

DIESEL MECHANIC



MINING QUALIFICATIONS AUTHORITY

CODE: PT

TUNE-UP A PRESSURE

TIMED FUEL SYSTEM

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OBJECTIVE:

WHAT YOU MUST DO

1. Describe the operation of a P.T. fuel system.
2. Adjust the injectors.
3. Set the valve clearance.
4. Adjust the idling speed.

WHAT YOU WILL BE GIVEN

1. A Cummins diesel engine.
2. All the necessary tools and equipment.

HOW WELL YOU MUST DO IT

1. The injectors and valve clearances must be adjusted as specified in the workshop manual.
2. The engine must start after the above adjustments have been made.
3. The engine must idle.
4. The engine must attain maximum speed.
5. There must not be any oil leaks.
6. There must not be any fuel leaks.
7. There must not be any damage to any fasteners.
8. All the fasteners must be tightened to torque specifications.
9. The operation of a P.T. fuel system must be described correctly.

ADDITIONAL RESOURCES:

1. Your Training Officer
2. Workshop Manual.
3. Audio-visual aids if available.

HAZARD IDENTIFICATION AND CONTROL (HIAC) FORM**PT****TUNE-UP A PRESSURE TIMED FUEL SYSTEM**

STEPS IN OPERATION / PROCESS	POTENTIAL ACCIDENT / INCIDENT	CONTROLS (BY RESPONSIBLE PERSON)
1. Use hand tools	<ul style="list-style-type: none"> Using damaged tools or wrong tools for the job can cause injury and damage to equipment. 	<ul style="list-style-type: none"> Always use the correct tool for the job. Ensure tools are in good condition. Use tools correctly. Wear appropriate PPE where necessary. Always take good care of tools. Maintain, clean and store it properly.
2. Adjust injectors and valves	<ul style="list-style-type: none"> Diesel fuel can be detrimental to health if it comes into prolonged contact with eyes and skin. 	<ul style="list-style-type: none"> Wear appropriate PPE where necessary.

NOTE: Before doing the practical work contained in this module, the learner must study the content of the above HIAC Form again and then sign the statement below:

The above risks, which will be encountered in this module, are fully understood and will be controlled during the practical work.

Signature of Learner:

Signature of Training Officer:

Date:

TUNE-UP A PRESSURE TIMED FUEL SYSTEM

ITEM / TASK: Introduction

DESCRIPTION:

1. INTRODUCTION

The **P.T. fuel system** is used exclusively on Cummins diesel engines. **P.T.** is an abbreviation for "**Pressure-time**". (Fig. 1)

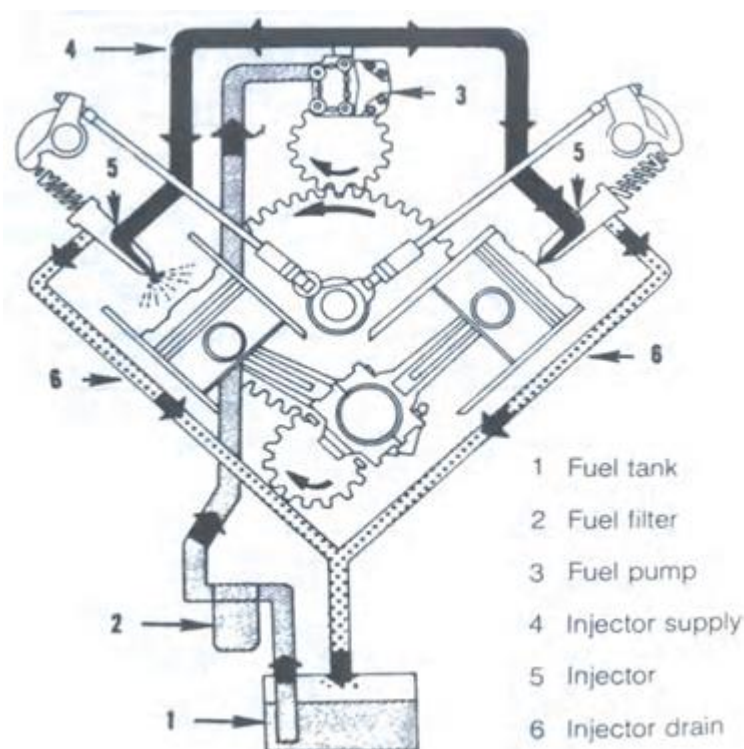
Fig. 1



- The simplicity of the Cummins PT fuel system is based on a pressure- time principle of fuel metering.
- The PT fuel system utilizes a fixed opening in the injector and variable pressure and time to meter the fuel charge.
- The pressure is controlled in the fuel pump and the metering is done by the injector.
- Pressure is regulated at the injector orifice by the throttle or governor in the fuel pump.
- The camshaft and the engine speed determine how long the injector orifice is open.
- This simple system of fuel delivery results in accurate fuel control, high pressure injection and controlled injection timing without troublesome timing or high pressure fuel lines

Schematic diagram of fuel flow and mechanical linkage in Cummins fuel system (Fig. 2)

Fig. 2

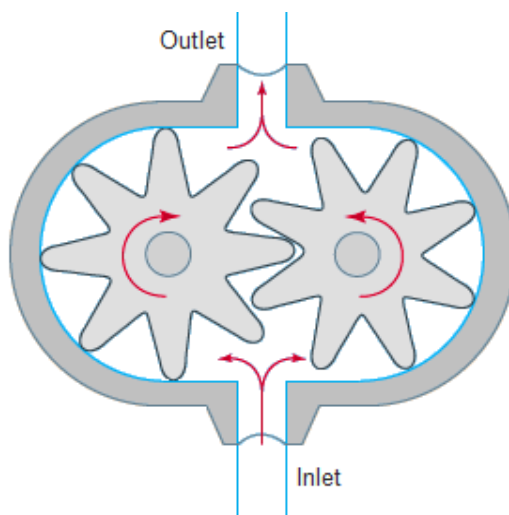


The governor design makes the PT fuel pump self-adjusting for wear, eliminating the need for frequent. In this system the injector is used to meter and inject the fuel into the cylinder.

Fuel pressure is supplied by a gear driven positive displacement fuel pump (combined with fuel pump).

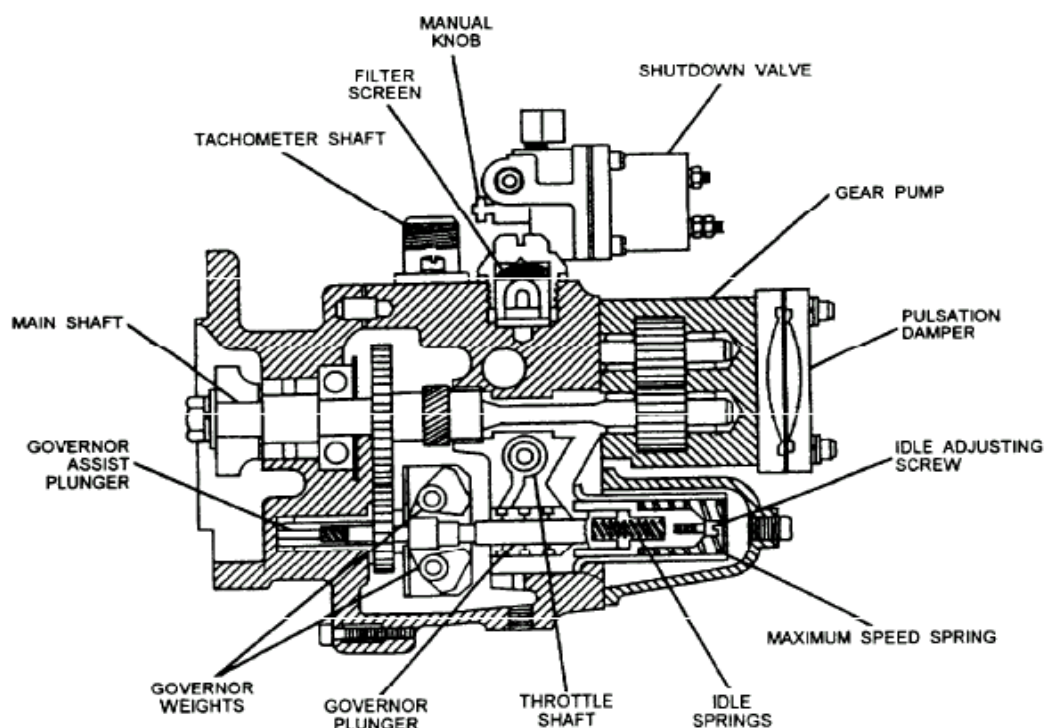
Gear driven positive displacement fuel pump (Fig. 3)

Fig. 3



PT fuel pump with gear pump (Fig. 4)

Fig. 4

**PT fuel pump with gear pump**

The gear pump, driven directly by the engine at engine speed, (most engines) maintains low pressure for the entire fuel system.

Passing around hardened steel gears, the fuel flows from the gear pump through a magnetic filter screen to the governor, and through the throttle shaft.

Then, still under low pressure, it passes through the shut-down valve the injectors.

A pulsation damper on the gear pump ensures even pressure throughout the system. A special line bleeds a small amount of fuel from the gear pump, to assure maximum cooling under adverse operating conditions.

Fuel pressure and engine speed is controlled by the governor and throttle. The flyweight type governor controls both idling and maximum engine speed.

The rotating governor plunger moves axially inside the governor housing. It is controlled by revolving weights and is balanced by a calibrated spring back acting in the opposite direction.

It has a recess which passes fuel, and a shoulder which acts as a valve, to control the flow to the throttle shaft.

A spring loaded bypass valve (button), allows excess fuel to pass through the governor housing, to the gear pump.

Throttle shaft movement, controlled by the operator, gives instant response to the need for more power.

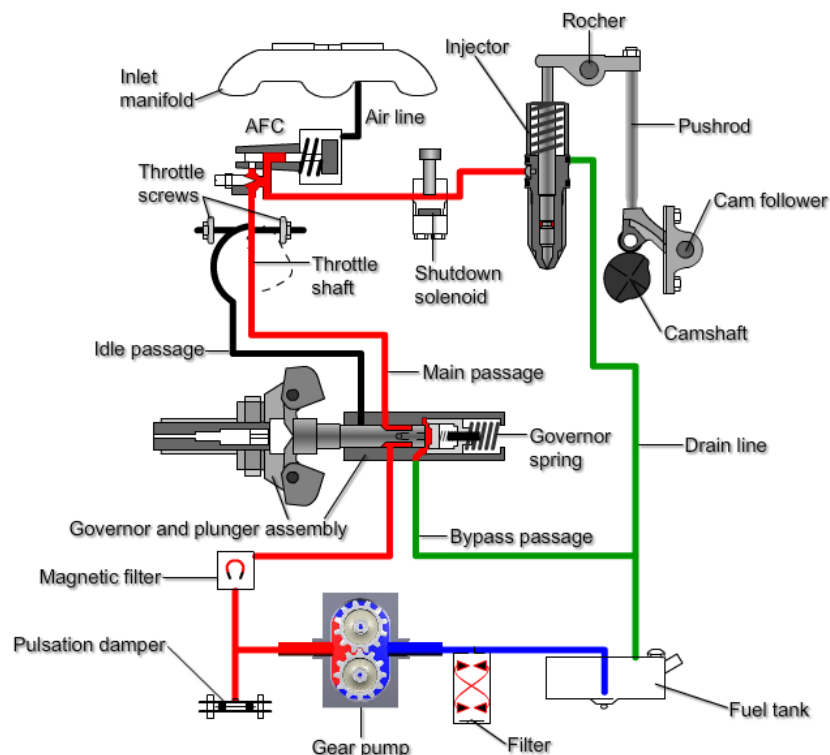
Movement of the throttle lever changes the amount of fuel available for flow and changes the fuel pressure to the injectors.

When the throttle is closed, fuel flow through the high speed ports is cut off and only sufficient fuel for idling reaches the injectors through the smaller idling passages.

When the throttle is opened, there is an instantaneous increase in fuel pressure at the injectors.

The PT System

Fig. 5



The PT system injectors

The PT injector is a simple mechanical unit that receives fuel under varying pressures from the fuel pump assembly, and meters, injects and atomises it through fine spray holes into the combustion chamber.

All injector types are similar in that they feature a plunger reciprocating in the injector body under the influence of the camshaft— pushrod—rocker combination and a return spring.

All feature continuous fuel circulation, so every type has both a fuel inlet and an outlet—an outlet apart from the spray holes, that is.

However, there are some considerable constructional differences and improvements in the more recently developed types, which are also a little different in operation from earlier designs.

Fig. 6



The time for metering is determined by the interval that the metering orifice (10) in the injector remains open.

This interval is established and controlled by the engine speed, which determines the rate of camshaft, rotation and consequently the injector plunger movement.

2. OPERATION OF THE INJECTOR

The metering and injection of the fuel is done in four stages namely:

- Metering
- Pre-injection
- Injection
- Purging.

a) Metering

The fuel from the pump, subjected to line pressure, enters the injector through the orifice.

At this metering stage the lobe of the cam is at the bottom and the plunger of the injector is kept in the upper position by the spring.

When the plunger is in an upper position the porting which feeds the cavity in the cup is open and the fuel will start to fill the cup.

The amount of fuel which will enter the cavity is dependent on the fuel pressure from the pump and the time that the porting is kept open for fuel to enter the cup.

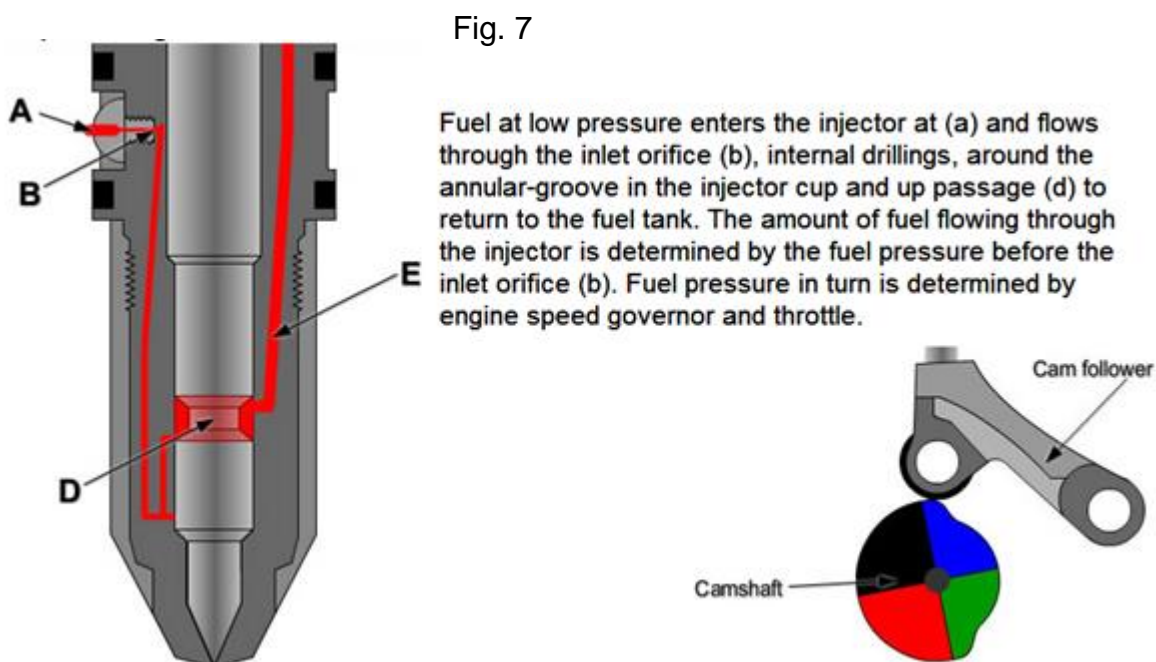
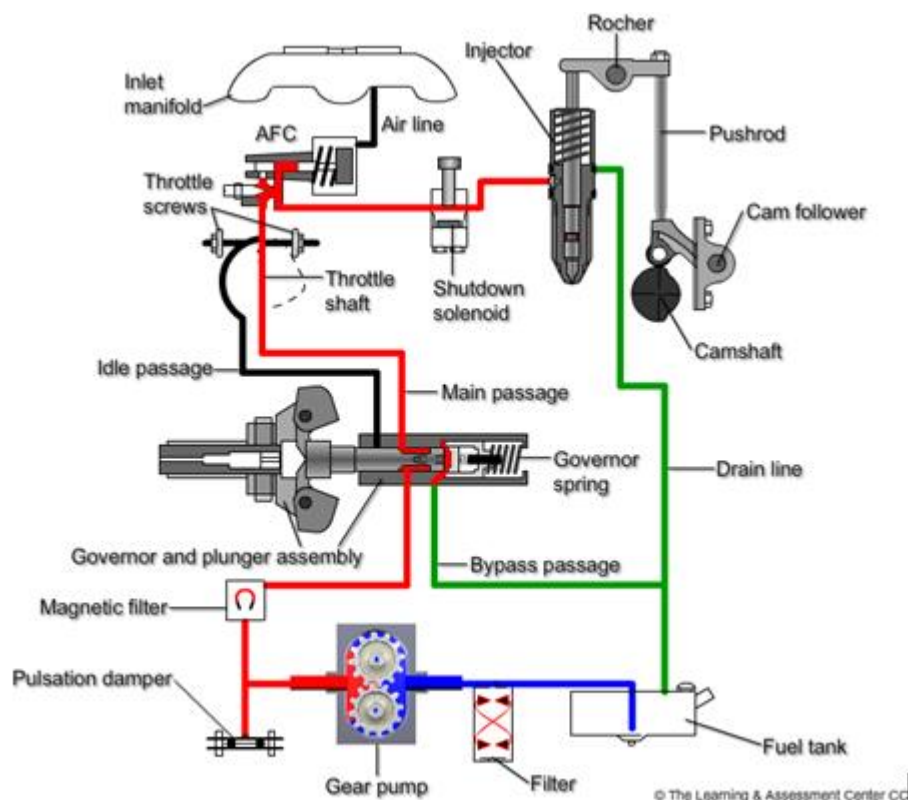


Fig. 8

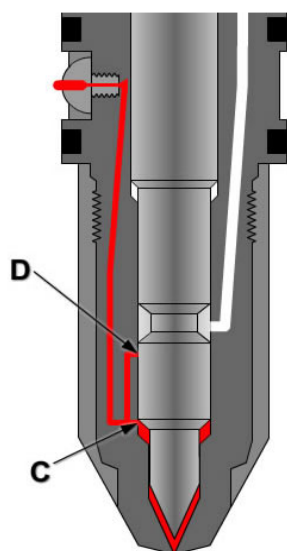


b) Pre-injection

The lobe on the camshaft starts to move the push rod upwards which in turn will move the plunger downwards through the rocker.

The fuel that entered the cup during the metering stage is compressed in the cup.
(Fig. 9)

Fig. 9



(fuel enters injector cup)

As the injector plunger moves upward, metering orifice (C) is uncovered and fuel enters the injector cup. The amount is determined by the fuel pressure. Passage (D) is blocked, momentarily stopping circulation of fuel and isolating the metering orifice from pressure pulsations.

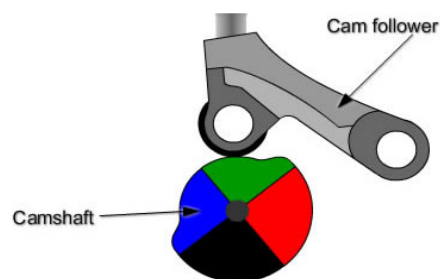
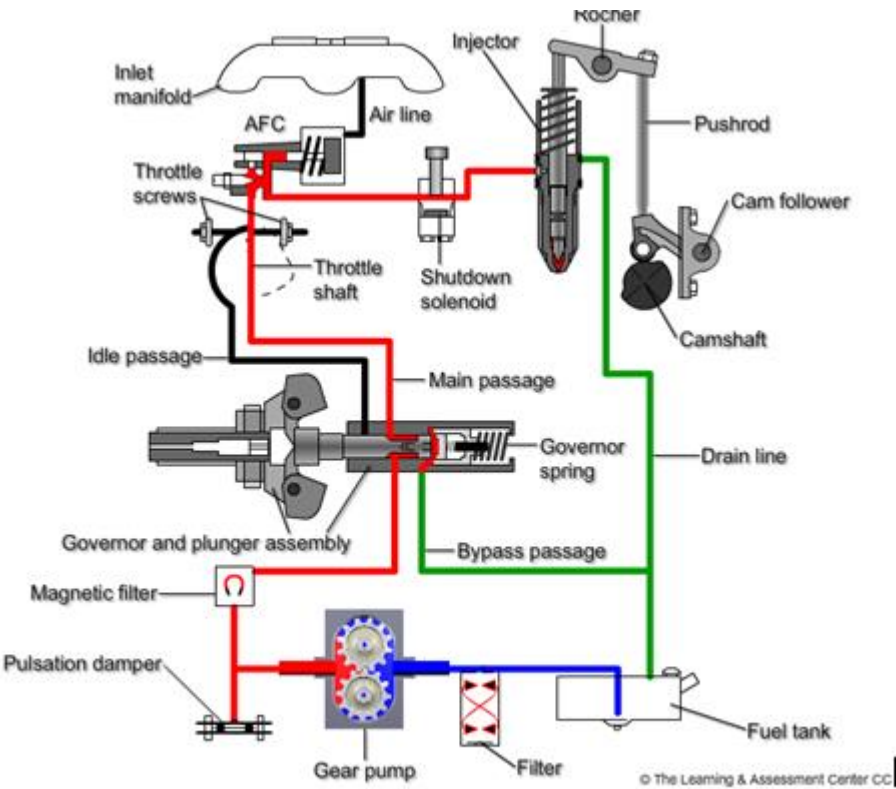


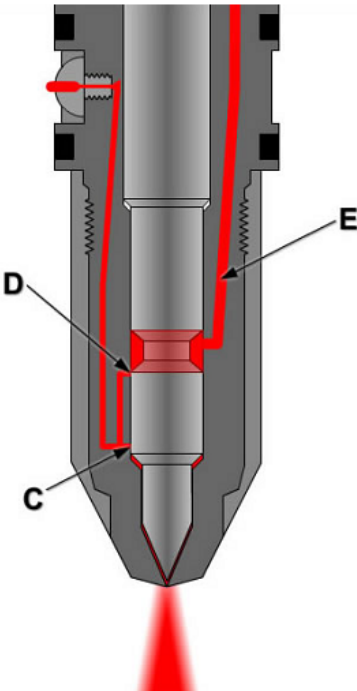
Fig. 10



c) Injection

As the lobe on the cam keeps on moving the push rod upwards and the plunger downward, the fuel is injected into the cylinder through the injector holes in the cup.

Fig. 11



(fuel Injection)

As the plunger moves down and closes the metering orifice, fuel entry into the cup is cut off. As the plunger continues down, it forces fuel out of the cup through tiny holes at high pressure as a fine spray. This assures complete combustion of fuel in the cylinder. When fuel passage (D) is uncovered by the plunger undercut, fuel again begins to flow through return passage (E) to the fuel tank.

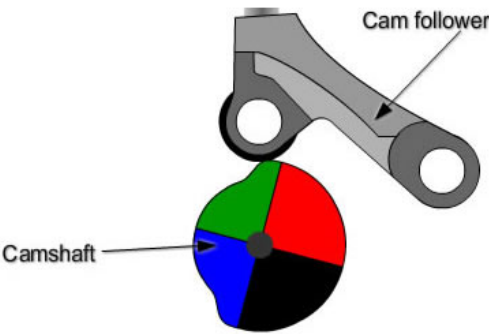
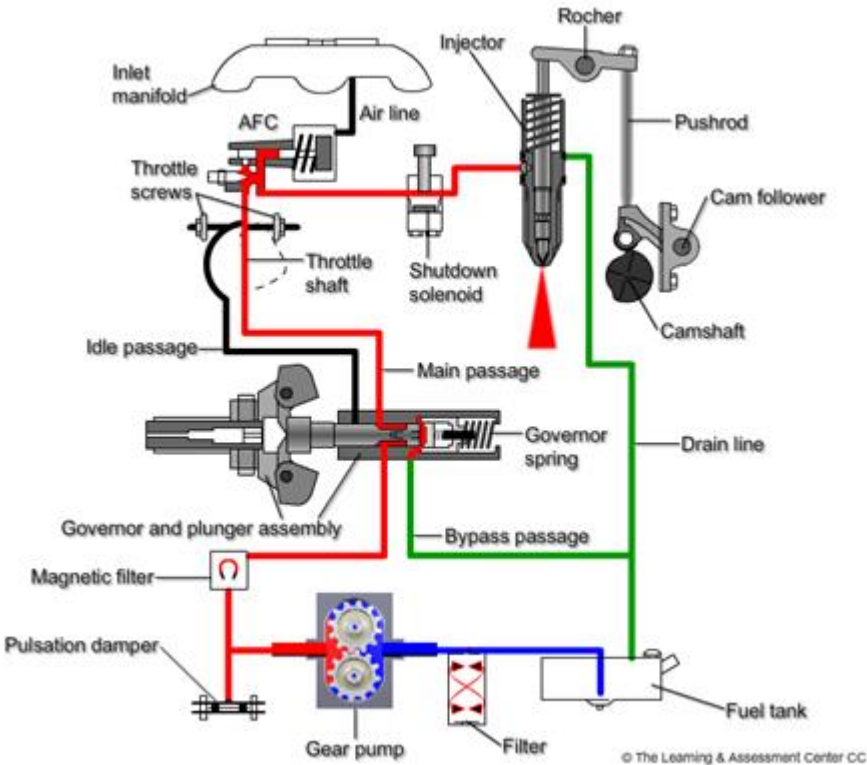


Fig. 12

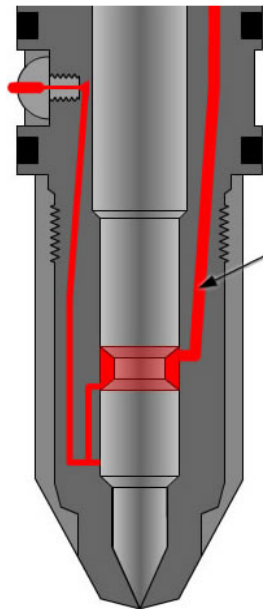


The fuel from the pump is still by-passed through the injector to the tank.

d) Purging

During the combustion stroke, the plunger is kept firmly against the seat in the cup to seal the cavity in the cup off from the cylinder, to prevent any combustion from taking place in the injector.

Fig. 13



(fuel circulates)
 After injection, the plunger remains seated until the next metering and Injection cycle. Although no fuel is reaching the injector cup, it does flow freely through the injector and is returned to the fuel tank through passage (E) This provides cooling of the injector and also warms the fuel in the tank.

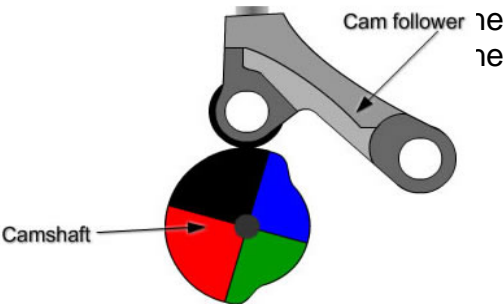
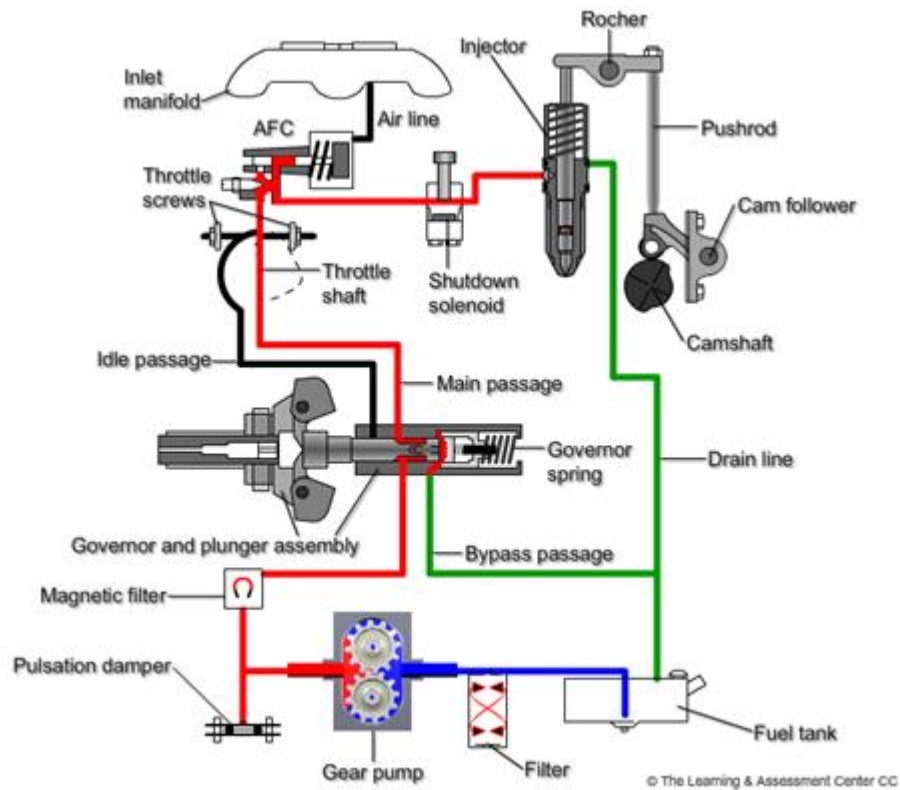


Fig. 14



GO ON TO THE NEXT PAGE TO DO THE SELF TEST.



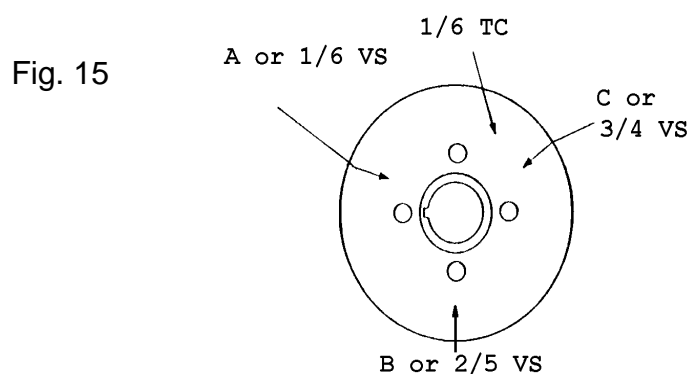
Without referring to your notes describe the four stages of metering and injection of the fuel in the P.T system:

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

LEARNER	TRAINING OFFICER
Date:	Date:
Signed:	Signed:

3. ADJUSTING THE INJECTOR PLUNGER AND VALVES

- Turn the crankshaft in the direction of rotation until the No.1 "VS" mark appears on the vibration damper or crankshaft pulley. (Fig. 15)



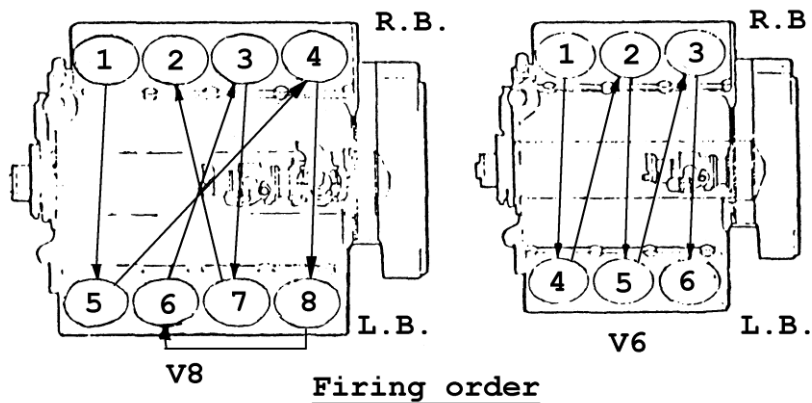
In this position, both the intake and the exhaust valves must be closed on No.1 cylinder. If not, turn the crankshaft through another 360° (1 revolution).

NB: Do not use the fan to rotate the engine.

- Tighten the injector hold-down caps crews to between 41 and 47 Newton meter (Nm).
- Turn the adjusting screw on the injector of the No. 1 cylinder until the plunger contacts the cup.
- Now turn it an additional 15° to squeeze the oil from the cup.
- Tighten the adjusting screw to 6, 8 Nm and tighten the locknut to between 41 and 47 Nm.
- Adjust the crossheads of No.1 cylinder.
- Adjust the valves of No.1 cylinder.

- By following the above procedure adjust the injector plunger and valves of all the cylinders. Adjust the valves and injector plunger for V6 and V8 engines in the sequence (Fig. 16)

Fig. 16

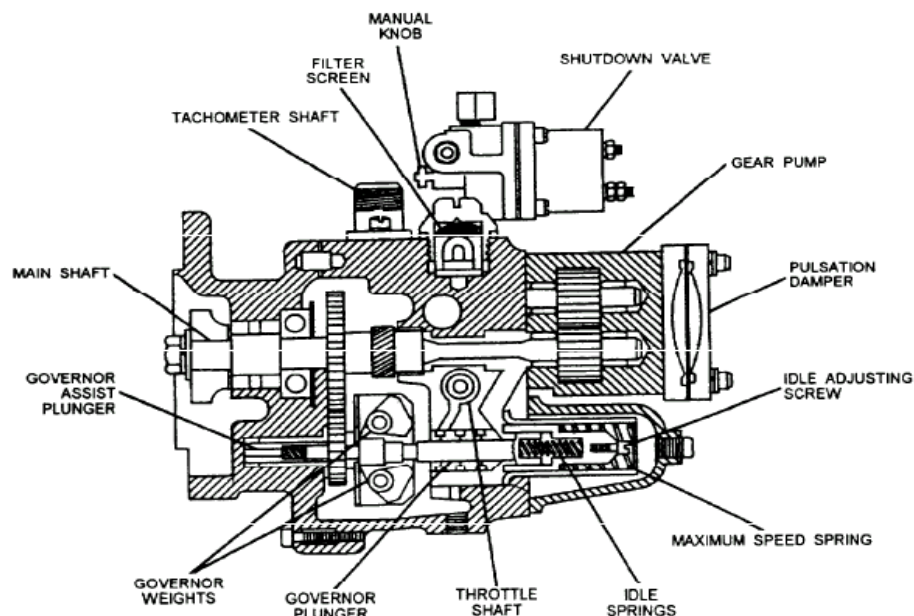


NB: Two complete revolutions of the crankshaft are needed to set all the injector plungers and valves. Injectors and valves can be adjusted for only one cylinder at any "VS" setting.

4. ADJUSTING THE IDLING SPEED

- Stop the engine
- Remove the plug covering the idling screw at the bottom of the pump.(Fig. 17)

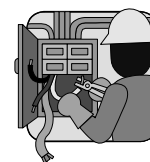
Fig. 17



- Turn the screw in to increase the idling speed or unscrew it to reduce the idling speed.
- Replace the plug.
- Start the engine and compare the idling speed with the specification in the workshop manual.

NB: Do not start the engine whilst the plug is removed, as fuel will come out of the plug hole.

Go on to the next page to do the practice.



PRACTICE

By referring to your workshop manual and your notes, adjust the injector plungers, valves and the idling speed of an engine fitted with a P.T. fuel system.

Call your Training Officer to check your work and ask him to sign you off when it is correct, then go on to the next section.

LEARNER	TRAINING OFFICER
Date:	Date:
Signed:	Signed:



REMEMBER ALWAYS WORK SAFE

Once you have passed the entire self-test and practices, you are now at liberty to request a Formative Assessment from your assessor.