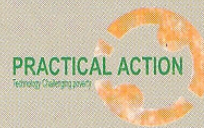
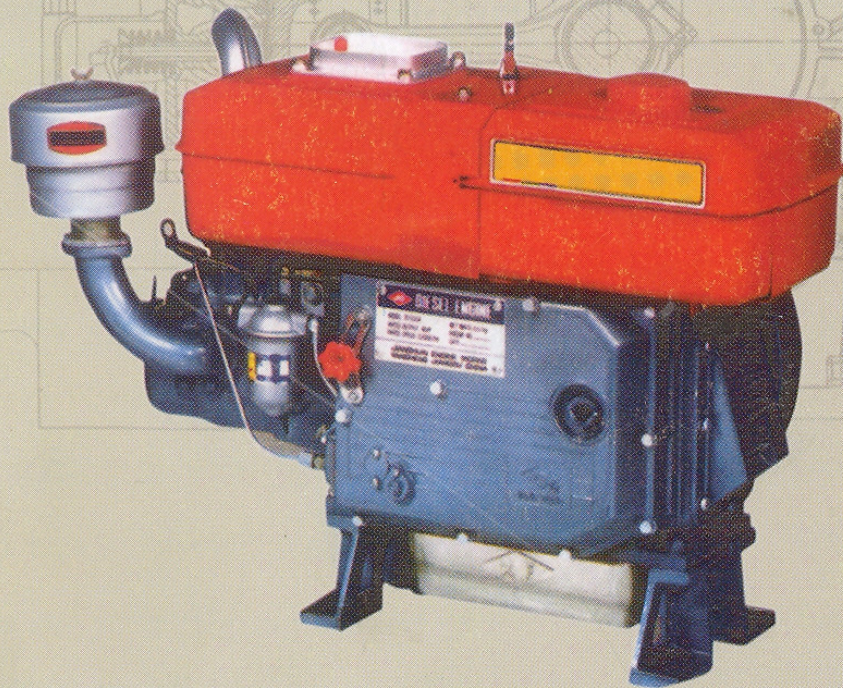


Diesel Engine Repair & Maintenance



Farm Machinery Adaptation & Dissemination
Practical Action Bangladesh

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Preface

Proper utilisation of resources for poverty reduction is one of the main objectives of present government, which has taken up special program to make agriculture mechanised. To achieve mechanised agriculture, diesel engine has various uses. Diesel engine can run irrigation pump, power tiller, power thrasher, seed drill machine etc. In addition diesel can also run vehicle, rice husking machine, break breaker etc.

It is very important to ensure proper and effective use of diesel engine.

Only a skilled person can do so. In Bangladesh, usually diesel engine operators/mechanics do not have any institutional education. They learn diesel engine operation and maintenance through the process of "learning by doing". Keeping these realities in mind, Practical Action Bangladesh is publishing this booklet in a simple manner. The booklet depicts the details of diesel engine and how it works, with figures and diagrams. It also describes the "problems and solving" that various parts of a diesel engine might have. The reader will get knowledge on how to repair and maintain a diesel engine from this booklet.

Previously, Practical Action Bangladesh has published a booklet on "Diesel engine repair & maintenance" This booklet is more informative and communicative than the previous one. We hope this booklet will serve people working with diesel engine.

Veena Khaleque

Country Director

Practical Action Bangladesh





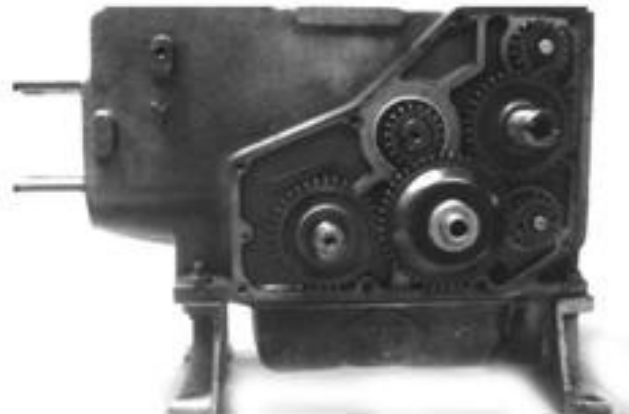
Crank Shaft



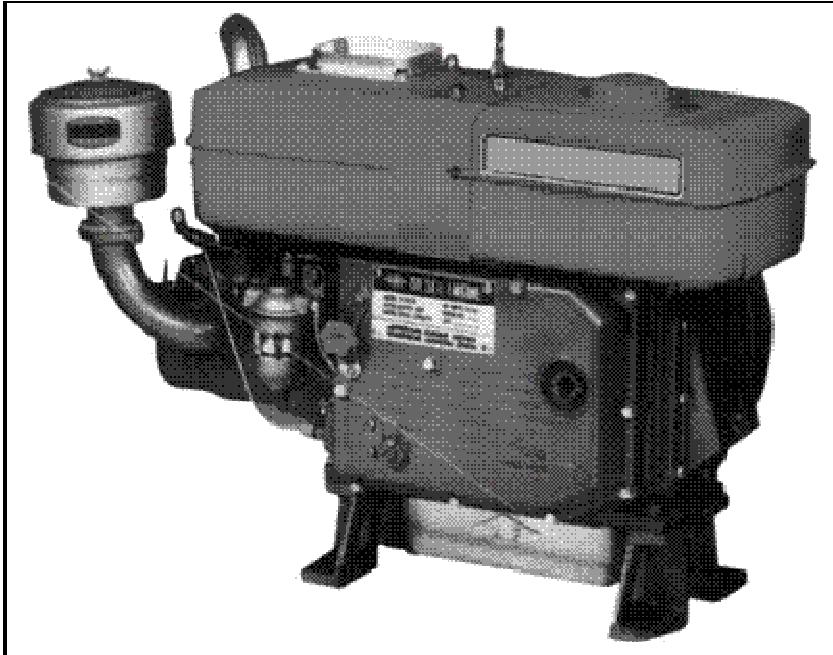
Connecting Rod & Piston



Engine Head



Engine Block & Timing



1. What is an engine ?

An engine is a mechanical system which transforms heat energy into mechanical energy using fuel.

There are generally two types of engine: internal and external combustion engines.

1.1 Internal combustion engines are divided based on the following :

- 1 Type of fuel - diesel, petrol and gas.
- 2 Stroke – four-stroke and two-stroke.
- 3 Cylinders - single and multiple cylinders.
- 4 Cooling system.

2. What is a diesel engine ?

The diesel engine is a type of internal combustion engine, more specifically, a compression ignition engine, in which the fuel is ignited by the high temperature of compressed gas, rather than a separate source of energy (such as a spark plug).

How diesel engines work

When gas is compressed its temperature rises. A diesel engine exploits this property in order to ignite the fuel. Air is drawn into the cylinder of a diesel engine, and compressed by the rising piston. This happens at a much higher compression rate than in a spark-ignition engine. At the top of the piston stroke diesel fuel is injected into the combustion chamber at high pressure through an atomising nozzle. It mixes with the hot, pressurised

air. The resulting mixture ignites and burns very rapidly. This contained explosion causes the gas in the chamber to expand, driving the piston down with considerable force, and creating power in a vertical direction. The connecting rod transmits this motion to the crankshaft which is forced to turn, delivering rotary power at the output end of the crankshaft. 'Scavenging' - pushing the exhausted gas-charge out of the cylinder and drawing in a fresh draught of air - is done through ports or valves.

A vital component of any diesel engine system is the governor, which limits the speed of the engine by controlling the rate of fuel delivery.

Diesel engine working principles

- Suction stroke
- Compression stroke
- Power stroke
- Exhaust stroke

Fuel and fluid characteristics

Diesel fuel is a product of crude oil, although other oils can be burned inside an adapted engine. Good quality diesel fuel can be synthesized from vegetable fat and alcohol. Diesel engines can work on thicker, heavier oil, or oil with higher viscosity, as long as it is heated in order to ease pumping and injection. These fuels are cheaper but dirtier than clean, refined diesel oil.

Diesel fuel is more difficult to ignite than gasoline because of its higher flash point, but once burning, a diesel fire can be extremely fierce.

The use of low-grade fuels can lead to serious maintenance problems.

3. Diesel engine supporting systems

A number of systems are in place for proper operation of an engine

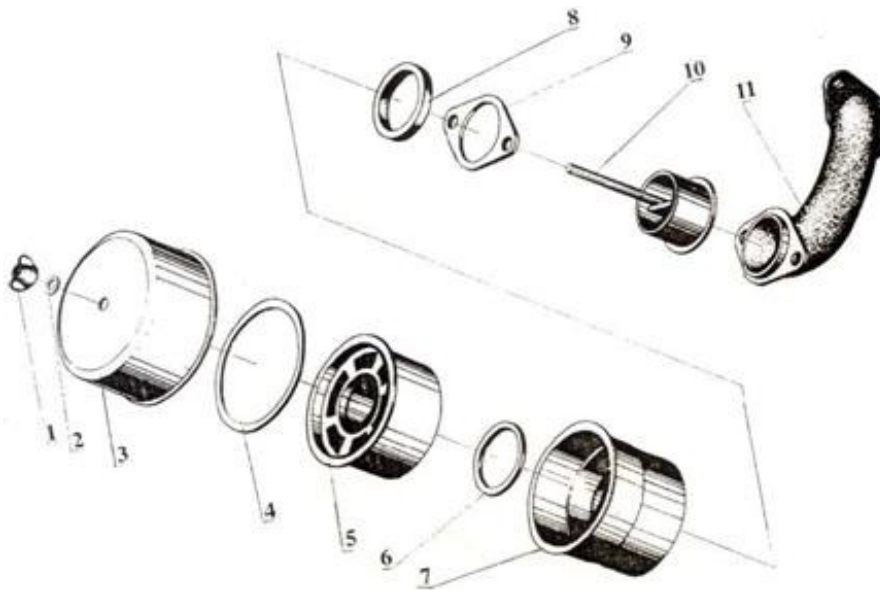
- Intake and exhaust system
- Starting system
- Fuel system
- Cooling system
- Lubricating system

3.1 Intake system and exhaust system

- The function of this system is to allow the purified air to the cylinder

Components :

- The system is composed of Air cleaner,
- Intake manifold,
- Intake valve,
- Super charger etc.



- | | |
|-------------------------|-----------------------|
| 1. Wing nut | 7. Air filter body |
| 2. Washer | 8. Rubber packing |
| 3. Air filter cover | 9. Air filter flange |
| 4. Rubber Packing | 10. Air filter sleeve |
| 5. Air filter cartridge | 11. Intake pipe |
| 6. Rubber packing | |

Faults and remedies

Fault	Remedy
1) Air cleaner jammed with dirt	Change
2) Internal manifold cracked	Change
3) Cage --- and bent stem of intake valve	Repair or change
4) Super charger not working properly	Repair or change

Exhaust system

Exhaust takes out burnt gas from the cylinder

Components:

- The system is composed of exhaust manifold
- Silencer pipe,
- Silencer box and
- Tail pipe



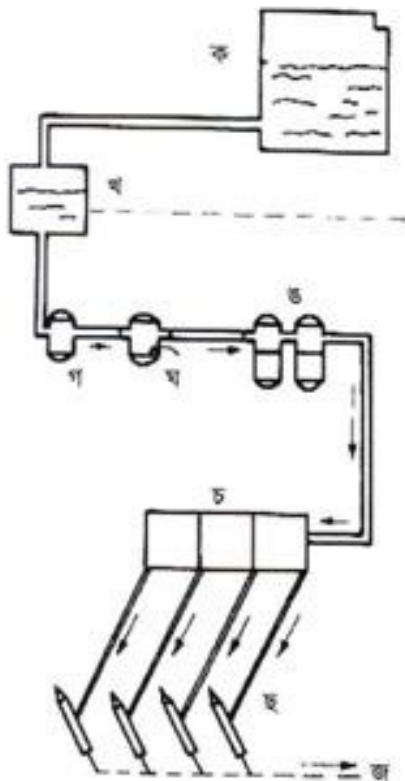
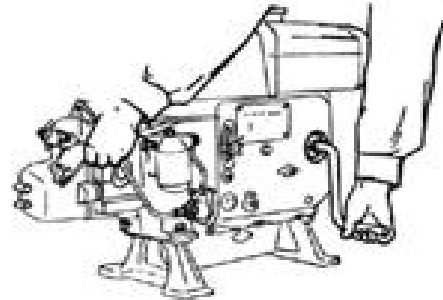
Faults and remedies

Faults	Remedy
1) Exhaust manifold broken or cracked	Change
2) Silencer pipe cracked	Repair or change
3) Silencer box jammed due to burnt or leaked carbon	Repair or change
4) Tail pipe leaking or cracked	Repair or change

3.2 Starting system

The system starts the engine by providing the initial rotations via :

- Hand-starting system
- Self-starting system
- Rope-starting system
- Pedal-starting system



3.2.1 Hand-starting system:

Hand-starting system is generally used in one cylinder diesel engine.

There is no fault in this system, one handle is used for starting. (Water, lubricant and fuel must be checked before starting)

3.3 Fuel system

Engine fuel system is very important through which the fuel is taken out of the fuel tank for combustion.

Essential components:

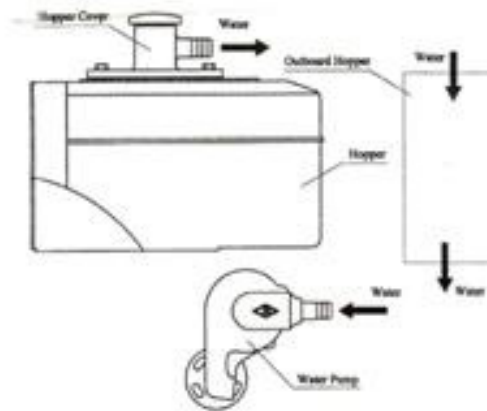
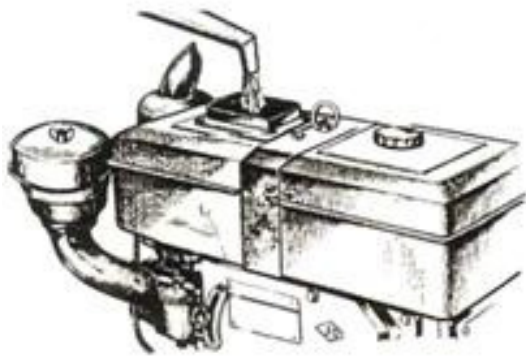
- fuel tank
- fuel line
- fuel filter
- low-pressure feed pump
- high-pressure fuel pump and injector / atomizer

Faults and remedies

Fault	Remedy
1) Fuel tank leaked/cracked	Repair or change
2) Fuel line leaked/cracked	Change
3) Filter jammed due to dirt	Change
4) Low pressure/feed pump faulty	Repair or change after checking
5) High pressure fuel pump faulty	Repair or change after checking
6) Injector faulty	Repair or change after checking

3.4 Cooling system

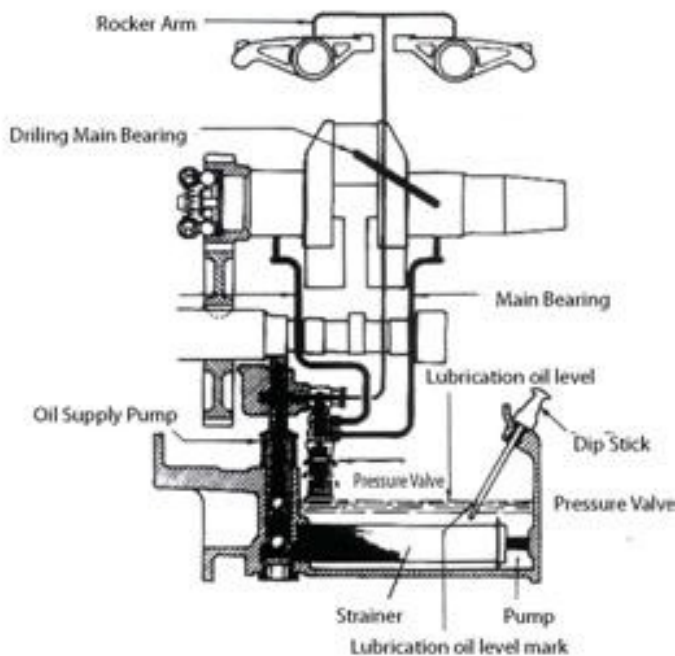
Engine cooling system enables the engine to maintain a constant operating temperature.



There are two types:

- Water cooling system
- Air cooling system

Different Parts of Lubricating Systems



3.5 Lubrication system

Using lubricant, the lubrication system prevents wear and tear of moving components and enables components to move faster and more efficiently.

The lubrication system serves three functions :

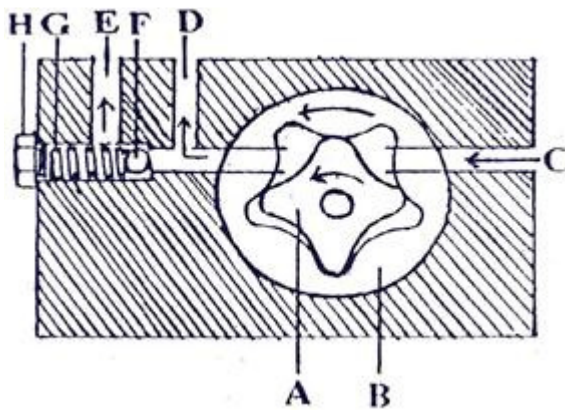
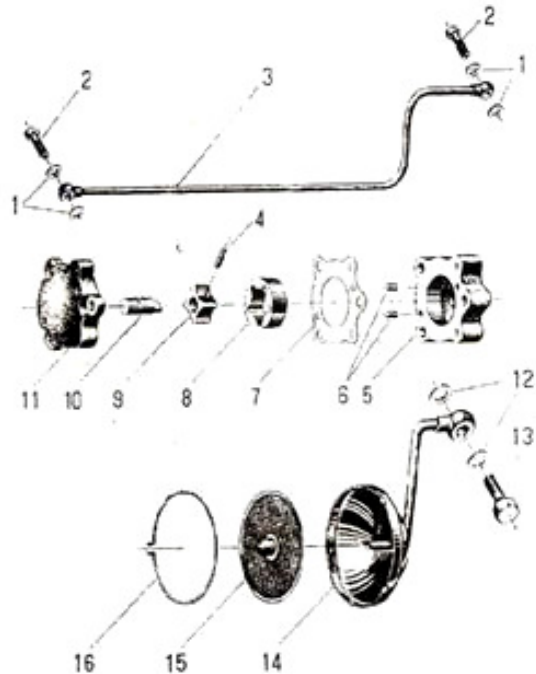
- Cooling
- Sealing
- Cleaning

Components:

- Strainer
- Oil pump
- Oil filter
- Oil pressure gauge
- Oil passage etc

Different Parts of Lubrication Systems

1. Copper Washer
2. Pipe Connection Bolt
3. Oil Pipe
4. Cylindrical Pin
5. Lubricating Oil Pump Body
6. Locating Pin
7. Lubricating Oil Pump Packing
8. Outer Rotor
9. Inner Rotor
10. Oil Shaft
11. Oil Pump Cover
12. Copper Washer
13. Pipe Connection Bolt
14. Oil Strainer Body Section with Pipe
15. Oil Strainer Screen
16. Circlip



Faults and remedies

Fault	Remedy
1) Strainer may be damaged	Change
2) Pump may not work	Repair or change
3) Oil filter jammed due to dirt	Change
4) Oil pressure gauge faulty	Repair or change (after checking)
5) Oil passage jammed	Clean

4. Faults during engine operation

Five common faults are faced during engine operation :

- 1 Over-heating
- 2 Excessive engine vibrations
- 3 Excessive fuel consumption
- 4 Excessive lubrication consumption
- 5 Excessive noise during operation

4.5 Possible reasons for over-heating of engine :

- 1 Low water quantity in radiator or water tank
- 2 Ignition starts after specified time
- 3 Fan belt lose or torn
- 4 Water jacket jammed
- 5 Faulty water pump
- 6 Low quantity of lubricating oil
- 7 Faulty lube oil pump
- 8 Broken fan blade
- 9 Engine operates over load
- 10 Engine operates at a high speed for a long time



4.6 Possible reasons for engine vibration :

- 1 Vibration damper or engine counter-weight are not working
- 2 Detonation and auto-ignition
- 3 Main engine bearing, the smaller end bearing of connecting rod, or the thrust bearing, have become loose.

4.7 Possible reasons for excessive fuel consumption :

- 1 Frequent starting and stopping uses a lot of fuel
- 2 Leak in fuel delivery line
- 3 Leak in fuel tank
- 4 Air cleaner jammed
- 5 Engine left in operation unnecessarily
- 6 Improper valve timing
- 7 Over loaded engine

4.8 Possible reasons of excessive lubrication consumption :

- 1 Piston wrongly fitted
- 2 Piston and connecting rod misaligned
- 3 Oil ring not placed exactly in oil ring grove
- 4 Too large a gap between piston and cylinder
- 5 Low tension of oil ring
- 6 Excessive wear of big-end bearing
- 7 Main oil seal cracked or damaged
- 8 Intake valve guide wrongly fitted
- 9 Excessive wear of cylinder taper and out / round
- 10 Engine head gasket cracked and damaged

4.9 Possible reasons for excessive noise during operation :

- 1 Wear and improper adjustment of engine parts
- 2 Abnormal condition due to detonation and auto-ignition
- 3 Poor quality fuel
- 4 Loose connecting rod

5. What is the function of the fuel injection pump?

Fuel injection pump sprays higher pressure diesel in the cylinder

6. How does fuel enter the fuel pump?

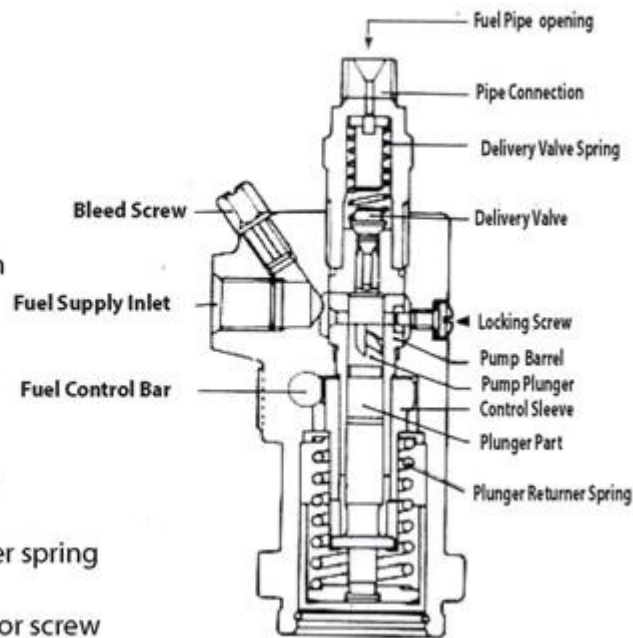
Fuel enters fuel pump via two methods:

- By gravity feed
- By pressure feed



7. Different parts of the in-line, high-pressure pump of a one-cylinder engine :

- Delivery valve spring
- Delivery valve
- Valve support
- Barrel
- Fuel chamber
- Toothed pinion
- Control rack
- Plunger
- Control sleeve
- Plunger retainer spring
- Adjusting bolt or screw
- Lock nut
- Cam roller



8. Possible explanations for less fuel in the fuel pump :

- Less fuel in fuel tank
- Filter jammed by dirt
- Less oil delivery by fuel transfer pump
- Air lock in fuel line

9. What is located above the plunger ?

- Vertical channel or slot
- Helical channel groove
- Annular groove

10. Types of non-return valve :

- Suction non-return valve
- Delivery non-return valve

11. How does a leak in the non-return valve affect fuel pump delivery ?

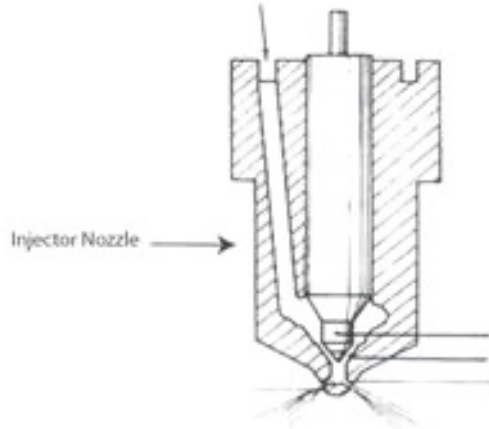
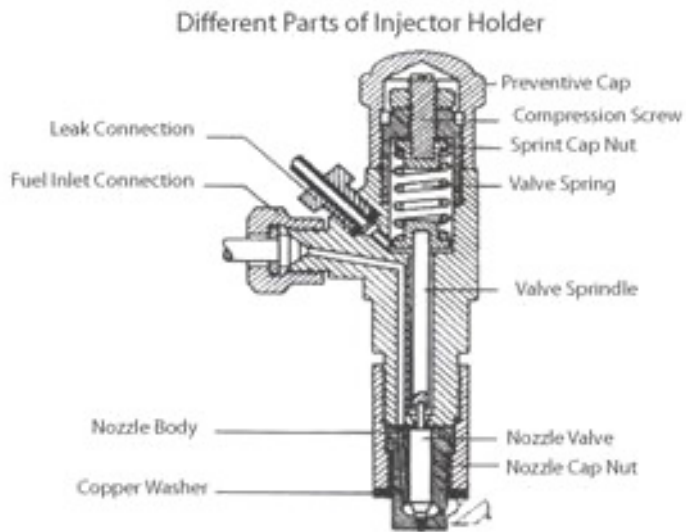
- A large leak will cause a drop in pressure, and the injector will not spray properly.
- A small leak will not affect the pump pressure; however less fuel will be sprayed through the injector.
- A small leak will slow the pump, and the fuel spray will be delayed.

12. Fuel pump pressure : Fuel pump delivers 240-700 Kg/cm² (4000-10,000 Psi)

13. Wearable and breakable parts of a fuel pump :

- Wear of plunger
- Wear of plunger bush
- Plunger retaining spring can lose tension
- Plunger-retaining spring can break
- Wear of bush and ball bearing
- Wear above tappet and bottom of plunger
- Wear of roller and fan

14. Nozzle Injector Holder

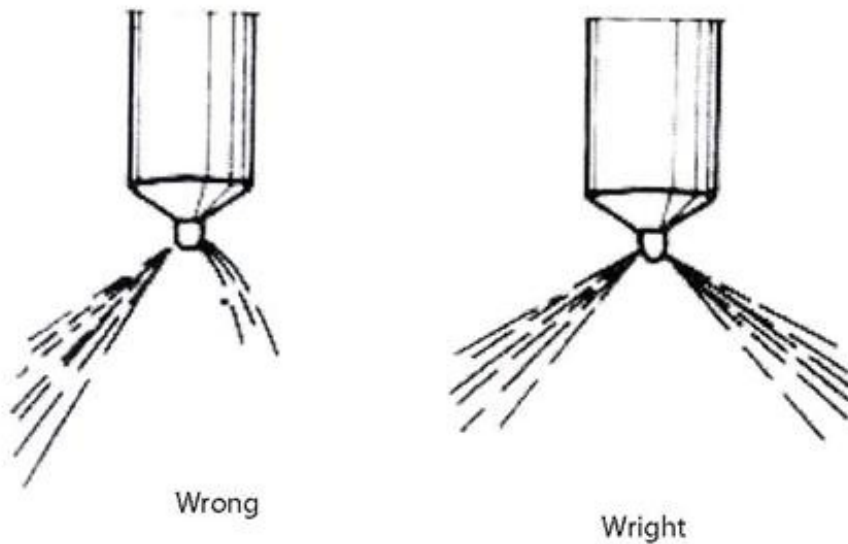


Due to Injector Fault
huge blacksmook
will exit from the
Exhaust Pipe



In the case of a fault in the injector, large amounts of black smoke will be emitted from the exhaust pipe.

15. Nozzle Servicing



- Open faulty nozzle and clean away soot (carbon); then check whether nozzle moves freely.
- Check delicate parts.
- Check nozzle valve and body.
- Immerse nozzle valve and body in clear diesel oil in order to remove carbon.
- Use copper wire brush - not a steel brush – to clean off soot (carbon).
- Fuel bore should be cleaned with a fine drill.



16. Air bleeding a diesel fuel system

The correct method of air bleeding the fuel system :

- Fill up the fuel tank with new diesel oil.
- Open valve of the tank.
- Loosen bleeding plug of the fuel filter and pump till fuel flow is continuous.
- Tighten the plug.
- Loosen injection line nut and crank the engine till fuel is flowing without foam.
- Close the injection line and check for leaks.



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