Effect of Plunger Diameter on In-Line Bosch Fuel Injection System of TATA SFC 407

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Abstract- *In this paper we mainly focus on change in performance of the diesel fuel injection system of TATA SFC 407. Mainly there are two types of pump are use in TATA SFC 407.They are1) In line pump and 2) VE pump. In this paper we are considering In-line Pump having pump Number F002A0Z160 and governor number RSV/300/1600A0C1181L. The engine of TATA SFC 407 consists of 4-cylinder pump and 4 injectors. The injector has multi-hole which fire the fuel in the cylinder. In this paper we will check the fuel cut-off of the pump and discharge pressure of the injector according to diameter size of the plunger use in the fuel pump and effect of change in diameter of plunger on fuel cut-off and discharge pressure.*

Keywords- Plunger diameter, Injector pressure, Discharge quantity, fuel cut-off.

I. INTRODUCTION

In internal combustion engine the power is develop by combusting the fuel inside the cylinder of engine at the certain pressure. The pressure ratio for the SI engine (petrol use as a fuel) and CI engine (Diesel use as a fuel) has different. Pressure ratio for the SI engine is 8 to 12 and for CI engine is 16 to 20 this exact ratio is depending upon the size of the engine and cylinder which is directly depend upon power required by to drive the machine. Generally, in SI engine gravity play an important role in fuel injecting throw carburetor and it is possible due to low pressure ratio required but this is not applicable in CI engine due to high pressure ratio therefore in CI engine fuel pump and injection system is use.

In CI engine the fuel pump sucks the fuel form bottom i.e. form fuel tank and provide to injector at high pressure and injector inject the fuel inside the cylinder from 130 to 750 bar according to requirement of the system. The fuel pump plays an important role in load carrying capacity, fuel consumption of system, combustion of fuel in cylinder as well as torque produce by the vehicle.

A. Types of bosch diesel fuel injection pump

1.) Common Rail Fuel Injection Pump
a. Normal Common Rail Fuel Injection Pump
b. Electronic Common Rail Fuel Injection Pump
2.) Distributor Fuel Injection Pump
3.) In-Line Fuel Injection Pump
4.) PF Pumps
a. K-Type PF Pump
b. Q-Type PF Pump
c. Monotype Block Pump

II. HISTORY

Bosch launched their first tests of Diesel injection systems in 1921, the company had already made a substantial contribution to the development of the spark-ignition engine by inventing the high-voltage magneto including a spark plug. 75 years ago, in November 1927, Bosch was the first company world-wide to start series production of Diesel injection pumps and nozzles. For the first time, engine manufacturers were thus able to purchase an injection system that permitted economically viable production of high-speed Diesel engines. Bosch's idea quickly turned into a success story. By now the company has manufactured more than 113 million Diesel injection systems and the demand for Diesel-powered automobiles is increasing rapidly. In Western Europe the market share of Diesel passenger cars currently amounts to 40 percent. This contribution by Robert Bosch GmbH presents an overview of the milestones of development so far and offers an outlook into the future.

III. CONSTRUCTION OF FUEL INJECTION SYSTEM

An in-line injection pump fuel system layout is schematically shown in Fig. In general, the in-line fuel pump consists of two filter in which one is primary filter and other one is secondary filter. The primary filter is use to remove the water and unwanted impurities mix in fuel, thee secondary filter connect the lift pump and pump also the return fuel pipe is joining to the secondary filter which pass to the fuel tank for reuse. Essentially all in-line diesel injection pumps use one or more cylinders, called barrels, where a reciprocating plunger produces very high pressures, in this pump there are four

cylinders of plunger are use are use which pipe are directly connected to the injector according to there firing order. Although various types of valve have been used for the start and end of injection. The distance between the all the pipe and the cylinder are different. This injector is place at the top of the combustion chamber in which the injector fire.

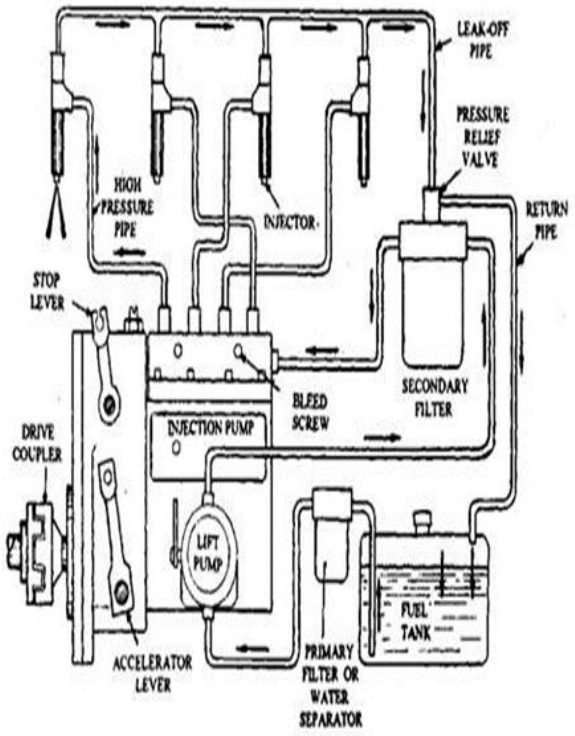

Fig .1. Schematic diagram of fuel injection system

IV. WORKING OF IN-LINE INJECTION PUMP SYSTEM

As the plunger is jerked upward by the cam, its upper end covers the fuel inlet port, so that above it fuels pressure starts to build up, initially slowly and then extremely rapidly. To terminate injection, this pressure is suddenly released by uncovering of the spill port. The spill groove is generally straight but inclined so that, by rotating the plunger, the timing of the spill point can be controlled, and so also the quantity of the fuel injected to match the engine requirement. The timing of the cut-off of the inlet port is constant, but the start of injection can be verified by incorporating a device to rotate the camshaft a few degrees relative to the drive shaft. In unit injectors, metering of fuel is achieved as described above, but in distributor type pumps it is altogether different. In all types, it is of prime importance to keep the leakage between the plungers and their barrels to a minimum.

V. METHODOLOGY

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VI. OBSERVATION

A. Test Specification of plunger 9411038352

Table.1. calibrated reading of pump with less diameter plunger

Speed (rpm)	Discharge Quantity (cm^3 /100 Stroke)
1600	6.5
800	3.0
300	0.6

B. Test Specification of plunger 9411038384

Table.2. calibrated reading of pump with greater diameter plunger

Speed (rpm)	Discharge Quantity (cm^3 /100 Stroke)
1600	7.0
800	3.5
300	1.0

VII. COMPARISON OF PUMPS HAVING GREATER AND LESS DIAMETER PLUNGERS

Table .3. compression between Pump having plunger of less and greater diameter

Parameter	Pump having plunger of less diameter	Pump having plunger of greater diameter
Plunger diameter	8.0 mm	9.5 mm
Valve diameter	2.5 mm	3 mm
Injector pressure	180-190 bar	200-210 bar
Injector hole diameter	0.210mm	0.198mm
Power generated	Less	More
Fuel supplied	Less	More

VIII. CONCLUSION

various test carried out on both the pump and injector at different pressure of fuel supplied to the pump. It is observed that pump with greater diameter plunger provider more fuel at same condition with cause more power generation. It also causes the change in firing sound of the engine. The high-pressure fuel also causes leakage of pipe with the normal delivery valve to avoid this use the delivery valve having greater Hight and flat hade.

IX. OBJECTIVE

The objective behind our experiment is to increase the fuel supply rate of the pump to the engine due to which more pressure exerted inside the cylinder by means of the injector. Which cause more production of the power at the same engine as well as at same ideal screw arrangement in fuel pump.

Fig .2. Actual fuel pump of TATA SFC 407

X. ACKNOWLEDGMENTS

We are thankful to Mr. P. P. Joshi for his constant guidance and encouragement throughout the implementation of this work. The background of sir in the field of Internal Combustion Engines helped us in understanding some of the practical concepts of the diesel injection pumps.

Also, we are grateful to Mr. Abhijeet Chhangani, proprietor of ABHIJEET DIESEL, khagan, for his constant help and support throughout the work. His immense interest in the field of diesel pumps and sharing of his knowledge really helped us in the performance analysis.

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