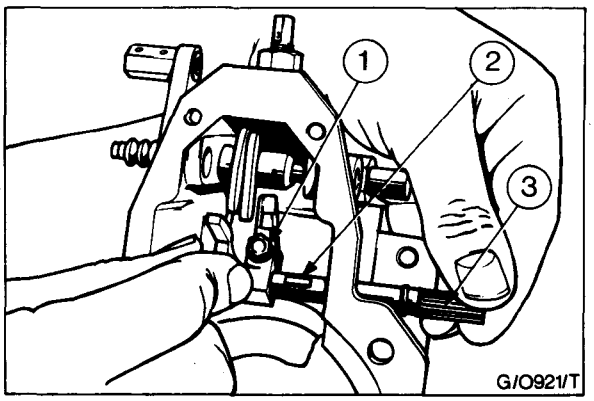


Fig. 46 - Removing the Governor Control Shaft (Dorset)
1. Governor Inner Control Lever
2. Key
3. Shaft

34. Remove the 'E' clips from the ends of the governor control shaft and slide the two flat washers and one dished washer from the left hand end of the shaft and one flat washer from the opposite end.

35. Hold the governor inner control lever and withdraw the shaft from the housing. Remove the lever. Prise the 'O' rings from the bushes on either side of the housing.

Naturally Aspirated Pumps

36. Remove the cambox oil filler plug and 'O' ring.

37. Unscrew the maximum fuel adjusting screw locknut and remove the flat washer and seal. Screw up the maximum fuel screw until the 'mushroom' at the lower end touches the top of the housing.

38. Remove the rubber boot from the excess fuel button, where fitted.

All Pumps:
39. Slacken the external stop control lever pinch bolt and remove the lever. Remove the circlip, flat washer and any shims from the shaft (Fig. 47).

40. Using a suitable size soft metal drift, tap out the roll pin securing the excess fuel lever to the excess fuel shaft. Recover the roll pin.

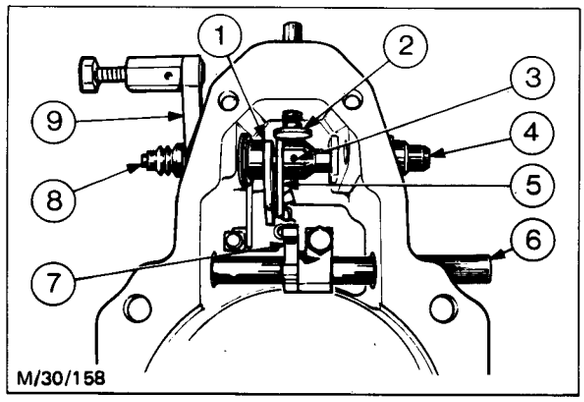


Fig. 47 - Stop Control and Excess Fuel Lever Assembly (Dorset)
1. Excess Fuel Lever
2. Maximum Fuel Screw
3. Roll Pin
4. Cap Nut
5. Stop Lever
6. Governor Control Shaft
7. Governor Inner Control Lever
8. Excess Fuel Button
9. Stop Control Lever

Dorset

41. Unscrew the capnut from the other end of the stop control/excess fuel shaft. Withdraw the spring from inside the capnut. Remove the washer from the threaded bush.

42. Hold the bellcrank lever and pull the excess fuel shaft out of the housing from the left hand side. Withdraw the bellcrank lever. Recover the soft washer which will fall from the shaft. Remove the 'O' ring from the excess fuel shaft.

43. Push the threaded bush into the housing and remove it.

44. Withdraw the excess fuel shaft through the solenoid mounting aperture. Lift out the excess fuel lever and remove the washer located between the excess fuel and stop control levers (Fig. 48).

45. Tap the stop control shaft and lever assembly into the housing to remove it. Recover the spring washer and shim from the inner end of the shaft. Remove the 'O' ring from the shaft bore.

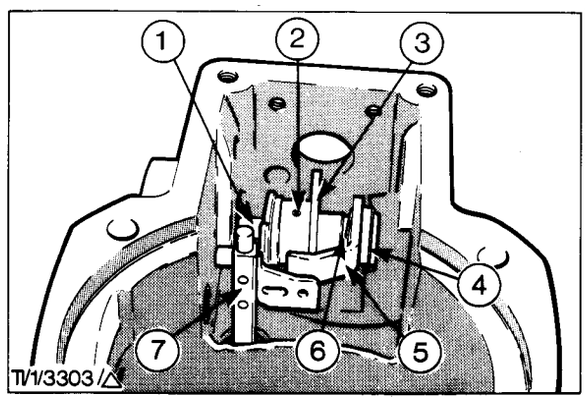


Fig. 48 - The Excess Fuel and Stop Control Shaft (Dover)
1. Excess Fuel Shaft
2. Roll Pin
3. Excess Fuel Lever
4. Spring Washer and Shim
5. Stop Control Lever
6. Washer
7. Fuel Control Rod

All Pumps

46. Naturally aspirated engines - Unscrew the maximum fuel adjusting screw from inside the governor housing and withdraw it. Remove the rubber seal.

47. Slacken the locknuts on the external speed adjusting screws and remove them if required for examination.

48. Slacken the control fork retaining screws.

49. Pumps with control rod damper - Unscrew the capnut and sealing washer. Remove the damper adjusting screw and locknut and unscrew the damper spring and sleeve assembly (where fitted) and remove it (Fig. 49).

NOTE: Some pumps have variations of this damper assembly.

50. Pass a suitable sized drift down inside the damper assembly from the threaded end and push out the retainer and plunger (where fitted).

51. Withdraw the damper spring from the sleeve.

52. Where a damper assembly is not fitted, remove the capnut and washer and unscrew the control rod rear bush retainer.

53. Carefully withdraw the control rod by pulling it from the governor housing. Collect the control forks as the rod is withdrawn.

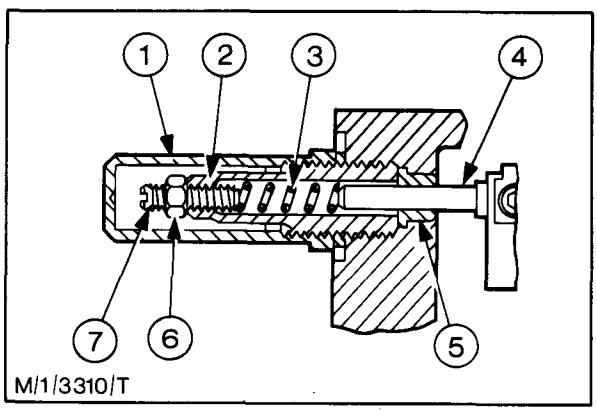


Fig. 49 - Damper Assembly Section View (Dover)
1. Capnut
2. Sleeve
3. Spring
4. Control Rod
5. Rear Bush
6. Locknut
7. Adjusting Screw

54. Drive out the expansion plug from the rear of the cambox using a long drift. Then drive out the rear bearing cup using a suitable drift through the expansion plug aperture.

55. Drive the rear bearing cup out of the governor housing using a suitable drift.

56. Remove the pump housing from the swivel vice.

57. Separate the leaves of the governor spring assembly for cleaning and inspection, noting which way they fit together for reassembly.

58. Remove the pin from the bottom end of the rocking lever.

59. Turbocharged pumps: Dismantle the rocking lever assembly. Remove the circlip, then push the two links slightly against each other. Pull the links apart until the short arm on the top link is clear of the bush on the bottom link. Release the tension, disengage the spring hooks and separate the components (Fig. 50).

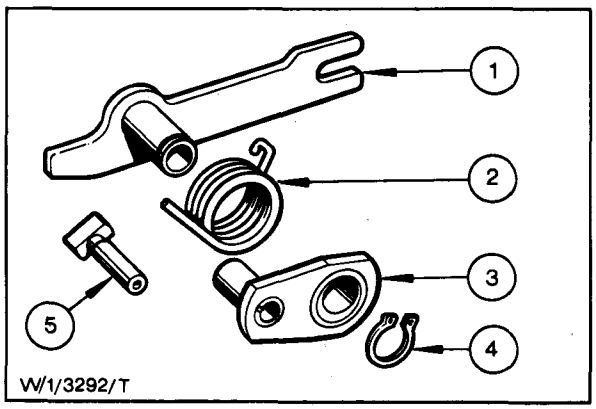


Fig. 50 - Rocking Lever Assembly - Turbocharged Pump
1. Top Link
2. Spring
3. Bottom Link
4. Circlip
5. Pin

COMPONENT INSPECTION AND RENEWAL

(Including the renewal of the governor control shaft and fuel control rod bushes)

NOTES: Discard all old oil seals, 'O' rings, lockwashers, gaskets, circlips, 'E' clips, split pins, self locking nuts and locking tabs (where fitted).

Where new components are used, all the storage protection grease and wax must be completely removed before installation.

Thoroughly clean and wash all the pump components in test fuel oil. Ensure that all old gasket material and sealant is removed.

Carefully inspect all the components for excessive wear or other damage. Particular attention should be paid to the following:

Pump Body

The following items must be completely free from scoring, scratching or ridging:

a) The bore and upper surface of the barrels.

b) The plungers.

c) The plunger feet.

d) The delivery valves, seats, stems, pistons and upper and lower seating faces.

All fuel control edges must be sharp, clean and unbroken.

The valve springs must be checked for cracks or irregularities in the coils.

The delivery valves must move freely in their guides.

Tappets

The outside diameters must be free from ridging or scratching.

The pins, bushes and rollers should be free from wear and excess movement when assembled. The rollers must rotate freely without hesitation.

The phasing spacer pad must be free from damage or excessive wear.

Camshaft

The cams must be free from damage or uneven wear caused by sticking tappet rollers.

The governor sleeve section should be free from ridging or scratching.

The roller bearings must be in good condition. If the rollers or cage are damaged or worn, they must be renewed and the bearing cups must be replaced. Bearings must be replaced in sets.

Cambox

Remove all the drain plugs and filler plugs and check their thread condition.

The outer mating face of the governor housing must be clean and free from burring or scratching otherwise the initial setting of the governor thrust collar may be incorrectly set.

The tappet bores must be free from wear or scoring.

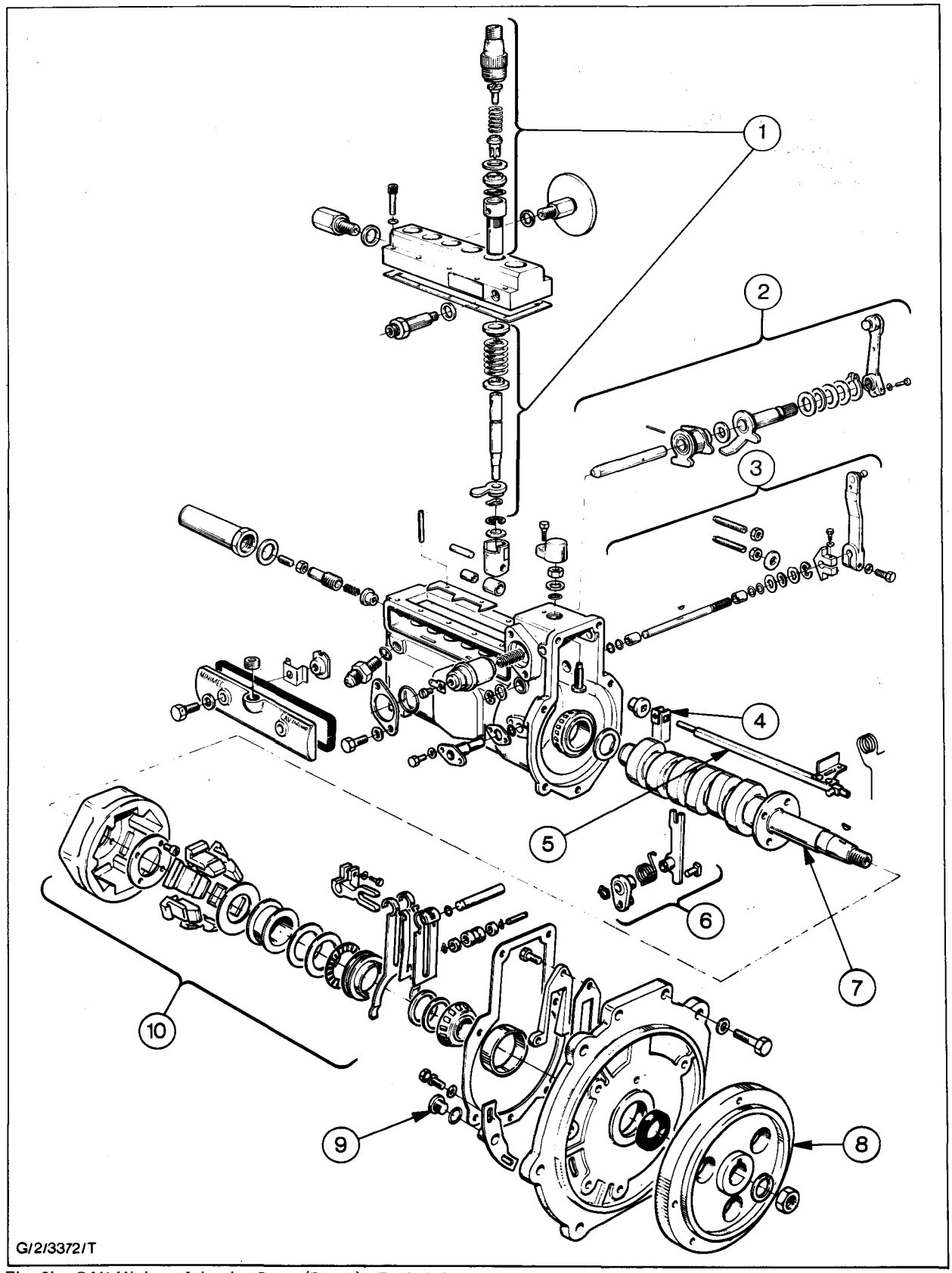


Fig. 51 - CAV Minimec Injection Pump (Dover) - Exploded

1. Injection Element Assembly
2. Excess/Stop Control Cross Shaft
3. Governor Control Cross Shaft
4. Control Rod Fork
5. Control Rod
6. Rocking Lever Assembly
7. Camshaft
8. Drive Gear Hub
9. Timing Aperture Plug
10. Governor Assembly

Controls

The control rod should be free from wear or ridging in the areas of the bushes.

The control rod bushes should be free from wear.

Insert the control rod and check for excessive movement in the bushes. There should be slight radial freedom. If the bushes need replacing, use the following procedures:

Rear Bush

1. Using a suitable drift from inside the cambox, drive the bush out.

2. Press a new bush into the housing until the shoulder on the bush locates against the shoulder in the housing.

Front Bush

1. Remove the rubber insert from the hole above the bush. Drive the bush retaining pin through the bush and remove it from the bush bore (Figs. 52 and 53).

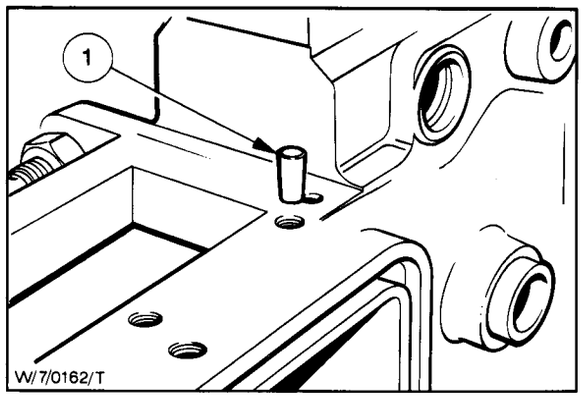


Fig. 52 - Control Rod Front Bush (Dorset)
1. Rubber Insert

2. Drive the bush out from inside the housing using a suitable size long drift.

3. Fit a new bush with the pin hole at the top in line with the hole in the housing. Drive the bush into the housing so that the pin holes are aligned.

4. Insert a new locating pin so that it retains the bush in position, but ensure that it does not protrude into the bush bore. Refit the rubber insert.

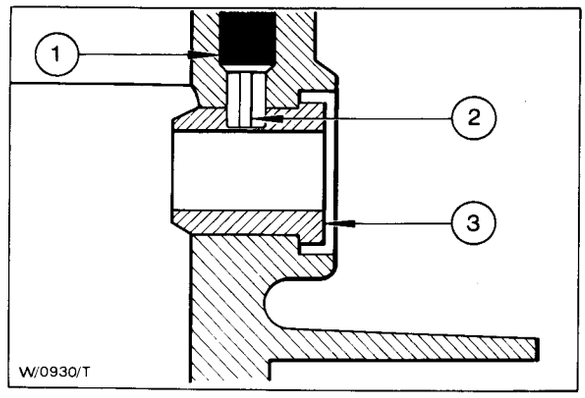


Fig. 53 - Control Rod Front Bush (Dorset)
1. Insert
2. Pin
3. Bush

The governor control shaft should be free from wear or ridging. Insert the shaft into the housing and check for excess movement in the bushes.

If the bushes need to be renewed, press them out of their locations into the casing. Press in new bushes to the dimensions shown in the following illustration (Fig. 54).

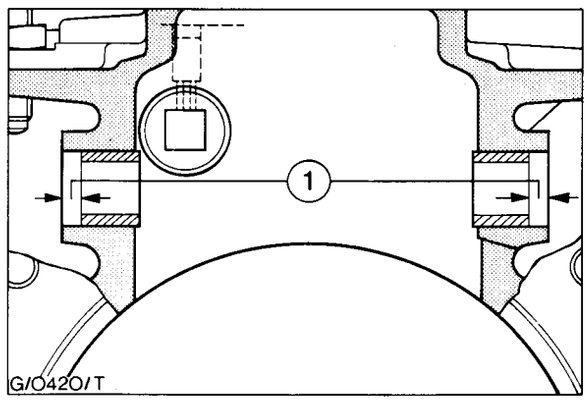


Fig. 54 - Governor Control Shaft Bushes - Locating Dimensions
1. Dimension 2,25 to 2,50 mm (0,089 to 0,098 in)

Where bushes have been renewed or where machining has
* been carried out ensure that all swarf is thoroughly
m removed from the cambox.
th

Boost Control Unit

Bc
All moving parts must be free from excessive wear,
* ridging or burring.
ri
The fuel rod must move freely in the fixing sleeve or
* housing without any apparent excess play.
or
All moving parts must operate freely.
*
The housing must not be damaged or cracked.
*
The side cover mating faces must be clean and free from
* nicks or burrs.
fr

ASSEMBLY

A
Boost Control Unit

B
NOTES: All circlips, 'E' clips, gaskets, 'O' rings, sealing
N and lockwashers and split pins must be renewed.
al
All moving parts should be lubricated with grease,
A anti-scuffing paste or powder as specified.
anti-scuffing paste or powder as specified.

If the modification described at the end of page 17 is being carried out, discard the original camplate and spring and fit a new camplate, Pt No 514152 and spring, Pt No 515227/16 during assembly (Lucas/CAV Pt Nos) Pump No 5525/2 will already have had this modification carried out. After the new parts have been fitted and if the additional governor spring and revised control rod damper parts have also been fitted, the pump No must be changed to P5525/2 from P5525. Refer to the notes after Operation 2 on page 43, operation 8 on page 50 and operation 7e on page 53.

1. Fit the knurled intermediate boost fuel adjusting wheel into the housing and screw it in to the limit of its travel (Fig. 55).

NOTE: When it reaches the click spring the spring will have to be held back to screw the wheel down.

2. Assemble the maximum fuel screw and clevis and retain it with a new lock nut and spring washer.

3. Fit the maximum fuel screw assembly into the housing and screw it into the bore leaving a 0,5mm (0,02in) gap between the top of the hexagon nut and the housing (Fig. 56).

4. Secure the adjuster in position with the Allen lock screw. Rotate the clevis so that the pin hole is nearest the centre of the housing.

5. Drive a new welch plug into the top of the maximum fuel screw bore.

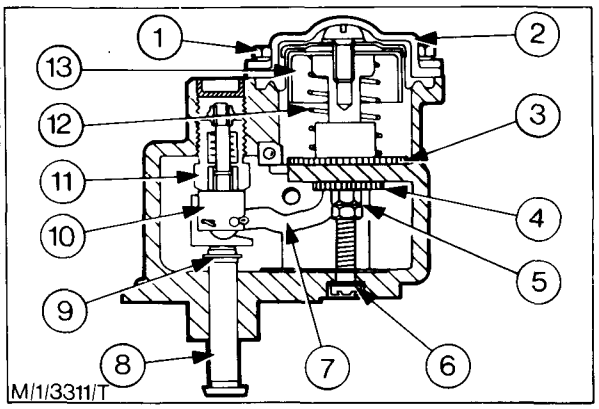


Fig. 55 - Boost Control Unit - Sectional View
1. Retaining Bolt
2. Air Inlet Cover
3. Fuel Adjusting Wheel (Intermediate Boost)
4. Fuel Adjusting Wheel (Zero Boost)
5. Locknut
6. Crosshead Screw
7. Camplate
8. Maximum Fuel Rod
9. 'E' Clip
10. Clevis
11. Maximum Fuel Screw (Maximum Boost)
12. Spring
13. Piston and Diaphragm Assembly

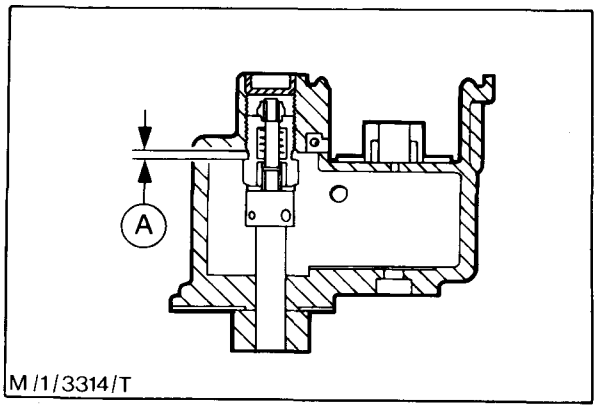


Fig. 56 - Maximum Fuel Screw Correctly Installed
A. 0,5mm (0,021in)

6. Fit the diaphragm to the piston. Fit the bottom plate to the piston and the retaining plate above. Fit the operating rod below the bottom plate and secure the components with a crosshead screw and new felt washer (Fig. 57).

NOTE: Apply sealant sparingly to the screw threads.

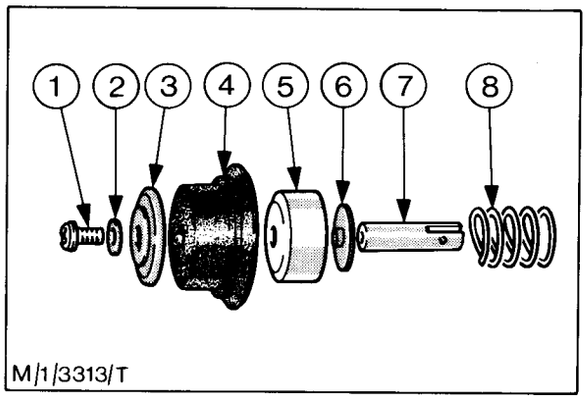


Fig. 57 - Piston and Diaphragm Assembly
1. Screw
2. Felt Washer
3. Retaining Plate
4. Diaphragm
5. Piston
6. Bottom Plate
7. Operating Rod
8. Spring

7. Lightly coat the diaphragm with the specified powder. Fit the return spring to the rod, locating it over the bottom plate. Fit the assembly into the housing.

8. Apply specified anti-scuffing paste to the camplate bearing surfaces. Fit the heel section to the lever section ensuring that the longer part of the heel section is at the bottom when installed. Rotate the maximum fuel screw clevis 90° anti-clockwise. Insert the cam plate assembly curve downwards into the clevis. Rotate the clevis and align the camplate with the operating rod (Fig. 58).

9. Depress the operating rod and engage the forked end of the camplate in the slotted end of the rod.

10. Move the plate back, if necessary, so that the hole in the rod is unobstructed. Insert the pin into the hole in the bottom of the rod with the flats on the pin parallel with the fork in the cam plate. Slide the camplate onto the pin so that the flats engage in the fork.

11. Align the hole in the camplate lever with the hole in the maximum fuel screw clevis and insert the clevis pin to retain the cam plate.

12. Align the clevis pin hole and insert a new split pin through the clevis and pin. Bend the ends over so that they face towards the clevis pin.

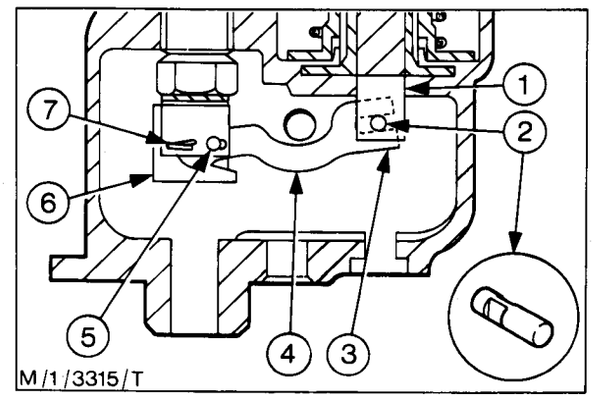


Fig. 58 - Camplate Installation
1. Operating Rod
2. Pin
3. Forked End of Camplate
4. Camplate Lever
5. Clevis Pin
6. Camplate Heel
7. Split Pin Installed in Clevis

13. Coat the cam plate, fuel rod and operating rod bearing surfaces with the specified anti-scuffing paste.

14. Fit a new washer and insert the crosshead screw through the hole in the bottom of the housing and screw the locknut and zero boost fuel adjusting wheel onto it (Fig. 59).

15. Apply sealant to the underside of the screw head and screw it home ensuring its spigot locates in the shoulder of the casting.

NOTE: When inserted, the knurled wheel must locate above the pin in the operating rod.

16. Set the zero boost fuel adjusting wheel 0,5 mm (0,02 in) from the body casting and secure lightly with the locknut.

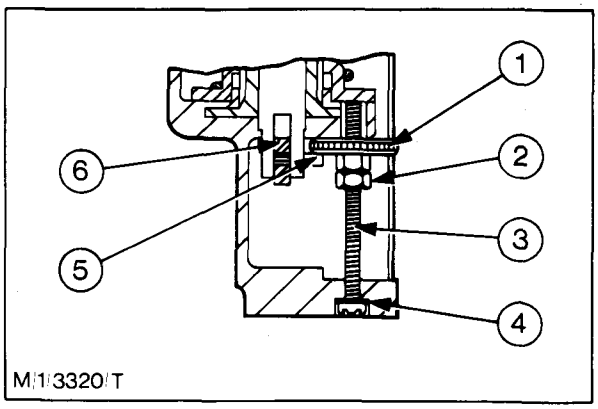


Fig. 59 - Zero Boost Fuel Adjusting Wheel Installed
1. Knurled Wheel
2. Locknut
3. Screw
4. Washer
5. Pin
6. Operating Rod

17. Fit the maximum fuel rod and secure it with a new 'E' clip (Fig. 55).

18. Engage the lip of the diaphragm in the groove in the housing and fit the air inlet cover, aligning the marks made on removal.

19. Fit the retaining bolts and washers and tighten them to the specified torque.

20. Carry out the boost control unit static setting procedure as follows:

21. Mount the boost control unit onto the mounting bracket (TOOL NO. HM 89558) - see Fig. 60.

22. Mount the dial gauge (TOOL NO. CT 9017) onto the mounting bracket with the spindle in contact with the bottom of the fuel rod.

23. Support the boost control unit and dial gauge assembly in the vertical position with the dial gauge at the bottom. It is important that the unit is tested and adjusted in this position, otherwise the correct settings may not be obtained.

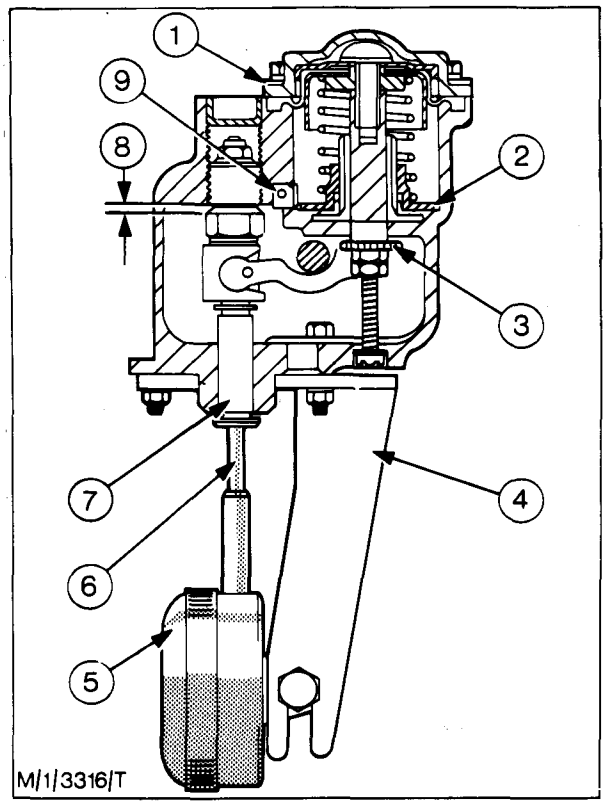


Fig. 60 - Boost Control Static Test Assembly
1. Boost Control Unit
2. Fuel Adjusting Wheel (Intermediate Boost)
3. Fuel Adjusting Wheel (Zero Boost)
4. Mounting Bracket
5. Dial Gauge
6. Spindle
7. Fuel Rod
8. Maximum Fuel Screw Setting
9. Click Spring

24. Connect the air supply from the boost control test rig (TOOL NO. HF 107) to the air connection on the boost control unit.

25. Adjust the boost test air pressure to 0,93 bar (0,95 kg/cm^2 13,5 lb/in^2) and zero the dial gauge.

NOTE: If the parts described before operation 1 under the sub-heading 'Boost Control Unit' under 'ASSEMBLY' on page 39 have been fitted, omit operations 26, 27 & 28 following and carry out operations 29, 30, 31 and 32 with reference to the associated table.

26. Reduce the air pressure until the fuel rod travel as shown on the dial gauge is 0,62 to 0,63 mm (0,024 to 0,025 in). The air pressure should be less than 0,39 bar (0,39 kg/cm^2 5,66 lb/in^2). Turn the intermediate boost fuel adjusting wheel one whole turn. Increase the air pressure to 0,93 bar and zero the dial gauge. Reduce the air pressure until the fuel rod travel is 0,62 to 0,63 mm. The air pressure should now be higher than it was previously but still less than 0,39 bar.

27. Repeat this process (returning to the datum pressure of 0,39 bar and zeroing the dial gauge each time) until the pressure required to give a fuel rod travel of 0,62 to 0,63 mm is 0,39 to 0,44 bar (0,39 to 0,45 kg/cm^2 5,66 to 6,38 lb/in^2).

CAUTION: UNDER NO CIRCUMSTANCES SHOULD THE INTERMEDIATE FUEL ADJUSTING WHEEL BE SCREWED UPWARDS MORE THAN 6 MM (0,236 IN).

28. When the intermediate boost fuel adjustment has been completed, reduce the air pressure to 0,12 bar (0,12 kg/cm^2 1,74 lb/in^2), adjust and lock the zero boost fuel adjusting wheel to give a fuel rod travel of 1,23 to 1,26 mm (0,048 to 0,050 in). Increase the boost pressure and note the pressure at which the fuel rod starts to move and the pressure at which it reaches the end of its travel.

These pressures should be 0,12 to 0,25 bar (0,12 to 0,25 kg/cm^2 1,74 to 3,63 lb/in^2) for the start of travel and 0,63 to 0,77 bar (0,64 to 0,76 kg/cm^2 9,14 to 11,17 lb/in^2) for the end of travel.

NOTE: The following operations 29, 30 & 31 together with the associated table apply only to boost control units modified as mentioned at the end of page 41.

29. Reduce the air pressure until the 'Intermediate Fuel Rod Travel' is shown on the dial gauge. The air pressure should be within the limits given in the table; if it is not, adjust wheel (2) Fig 60, until the correct rod travel and pressure is obtained.

NOTE: Right hand rotation increases pressure and left hand rotation decreases pressure. Under no circumstances should the wheel be adjusted to give a fuel rod travel greater than 6mm.

If it is necessary to adjust wheel (2), increase boost pressure to 'Reference Pressure No 1, zero the gauge and repeat the test.

11. When the 'Intermediate Fuel Rod Travel' setting is satisfactory, decrease the boost pressure to 'Reference Pressure No 2 and adjust wheel (3), Fig. 60 to give the specified 'Total Fuel Rod Travel'. Lock the wheel and increase boost pressure until fuel rod starts to move; note the pressure. Increase pressure until fuel rod reaches the limit of its travel and note the final pressure. 'Start Pressure' and 'Finish Pressure' should be within the specified limits.

12. Ensure that wheel (2) is locked by the 'click spring' after final adjustment.

Reference Pressure No 1	0,93 bar (9,5 kgf/cm^2 or 13,54 lbf/in^2)
Intermediate Rod Travel	1,07 to 1,08mm (0,042 to 0,043 in)
Pressure for Intermediate Rod Travel	0,37 to 0,41 bar (3,74 to 4,21 kgf/cm^2 or 5,32 to 5,99 lbf/in^2
Reference Pressure No 2	0,07 bar (0,7 kgf/cm^2 or 0,97 lbf/in^2
Total Fuel Rod Travel	2,14 to 2,16mm (0,84 to 0,085 in)
Start Pressure	0,25 to 0,37 bar (2,59 to 3,80 kgf/cm^2 or 3,68 to 5,41 lbf/in^2)
Finish Pressure	0,47 to 0,59 bar (4,76 to 5,98 kgf/cm^2 or 6,77 to 8,51 lbf/in^2)

Initial Setting Data for Modified Boost Control Units

Pump Body and Tappets

NOTE: All pumping element components must be dipped in clean test oil before reassembly

1. On Dover pumps the barrel seating locations in the pump body should be checked by the following air pressure test:

a) Assemble the barrels into their original locations in the pump body.

b) Assemble the delivery valve, guide, a new 'O' ring, valve spring and volume reducer to each location.

c) Screw in the delivery valve holders and tighten them to the specified torque.

d) Assemble the plungers into their original locations and set them 10mm (0,4in) down from the top of the barrels. Secure them in this position with a slave plate. The angular position of the plungers is not important.

⚠ WARNING: THE PLUNGERS MUST BE ADEQUATELY SECURED BY THE SLAVE PLATE OTHERWISE PERSONAL INJURY MAY RESULT WHEN THE PUMP BODY IS PRESSURISED.

e) Fit a fuel inlet union to the fuel gallery and blank off the outlets with suitable plugs.

f) Connect a 3,45 bar (50 lb/in^2) compressed air supply to the inlet union.

g) Immerse the assembly in a test tank containing clean test fuel oil with the plungers pointing upwards. Observe any escaping air and note where the bubbles are emerging.

h) If leakage is observed, dismantle the pump body assembly. The barrel seating locations will have to be resurfaced by the manufacturer. Fit a replacement pump body and reassemble the components. Retest the assembly.

i) If no leakage is noted, turn off and disconnect the air supply.

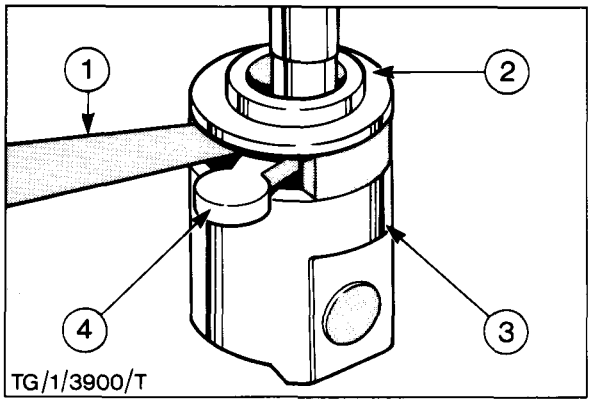


Fig. 61 - Checking Plunger Arm Clearance
1. Feeler Gauge
2. Spring Seat
3. Tappet
4. Plunger Arm

k) Where any one delivery valve and guide assembly, or pumping element, needs replacing the complete set should be renewed. New and used components may not be mixed.

2. Invert the pump body and fit each upper spring seat plunger, spring and lower spring seat assembly in turn to the appropriate barrel.

CAUTION: ALL MATED PUMPING ELEMENT COMPONENTS MUST BE REASSEMBLED TOGETHER.

3. Assemble the phasing spacer to each tappet, boss uppermost, and secure it with a circlip.

NOTE: If a new phasing spacer is fitted it should be the same thickness as the original.

4. Fit the roller and bush together and assemble them into the appropriate tappet. Insert the pin.

5. Check the clearance between each tappet phasing spacer and its plunger. Hold the plunger and lower spring seat in position on the tappet and check with a feeler gauge that the clearance between the plunger arm and seat is as specified. If necessary, change the spring seat (Fig. 61).

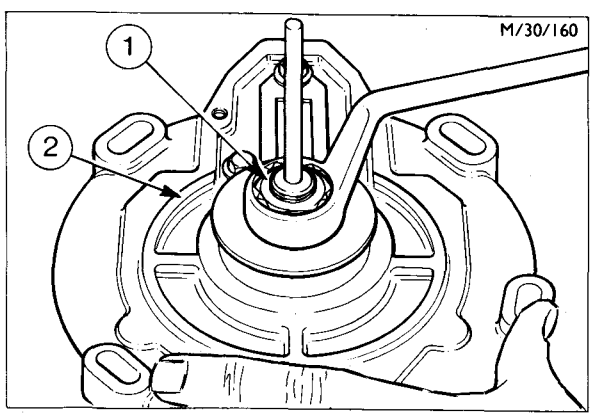


Fig. 62 - Installing a New Bearing Cup
1. Installer
2. Drive Hub Housing

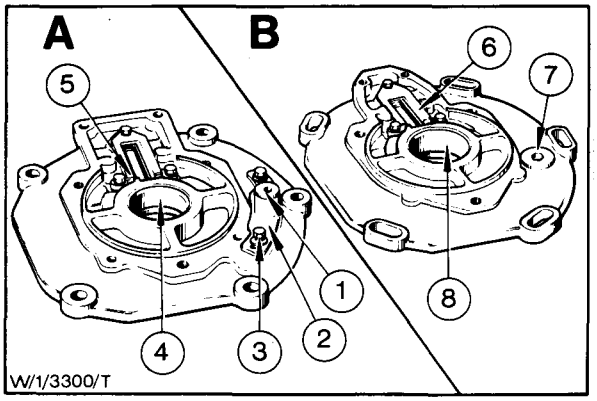


Fig. 63 - Front Mounting Flanges
A. Dover
B. Dorset
1. Timing Plug
2. Timing Quadrant
3. Shear Bolt
4. Bearing Cup
5. Governor Ramp
6. Governor Ramp
7. Timing Plug
8. Bearing Cup

Front Mounting Flange

1. Fit a new front bearing cup to the front mounting flange using the installer (TOOL NO. CT 9051). Ensure the bearing cup is drawn fully home into its location (Fig. 62).

2. Fit the governor ramp to the front mounting flange. Use the orginal shim pack. Refer to Fig. 63.

NOTE: If an additional governor leaf spring is being fitted (refer to note after Operation 6 on page 19) an 0,3mm shim must be removed.

3. Fit the retaining bolts and lockwashers and tighten them to the specified torque.

4. Dover - Fit the timing plug to the timing quadrant and assemble the quadrant loosely onto the front mounting flange retaining it with two new shear bolts.

5. Dorset - Screw the timing plug and new washer loosely into position.

NOTE: The setting and final fitting of the timing plugs/plates, etc. is carried out during phasing and calibration.

Do not fit a new oil seal to the front mounting flange at this stage.

Camshaft and Governor Weights

NOTE: The governor weights assemblies are not fully reassembled at this stage as dimensional checking has to be carried out during later stages of pump reassembly.

1. Dorset - Fit the governor weights assembly to the camshaft ensuring the dowel is correctly engaged. Fit the four retaining bolts and new locking plates, ensuring one of the locking plates covers the dowel. Tighten bolts to the specified torque value, then bend up the locking plate tabs to secure bolt heads.

2. Dover - Fit the governor weight cage and retaining plate onto the camshaft. Insert the four socket head bolts and tighten them to the specified torque (Fig. 64).

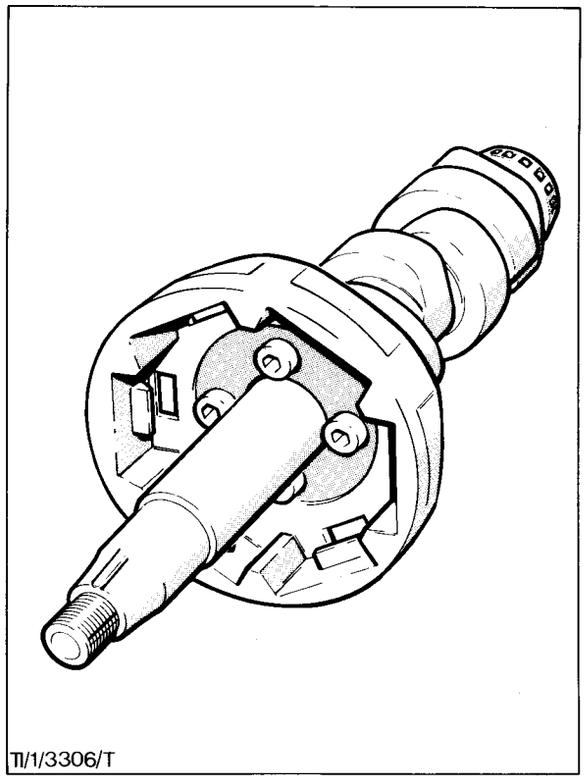


Fig. 64 - Governor Weight Cage Installed (Dover)

3. If the camshaft end-float measured on dismantling was correct, divide the original total shim pack into two packs of equal thickness.

4. If the end-float was incorrect then add or subtract shims to the original pack so that the correct end-float will be obtained on reassembly. Then divide the total shim pack in half.

NOTE: The shims must be absolutely dry and clean so that the end float measurement is accurate.

5. Fit the stop disc and one half of the total shim pack onto the governor end of the camshaft and press on the roller bearing using a suitable tubular adaptor. Ensure the shim pack and stop disc or washer is tightly clamped. Repeat the procedure with the other half of the shim pack on the other end of the camshaft; no stop disc is fitted at the rear end.

Cambox and Controls

NOTE: During reassembly all bearing surfaces must be lubricated.

1. Fit a new camshaft rear bearing cup in the cambox using the installer (TOOL NO. CT 9051), ensuring that it is drawn fully home into its location (Fig. 65).

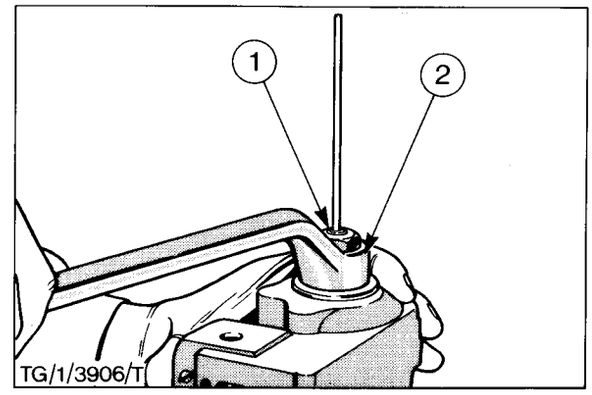


Fig. 65 - Installing a New Rear Bearing Cup (Dorset Shown)
1. Installer 2. Ring Spanner

2. Apply a thin coat of suitable sealant to the outer edge of a new expansion plug and press it into position in the end of the cambox from inside, until the domed surface of the plug is 3 to 4 mm (0,12 to 0,16 in) above the surface of the cambox (Fig. 66).

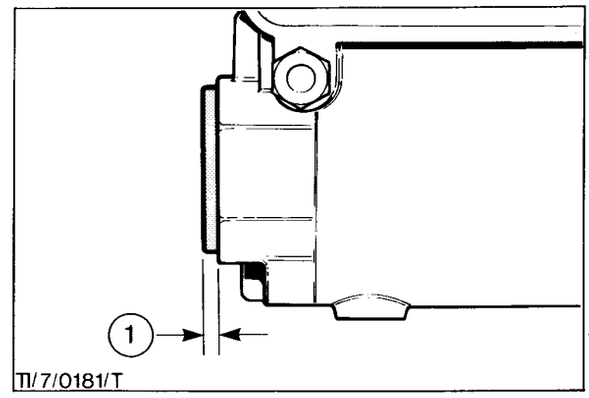


Fig. 66 - Expansion Plug Installation
1. Correct Installation Dimensions - 3 to 4 mm (0,12 to 0,16 in)

3. Fit the speed control adjusting screw(s) and locknuts if removed.

NOTE: A large flat washer is located under the bottom locknut.

4. Mount the cambox on the swivel vice using the appropriate adaptor plate.

5. Insert the fuel control rod through the front bush into the cambox. As the rod emerges into the tappet chamber, fit the control forks onto it. Push the rod home.

6. On Dover pumps, check the control rod for free movement throughout its travel range, the control rod should also have slight radial movement.

7. Set the master fork on the end of the square section of the control rod as shown and tighten the Allen screw (Fig. 67).

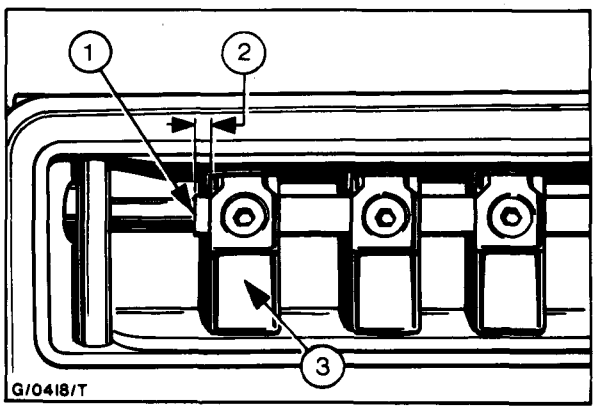


Fig. 67 - Setting the Master Fork
1. Control Rod
2. Setting dimension - 0 to 1,0mm (0 to 0,040 in)
3. Master fork

8. Set the remaining forks along the rod approximately 25,0 mm (1,0 in) apart, and tighten the Allen screws.

9. Screw in the rear control rod bush retaining screw and tighten to the specified torque.

10. On pumps without a control rod damper unit - Fit the capnut using a new washer and tighten to the specified torque.

11. Naturally Aspirated Engines - Screw the maximum fuel adjusting screw into the governor housing from inside until it is at the upper limit of its travel.

12. Fit a new washer to the stop control shaft. Insert the shaft into its bore from inside the housing. Fit a new 'O' ring over the splined end of the shaft and press it into the recess in the housing. Fit the shim(s) and washer to the shaft and retain the assembly using a new circlip.

NOTE: The shaft should be shimmed to allow free rotation without end float.

Dover:

13. Insert the excess and maximum fuel lever into the governor housing from the front with the boss nearest the stop control shaft. Insert the excess fuel shaft into the housing with the pointed end facing outwards and push the shaft through the lever bore. Fit a washer onto the inner end of the excess fuel shaft and engage the shaft into the hollow stop control shaft (Fig. 68).

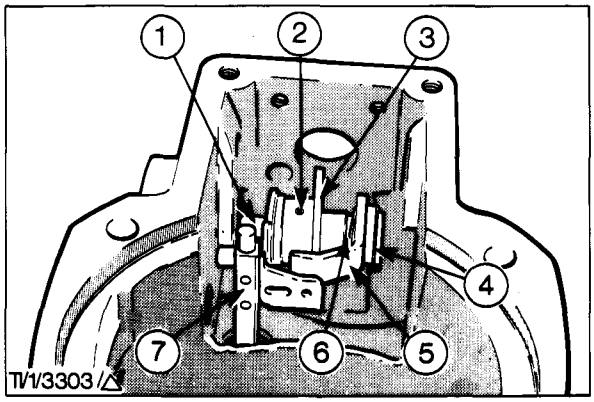


Fig. 68 - Excess Fuel and Stop Control Shaft Assembly (Dover)
1. Excess Fuel Shaft
2. Roll Pin
3. Excess Fuel Lever
4. Spring Washer and Shim
5. Stop Control Lever
6. Washer
7. Fuel Control Rod

14. Align the holes in the lever assembly and shaft and fit a new roll pin to retain the lever in position with the bell shaped lever facing downwards.

15. Fit the spring onto the excess fuel shaft and then install the solenoid unit. Fit a new 'O' ring onto the solenoid and then fit the retaining collar. Secure it with the two small bolts (Fig. 69).

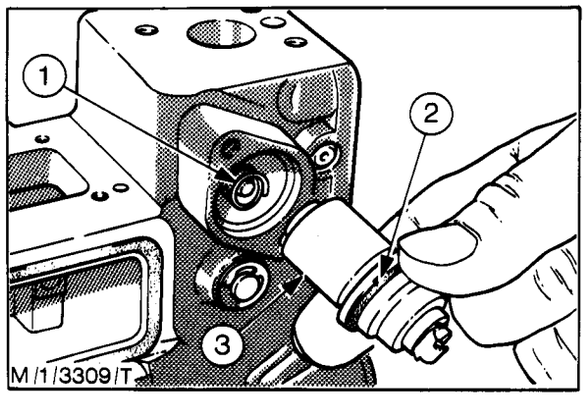


Fig. 69 - Installing the Excess Fuel Solenoid (Dover)
1. Spring
2. 'O' Ring
3. Solenoid

Dorset:
16. Rotate the stop control shaft clockwise until the bellcrank lever is at the end of its travel with the control rod in the stop position. Set the initial position of the external stop control lever on the shaft so that the lever sits approximately 30° forward from the vertical. Tighten the pinch bolt (Fig. 70).

NOTE: This setting may need revision when the pump is mounted on the engine.

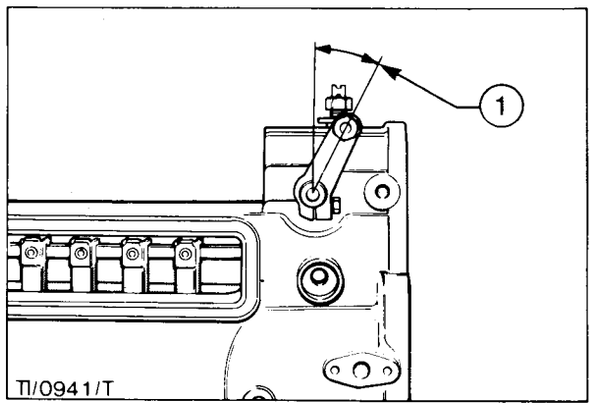


Fig. 70 - Stop Control Lever Initial Setting
1. 30°

17. Fit a new 'O' ring to the excess fuel control shaft and insert the shaft through the hollow stop control shaft, large diameter first. Fit a new fibre washer over the inner end of the shaft when installed.

18. Insert the excess fuel lever into the governor housing from the front with the boss facing the side of the housing and push the excess fuel shaft through its bore. Temporarily fit the threaded capnut, or bush where fitted, to support the shaft. Align the holes and fit a new roll pin to secure the lever to the shaft.

19. Remove the threaded capnut, or bush where fitted. Fit the spring inside it and fit a new washer on the thread. Refit the capnut and tighten to the specified torque.

20. Fit a new rubber boot over the excess fuel button, where fitted, ensuring the boot engages in the grooves in the shaft.

Naturally Aspirated Engines:
21. Set the maximum fuel adjusting screw initially so that the master fork is 10 mm (0,4 in) from the control rod rear bush when the control rod is pushed towards the governor end of the housing.

22. Fit a new rubber seal to the housing and a washer and locknut to the maximum fuel adjusting screw. Do not tighten the locknut.

23. Fit the cambox oil filler plug using a new 'O' ring.

All Engines:
24. Holding the splined end of the governor control shaft, insert the shaft into the bore in the housing from the stop screw side. Insert the governor inner control lever into the housing from the front with the pinch bolt uppermost. Slide it onto the shaft.

25. Fit the key in the keyway, locate the inner control lever centrally over it and tighten the pinch bolt.

26. Fit a new seal and 'O' ring to each end of the governor control shaft, and push them into the recesses in the housing.

27. Fit two flat washers and one dished washer to the splined end of the shaft and fit one flat washer to the other end. Secure the shaft in position with a new 'E' clip at each end.

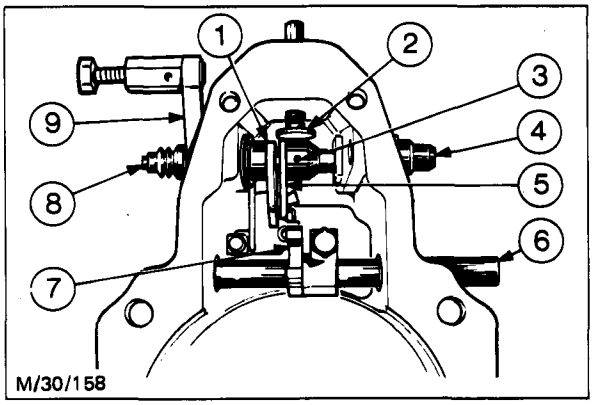


Fig. 71 - Controls Installed (Naturally Aspirated Pump)
1. Excess Fuel Lever
2. Maximum Fuel Screw
3. Roll Pin
4. Capnut
5. Stop Lever
6. Governor Control Shaft
7. Governor Inner Control Lever
8. Excess Fuel Button
9. Stop Control Lever

Camshaft and Governor Assembly

1. Feed the camshaft into the cambox until the rear bearing fully engages in the cup.

2. Temporarily fit the front mounting flange (without the oil seal) using a new gasket.

3. Fit and tighten the retaining bolts to the specified torque.

4. Fit the camshaft end float adaptor and dial indicator gauge assembly (TOOL NOS. CT 9017 and 9017-1) to the drive end of the camshaft. Pack the joint between the adaptor and dial gauge where necessary to ensure the dial gauge anvil rests squarely on the flat surface of the front mounting flange (Fig. 72).

5. Pull the adaptor firmly away from the pump and zero the dial gauge. Push the adaptor firmly towards the pump and note the end float reading on the gauge.

6. If the end float is not to specification, carefully remove the front mounting flange so as not to damage the gasket and withdraw the camshaft. Remove the front bearing carefully and add or subtract shims as necessary. Refit the assembly and check the end float as before until correct.

7. Remove the front mounting flange and withdraw the camshaft assembly. Ensure the gasket is not damaged.

8. If the shimming was correct without adjustment, remove the front bearing and withdraw the shim pack and stop disc, (where fitted), from the camshaft.

9. If the shimming required alteration, then carefully remove both front and rear bearings from the camshaft. Withdraw the shim packs from the camshaft and divide the total pack (after adjustment) in half.

10. Fit one half of the total shim pack to the rear end of the camshaft and press on the bearing ensuring the shims are tightly clamped.

11. Dover - Install the governor weights in the cage. Fit the thrust washer and governor thrust sleeve onto the shaft so they seat correctly inside the weights.

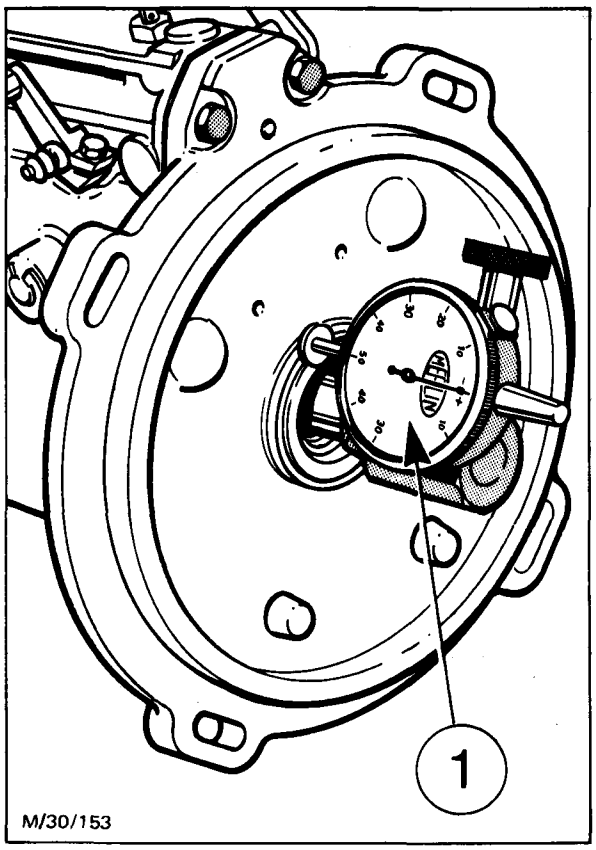


Fig. 72 - Measuring the Camshaft End Float (Dorset)
1. Dial Gauge

12. Dorset - Slide the governor thrust sleeve onto the camshaft and locate it correctly within the weight assembly.

13. All - Rotate the pump so that the governor housing is pointing upwards. Feed the camshaft and governor weights assembly into the cambox ensuring the rear bearing is fully located in the cup.

14. Push down on the thrust sleeve and governor weights assembly to ensure that they are fully closed.

15. Fit the centralising and measuring gauge (TOOL NO. HM 927) without a gasket over the end of the camshaft and secure it to the governor housing flange with three bolts (Fig. 73).

16. Using a suitable micrometer or vernier depth gauge, measure dimension X from the end face of the thrust sleeve to the governor housing gasket face.

NOTES: The governor assembly must be fully closed or the measurement will be incorrect.

Remember to subtract the thickness of the centralising and measuring gauge.

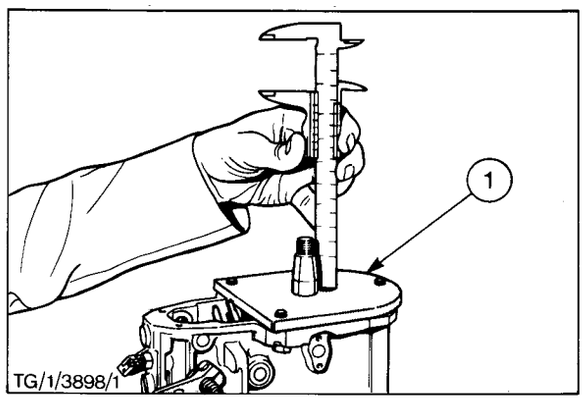


Fig. 73 - Measuring Dimension 'X'
1. Centralising and Measuring Gauge

17. Refer to 'Specifications' and select the correct size thrust collar appropriate to the measurement of the dimension.

18. Remove the gauge plate from the governor housing.

19. Dorset - Fit the thrust bearing and selected thrust collar, with the chamfered flange outwards, to the camshaft. Push them fully home.

20. Dover - Fit the two thrust washers, thrust race and selected thrust collar, with the spigot facing outwards, to the camshaft. Push them fully home.

21. All - Refit the gauge plate and secure it in position.

22. Measure dimension 'Y', from the face of the thrust collar to the governor housing gasket face. If dimension 'Y' is not within the specified tolerance, select and fit the next size thrust collar. Repeat the measurement until it meets the specification (Fig. 74).

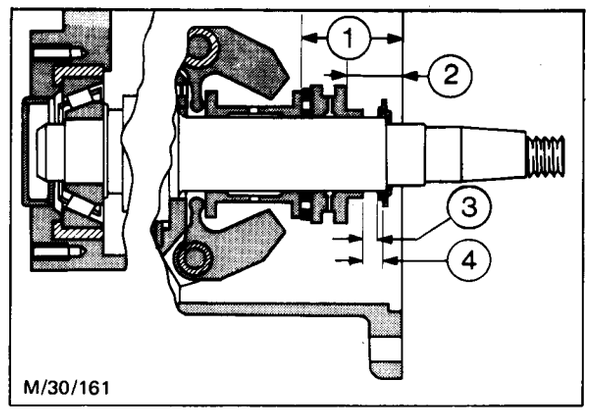


Fig. 74 - Governor Checking Dimensions (Dover & Dorset)
1. Dimension X
2. Dimension Y
3. Dimension B
4. Dimension A

23. Remove the gauge plate and withdraw the camshaft and governor assembly.

24. Hold the camshaft vertically, ensuring the governor weights are fully closed. Place the stop disc or stop washer on the camshaft so that it fully abuts the shoulder. Ensure that the 'top hat' type of stop disc is the right way round.

25. Dorset - Measure dimension 'A', from the end of the thrust collar spigot, or governor hub sleeve, to the rear face of the stop disc or stop washer (Fig. 74).

26. Dorset - Select the appropriate size spacer ring for the 'A' dimension measurement as specified. Remove the stop disc and fit the spacer ring to the camshaft. Refit the stop disc.

27. Measure dimension 'B', from the end of the thrust collar spigot, or governor hub sleeve, to the rear face of the spacer ring, when the spacer ring is tight against the stop disc (Fig. 75).

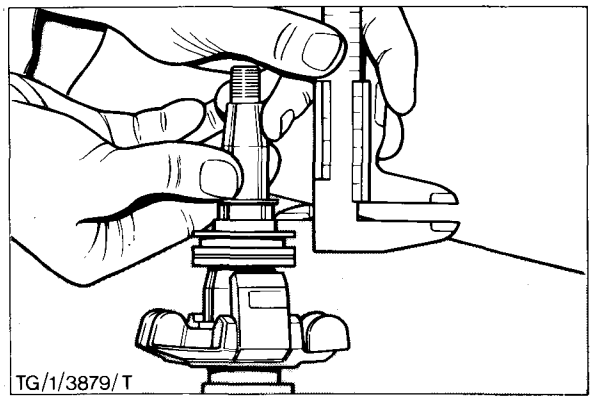


Fig. 75 - Measuring Dimension B (Dorset Shown)

28. Dover - There is no dimension 'A' specified. A spacer ring should be selected to give the specified dimension 'B'.

29. If dimension 'B' is not within the specifed tolerance fit the next spacer ring, repeat the measurement until the specification is met.

30. Fit the other half of the total shim pack onto the front end of the camshaft against the stop disc. Press on the front bearing ensuring the shim pack and stop disc are tightly clamped.

31. Rotate the governor inner control lever so that it allows the camshaft unobstructed access and feed the camshaft assembly into the cambox so that the rear bearing engages fully in its cup.

Controls

1. Turbocharged pumps - Assemble the rocking lever. Place the spring on the bottom link fulcrum bush with the short hook leading. Engage the fulcrum bushes of the links and hook both ends of the spring onto their respective links. Rotate the links against the spring tension and engage the short arm on the top link over the bush on the bottom link. Ensure the spring coils are not trapped in the fulcrum bush and push the link assembly fully together and fit the retaining circlip (Fig. 76).

2. Fit a new gasket and 'O' ring to the pivot shaft and insert the shaft halfway into the housing.

3. Fit the pin into the lower end of the rocking lever and place the lever assembly in position in the housing. Engage the fork on the control rod stud and the pin in the thrust collar groove.

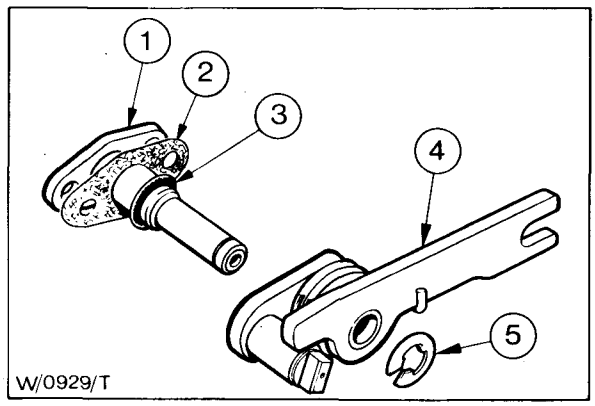


Fig. 76 - Rocking Lever and Pivot Shaft Assembly (Turbocharged Pumps)
1. Pivot Shaft
2. Gasket
3. 'O' Ring
4. Rocking Lever
5. Circlip

4. Turbocharged pumps - Push the pivot shaft fully home engaging the rocking lever fulcrum bush onto it.

5. Naturally aspirated pumps - Fit the thrust washer over the end of the pivot shaft as it protrudes into the housing then push the shaft through the rocking lever pivot hole and fully home. Fit a new 'E' clip to the pivot shaft between the thrust washer and housing (Fig. 77).

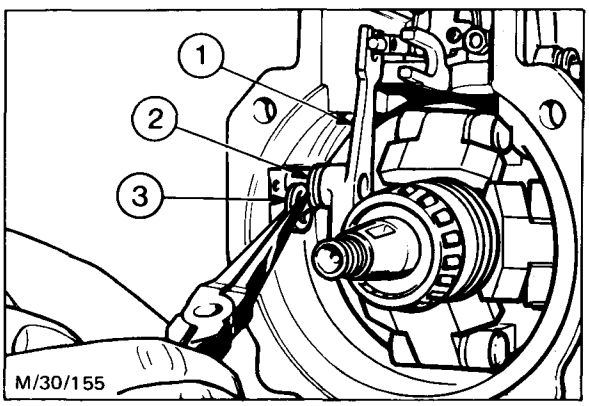


Fig. 77 - Rocking Lever Installation (Naturally Aspirated Pumps)
1. Rocking Lever
2. Thrust Washer
3. 'E' Clip

6. Fit the two pivot shaft retaining bolts and tighten them to the specified torque.

7. All - Fit a new 'O' ring to the governor spring pivot shaft.

8. Assemble the governor spring leaves correctly and place them in position in the housing with the rounded ends of the long leaf resting on the front face of the thrust collar.

NOTE: If the modification to prevent 'undershoot stall' is being carried out, then the additional interleaf spring should be fitted at this stage - refer to note after operation 6 on page 19.

9. Dorset - Insert the governor spring pivot shaft, threaded end first, from the side opposite the excess fuel button.

10. Dover and Dorset - Insert the plain end of the governor spring pivot shaft first from the excess fuel button or solenoid side.

11. Drive the shaft home so that the driven end is flush with the housing.

12. Naturally aspirated pumps - Fit the external excess fuel bracket (where fitted) onto the threaded end of the governor spring pivot shaft and retain it with a new self locking nut tightened to the specified torque.

13. Place the small dumb-bell shaped roller in the governor inner control lever fork with the lever in the raised position (Fig. 78).

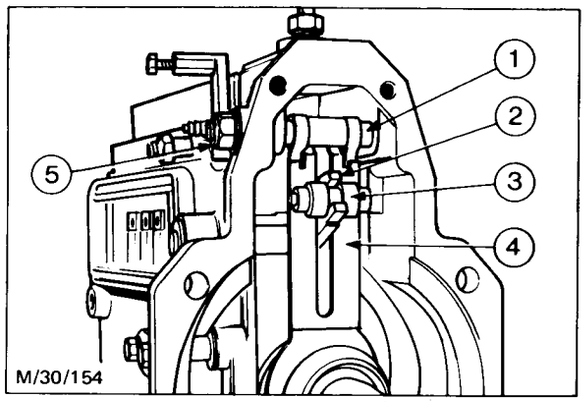


Fig. 78 - Governor Spring Assembly (Naturally Aspirated)
1. Governor Spring Pivot Shaft
2. Governor Inner Control Lever
3. Dumb Bell Roller
4. Governor Leaf Spring
5. Self Locking Nut

Front Mounting Flange

1. Fit a new oil seal to the front mounting flange with the lip facing inwards. Press the seal in squarely so that it lies flush with the boss on the outside of the flange.

2. Fit the flange/rear cover using the new gasket used for setting the camshaft end float. Ensure that the oil seal is not damaged as the flange is fitted (Fig. 79).

3. Screw in the retaining bolts and lockwashers and tighten them to the specified torque.

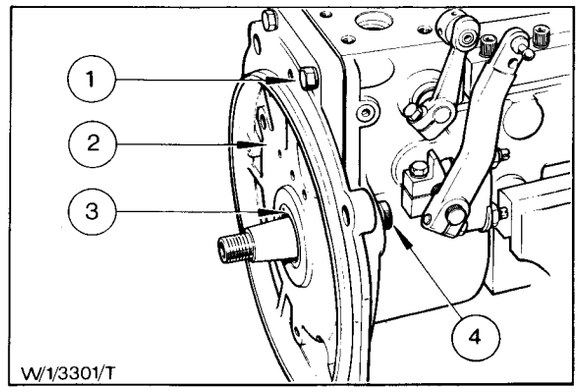


Fig. 79 - Front Mounting Flange Installed (Dover)
1. Retaining Bolt
2. Flange
3. Oil Seal
4. Retaining Bolt

Pump Body and Tappets

CAUTION: ALL MATED PUMPING ELEMENTS MUST BE FITTED TO THEIR ORIGINAL LOCATIONS.

1. Dorset - Fit the steel 'T' pieces to their locations between the tappet bores in the cambox (Fig. 80).

2. Fit the tappet assemblies to their original bores with the cutaway sections facing the control rod. Take care not to dislodge the 'T' pieces, where fitted.

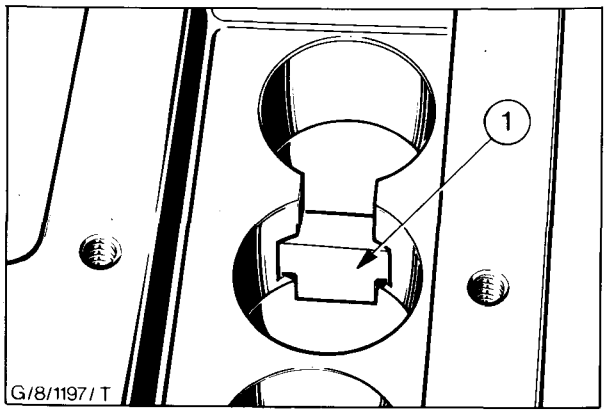


Fig. 80 - Tappet Locating 'T' Pieces (Dorset)
1. 'T' Piece

3. Dover - Fit the 'E' shaped tappet retaining plate to the tappet chamber and retain it with the two long grub screws (Fig. 81).

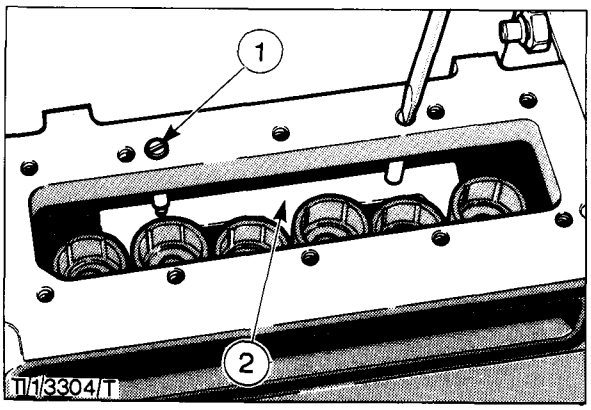


Fig. 81 - Installing the Tappet Retaining Plate
1. Grub Screw 2. 'E' Plate

4. Align the control rod so that the forks are centralised. Rotate the pump onto its side with the tappet chamber aperture downwards.

5. Hold the pump body assembly on its side with the plunger arms all parallel and pointing downwards as shown in Fig. 82. Assemble the pump body to the cambox and engage the plunger arms in the control forks. Rotate the complete unit to the vertical plane and check that the plunger arms are all correctly located in the forks.

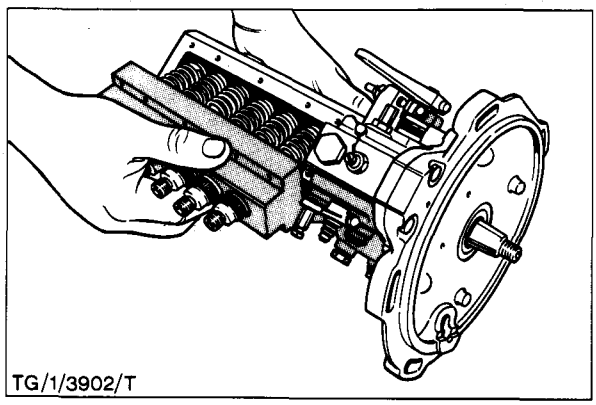


Fig. 82 - Assembling the Pump Body to the Cambox

6. Position any brackets removed during dismantling onto the pump body and insert the Allen retaining bolts and washers.

7. Depress the pump body and screw in the retaining bolts. Tighten them evenly and gradually to the specified torque in the sequence shown in Fig. 83.

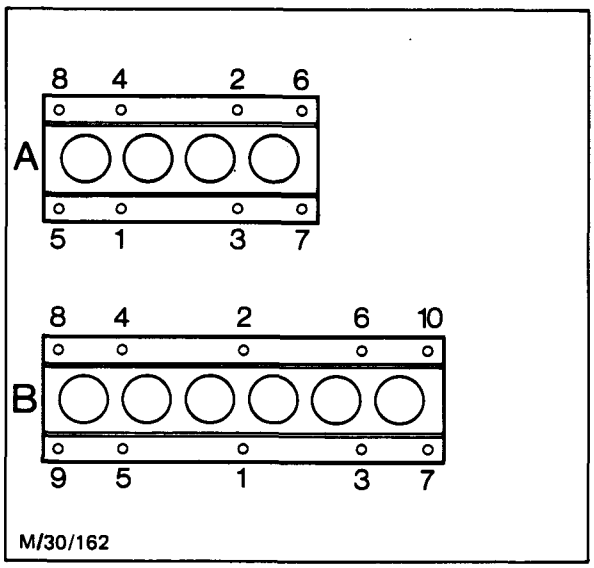


Fig. 83 - Pump Body Bolt Tightening Sequence
A. 4 Cylinder B. 6 Cylinder

8. Check that the control rod and plungers move freely through their full travel.

9. Screw in the fuel unions, blanking plugs and bleed screws/self purge valves, where fitted, using new washers, and tighten them to the specified torque.

10. Dover (naturally aspirated only) - Screw in and tighten the fuel gallery damper and tighten securely (Fig. 84).

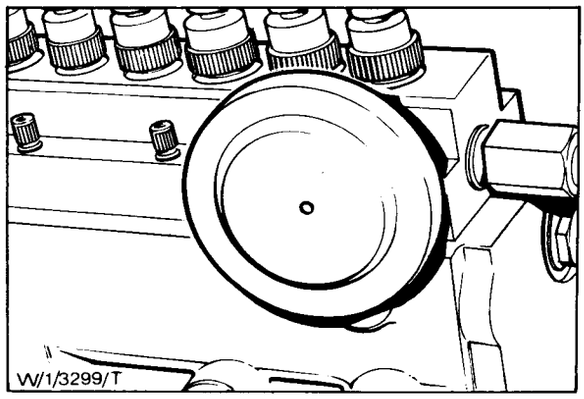


Fig. 84 - The Damper Installed (Dover Naturally Aspirated Only)

Boost Control Units

If the pump is to be phased and calibrated immediately, attach the boost control unit to it in a plastic bag with all components.

NOTE: If the pump is not to be immediately phased and calibrated, loose assemble the boost control units to the pump at this stage, as follows:

1. Fit a new gasket to the governor housing and place the unit in position.

2. Fit the one internal and two external retaining bolts and tighten them hand tight.

3. Fit a new sealing ring to the recess in the side cover. Fit the side cover using a new shear bolt and rubber washer. Screw the bolt in hand tight.

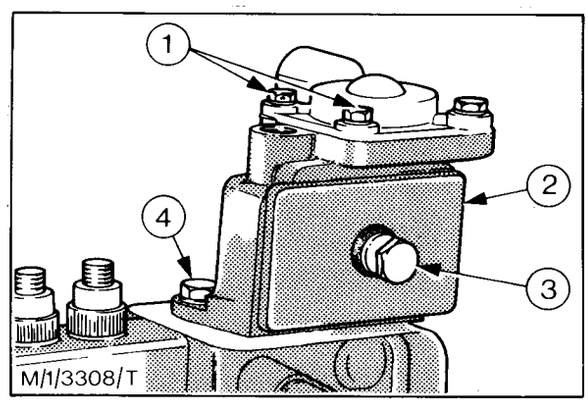


Fig. 85 - Boost Control Unit Installed (Dover)
1. Top Cover Bolts
2. Side Cover
3. Shear Bolt
4. Retaining Bolt

After the overhauled pump has been phased, install the boost control unit as follows:

1. Remove the loosely assembled side cover from the boost control unit. Place the unit in position on the pump with a new gasket. Screw in the three securing bolts and tighten to the specified torque.

NOTE: The basic setting of the boost control unit is carried out during the reassembly part of the overhaul procedure.

2. Mount the boost air supply and measuring equipment (TOOL No. HF 107) on the test stand. Attach a compressed air supply to the inlet connection.

3. Secure the governor control lever in the maximum speed position.

4. Turn on the boost air supply and adjust the pressure to the specified maximum. Check that the boost control mechanism and control rod moves fully and smoothly into the maximum boost position.

5. Slowly reduce the boost air pressure to zero and check that the mechanism moves moothly over its complete travel to the zero boost position.

6. Ensure that all the control fork securing screws are tight.

Ancillary Components

1. Fit the external governor control lever to the shaft with the lever in the vertical plane. Tighten the pinch bolt.

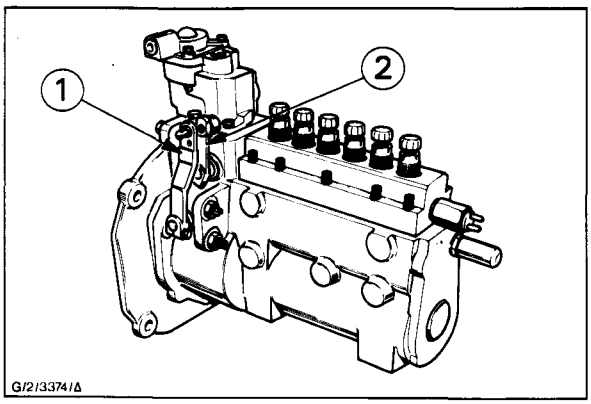


Fig. 86 - External Control Levers (Dover Illustrated)
1. Governor Control Lever 2. Stop Control Lever

NOTE: This is only a temporary setting for calibration purposes. Final lever position is set during installation on the engine.

2. All - Fit and tighten all the oil drain, level and filler plugs (where fitted) to the specified torque, using new washers.

3. Fit the key to the camshaft keyway.

NOTE: Dorset and Dover Woodruff keys are not interchangeable.

4. Dorset - Fit the drive gear to the camshaft engaging it on the key. Loosely fit the retaining nut and washer.

5. Dover - Fit the drive gear hub to the camshaft engaging it on the key. Fit the retaining nut and washer. Tighten the nut to the specified torque.

6. Remove the injection pump from the swivel vice and ensure that all apertures are blanked off if the pump is not to be phased and calibrated immediately.

7. The following components should be loosely assembled to the pump as they will have to be removed prior to phasing and calibration:

a) The retaining plates and side cover (using a new rubber seal).

b) The side cover oil filler plug using a new washer (turbocharged pumps only).

c) The delivery valve holder locking devices.

d) The self purging air valve.

e) The control rod buffer spring and adjusting assembly (where fitted).

NOTE: If the modification to prevent 'undershoot-stall' is being included, then the revised spring and spacer should be fitted - refer to the note after Operation 6 on page 19.

INJECTOR OVERHAUL

DISMANTLING

CAUTION: KEEP THE NOZZLE AND NEEDLE FROM ANY ONE INJECTOR TOGETHER AS THEY ARE A MATCHED PAIR.

1. Place the injector on the dismantling jig (TOOL NO. HH112) and remove the nozzle nut using the socket (TOOL NO. CT 9009). Remove the nozzle and needle valve, the spacer, the spring seat and the spring. Remove the pressure adjustment shims from the top of the spring recess, these may be held in by suction (Fig. 87).

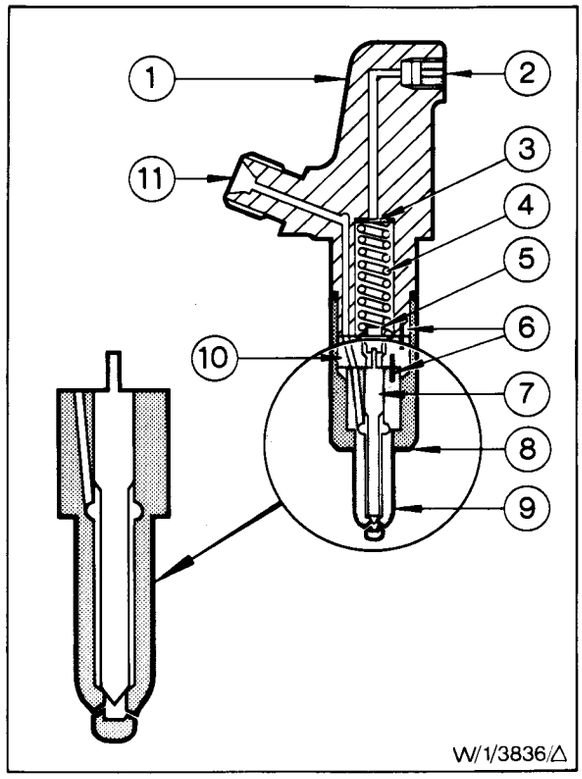


Fig. 87 - Injector - Section View
1. Nozzle Holder
2. Leak-Off Connector
3. Shim
4. Spring
5. Spring Seat
6. Dowel Pins
7. Needle Valve
8. Cap Nut
9. Nozzle
10. Adaptor Plate Assembly
11. Inlet Connection

CLEANING AND INSPECTION

1. The cleaning of injectors is best achieved by the use of suitable tools, such as the injector cleaning kit (TOOL NO. FT 9101). All the injector components must have all the carbon completely removed; the four spray holes should be cleaned using the wire probes in the kit (Fig. 88).

2. Hold the probes in the hand chuck provided and, to avoid bending or breaking the wire, ensure that only 1,0 mm (0,04 in) protrudes from the chuck. The probe wire diameter must be 0,01 mm (0,0004 in) less than the specified spray hole diameter.

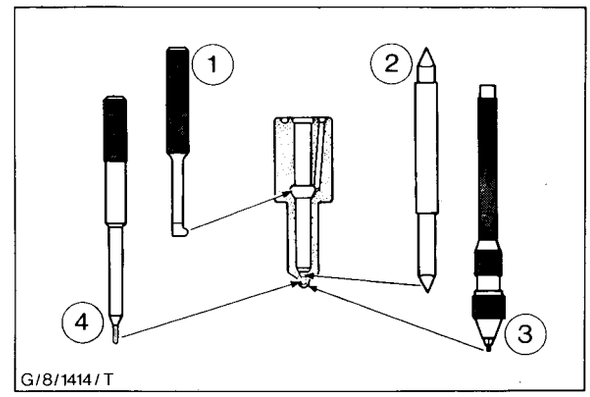


Fig. 88 - Injector Cleaning Tools
1. Recess Scraper
2. Seat Scraper
3. Nozzle Hole Probe and Chuck
4. Tip Scraper

⚠ WARNING: ADEQUATE EYE PROTECTION AND PROTECTIVE CLOTHING MUST BE WORN WHEN HANDLING ACETONE OR CAUSTIC SODA. LIQUID ACETONE AND ITS ACCOMPANYING VAPOUR ARE HIGHLY INFLAMMABLE. IT SHOULD NOT BE USED NEAR A NAKED FLAME OR NEAR ELECTRICAL EQUIPMENT. THE WORKING AREA MUST BE WELL VENTILATED. NO SMOKING. NO STATIC DISCHARGES. AVOID PROLONGED SKIN CONTACT. IF SPLASHED IN THE EYE, OPEN EYELIDS FULLY, WASH EYE CONTINUOUSLY WITH WATER FOR 10 MINUTES. OBTAIN MEDICAL ADVICE WITHOUT DELAY. CAUSTIC SODA IS CORROSIVE AND WILL CAUSE SKIN BURNS. SKIN CONTACT MUST BE AVOIDED AT ALL TIMES. IF SKIN CONTACT OCCURS, RINSE THOROUGHLY WITH WATER IMMEDIATELY AND CONTINUE FOR A FEW MINUTES. THEN WASH WITH SOAP AND WATER AND PAT DRY. CONTAMINATED CLOTHING MUST BE QUICKLY REMOVED. IF SWALLOWED, TAKE IMMEDIATELY TO HOSPITAL. A CUPFUL OF WATER OR MILK MAY BE GIVEN SLOWLY IF ABLE TO SWALLOW. IF SPLASHED IN THE EYE, OPEN EYELIDS FULLY, WASH EYE CONTINUOUSLY WITH WATER FOR 10 MINUTES. OBTAIN MEDICAL ADVICE WITHOUT DELAY.

3. When there is a hard carbon deposit which cannot be readily removed by using the tools alone, one of the following two solvents may be used:

a) Acetone - Immerse the nozzle in acetone for up to half an hour which will normally be sufficient to soften the deposit. On removing the nozzle from the acetone it is important to rinse it immediately in clean test oil to prevent corrosion occurring on the highly finished surfaces.

b) Caustic Soda - Dissolve 55 g (2 oz) of caustic soda in 0,5 litre (1 pint) of water (11% concentration by weight), and add 15 g (0,5 oz) of non-foaming detergent. Place the nozzle in the solution and boil for at least 1 hour but not more than 1.5 hours.

CAUTION: A CONCENTRATION OF CAUSTIC SODA OF MORE THAN 15% MAY CAUSE ROUGHENING OF IMPORTANT SURFACES OF THE NOZZLE AND THUS MAKE THE INJECTOR UNSERVICEABLE. TO PREVENT THIS OCCURRING, AS A RESULT OF EVAPORATION, HOT WATER SHOULD BE ADDED PERIODICALLY TO THE BOILING SOLUTION TO MAINTAIN, OR SLIGHTLY EXCEED, ITS ORIGINAL LEVEL.

4. After treatment, remove the nozzle from the solution and wash it in running water to remove all traces of caustic soda. After washing, immerse the nozzle in a de-watering oil and remove the surplus by draining.

* If it was necessary to use one of the solvents it may still be necessary to remove particles of softened carbon lodging in recesses or corners with the tool kit.

6. An additional aid to cleaning the nozzle interior is the self contained nozzle 'Multiclean' machine (TOOL NO. HH013).

7. Using the 'Probelight' kit (TOOL NO. ANR6) and the Nozzle Viewer (TOOL NO. HH103), (Fig. 89) carefully examine the nozzle and needle seat. If the seats are ridged, pitted or discoloured due to overheating, and it is decided to recondition the existing nozzle and needle rather than use new parts, either Lucas CAV or Leslie Hartridge Ltd., should be consulted since this work is highly specialised.

8. Check the spring for breaking or cracks in the wire. Inspect all the remaining parts for excessive wear and damage and replace with new parts as necessary.

9. With the nozzles held at 45° from the vertical, lift the needle valve 7 mm (0,28 in) from its seat. Check that it is free to fall back to its seat, under its own weight, when it is wet with test oil. After having been pressed home by hand in any one position, the needle must also be free to fall from its seat when the nozzle is inverted and still inclined at the same angle from the vertical.

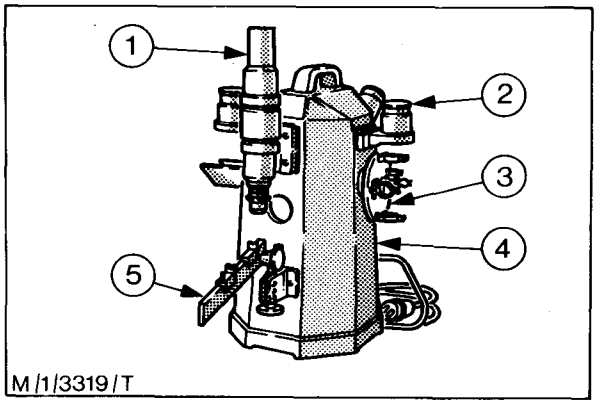


Fig. 89 - Nozzle Viewer (Tool No. HH 103)
1. Needle Microscope
2. Nozzle Viewer
3. Nozzle Holder
4. Light Projector
5. Needle Holder

ASSEMBLY

NOTE: Rinse all the injector parts in clean test oil before reassembly, but DO NOT dry them. All the parts must remain wet during reassembly. On no account must rag or absorbent paper be allowed to come into contact with the injector parts.

1. Place the injector holder on the dismantling jig and place the original pressure adjusting shims in the spring recess in the holder followed by the spring. Place the spring seat, the spacer and the nozzle assembly in position (ensuring that the dowels engage correctly), screw on the retaining nut and tighten to the specified torque using the socket (TOOL NO. CT 9009).

2. After assembly, if the injector is not to be tested and adjusted immediately, fit the union connectors and the nozzle with dust caps.

TESTING AND ADJUSTMENT

⚠ WARNING: WHEN TESTING INJECTORS, GREAT CARE SHOULD BE TAKEN TO ENSURE THAT THE ATOMISED SPRAY FROM THE NOZZLE DOES NOT COME INTO CONTACT WITH THE HANDS OR ANY OTHER PART OF THE BODY. THE HIGH PRESSURES INVOLVED WITH THE ATOMISATION OF THE TEST OIL MAY CAUSE IT TO PENETRATE THE SKIN AND CAUSE POSSIBLE BLOOD POISONING. GOGGLES, GLOVES AND SUITABLE PROTECTIVE CLOTHING SHOULD BE WORN DURING TESTING.

NOTES: New or reconditioned injectors that have previously been tested and adjusted and have subsequently been stored, must always be tested for opening pressure and spray condition, irrespective of their shelf life, before fitting to an engine.

The test machine (Fig. 90) must be maintained, in accordance with the manufacturer's operating manual.

Before testing injectors for opening pressure or back leak, close the pressure gauge isolating valve and then open it one quarter of a turn (90°). This will act as a damper and prevent the gauge needle from oscillating too violently. With this dampening effect, it is still difficult to make an accurate reading as to when the nozzle actually 'bursts'. The best method is to depress the machine handle to build up pressure slowly, watch the gauge carefully and note the highest pressure on the gauge just before the injection 'bursts'.

When flushing and settling the injector needle and spring or when testing the injector spray condition and pattern, always close the pressure gauge isolating valve to (i) protect and prolong the life of the gauge, (ii) prevent the oscillating gauge affecting the spray pattern.

If the injector does not pass one or more of the following tests, it must be dismantled, checked, reassembled and retested. If the injector fails one or more of the tests for a second time it must be scrapped.

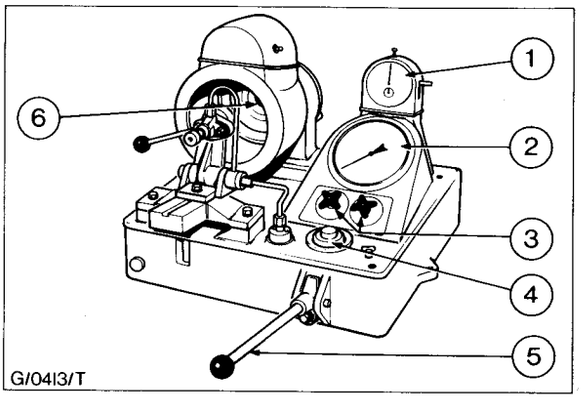


Fig. 90 - Nozzle Tester (Hartridge Testmaster)
1. Back Leakage Timer
2. Pressure Gauge
3. Pressure and Flow Control Valves
4. Paper Filter Element
5. Pump Handle
6. Spray Chamber

Pressure Setting

1. Remove the blanking cap, if fitted, from the injector high pressure union and the nozzle and place the injector on the test machine mounting bracket (TOOL NO. HH 601). Connect the high pressure pipe and tighten the union nut securely. Open the test oil flow control valve on the machine one full turn. Switch on the spray chamber light and extractor fan.

2. Quickly operate the pump handle several times to flush the injector and to settle the spring and needle.

3. Pump the machine handle and slowly turn the test oil flow control valve on the machine towards the closed position until the flow is just sufficient to produce a well atomised spray.

4. Pump the machine handle and note the opening pressure registered on the gauge. If the injector is not opening at the specified pressure, remove the injector from the test machine.

5. Dismantle the injector and change the pressure adjusting shim. A thicker shim will increase the opening pressure, a thinner shim will reduce the pressure. A change of shim thickness of 0,01 mm (0,0004 in) will make a change in pressure of approximately 1 bar (1 kg/cm^2 14,5 lbs/in^2). Reassemble the injector and retest. Repeat this procedure on a 'trial and error' basis until the nozzle opening pressure is within the specified tolerance.

Spray Pattern

NOTE: The pumping rate on the test machine handle is very important when testing spray pattern. The handle should be pumped at a rate of 1 to 2 down strokes per second.

1. Pump the machine handle and observe the spray from the injector. For correct functioning it is essential that the injector 'chatters' throughout the entire period of spraying.

2. The spray from the four holes in the nozzle must be equal in shape, size and intensity. The spray must also be free from hosing, streaks and softness.

Back Leak Test

1. Press down on the pumping handle slowly until the specified back leak test upper pressure is obtained. Take the hand off the pumping handle and start the timer while the gauge is still registering the upper pressure. Measure the time taken for the pressure to fall to the specified lower pressure. The time taken for this fall in pressure should be within the specified tolerance.

2. If the back leak time is greater than the specified value, this could indicate that the needle to nozzle clearance is too tight and the needle may seize if this nozzle assembly is used in an engine, change for another nozzle assembly and retest.

3. If the back leak time is less than the specified value first check for external leaks, such as at the pipe union connection and the nozzle to holder sealing face, also check the nozzle retaining nut torque. Next carry out the nozzle seat leakage test. If this test proves negative, then the cause is probably too much clearance between the needle and nozzle, change for another nozzle assembly and retest.

Nozzle Seat Leakage Test

1. Ensure that the spray chamber extractor fan is switched off.

2. Wipe the nozzle tip with absorbent paper or non-fluffy cloth to ensure that the nozzle is completely dry. Push down on the pump handle slowly to raise the pressure to 10 bar (145 lb/in^2) below the specified nozzle opening pressure and continue to push down on the handle sufficient to maintain the pressure steady at this value for 6 seconds. After this time nozzle dampness is permissible but if any visible droplet forms the injector has failed this particular test.

NOTE: Failure in this test indicates poor sealing between the needle and nozzle seats. This could be caused by, foreign matter trapped on the seat, incorrect seat angles, non-concentric seats or damaged seat faces.

3. Remove the injector from the test machine. If the injector has passed all the tests satisfactorily and is not to be fitted to an engine immediately, replace the dust caps on the high pressure union connection and on the nozzle.

SPECIFICATIONS

INJECTION PUMPS - TESTING

Pump rotation (all types) - clockwise viewed from the drive end

Lubricant quantities for test stand operation only:
4 and 6 cylinder pumps 0,40 litre (0,70 pint)

Unless stated otherwise, all fuel delivery figures are taken over 200 shots.

PHASING

PUMP REFERENCE NO.	Phasing - stroke to close the inlet port (mm) Initial Setting	In Service Check	Phase Angle Tolerance	Start Retard Angle Setting Master Element	Start Retard Angle Check (after Calibration)	Timing Tolerance (No. 1 Element at Spill Cut-Off to Entry of Timing Tool)
P5510/2	2,9 to 3,1	2,85 to 3,15	±1°	-	-	± 1/2°
P5513/2	2,9 to 3,1	2,85 to 3,15	±1°	-	-	± 1/2°
P5537/A	2,9 to 3,1	2,85 to 3,15	±1°	3° Min.	3° Min. (No. 4)	± 1/2°
P5485/3	2,9 to 3,1	2,85 to 3,15	±1°	1,3° to 1,7°	1° to 2° all elements	± 1/2°
P5515/2	2,9 to 3,1	2,85 to 3,15	±1°	-	-	± 1/2°
P5538/A	2,9 to 3,1	2,85 to 3,15	±1°	3° Min.	3° Min. (No. 6)	± 1/2°
P5486/2	2,9 to 3,1	2,85 to 3,15	±1°	1,3° to 1,7°	1° to 2° all elements	± 1/2°
P5542	2,9 to 3,1	2,85 to 3,15	±1°	3° Min.	3° Min. (No. 6)	± 1/2°
P5519/2	2,9 to 3,1	2,85 to 3,15	±1°	-	-	± 1/2°
P5520/2	2,9 to 3,1	2,85 to 3,15	±1°	-	-	± 1/2°
P5539/A	2,9 to 3,1	2,85 to 3,15	±1°	3° Min.	3° (No. 6)	± 1/2°
P5487/3	2,9 to 3,1	2,85 to 3,15	±1°	1,3° to 1,7°	1° to 2° all elements	± 1/2°
P5543	2,9 to 3,1	2,85 to 3,15	±1°	3° Min.	3° Min. (No. 6)	± 1/2°
P5523/2	2,9 to 3,1	2,85 to 3,15	±1°	-	-	± 1/2°
P5540/A	2,9 to 3,1	2,85 to 3,15	±1°	3° Min.	3° Min.	± 1/2°
P5488/2	2,9 to 3,1	2,85 to 3,15	±1°	2,3° to 2,7°	2° to 3° all elements	± 1/2°
P5488/2E	2,9 to 3,1	2,85 to 3,15	±1°	2,3° to 2,7°	2° to 3° all elements	± 1/2°
P5525/2	2,9 to 3,1	2,85 to 3,15	±1°	-	-	± 1/2°

CALIBRATION

PUMP REFERENCE NO.	In-Service Check Maximum Boost Pressure Bar	In-Service Check Maximum Boost Pressure lbf/in²	Maximum Fuel Delivery from Master Element. On Boost Control Pumps Maximum Boost Pressure to be Applied	Maximum Spread on other Lines	Increase in Average Max. Fuel Delivery Compared to Average Max. Fuel Delivery at Lower Speed. On Boost Control Pumps, Maximum Boost Pressure to be Applied	Maximum Spread on any Line	Average Maximum Fuel Delivery on Boost Control Pumps with Boost Pressure Set to Zero
P5510/2	-	-	10,4 to 10,6 cc at 600 rpm	1,0 cc	3,0 to 4,2 cc at 1200 rpm	1,3 cc	-
P5513/2	-	-	14,3 to 14,5 cc at 600 rpm	1,0 cc	2,4 to 3,6 cc at 1200 rpm	1,3 cc	-
P5537/A	-	-	13,7 to 13,9 cc at 700 rpm	1,0 cc	-	-	-
P5485/3	-	-	11,1 to 11,3 cc at 600 rpm	1,0 cc	2,8 to 4,0 cc at 1200 rpm	1,3 cc	-
P5515/2	-	-	8,5 to 8,7 cc at 600 rpm	1,0 cc	3,3 to 4,5 cc at 1200 rpm	1,3 cc	-
P5538/A	-	-	10,6 to 10,8 cc at 700 rpm	1,0 cc	-	-	-
P5486/2	-	-	7,4 to 7,6 cc at 600 rpm	1,0 cc	3,4 to 3,6 cc at 1200 rpm	1,3 cc	-
P5542	-	-	13,2 to 13,4 cc at 1100 rpm	1,0 cc	-	-	-
P5519/2	-	-	10,8 to 11,0 cc at 600 rpm	1,0 cc	3,7 to 4,9 cc at 1200 rpm	1,3 cc	-
P5520/2	-	-	11,8 to 12,0 cc at 600 rpm	1,0 cc	2,6 to 3,8 cc at 1200 rpm	1,3 cc	-
P5539/A	-	-	13,7 to 13,9 cc at 700 rpm	1,0 cc	-	-	-
P5487/3	-	-	9,5 to 9,7 cc at 600 rpm	1,0 cc	3,9 to 5,1 cc at 1200 rpm	1,3 cc	-
P5543	-	-	14,2 to 14,4 cc at 1100 rpm	1,0 cc	-	-	-
P5523/2	-	-	12,8 to 13,0 cc at 600 rpm	1,0 cc	3,3 to 4,5 cc at 1150 rpm	1,3 cc	-
P5540/A	-	-	13,9 to 14,1 cc at 700 rpm	1,0 cc	-	-	-
P5488/2	0,93	13,5	14,3 to 14,5 cc at 600 rpm	1,0 cc	1,3 to 2,5 cc at 1150 rpm	1,3 cc	9,1 to 9,9 cc at 600 rpm
P5488/2E	0,93	13,5	14,3 to 14,5 cc at 600 rpm	1,0 cc	1,3 to 2,5 cc at 1150 rpm	1,3 cc	9,1 to 9,9 cc at 600 rpm
P5525/2	0,93	13,5	18,4 to 18,6 cc at 600 rpm	1,0 cc	0,8 to 2,0 cc at 1150 rpm	1,3 cc	8,8 to 10,0 cc at 600 rpm

CALIBRATION

PUMP REFERENCE NO.	Initial Setting Maximum Boost Pressure		Maximum Fuel Delivery from Master Element. On Boost Control Pumps Maximum Boost Pressure to be Applied	Maximum Spread on other Lines	Average Maximum Fuel Delivery on Boost Control Pumps with Boost Pressure Set to Zero	Average Fuel Delivery on Boost Control Pumps with Boost Pressure Set at 0,45 to 0,46 Bar (6,48 to 6,67 lbf/in^2)
	Bar	lbf/in^2				
P5510/2	-	-	10,4 to 10,6 cc at 600 rpm	0,2 cc	-	-
P5513/2	-	-	14,3 to 14,5 cc at 600 rpm	0,2 cc	-	-
P5537/A	-	-	13,7 to 13,9 cc at 700 rpm	0,2 cc	-	-
P5485/3	-	-	11,1 to 11,3 cc at 600 rpm	0,2 cc	-	-
P5515/2	-	-	8,5 to 8,7 cc at 600 rpm	0,2 cc	-	-
P5538/A	-	-	10,6 to 10,8 cc at 700 rpm	0,2 cc	-	-
P5486/2	-	-	7,4 to 7,6 cc at 600 rpm	0,2 cc	-	-
P5542	-	-	13,2 to 13,4 cc at 1100 rpm	0,2 cc	-	-
P5519/2	-	-	10,8 to 11,0 cc at 600 rpm	0,2 cc	-	-
P5520/2	-	-	11,8 to 12,0 cc at 600 rpm	0,2 cc	-	-
P5539/A	-	-	13,7 to 13,9 cc at 700 rpm	0,2 cc	-	-
P5487/3	-	-	9,5 to 9,7 cc at 600 rpm	0,2 cc	-	-
P5543	-	-	14,2 to 14,4 cc at 1100 rpm	0,2 cc	-	-
P5523/2	-	-	12,8 to 13,0 cc at 600 rpm	0,2 cc	-	-
P5540/A	-	-	13,9 to 14,1 cc at 700 rpm	0,2 cc	-	-
P5488/2	0,93	13,5	14,3 to 14,5 cc at 600 rpm	0,2 cc	9,1 to 9,9 cc at 600 rpm	-
P5488/2E	0,93	13,5	14,3 to 14,5 cc at 600 rpm	0,2 cc	9,1 to 9,9 cc at 600 rpm	-
P5525/2	0,93	13,5	18,4 to 18,6 cc at 600 rpm	0,2 cc	8,8 to 10,0 cc at 600 rpm	14,0 to 15,0 cc at 900 rpm

GOVERNOR SETTING

PUMP REFERENCE NUMBER	In-Service Checks Maximum Boost Pressure bar	lbf/in^2	Average Fuel Delivery On Boost Control Pumps Maximum Boost Pressure to be Applied	Average Fuel Delivery On Boost Control Pumps Maximum Boost Pressure to be Applied	Average Fuel Delivery On Boost Control Pumps, Maximum Boost Pressure to be Applied
P5510/2	-	-	3,0 cc at 1340 rpm	12,0 cc at 1270 to 1310 rpm	13,8 to 15,0 cc at 1250 rpm
P5513/2	-	-	3,0 cc at 1410 rpm	14,0 cc at 1330 to 1370 rpm	16,4 to 17,6 cc at 1300 rpm
P5537/A	-	-	2,0 cc at 940 rpm	12,0 cc at 910 to 930 rpm	13,6 to 14,4 cc at 900 rpm
P5485/3	-	-	3,0 cc at 1460 rpm	12,0 cc at 1340 to 1400 rpm	13,8 to 15,0 cc at 1300 rpm
P5515/2	-	-	3,0 cc at 1340 rpm	10,0 cc at 1270 to 1310 rpm	11,8 to 13,0 cc at 1250 rpm
P5538/A	-	-	2,0 cc at 945 rpm	10,0 cc at 910 to 930 rpm	11,2 to 12,0 cc at 900 rpm
P5486/2	-	-	3,0 cc at 1440 rpm	10,0 cc at 1340 to 1400 rpm	11,2 to 12,4 cc at 1300 rpm
P5542	-	-	2,0 cc at 1310 rpm	12,0 cc at 1270 to 1290 rpm	13,8 to 14,6 cc at 1250 rpm
P5519/2	-	-	3,0 cc at 1340 rpm	12,0 cc at 1270 to 1310 rpm	14,5 to 15,7 cc at 1250 rpm
P5520/2	-	-	3,0 cc at 1420 rpm	14,0 cc at 1340 to 1380 rpm	14,6 to 15,8 cc at 1300 rpm
P5539/A	-	-	2,0 cc at 950 rpm	12,0 cc at 910 to 930 rpm	13,6 to 14,4 cc at 900 rpm
P5487/3	-	-	3,0 cc at 1470 rpm	12,0 cc at 1340 to 1400 rpm	13,6 to 14,8 cc at 1300 rpm
P5543	-	-	2,0 cc at 1320 rpm	12,0 cc at 1270 to 1290 rpm	14,7 to 15,5 cc at 1250 rpm
P5523/2	-	-	3,0 cc at 1310 rpm	16,0 cc at 1230 to 1270 rpm	16,5 to 17,7 cc at 1200 rpm
P5540/A	-	-	2,0 cc at 945 rpm	12,0 cc at 905 to 925 rpm	13,7 to 14,5 cc at 900 rpm
P5488/2	0,93	13,5	3,0 cc at 1350 rpm	13,0 cc at 1240 to 1300 rpm	15,7 to 16,9 cc at 1200 rpm
P5488/2E	0,93	13,5	3,0 cc at 1350 rpm	13,0 cc at 1240 to 1300 rpm	15,7 to 16,9 cc at 1200 rpm
P5525/2	0,93	13,5	4,0 cc at 1400 rpm	18,0 cc at 1270 to 1330 rpm	19,3 to 20,5 cc at 1225 rpm

PUMP REFERENCE NUMBER	GOVERNOR SETTING			EXCESS FUEL BAULKING DEVICE CHECK	EXCESS FUEL CHECK		IDLE SPEED FUEL DELIVERY SETTING	
	Initial Speed (Fuel Delivery Ceases)	Setting Speed (Control Rod Starts to Move)	Checking Speed (Control Rod Against Maximum Fuel Stop)	Maximum Average Fuel Delivery	Average Fuel Delivery (200 Shots)	Average Fuel Delivery (100 Shots)	Average Fuel Delivery	Maximum Line Spread
P5510/2	1380 rpm	1310 rpm	1260 rpm	-	-	8,5 to 10,5 cc at 50 rpm	3,0 to 4,0 cc at 300 rpm	1,6 cc
P5513/2	1460 rpm	1360 rpm	1320 rpm	-	-	8,5 to 10,5 cc at 50 rpm	3,0 to 4,0 cc at 300 rpm	1,6 cc
P5537/A	970 rpm	930 rpm	900 rpm	13,7 cc at 700 rpm	17,5 cc min. at 100 rpm	-	2,0 to 4,0 cc at 500 rpm	1,6 cc
P5485/3	1520 rpm	1420 rpm	1350 rpm	-	-	7,5 to 9,5 cc at 50 rpm	3,0 to 4,0 cc at 325 rpm	1,6 cc
P5515/2	1380 rpm	1300 rpm	1250 rpm	-	-	8,5 to 10,5 cc at 50 rpm	3,0 to 4,0 cc at 300 rpm	1,6 cc
P5538/A	970 rpm	930 rpm	910 rpm	10,6 cc at 700 rpm	17,5 cc min. at 100 rpm	-	2,0 to 4,0 cc at 500 rpm	1,6 cc
P5486/2	1510 rpm	1420 rpm	1350 rpm	-	-	7,5 to 9,5 cc at 50 rpm	3,0 to 4,0 cc at 325 rpm	1,6 cc
P5542	1350 rpm	1280 rpm	1250 rpm	13,2 cc at 1100 rpm	17,5 cc min. at 100 rpm	-	2,0 to 4,0 cc at 600 rpm	1,6 cc
P5519/2	1385 rpm	1300 rpm	1260 rpm	-	-	8,5 to 10,5 cc at 50 rpm	3,0 to 4,0 cc at 300 rpm	1,6 cc
P5520/2	1445 rpm	1360 rpm	1310 rpm	-	-	8,5 to 10,5 cc at 50 rpm	3,0 to 4,0 cc at 300 rpm	1,6 cc
P5539/A	970 rpm	935 rpm	910 rpm	13,7 cc at 700 rpm	17,5 cc min. at 100 rpm	-	2,0 to 4,0 cc at 500 rpm	1,6 cc
P5487/3	1530 rpm	1420 rpm	1350 rpm	-	-	7,5 to 9,5 cc at 50 rpm	3,0 to 4,0 cc at 325 rpm	1,6 cc
P5543	1365 rpm	1290 rpm	1250 rpm	14,2 cc at 1100 rpm	17,5 cc min. at 100 rpm	-	2,0 to 4,0 cc at 600 rpm	1,6 cc
P5523/2	1340 rpm	1250 rpm	1210 rpm	-	-	8,5 to 10,5 cc at 50 rpm	3,0 to 4,0 cc at 300 rpm	1,6 cc
P5540/A	975 rpm	925 rpm	900 rpm	13,9 cc at 700 rpm	17,5 cc min. at 100 rpm	-	2,0 to 4,0 cc at 500 rpm	1,6 cc
P5488/2	1410 rpm	1290 rpm	1220 rpm	-	-	7,5 to 9,5 cc at 50 rpm	3,0 to 4,0 cc at 325 rpm	1,6 cc
P5488/2E	1410 rpm	1290 rpm	1220 rpm	-	-	7,5 to 9,5 cc at 50 rpm	3,0 to 4,0 cc at 325 rpm	1,6 cc
P5525/2	1430 rpm	1320 rpm	1250 rpm	-	-	8,5 to 10,5 cc at 50 rpm	3,0 to 4,0 cc at 325 rpm	1,6 cc

PUMP REFERENCE NUMBER	STOP CONTROL CHECK Maximum Fuelling Re-Start Time after Stop Control Operated	FUEL CUT-OFF CHECK Maximum Fuel Delivery from any Line in 600 Shots
P5510/2	2 secs. at 300 rpm	1,0 cc at 1500 rpm
P5513/2	2 secs. at 300 rpm	1,0 cc at 1500 rpm
P5537/A	2 secs. at 400 rpm	1,0 cc at 1100 rpm
P5485/3	2 secs. at 325 rpm	1,0 cc at 1600 rpm
P5515/2	2 secs. at 300 rpm	1,0 cc at 1500 rpm
P5538/A	2 secs. at 400 rpm	1,0 cc at 1100 rpm
P5486/2	2 secs. at 325 rpm	1,0 cc at 1600 rpm
P5542	2 secs. at 500 rpm	1,0 cc at 1450 rpm
P5519/2	2 secs. at 300 rpm	1,0 cc at 1500 rpm
P5520/2	2 secs. at 300 rpm	1,0 cc at 1600 rpm
P5539/A	2 secs. at 400 rpm	1,0 cc at 1100 rpm
P5487/3	2 secs. at 325 rpm	1,0 cc at 1600 rpm
P5543	2 secs. at 500 rpm	1,0 cc at 1450 rpm
P5523/2	2 secs. at 300 rpm	1,0 cc at 1500 rpm
P5540/A	2 secs. at 400 rpm	1,0 cc at 1100 rpm
P5488/2	2 secs. at 325 rpm	1,0 cc at 1500 rpm
P5488/2E	2 secs. at 325 rpm	1,0 cc at 1500 rpm
P5525/2	2 secs. at 325 rpm	1,0 cc at 1500 rpm

INJECTION PUMPS - OVERHAUL

Pump lubricant	Ford Specification SM-2C-1017A
Total cam lift (Nominal)	
Dorset	7,0 mm (0,28 in)
Dover	9,0 mm (0,35 in)
Plunger diameter (Nominal)	
Dorset (Combine governing)	9,0 mm (0,35 in)
Dorset (Class 'A' governing)	8,0 mm (0,315 in)
Dover	9,0 mm (0,35 in)
Camshaft end-float (all pumps)	0,05 to 0,13 mm (0,002 to 0,005 in)
End float adjusting shim sizes	0,1 and 0,2 mm (0,004 and 0,008 in)
Plunger arm clearance (all pumps)	0,05 to 0,20 mm (0,002 to 0,008 in)

Governor Setting Dimensions

Dimension X				Thrust Collar No.	
Dorset		Dover		Dorset	Dover
mm	in	mm	in		
31,10 31,50	1,224 1,240	32,90 33,24	1,295 1,309	2	1
31,51 32,00	1,241 1,260	33,25 33,59	1,309 1,322	3	2
32,01 32,50	1,260 1,280	33,60 33,99	1,323 1,338	4	3
32,51 33,00	1,280 1,299	34,00 34,44	1,339 1,356	5	4
33,01 33,50	1,300 1,319	34,45 34,79	1,356 1,370	6	1 + 1
-	-	34,80 35,14	1,370 1,383	-	1 + 2
-	-	35,15 35,49	1,384 1,397	-	1 + 3 or 2 + 2
-	-	35,50 35,84	1,398 1,411	-	1 + 4 or 2 + 3
-	-	35,85 36,19	1,411 1,425	-	2 + 4 or 3 + 3
-	-	36,20 36,54	1,425 1,439	-	3 + 4

Dimension Y

Dorset	19,90 to 20,60 mm (0,783 to 0,811 in)
Dover	20,00 to 20,70 mm (0,787 to 0,815 in)

Dorset Pumps Only

Dimension A		Spacer Ring Number	Packing Colour
mm	*in*		
7,50 7,75	0,295 0,305	505353	Red
7,76 8,00	0,306 0,315	505354	White
8,01 8,25	0,315 0,325	505355	Blue
8,26 8,50	0,325 0,335	505356	Yellow
8,51 8,75	0,335 0,344	505357	Green
8,76 9,00	0,345 0,354	505358	Orange
9,01 9,25	0,355 0,364	505359	Purple

Dimension B

Dorset	5,90 to 6,20 mm (0,232 to 0,244 in)
Dover	6,50 to 6,80 mm (0,256 to 0,268 in)

Boost Control Unit - Overhaul

Anti-scuffing paste	SAM 1C 9017 A
Diaphragm powder	Molykote Z

INJECTORS - OVERHAUL

Spray hole diameter

Naturally aspirated	0,30 mm (0,0118 in)
Turbocharged	0,33 mm (0,0130 in)

INJECTORS - TESTING

NOTE: For the purposes of this Workshop Manual with respect to pressure setting:

Category A injectors are new injectors, or reconditioned injectors fitted with a new spring, that have had a maximum of 10 hours running time in an engine.

Category B injectors are new injectors, reconditioned injectors or used injectors removed from a vehicle in service, all of which have run in an engine for more than 10 hours.

Pressure Setting	Bar	kg/cm^2	lb/in^2
Category A Injectors			
Naturally Aspirated and Turbocharged	208 to 218	212 to 222	3017 to 3162
Category B Injectors			
Naturally Aspirated and Turbocharged	198 to 208	202 to 212	2872 to 3017

Range of Adjusting Shim Thicknesses

mm	in	mm	in	mm	in	mm	in
0,30	0,0118	0,50	0,0197	0,62	0,0244	1,28	0,0504
0,41	0,0161	0,53	0,0209	0,65	0,0256	1,58	0,0622
0,44	0,0173	0,56	0,0220	0,68	0,0268		
0,47	0,0185	0,59	0,0232	0,98	0,0386		

Back Leak Time

For a fall in pressure from 150 to 100 bar (153 to 102 kg/cm^2; 2175 to 1450 lb/in^2) 6 to 30 seconds

Ambient temperature/back leak time correction chart

Ambient Temperature		Corrected Time in Seconds	
°C	°F		
10	50	7 to 34,5	
16	60	6 to 30	Nominal
21	70	5,5 to 27	
27	80	5 to 24	
32	90	4,5 to 21	

TIGHTENING TORQUES (Clean threads slightly oiled)	Injection Equip. Dover	Injection Equip. Dorset	Nm	kgf m	lbf ft
Injection Pumps					
Drive gear bolts	*		20 to 25	2,0 to 2,5	15 to 18
Drive hub nuts	*		60 to 65	6,1 to 6,6	44 to 48
Drive gear nut		*	59 to 69	6,1 to 7,0	43 to 51
Front mounting flange - large bolts	*	*	16 to 20	1,66 to 2,06	12 to 15
- small bolts	*	*	5,5 to 8	0,56 to 0,82	5 to 6
Pump body to cambox - Allen screws	*	*	7,0 to 8,0	0,70 to 0,80	5 to 6
Delivery valve holder	*	*	52 to 57	5,3 to 5,8	38 to 42
Delivery valve holder locking device - screws	*	*	5,5 to 8	0,56 to 0,82	5 to 6
Governor weights assembly/Governor hub carrier bolts		*	11 to 12	1,12 to 1,22	8 to 9
Governor ramp - bolts	*	*	2,5 to 4	0,26 to 0,40	24 to 36 lb.in.
Governor spring shaft/excess fuel bracket - lock nut		*	16,5 to 20	1,68 to 2,06	12 to 15
Excess fuel/stop control shaft - capnut		*	16,5 to 20	1,68 to 2,06	12 to 15
Rocking lever pivot shaft - bolts	*	*	2,5 to 4	0,26 to 0,40	24 to 36 lb.in.
Timing plug		*	34 to 41	3,5 to 4,2	25 to 30
Control rod fork - locking screws	*	*	2 to 3,5	0,22 to 0,36	18 to 30 lb.in.
Control rod - capnut	*	*	11 to 13,5	1,2 to 1,3	8 to 10
Control rod damper sleeve	*	*	16,5 to 20	1,68 to 2,06	12 to 15
Control rod damper adjusting screw - locknut	*	*	7 to 9,5	0,70 to 0,96	5 to 7
Side cover - bolts	*	*	8 to 11	0,82 to 1,12	6 to 8
Side cover retainer - locking bolts		*	2,5 to 5,5	0,26 to 0,56	24 to 48 lb.in.
Fuel gallery - inlet union	*	*	34 to 41	3,5 to 4,2	25 to 30
Fuel gallery - bleed union	*	*	34 to 41	3,5 to 4,2	25 to 30
Pinch bolts - stop lever, governor control inner and outer levers and quadrant	*	*	2,5 to 4	0,26 to 0,40	24 to 36 lb.in.
Fuel/speed adjusting screws - locknut	*	*	16 to 20	1,64 to 2,06	12 to 15
Cambox drain plug		*	11 to 13,5	1,1 to 1,4	8 to 10
Oil filler/level plug		*	8 to 10,5	0,84 to 1,10	6 to 8
Side cover oil filler plug (turbocharged pumps)	*		8 to 10,5	0,84 to 1,10	6 to 8
Injector pipe union nuts	*	*	17 to 20	1,7 to 2,0	13 to 15
Boost Control Unit					
Boost control unit to governor housing - bolts	*		7,0 to 9,5	0,70 to 0,95	5 to 7
Injectors					
Nozzle retaining nut	*		43 to 53	4,38 to 5,40	32 to 39
Injector retaining bolts	*		17 to 22	1,8 to 2,2	12 to 16