FUEL SYSTEM

Final Fuel Filter

The final fuel filter is mounted on the front left hand side of the cylinder head.

It is of the screw-on canister type where the filtering element is an integral part of the canister.

To Renew Element of Final Fuel Filter

1. Thoroughly clean the filter assembly.
2. Unscrew the canister (Fig. 1) by hand or, if necessary, by using a suitable wrench.

   Discard the canister.
3. Apply clean fuel oil to the top seal of the replacement canister.
4. Screw on the replacement canister until the seal just touches the filter head and then tighten by hand a further two thirds of a turn.
5. Bleed the fuel system as detailed later, and then run the engine and check for leaks.

Fuel Lift Pump

The fuel lift pump is a mechanical diaphragm type pump mounted on the right hand side of the engine and driven by an eccentric on the engine camshaft.

To Remove and Fit Fuel Lift Pump

1. Release top clamp of priming lever cable.
2. Disconnect inlet and outlet pipes at pump.
3. Remove pump from cylinder block.
4. Fit pump with new gasket.
5. Reconnect inlet and outlet pipes.
6. Bleed fuel system as detailed later.

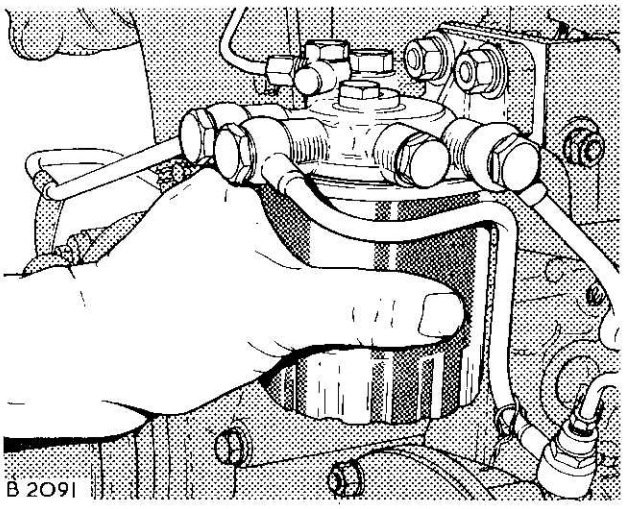


Fig. 1

To Dismantle Fuel Lift Pump (Fig. 2)

1. Clean exterior of pump and mark flanges of housing (3) and body (14) to ensure correct replacement.
2. Remove end cover (1) and pulsator diaphragm (2).
3. Remove valve clips (8) and valves (9).
4. Depress diaphragm (4) and unhook from rocker arm (7). Remove spring (10), seal retainer (11), and seal (12).

Lift Pump Inspection

Inspect the cover, housing and body for cracks or other damage and the flanges for distortion.

Check the valves for correct function and renew where necessary.

Check diaphragms for deterioration, cracks or other damage and renew where necessary.

To Assemble Fuel Lift Pump (Fig. 2)

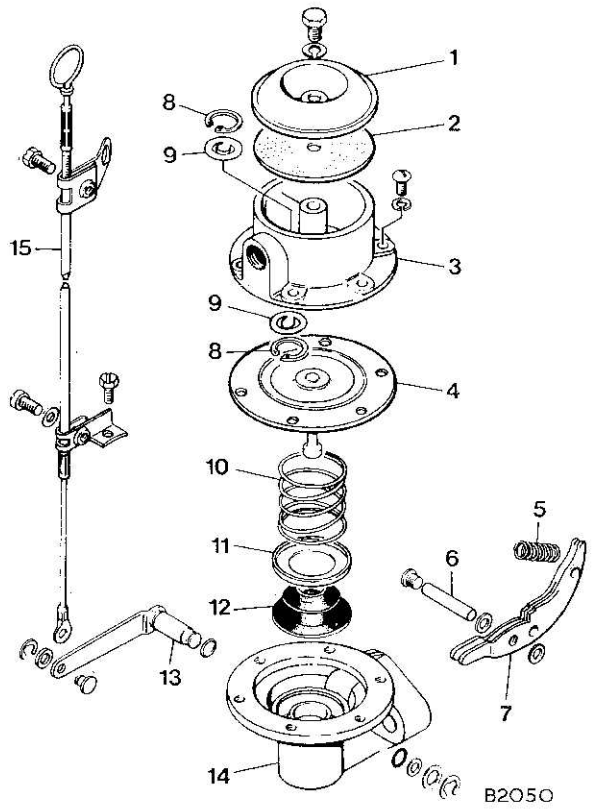
1. Fit new seal (12) in body (14).
2. Position spring retainer (11) and spring (10).

3. Pass spindle of diaphragm (4) through seal and hook on to rocker arm (7). Line up screw holes of diaphragm and body.

4. Position valves (9) in housing (3) and retain with circlips (8).

5. Position housing on body with location marks in line, press rocker arm so that diaphragm is flush with edge of flanges and secure housing to body.

6. Fit pulsator diaphragm (2) and end cover (1).



1	COVER	9	VALVE
2	PULSATOR DIAPHRAGM	10	SPRING
3	HOUSING	11	RETAINER
4	DIAPHRAGM	12	SEAL
5	SPRING	13	PRIMING LEVER
6	PIN	14	BODY
7	ROCKER ARM		
8	CLIP		

Fig. 2

Fuel Injection Pump

The distributor type injection pump is fitted on the rear face of the timing case on the left hand side of the engine and is driven through an idler gear by the crankshaft gear.

The pump is lubricated by the fuel oil passing through it.

To Remove Fuel Injection Pump

1. Remove rocker cover and turn crankshaft until valves of No 6 cylinder are rocking (inlet valve opening and exhaust valve closing). This is to turn the pump drive shaft key towards the top so that it does not fall into the timing case.

2. Remove high pressure fuel pipes, marking pipes with respective cylinder numbers to simplify refitting.

3. Disconnect stop and speed controls from pump.

4. Remove pump inlet and return pipes.

5. If pump is to be refitted, ensure that there is a mark on the timing case that is in line with the mark on the pump flange (Fig. 3).

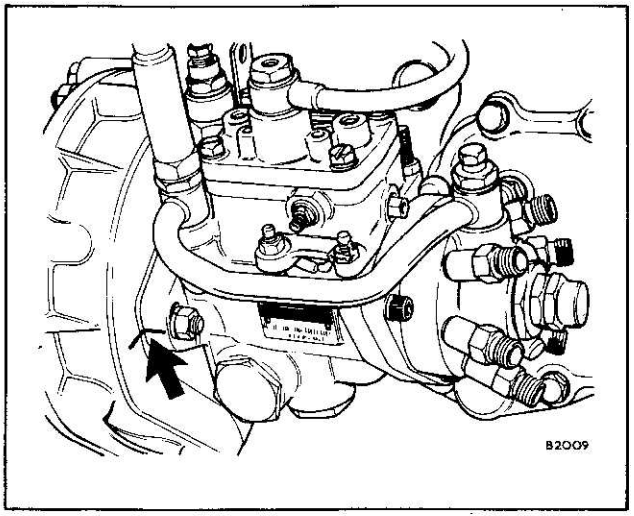


Fig. 3

6. Remove cover plate from timing cover and remove pump gear securing nut (Fig. 4).

7. Remove nuts securing pump to timing case.

8. Fit special extractor to pump gear and release pump gear (Fig. 5). Remove pump ensuring that key does not fall into timing case.

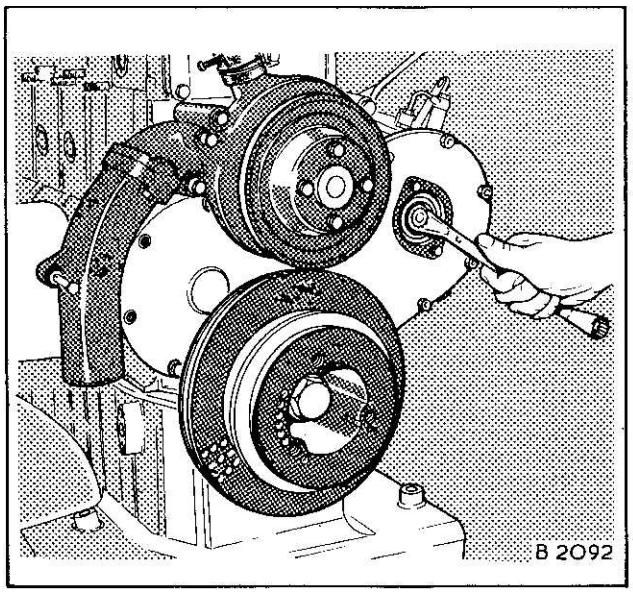


Fig. 4

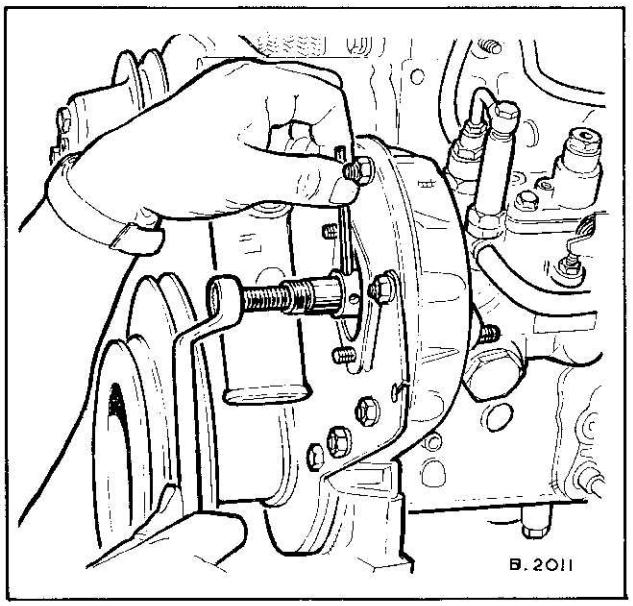


Fig. 5

To Fit Fuel Injection Pump

1. Turn pump shaft so that key is lined up with keyway in gear, pass shaft through gear and position pump on rear of timing case.

2. Fit gear to pump shaft and tighten nut to torque.

3. If refitting original pump, position pump with timing marks aligned (Fig. 3) and secure pump. If fitting new pump, time pump as detailed in A315.

4. Fit fuel pipes to pump. The relevant marked letters and cylinder numbers of the pump outlets are given in Fig. 6.

5. Fit stop and speed controls.

6. Bleed pump as detailed later.

7. Check slow running speed, as detailed below. If a new pump has been fitted, check maximum no load speed.

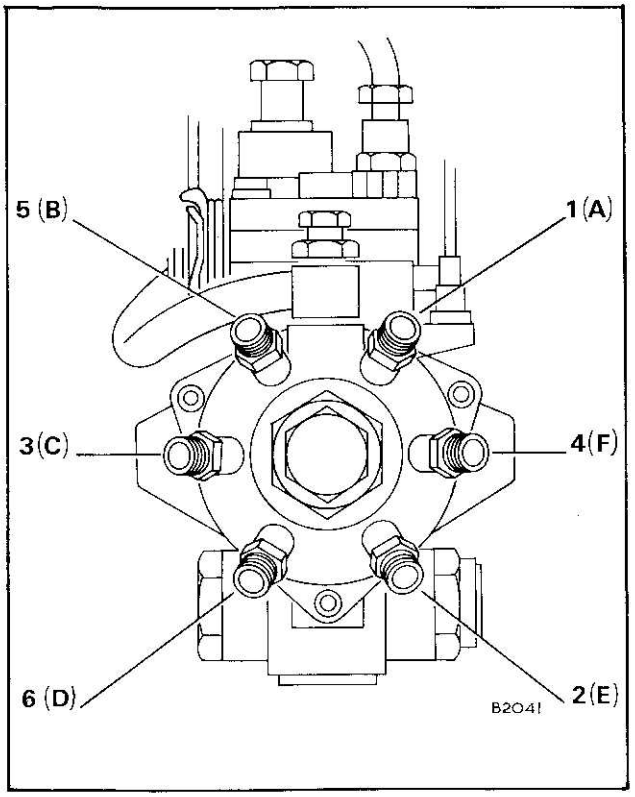


Fig. 6

To Adjust Slow Running Speed

With engine at normal working temperature, adjust slow running speed to 600/650 rev/min by the front adjustment screw of throttle lever (1), Fig. 7.

Release locknut and turn screw anti-clockwise to increase engine speed and clockwise to decrease speed. Secure adjusting screw by tightening locknut.

Maximum No Load Speed Adjustment

The maximum speed adjustment screw (2), Fig. 7, on original fuel pumps is sealed at the factory and should not be iterfered with. When fitting a replacement pump, however, the maximum no load speed should be checked and reset, where necessary.

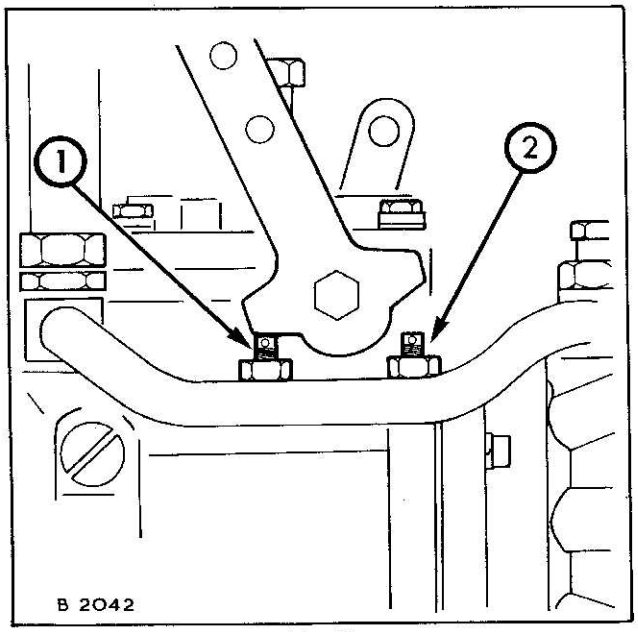


Fig. 7

With engine at normal operating temperature, release locknut and set engine maximum no load speed to 4050 rev/min. Turn screw clockwise to increase engine speed and anti-clockwise to decrease speed.

Secure adjusting screw by tightening locknut and seal screw.

Bleeding the Fuel System

Whenever the fuel filter element is renewed or the water trap cleaned, the filter should be bled as follows.—

1. Unscrew the vent plug, Fig. 8, on the top of the fuel filter by two or three turns.

2. Operate the fuel lift pump priming lever until fuel, free from air bubbles, issues from the filter vent point and then tighten the filter vent plug. If the fuel lift pump driving cam on the engine camshaft is on maximum lift, it will not be possible to operate the hand primer. If so, the crankshaft should be turned through one complete revolution.

Whenever air has entered the complete fuel system through running out of fuel, injection pump removal, etc., the system should be bled as follows:—

1. Bleed the fuel filter as detailed above.

2. Slacken the fuel injection pump vent plug, Fig. 9, and operate the priming lever cable until fuel, free from air bubbles, flows from the vent point and then tighten the vent plug.

3. Slacken the union at the injector end of one of the high pressure fuel pipes.

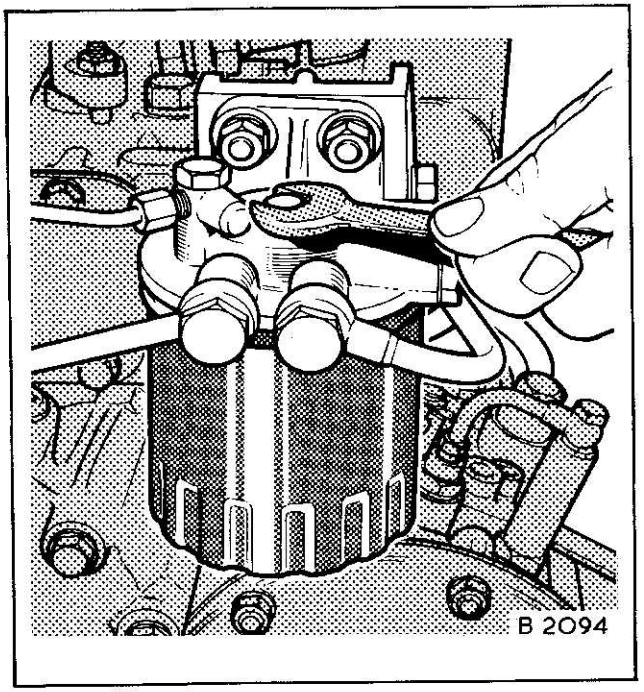


Fig. 8

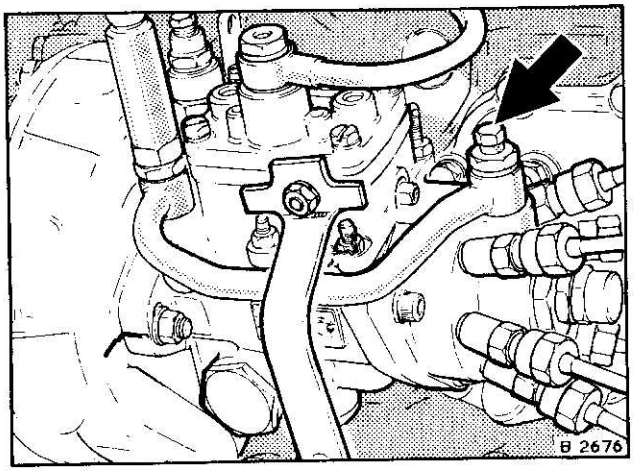


Fig. 9

4. Set the accelerator at the fully open position, ensure that the stop control (where fitted) is in the run position and crank the engine until fuel, free from air bubbles, flows from the pipe.

5. Tighten the union on the fuel pipe and the engine is ready for starting.

If, after bleeding the fuel system, the engine starts, runs satisfactorily for a few moments and then loses power, misfires or stops and when checked, the system is found to be full of air, then a leak on the suction side is indicated.

Injectors

A faulty injector may show itself as an intermittent or consistent misfire and can be detected by running the engine at fast idling speed and slackening off each injector high pressure pipe union in turn, taking particular notice of the note of the engine. The faulty injector will have little or no effect upon the engine note as the union is slackened off. Replace with a known good injector or service the injector as detailed later.

When replacing an injector, never bend the high pressure pipe between the injector and the fuel injection pump. The pipe should be loosened at the pump and any pipe clamp released before removing the injector. Release the injector by removing the two securing nuts and remove the injector and its seating washer. Fit the replacement injector with a new seating washer, position it squarely on its seat and secure it by tightening the two securing nuts down evenly to a final torque of 2,4 kgf m (17 lbf ft), giving each nut a slight turn at a time. Having fitted the injector and pipes, run the engine and check for any 'blowing' from the injector seat or any leaks at the pipe unions.

The data for the injectors will be found in 'Data'. When checking a used injector that has not been dismantled, an operating pressure between the 'Working Pressure' and the 'Setting Pressure' is satisfactory. No attempt should be made to reset the pressure unless the proper testing equipment is available.

Servicing Injectors

No attempt should be made to service the injectors unless the proper equipment is available.

Preparation

The most suitable bench for injector maintenance is one that is zinc, linoleum or plastic covered, absolutely free from dust, dirt, filings, grease or acids, where no other work is done and where the use of cotton waste or fluffy rags is forbidden. It should also be provided with a small vice (the jaws being protected with clean soft copper or aluminium shields) and a dust proof drawer for holding the nozzle cleaning tools.

Dismantling (Fig. 10)

The injector should be placed on a suitable holding plate, nozzle downwards, first remove the nozzle holder cap nut: this also acts as a locknut. Release the nozzle spring tension by turning the adjusting screw in an anti-clockwise direction.

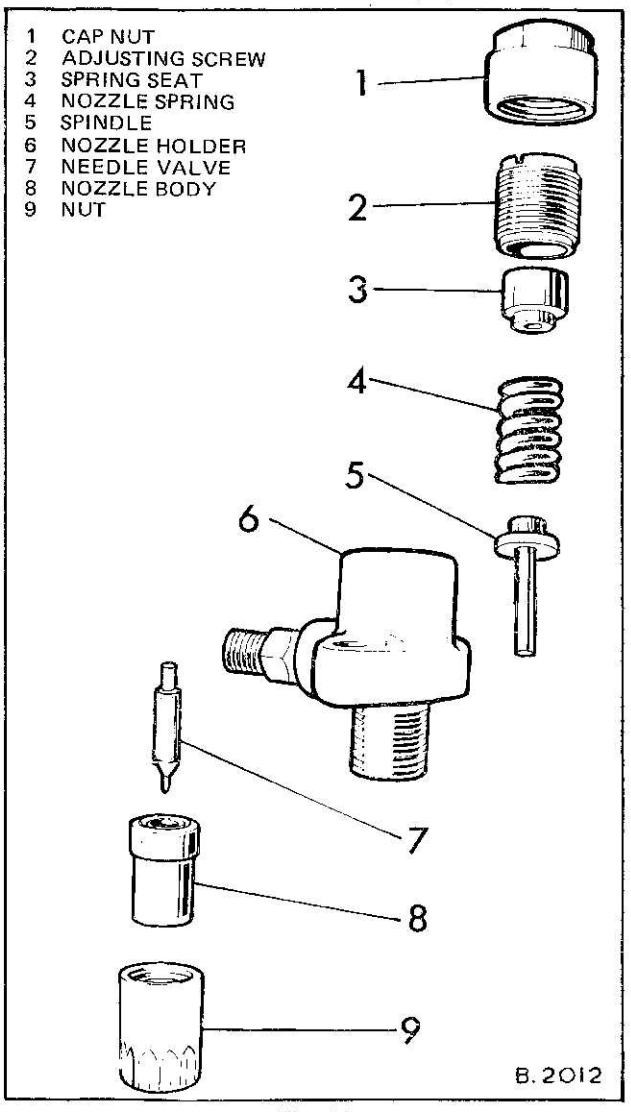


Fig. 10

Reverse the position of the injector on the holding plate and remove the nozzle cap nut and nozzle taking care not to drop the nozzle needle onto the floor. Complete the dismantling by removing the adjusting screw, spring seat, spring and spindle. Inspect visually for signs of corrosion, distortion, etc.

Keep all the dismantled parts together in a tray to facilitate re-assembly after cleaning. The nozzle body and needle are matched items and should be kept together.

To hold the nozzle holder cap nut in a vice or to use badly worn or adjustable wrenches is to invite trouble.

Inspection

The nozzle needle should be free from all traces of damage. It is important that it is not 'blued' at the tip due to overheating. If the nozzle is 'blued' or the seating has a dull circumferential ring indicating wear or pitting, the complete unit (nozzle) should be renewed.

The stem of the nozzle needle should be clean and bright, free from high spots or dull patches, and the grooves free from foreign matter of any kind; similarly the nozzle needle bore in the nozzle body should be free from any of the above and the small drilled passages should be checked to see that they are clear.

Cleaning

Injector cleaning kits are commercially available and these include brass scrapers, cleaning wires and a brass wire brush.

Starting with the nozzle assembly, remove the needle from the nozzle body and by using the special soft brass scrapers, remove any carbon which may be present on the nozzle body seat.

Brush all carbon from the nozzle body using the brass wire brush.

For cleaning the orifice, select the appropriate sized probe from the cleaning kit and insert this in the nozzle body pintle hole cleaner. Pass the proble down the bore of the nozzle body until it protrudes through the orifice, then turn with a rotary motion until the carbon is removed.

It is important that care is exercised with the nozzle needle and in particular the pintle on the end to prevent damage to either as a scratch or burr may cause needle leakage or spray distortion. Displace hard carbon with a suitable piece of wood.

To ensure that the small feed channels in the body are clear, a drill or wire of the appropriate diameter should be applied with a rotary action pressing between the fingers.

After ensuring that the exterior of the injector nozzle is clean and free from carbon, the nozzle needle and nozzle body may be thoroughly washed in clean fuel oil or an approved alternative, assembled together whilst submerged in the clean oil and left immersed until it is intended to re-assemble the injector. Should it be desired to store the nozzle assembly for any period of time, then the needle and nozzle should be lightly smeared with petroleum jelly or grease and stored away, preferably in a dust-proof drawer.

The injector body should now receive attention. It should be washed in clean fuel oil or an approved alternative, care being taken to ensure that the highly ground face is free of scratches. This face must register with the injector nozzle flange cleanly and squarely to form the high pressure joint and must therefore be handled in such a way as to avoid damage to the surface. The exterior of the injector body should be thoroughly cleaned.

Re-Assembly

The injector body and nozzle assembly may now be assembled carefully, after having immersed the pressure faces of each in clean fuel oil or an approved alternative, to ensure that these faces are absolutely clean. Place the injector body on the holding plate, pressure face uppermost, place the securing flange in position then locate the nozzle assembly and secure with the nozzle cap nut, tightening carefully to a torque of 8,0 kgf m (58 lbf ft).

Excessive tightening of this cap may result in distortion of the nozzle and its consequent failure. Care should be exercised that the leverage applied is not excessive. Reverse the injector on the plate and refit spindle, spring, spring seat and adjusting screw. Transfer the injector from the holding plate and fit to the injector testing pump.

Pump up slowly until fuel spurts from the orifice of the nozzle and whilst still pumping slowly, turn the adjusting screw using a suitable screwdriver, in a clockwise direction increasing the spring tension until the breaking pressure is that quoted against the appropriate setting pressure.

The injector is good for service if, when the injector testing pump is operated with sharp downward movements, a clean cracking sound is heard when the needle lifts.

When testing injectors for spray formation, as opposed to setting the nozzle breaking pressure, always isolate the pressure gauge by means of the valve fitted, to prevent possible damage caused by rapid fluctuations in pressure.

Back Leakage

Adjust the breaking pressure to 290 atm (4300 lbf/in^2). Pump up sufficient pressure to raise the nozzle needle from its seat, pump up again slowly to just below this pressure, then upon releasing the hand lever and allowing the pressure to fall off naturally, record the time (with the aid of a stop watch) taken for the pressure shown on the gauge to fall from 245 to 190 atmospheres (3600 to 2800 lbf/in^2). For a nozzle in good condition, this time should not be less than 3 seconds.

When carrying out this test, observe that no leakage occurs at the lapped pressure faces of the nozzle holder and injector body. Leakage may be external, when it is at the nozzle cap nut screw head, or internally, in which case it cannot be readily distinguished from excessive leakage past the needle stem. If leakage past the lapped face is suspected, do not overtighten the nozzle cap nut in an effort to cure such leakage, but remove the nozzle and re-examine the pressure faces for signs of dirt or surface imperfections.

Clean thoroughly, and if all appears to be in order, replace components and re-test.

If the pressure drop time is still low, this indicates excessive leakage past the lapped stem of the nozzle needle and both nozzle and needle should be replaced with a new assembly.

Pressure Setting

The settings are given in 'Data'. New injectors or reconditioned injectors fitted with new springs, should be set at the 'Setting Pressure'. This pressure allows for the initial drop that occurs in the first few hours of operation. Reconditioned injectors that have had their original springs fitted should be set at the 'Working Pressure'.

To set the pressure, slowly move the hand lever downwards and carefully watch the pressure gauge for the highest recorded pressure before the needle flicks, indicating the needle is lifting off its seat. Any necessary adjustment is effected by loosening the capnut and turning the adjusting screw clockwise to increase or anti-clockwise to decrease the breaking pressure. Tighten the capnut and recheck the pressure before removing the injector from the injector testing pump.

When the injector has been cleaned, re-assembled, the breaking pressure set to the recommended figure, and the spray formation found to be satisfactory, the following check should also be carried out on the injector testing pump before returning the injector to service.

Seat Tightness

Wipe nozzle tip dry, pump up the pressure to approximately 10 atmospheres (150 lbf/ft^2) below the nozzle opening pressure, when the nozzle bottom face must remain substantially dry for 10 seconds and there must be no tendency for blobs of fuel to collect or drip. A slight dampness may be ignored.