ASSIGNMENT 1
DIESEL POWER PLANT

GROUP - 3

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INTRODUCTION

In today's world, power generation has become the need of the hour. Power is needed for doing practically everything. Thus, this gives the importance to power plants. Knowing the importance and utility of these plants we decided to keep this as one of the topics for our assignment.

A prime mover is required to revolve the rotor of an alternator in order to generate electrical power. Different methods can be used to drive the primary mover. One of the most common techniques of generating power is to use a diesel engine as the primary mover. The power station is known as a diesel power station when the alternators' prime mover is a diesel engine. Although steam power stations and hydroelectric plants are typically used to create bulk electricity at lower rates, diesel power stations are gaining traction in areas where power demand is low, a sufficient supply of coal and water is absent, and transportation facilities are limited.

BACKGROUND

Rudolf Diesel was born in 1858 in Paris, France, and is most known for inventing the engine that carries his name. Diesel opened his first shop in Paris in 1885 to begin work on a compression ignition engine. The procedure would take 13 years to complete. He acquired several patents in the 1890s for his creation of a fuel-efficient, slow-burning, compression-ignition internal combustion engine.

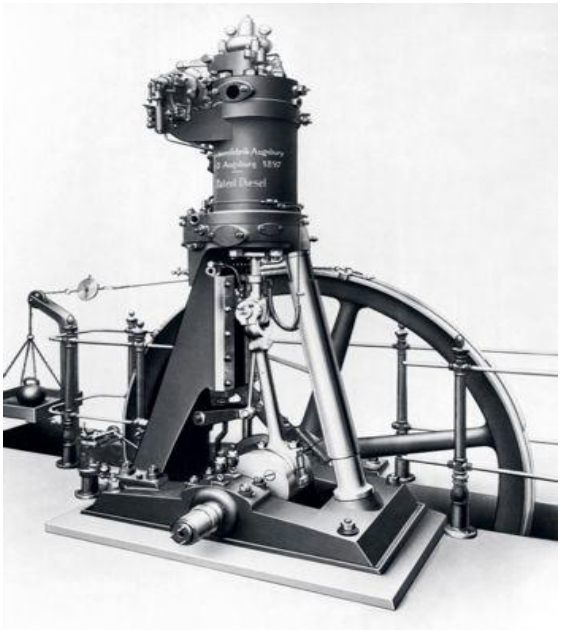

FIG. 1.0. THE 3RD TEST ENGINE BUILT BY DIESEL IN 1897

While the first engine test failed, a series of improvements and subsequent tests led to a successful test on February 17, 1897, when Diesel demonstrated a 26.2 percent efficiency with the engine, a significant achievement given that the popular steam engine at the time had an efficiency of around 10%. Later many engineers and developers contributed to the effort to increase the market viability of Rudolf Diesel's concept.

INDIA'S FIRST DIESEL POWER PLANT

Brahmapuram Diesel Power Plant is a 106.6 MW public sector power plant in Kochi, India, that was commissioned in 1997 by the Kerala State Electricity Board. Kerala Load Distribution Center is in charge of it (KLDC). The facility is powered by MAN B&W's large-bore 4 stroke diesel engines.

PERFORMANCE TESTING OF A DIESEL POWER PLANT

The diesel engine's performance is centred on power and efficiency. The engine's characteristics, such as piston speed, air-fuel ratio, compression ratio, inlet air pressure, and temperature, vary. The two most common operating circumstances for I.C. engines are (a) constant speed with variable load and (b) variable speed with variable load.

The engine is subjected to a battery of tests to evaluate its performance parameters, such as indicated power (I.P.), brake power (B.P.), frictional power (F.P.), mechanical efficiency (m), thermal efficiency, fuel consumption, and specific fuel consumption, among others.

THEORY

When a system is brought through a sequence of stages before being returned to its start condition, it is called a thermodynamic cycle. The system may perform work on its surroundings while going through this cycle, thereby operating as a heat engine. **Carnot's theorem** is a formal statement of this fact: *No engine operating between two heat reservoirs can be more efficient than a Carnot engine operating between the same reservoirs.*

$$\eta_I = \frac{W}{Q_{\mathrm{H}}} = 1 - \frac{T_{\mathrm{C}}}{T_{\mathrm{H}}}$$

ELEMENTS OF DIESEL POWER PLANT

AIR INTAKE SYSTEM

Wet or dry air intake systems are the most common. In a wet filter intake system, air is sucked or bubbled through a housing that contains an oil bath, allowing the oil in the filter to remove debris from the air. The air is then passed through a screen-like material to guarantee that any entrained oil is eliminated. A dry filter system collects and traps dirt before it enters the engine using paper, cloth, or a metal screen material. The intake system is often intended to draw fresh air and also helps reduce noise from the air movement.

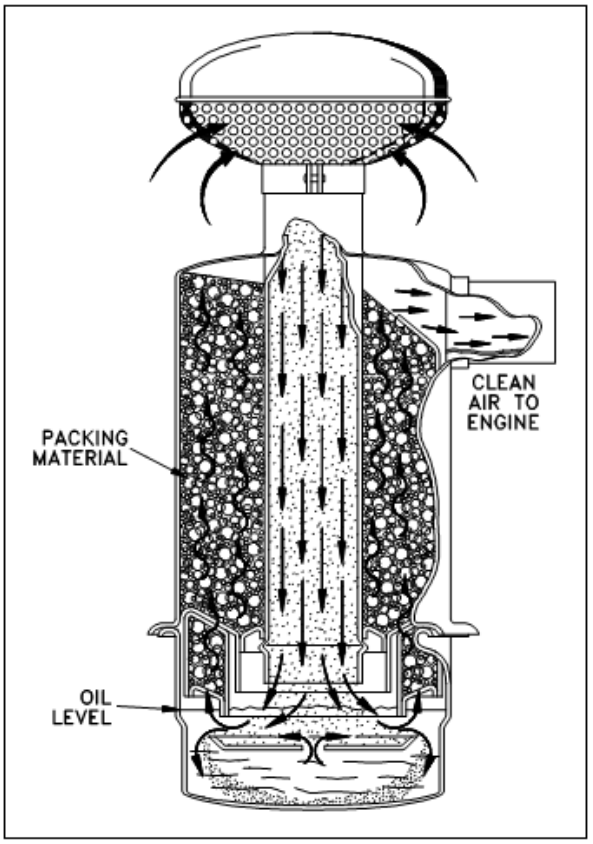

FIG. 1.1. AIR INTAKE FILTER

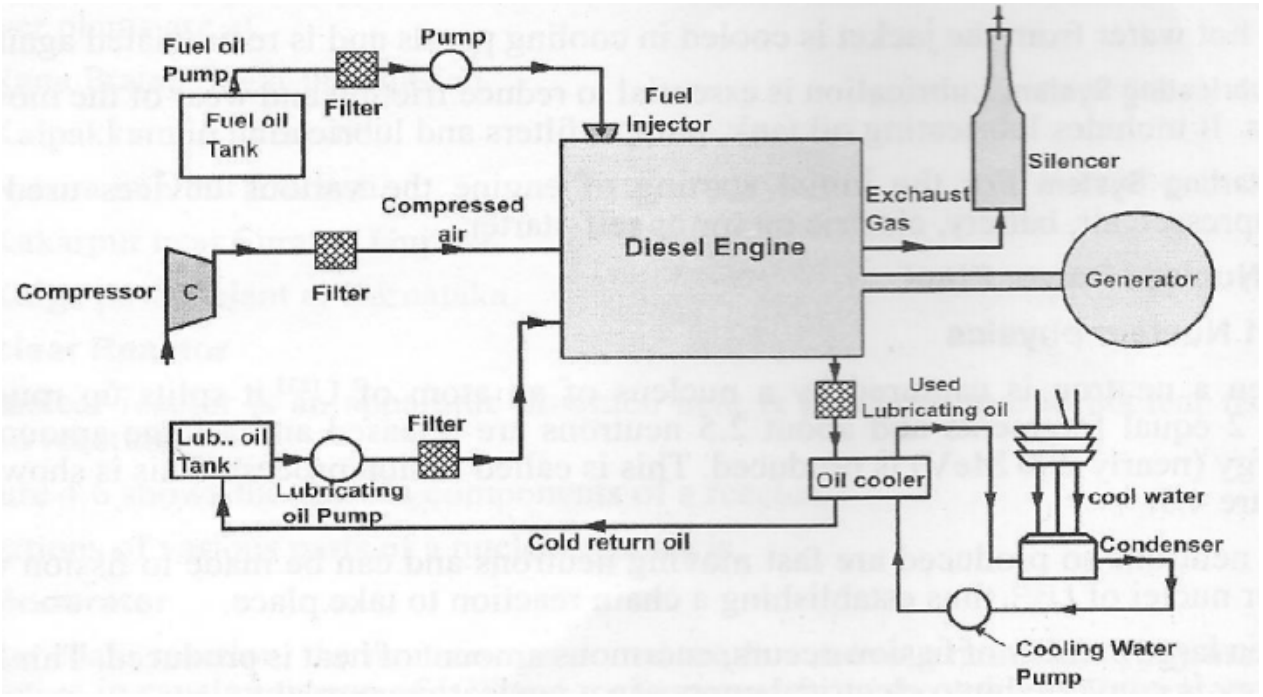

FIG 1.2. SCHEMATIC ARRANGEMENT OF DIESEL PLANT

FUEL SUPPLY SYSTEM

It is made up of a storage tank, strainers, a fuel transfer pump, and an all-day fuel tank. The fuel oil is delivered to the facility by rail or road. The oil is kept in a storage tank. At daily or brief intervals, oil is pumped from the storage tank to a smaller all-day tank. Fuel oil is pumped from this tank and filtered through strainers to remove suspended contaminants. The fuel injection pump injects clean oil into the engine.

EXHAUST SYSTEM

A diesel engine's exhaust system serves three purposes. First, the exhaust system transports the used combustion gases out from the engine to the atmosphere, where they are diluted by the atmosphere. This preserves the habitability of the region around the powerplant. Second, if a turbocharger is employed, the exhaust system restricts and channels the gases. Third, the exhaust system allows for the installation of mufflers to reduce engine noise.

COOLING SYSTEM

Cooling is used to maintain the temperature of the engine components within acceptable operating limits. A water source, a pump, and cooling towers comprise the cooling system. The pressure forces water through the cylinder and head jacket. Cooling towers cool the hot water, which then is recirculated for cooling.

LUBRICATING SYSTEM

The system reduces the wear on the engine's rubbing surfaces. It consists of a lubricating oil tank, a pump, a filter, and an oil cooler. The pump draws

lubricating oil from the lubricating oil tank and runs it through a filter to eliminate contaminants. The clean lubrication oil is fed to the lubrication points. .

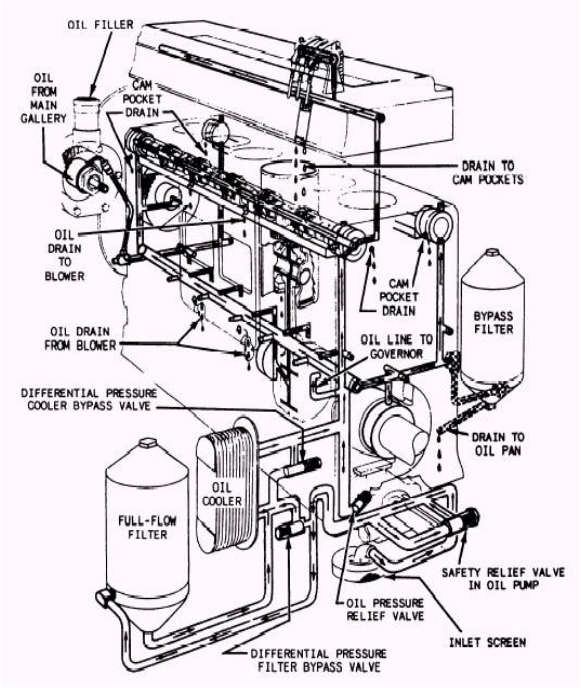

FIG. 1.3. INTERNAL LUBRICATION SYSTEM

ENGINE STARTING SYSTEM

This is an arrangement where the engine is rotated initially on start, until firing begins and the unit operates on its own power. Smaller sets are started manually using handles, whereas large units are started by compressed air. In the latter situation, high-pressure air is introduced into a few of the cylinders, causing them to function as reciprocating air motors, turning the engine shaft. Fuel is injected into the remaining cylinders, causing the engine to start on its own. The engine will be fired by the starting motor. The starting motor will spin the engine at a high enough rpm to allow the compression of the engine to ignite the gasoline and start the engine. When the running motor overdrives the starting motor, it disengages the flywheel

FUEL INJECTION SYSTEM

In an internal combustion engine, fuel injection is a mechanism for combining fuel with air. The majority of fuel injection systems are designed for diesel applications. The diesel gasoline hardware has become similar since the introduction of electronic fuel injection

BENEFITS

Smoother and more consistent engine response during fast throttle transitions, simpler and more trustworthy engine starting, better performance at extremely high or low ambient temperatures, extended maintenance intervals, and higher fuel economy are all operational benefits. The fuel injection eliminates the choke, which is needed on carburetor-equipped vehicles when starting the engine from cold and then adjusted when the engine heats up.

BASIC FUNCTION

A mass airflow sensor or manifold absolute pressure sensor is often installed at the intake, either in the air tube going from the air filter box to the throttle body or directly to the throttle body itself. It detects the mass of the air passing through it, providing the computer with an accurate estimate of how much air is entering the engine.

The Throttle Body is the next component in sequence. A throttle position sensor is often installed on the throttle body's butterfly valve. The throttle position sensor (TPS) communicates the position of the throttle butterfly valve to the computer, which is used to determine the load on the engine.

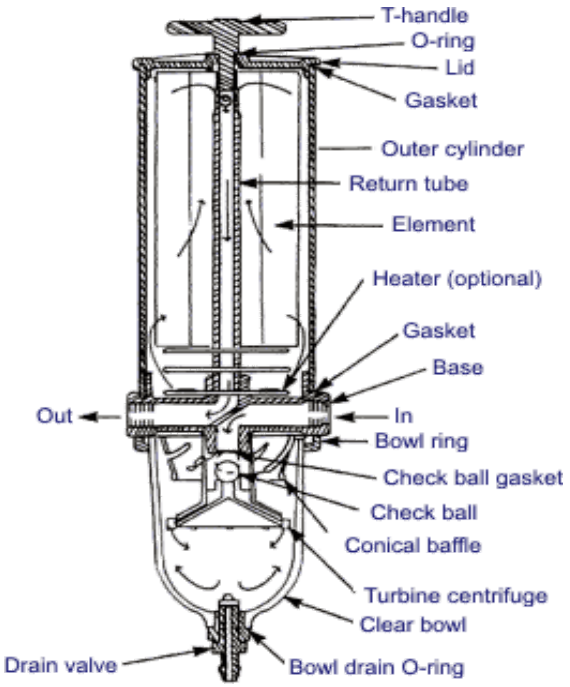

FIG. 1.4. FUEL INJECTION COMPONENTS

FUNCTIONAL DESCRIPTION

The Engine Control Unit (ECU) is a computer that monitors engine operating parameters via multiple sensors and is at the heart of an EFI system. The ECU evaluates these characteristics in order to compute the required amount of gasoline to be injected, and regulates engine function by adjusting fuel and/or air flow, among other things.

VARIOUS INJECTION SCHEMES

CONTINUOUS FUEL INJECTION

Continuous fuel injection systems spray fuel continuously from each injector just before the intake valve. The fuel pressure regulator keeps the fuel line pressure stable by returning surplus gasoline to the gas tank. Based on the quantity of airflow through the intake and the engine temperature, the mixture control unit adjusts the quantity of fuel delivered to the injectors. This data is supplied into a computer, which regulates the fuel injection rate, using an electrical system.

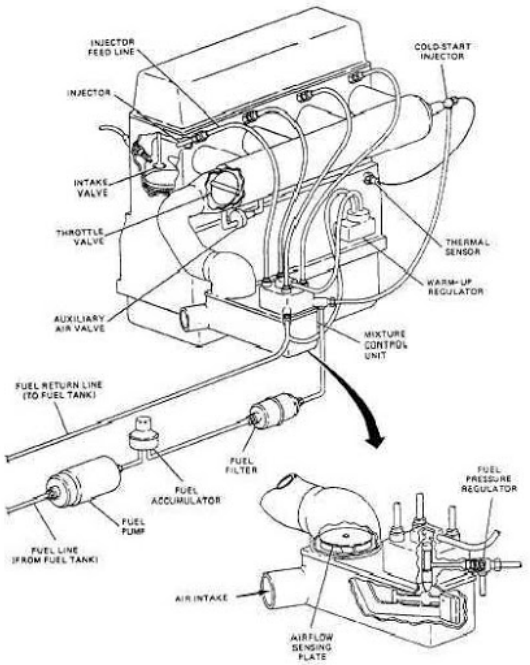

FIG. 1.5. CONTINUOUS FUEL INJECTION

THROTTLE BODY INJECTION SYSTEM

It is a type of continuous injection in which one or two injectors feed gasoline to the engine from a central location in the intake manifold. It is less expensive to construct and does give considerable precision fuel metering.

Airflow sensors and electrical processors are typically installed in the air cleaner body.

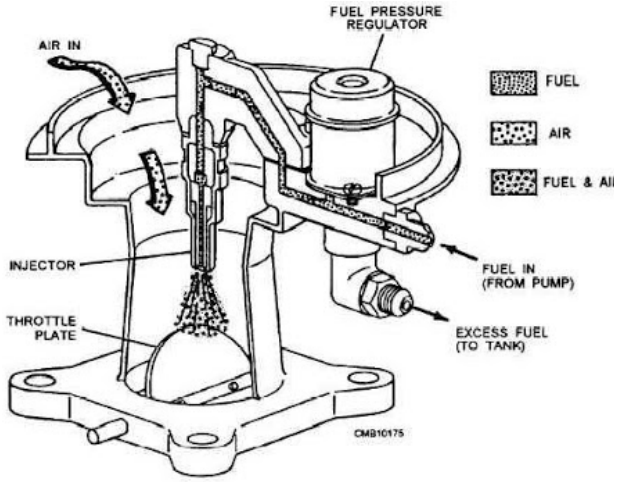

FIG. 1.6. THROTTLE BODY INJECTION

MULTI-POINT FUEL INJECTION

Multi-point fuel injection injects fuel into the intake port just upstream of the intake valve of the cylinder. MPFI (or simply MPI) systems can be sequential, with injection timed to correspond with each cylinder's intake stroke, batched, with fuel injected to the cylinders in groups, or with gasoline injected to all cylinders at the same time.

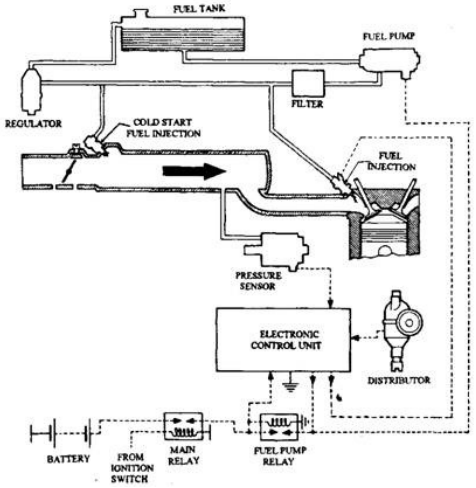

FIG. 1.7. MULTI-POINT FUEL INJECTION

PRESENT STATUS OF TECHNICAL DEVELOPMENT

Today, even with the fast growth of non-conventional ways of power generation, the importance of conventional power plants has not decreased. Especially, in India, the total installed capacity of power produced by diesel is nearly 75,000 MW and this number will not decrease in the near future.

Improved specific fuel usage and reduced de-rating are important factors in improving engine performance. The ISO 3046-1 standard specifies the following Standard Reference Conditions for diesel engines: ISO 15550: 2002; ISO 3046–1: 2002; Air temperature 25 C Air pressure 100 kPa Relative humidity 30 %.

Because it is useless for the operation and maintenance of the diesel power plant, the operational parameters of the engine and its auxiliary system cannot be changed from their optimum limits.

The following maintenance is required for the current diesel electric power plants. Maintaining the diesel engine's working condition every half hour. Keeping accurate records of instrument readings in a log sheet. Check the fuel oil level on a regular basis. Filtration of the fuel to remove contaminants. Clean the gasoline tank on a regular basis.

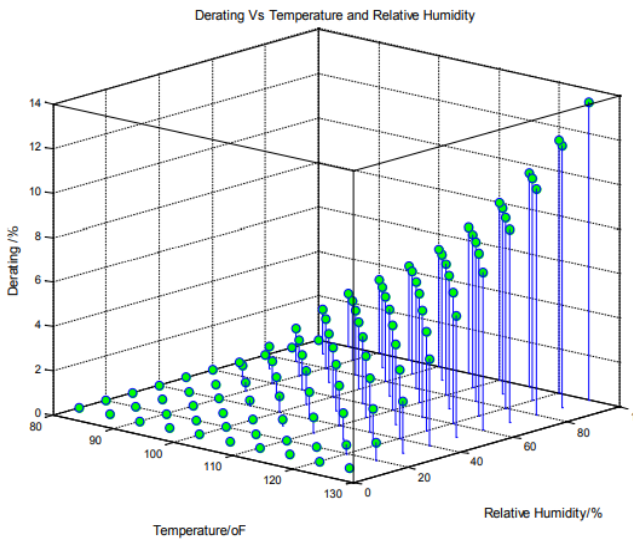

FIG. 1.8. PERCENTAGE ENGINE DE-RATING VS PERCENTAGE HUMIDITY AND TEMPERATURE

The performance of a diesel engine might be improved in two ways:
1. avoid engine de-rating and maintain rated output; and
2. reduce specific fuel consumption and enhance engine efficiency.

Advantages of the Current Diesel Power Station. It only takes up a very small amount of space. It has a quick start feature, allowing the compact diesel generator set to be started in a matter of seconds. There may not be any standby loss in the system because these machines can easily be started and stopped as needed. In this style of power station, cooling is simple and requires less water. The initial investment is lower than for other types of power plants. Thermal efficiency of diesel is quite higher than of coal. The overall cost is much less than that of a steam power station of the same capacity.

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