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Date.....Experiment No.....P.No.....

Name ..Hema....Rajput.....Faculty No.....Class..B.E.1st year.....

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4	To study layout of fuel supply system of petrol engine, A.C Mechanical fuel pump, Simple Carburetor	17 - 21	16/10/23 (10)	16-10-202	
5	To study layout of fuel suppl system of diesel engine, disel fuel pump diesel fuel injector	22 - 26		16-10-2023	
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7	Measure bore, stroke and clearance volume of given Petrol Engine & find r	30-10-2023		
8	Measure and draw valve timing diagram for 4 stroke single cylinder horizontal kirloskar diesel Engine	30-10-2023		
9	Conduct a constant Speed load test on a Junkers Diesel Engine & calculate BHP, BSE mechanical efficiency & Indicated power (using Willan's line method	30-10-2023		9/11/23
10	To study various of boiler accessories and the boiler mountings	30-10-2023		
11	To study and conduct test on Mark steam boiler and plot the temperature relationship for saturated steam	30-10-2023	58-59	

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Date 11.09.2023 Experiment No. 1 P. No. 1

Name Hemo Rajput Faculty No. Class. BE 1st year Batch. G1 I (5)

Basic idea of Engine and its Classification

Heat Engine :

A heat engine is a device which transform the chemical energy of a fuel into thermal energy and uses this energy to produce mechanical work. It is classified into two types

External Combustion engine

Internal Combustion engine

External Combustion Engine

In this engine, the products of combustion of air and fuel transfer heat to a second fluid which is the working fluid of the cycle.

Examples

In the steam engine or a steam turbine plant, the heat of combustion is employed to generate steam which is used in a piston engine (reciprocating type engine) or a turbine (rotary type engine) for useful work.

In a closed cycle gas turbine, the heat of combustion in an external furnace is transferred to gas, usually air which the working fluid of the cycle.

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Internal Combustion engine

In this engine, the combustion of air and fuels take place inside the cylinder and are used as the direct motive force. It can be classified into the following types

(1) According to the basic engine design - (a) Reciprocating engine (use of cylinder piston arrangements) (b) Rotary engine (use of turbine)

(2) According to the type of fuel used (a) Petrol engine (b) diesel engine (c) gas engine (CNG, LPG) (d) Alcohol engine (ethanol, methanol etc.

(3) According to the number of strokes per cycle - (a) Four stroke and (b) Two stroke engine

(4) According to the method of igniting the fuel (a) Spark ignition engine (b) Compression ignition engine and (c) hot spot ignition engine

(5) According to the working cycle (a) Otto cycle (constant volume cycle) engine (b) diesel cycle (constant pressure cycle) engine (c) dual combustion cycle (semi diesel cycle) engine

(6) According to the fuel supply and mixture preparation (a) Carburetted

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Date 11.09.2023 Experiment No. 1 P. No. 3

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type (fuel supplied the carburettor), (b) Injection type (fuel injected into inlet ports or inlet manifold fuel injected into the cylinder just before ignition

(7) According to the number of cylinder - (a) single cylinder and (b) multi-cylinder engine

(8) Method of cooling - Water cooled or air cooled

(9) Speed of the engine - slow speed, medium speed and high speed engine

(10) Cylinder Arrangement - Vertical, horizontal, inline, V-type, radial, opposed Cylinder or piston engines

(11) Valve or port design and location - Overhead (I head), side valve (L head) in two stroke engines: cross scavenging, loop scavenging, uniform scavenging

(12) Method governing - Hit and miss governed engines, quantitatively governed engines and qualitatively governed engine

(13) Application - Automotive engine for land transport, marine engines for propulsi of ships, aircraft engines for aircraft propulsion, industrial engines, prime movers for electrical generators.

18/9/23

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Date 18:09:2023 Experiment No. 2 P. No. 1

Name Hema Rajput Faculty No. Class B.E. 1st Year Batch (A1) (15)

Objective :

To study working of four stroke cycle petrol engine and four stroke cycle diesel engine with the helps of models.

(b) To study working of two stroke cycle petrol engine and two stroke cycle diesel engine with the help of models

Theory :

Nickolaus otto is credited with building the first four-stroke cycle engine in 1867, considered the basis of our modern engines. In his honour it is often called the otto cycle engine. A four-stroke (also four-cycle) engine is an internal combustion (IC) engine in which the piston completes four seperate strokes while turning the crankshaft. A stroke refers to the full travel of the piston along the cylinder in either direction

Working of four-stroke Petrol Engine

1. **Intake Stroke**

- The piston moves from TDC to BDC (down)
- The intake valve is open
- The exhaust valve is closed
- The piston creates a suction (vacuum) and air and fuel are sucked into the cylinder

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Compression stroke:

- The piston moves from BDC to TDC (up)
- Both values are closed
- The piston compresses the air and fuel mixture

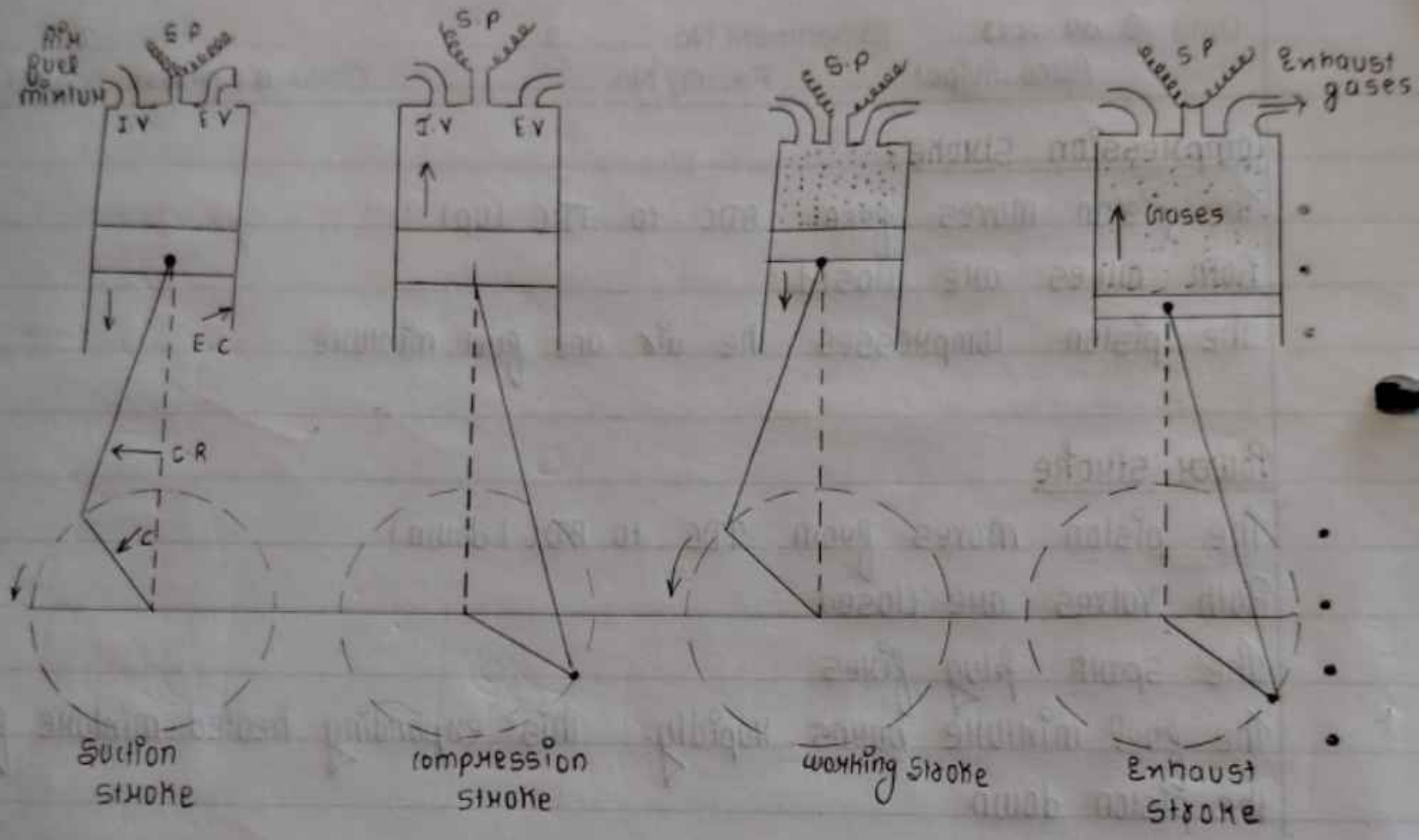
Power stroke

- The piston moves from TDC to BDC (down)
- Both valves are closed
- The spark plug fires
- The fuel mixture burns rapidly. This expanding heated mixture forces the piston down

Exhaust stroke

- Piston move from BDC to TDC (up)
- The intake valve is closed
- The exhaust valve is open
- The piston pushes the exhaust out

The diesel engine, named after Rudolf Diesel, is an internal combusti engine in which ignition of the fuel is caused by the elevated temperature of the air in the cylinder due to the mechanical compression (adiabatic compression) thus the diesel engine is a so-called compression-ignition engine (CI)



I.V = Inlet valve , E.V = Exhaust valve E.C = Engine cylinder C.R = connecting rod C = Crank S.P = Spark plug

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Name Hema Rajput Faculty No. Class B.E 1st Year Batch [illegible]

Working of four stroke Diesel Engine

1 Suction stroke

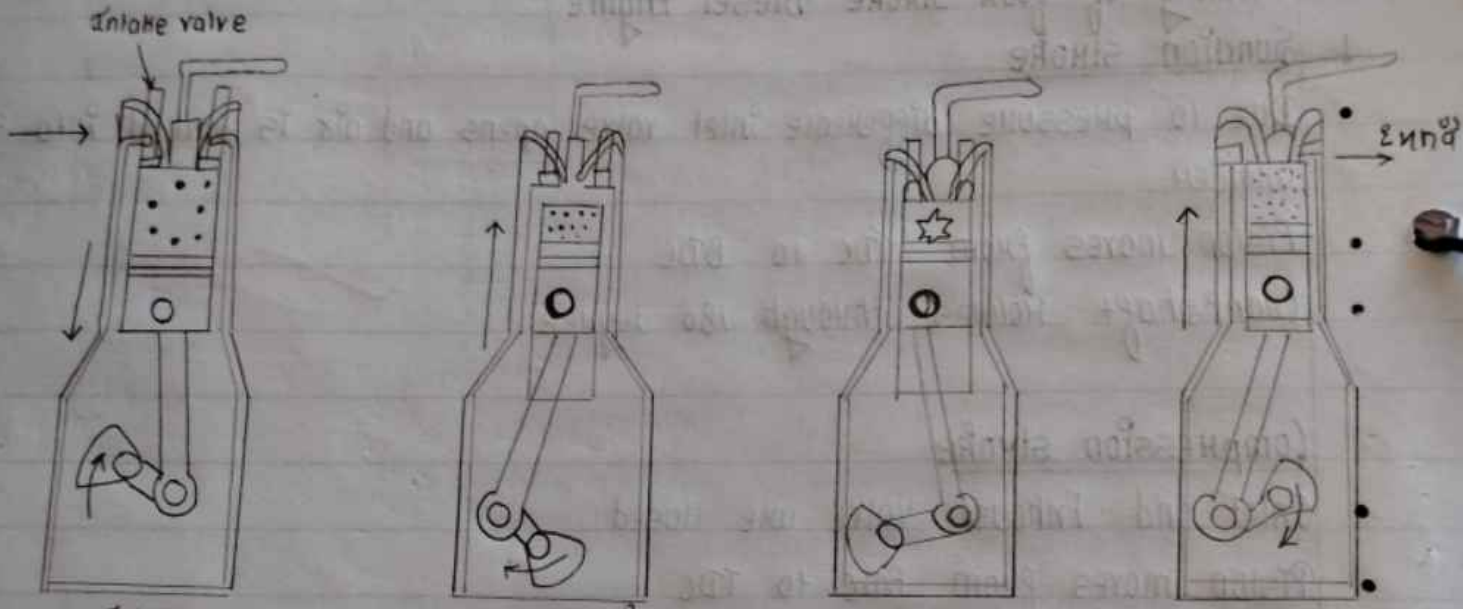
- Due to pressure difference inlet valve opens and air is sucked into the cylinder
- Piston moves from TDC to BDC
- Crankshaft rotates through 180 degree

Compression stroke

- Inlet and Exhaust valve are closed
- Piston moves from BDC to TDC
- Pressure and temperature of charge increases
- Crankshaft rotates through 360 degree i.e. one complete revolution

Expansion Stroke

- Fuel is injected through fuel injector before the piston reaches TDC
- Temperature of air is high enough to ignite the fuel
- Sudden increase in the temperature and pressure
- Combustion products pushes the piston in the downward direction due to high pressure
- Piston moves from TDC to BDC
- Both inlet and exhaust valves are closed


Intake valve
Intake
compression
power
exhaust

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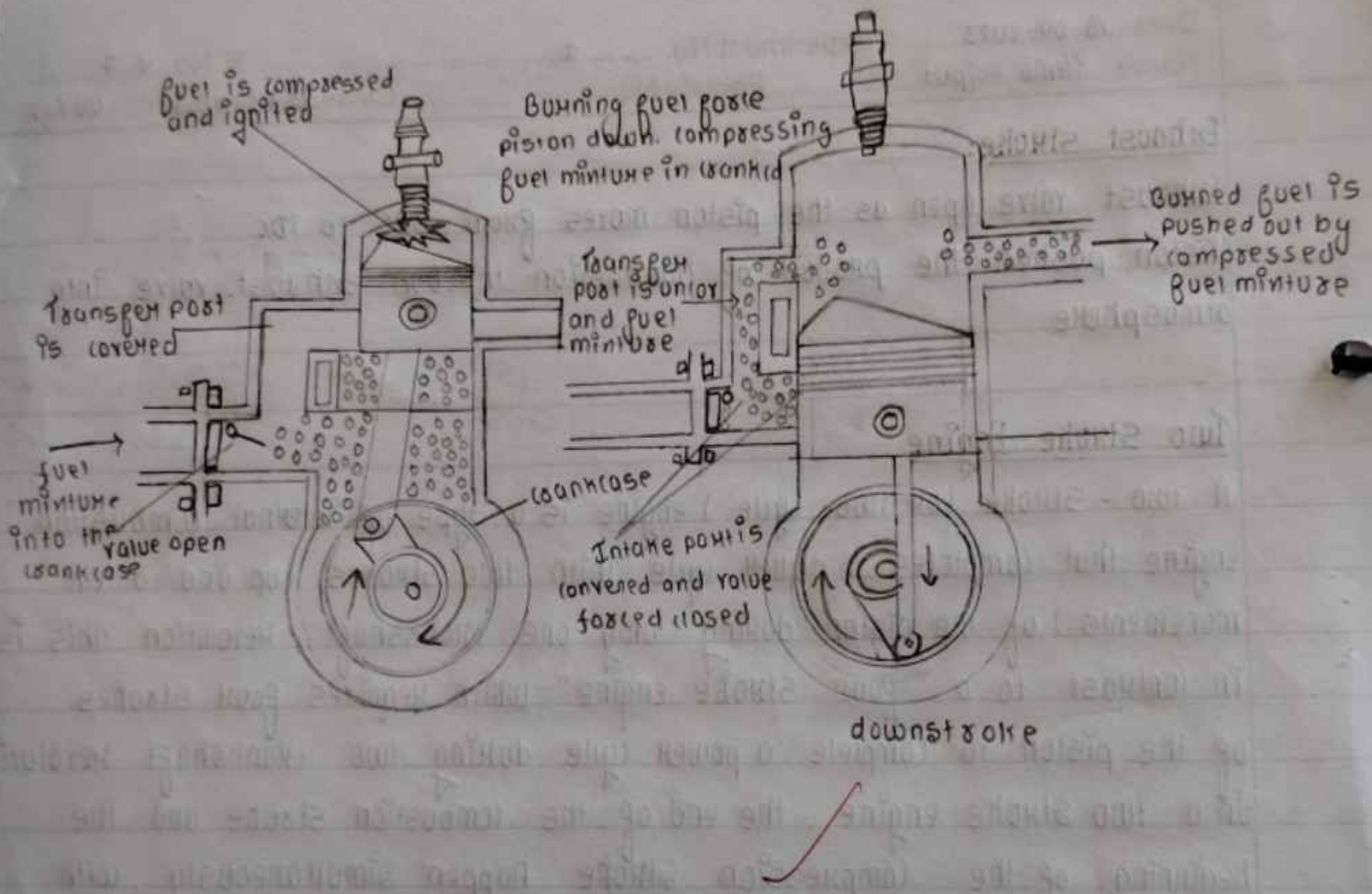
Name Hemo. Rajput Faculty No. Class B.E 1st year Batch 03.1.15

Exhaust stroke:

Exhaust valve open as the piston moves from BDC to TDC
Piston pushes the product of combustion through exhaust valve into atmosphere

Two Stroke Engine

A two-stroke (or two-cycle) engine is a type of internal combustion engine that completes a power cycle with two strokes (up and down movements) of the piston during only one crankshaft revolution. This is in contrast to a "four-stroke engine" which requires four strokes of the piston to complete a power cycle during two crankshaft revolution
In a two stroke engine, the end of the combustion stroke and the beginning of the compression stroke happen simultaneously, with the intake and exhaust (or scavenging) functions occurring at the same time
Two-stroke engines often have a high power-to-weight ratio, power being available in a narrow range of rotational speeds (called the "power band". Compared to four-stroke engines, two stroke engines have a greatly reduced number of moving parts
In two stroke cycle engines
In two stroke cycle engines, the whole sequence of events i.e suction compression, power and exhaust are completed in two stroke of the piston.


fuel is compressed and ignited
Burning fuel forte piston down. compressing fuel mixture in crankcase
Burned fuel is pushed out by compressed fuel mixture
Transfer port is covered
Transfer port is open and fuel mixture
fuel mixture into the crankcase
Value open
crankcase
Intake port is covered and value forced closed
downstroke

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one revolution of the crankshaft. There is no valve in this type of engine. Gas movement take place through holes called ports in the cylinder. The crankcase of the engine is air tight in which the crankshaft rotates.

Upward stroke of the piston (Suction + Compression):

When the piston moves upward it covers two of the ports, the exhaust port and transfer port. which are normally almost opposite to each other. This traps the charge of air-fuel mixture drawn already in to the cylinder. Further upward movement of the piston compresses the charge and also uncovers the suction port. Now fresh mixture is drawn through this port into the crankcase. Just before the end of this stroke, the mixture in the cylinder is ignited by a spark plug. Thus, during this stroke both suction and compression events are completed.

Downward stroke (Power + Exhaust)

Burning of the fuel rises the temperature and pressure of the gases which forces the piston to move down the cylinder. When the piston move down, it closes the suction port, trapping the fresh charge drawn into the crankcase during the previous upward stroke. Further downward movement of the piston uncovers first and exhaust port and then the transfer port driving out the burnt gases through the exhaust port. Special shaped piston crown deflects the incoming mixture up around the cylinder so that

It can help in driving out the exhaust gases During the downward stroke of the piston power and exhaust events are completed

Advantage of 2- Stroke Engine over 4- Stroke engine

(1) The two- stroke cycle engine gives one working stroke for each revolution of the crankshaft. Hence theoretically the power developed for the same engine speed and cylinder volume is twice that of the four- stroke cycle engine, which gives only one working stroke for every two revolutions of the crankshaft. However, in practice because of poor scavenging, only 50-60 % extra power is developed

(2) Due to one working stroke for each revolution of the crankshaft, the turning moment of the crankshaft is more uniform. Therefore, a two- stroke engine requires a lighter flywheel

(3) The two- stroke engine is simpler in construction. The design of its parts is much simpler and their maintenance easier than that of the valve mechanism

(4) The power required to overcome frictional resistance of the suction and exhaust stroke is saved, resulting in some economy of fuel

(5) Owing to the absence of the cam, camshaft, rockers etc of the valve mechanism the mechanical efficiency is higher

(6) The two- stroke engine gives fewer oscillations

(7) For the same power, a two- stroke engine is more compact and requires

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Name Heera Rajpurohit Faculty No. Class B.E. 1st year Batch G1 I.I.S.

less space than a four-stroke cycle engine. This make it more suitable for use in small machines and motorcycles

(8) A two-stroke engine is lighter in weight for the same power and speed especially when the crankcase compression is used

(9) Due to its simpler design it requires fewer spare parts

(10) A two-stroke cycle engine can be easily reversed if it is of the valve less type

Disadvantages

(1) The scavenging being not very efficient in a two-stroke engine, the dilution of the charges takes place which results in poor thermal efficiency

(2) The two-stroke spark ignition engines do not have a separate lubrication system and lubricating oil is mixed with the fuel. This is not as effective as the lubrication of a four-stroke engine. Therefore, the parts of the two stroke engine are subjected to great wear and tear

(3) In a spark ignition two-stroke engine, some of the fuel passes directly to the exhaust. Hence the fuel consumption per horsepower is comparatively highers

(4) With heavy loads of two-stroke engine get heated up due to excessive heat produced. At the same time the running of the engine is not very smooth at light loads

(5) It consumes more lubricating oil because of the greater amount of heat generat

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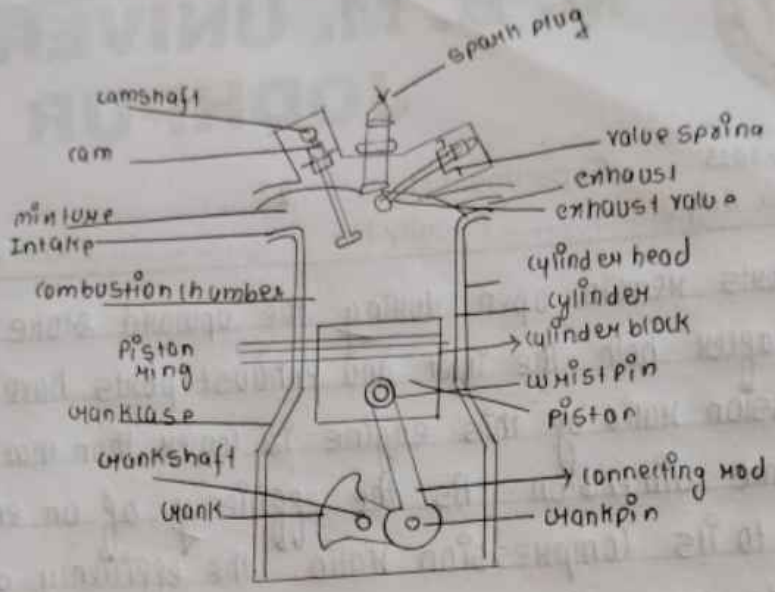
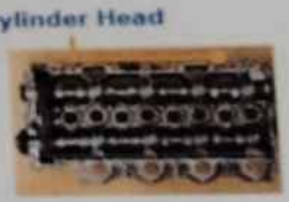
(6) Since the ports remain open during the upward stroke, the actual compressi start only after both the inlet and exhaust ports have been closed. Hence the compression ratio of this engine is lower than that of four-stroke engine of same dimension. As the efficiency of an engine is directly proportional to its compression ratio, the efficiency of a two-stroke cycle engine is lower than that of a four-stroke cycle engine of the same size.

good 9/10/23 (10)

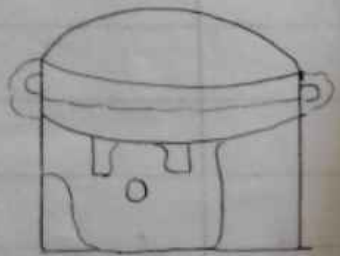
Components of I.C Engine





Engine block

2) Cylinder



3) Piston

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P. No. 12

Date 9.10.2023 Experiment No. Class B.E. 1st year Batch G1.1(15)

Name Hema Rajput Faculty No.

Objective:

To study various part of IC engine mechanism with the help of sectioned working model of four stroke single cylinder kirloskar engine and dismantled four-cylinder four stroke fiat car engine

1 **Engine Block:**

The engine block is the foundation and centre of the engine. Blocks come in many different sizes, shapes and styles

The engine block holds the cylinder, the crankshaft, connecting rods and pistons

The large round holes in the block, called cylinders, are where the pistons slide up and down

2. **Cylinder:**

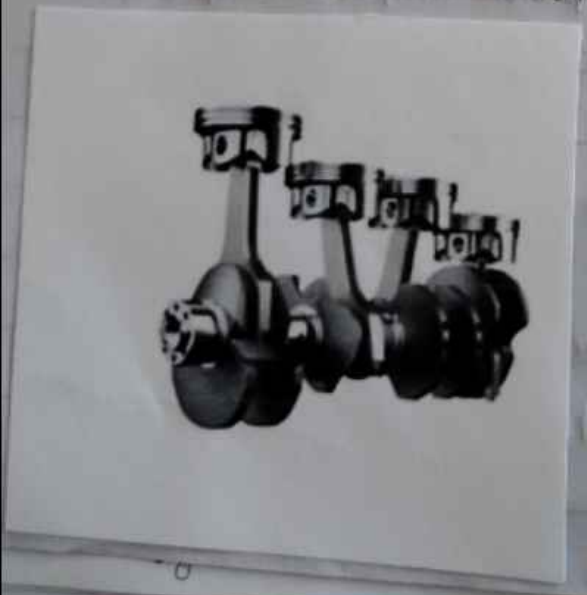
The cylinder is the space in which the piston reciprocates up and down by the energy generated from the combustion of the air / fuel mixture in the combustion chamber

3. **Piston:**

A piston slides up and down a cylinder and pushes the crankshaft around. The piston connects to the crankshaft via the connecting rods

4) Piston Rings

5) connecting Rod



6) Crankshaft

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4 **Piston Rings:**

Each piston has two compression rings and one oil control ring to help seal the piston in the cylinder

Compression rings seal the cylinder so that combustion gas generated at the time of ignition does not leak into the opening between the piston and the cylinder

The oil rings act in a scraping manner, keeping excess oil out of the combustion chamber.

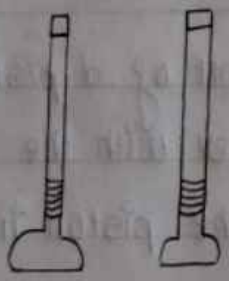
5. **Connecting Rod**

A connecting rod also called a con rod, is the part of a piston engine which connects the piston to the crankshaft. Together with the crank, the connecting rod converts the reciprocating motion of the piston into the rotation of the crankshaft.

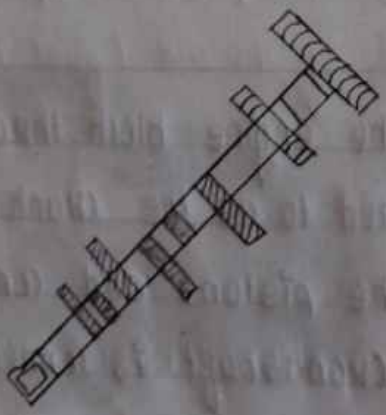
6 **Crankshaft**

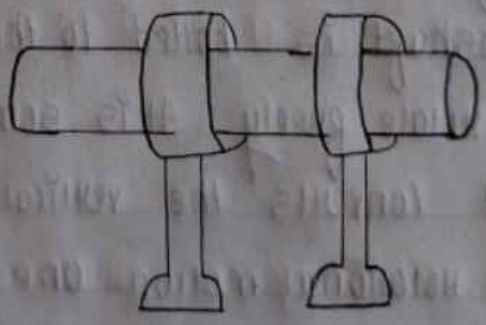
The crankshaft is bolted to the bottom of the engine block through bearing so it can rotate freely. It is sometimes referred to as the crank. The crankshaft converts the vertical motion of the pistons and connecting rods to a rotational motion. One end of the crankshaft is connected to a flywheel that transfers the engine power to the wheels through a transmission (manual or automatic)

7) Cylinder Head



8) Valves





Cam and Shaft

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Name ..Hemo..Rajput..... Faculty No. .....Class B.E. 1st year Batch (A1) (A5)

7 **Cylinder Head:**

The cylinder head is bolted to the top of the cylinder block. It serves as a cover for the cylinders and pistons. The cylinder head helps to create the top part of the combustion chamber. An engine "breathes" through the cylinder head. It lets an air / gas mixture into the engine and exhaust out of the engine. The valves and valve train control the breathing of the engine by opening and closing the valves at the appropriate time

8 **Valves**

Valves can be divided into two groups

Intake valves control the flow of the air / gas mixture into the engine

Exhaust valves control the flow of exhaust out of the engine

Size of Exhaust valve is more than the size of inlet valve

9 **Cam and Camshaft**

The camshaft controls the opening and closing of the valves. There is one lobe on the camshaft for each valve in the engine. Camshaft lobe design dictates three things

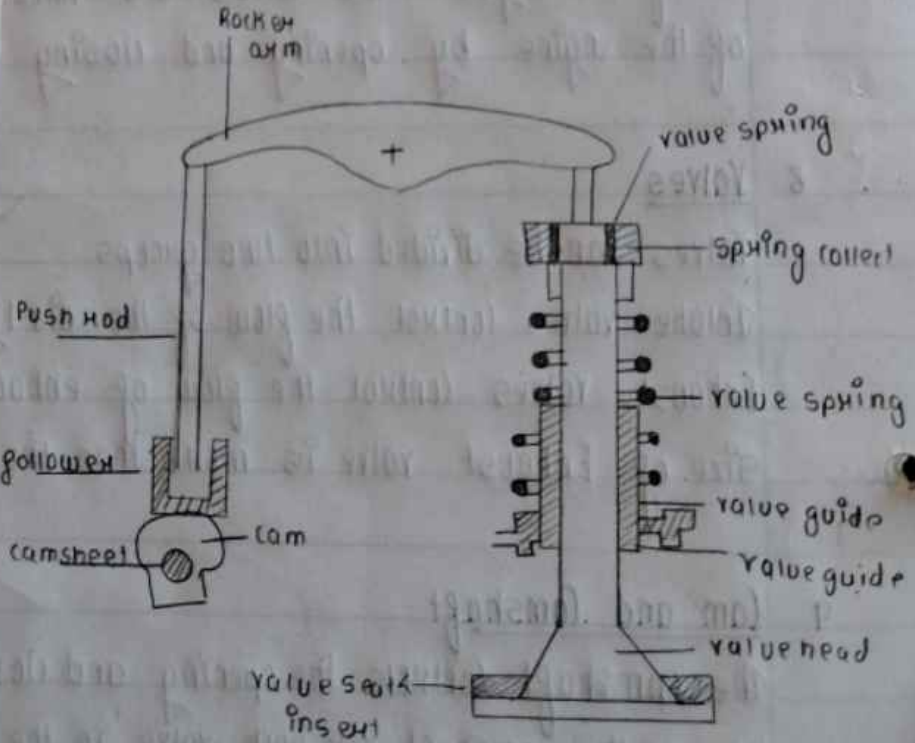
How far the valve opens

How far the valve opens

How long the valve opens

Depending on the engine type, the camshaft can be located either in the engine block or over the head (OHC) or double OHC (DOHC)

10) flywheel



11) Rocker arm

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10 **Flywheel:**

Flywheel, heavy wheel attached to a rotating shaft so as to smooth out delivery of power from a motor to a machine. The inertia of the flywheel opposes and moderates fluctuations in the speed of the engine and stores the excess energy for termittent use

11 **Rocker Arm:**

A rocker arm (in the content of an internal combustion engine of automotive machine, motorcycle and reciprocating aviation types) is an oscillating lever that conveys radial movement from the cam lobe into linear movement as the poppet valve to open it. The opposite end opens the valve

12 **Gudgeon Pin:**

An internal combustion engines, the gudgeon pin (UK, wrist pin or piston pin (US) connects the piston to the connecting rod and provides a bearing for the connecting rod to pivot upon as the piston moves

13 **Inlet and Exhaust manifold:**

Featuring a series of tubes, the intake manifold ensures that the air coming into the engine is evenly distributed to all the cylinders. This air is used during the first stroke of the combustion process. The intake manifold also helps cool down the cylinders to prevent the engine from overheating. The exhaust manifold is the first part of your vehicle's

13) Inlet and exhaust manifold

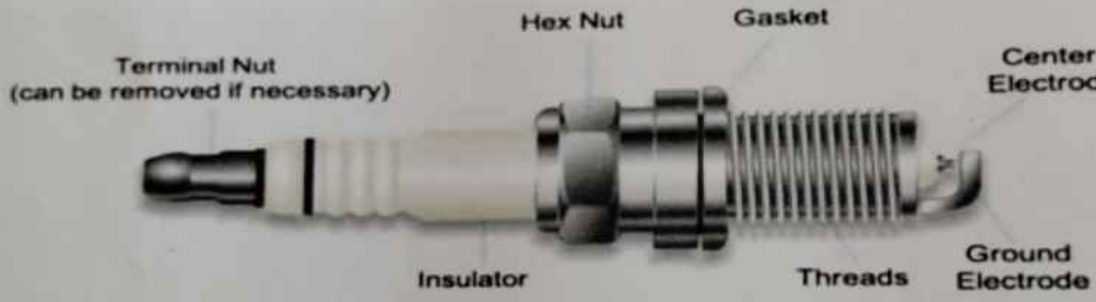
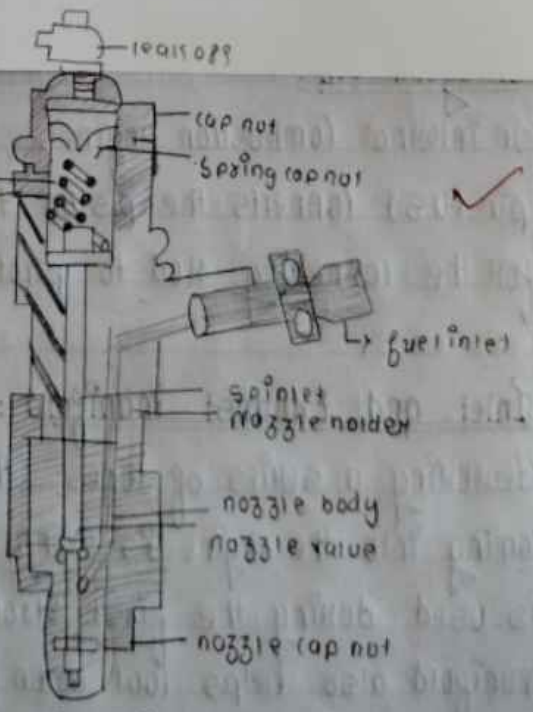


Fig2a: Spark plug

14) Spark plug



15) fuel injector

exhaust system. It is connected to your vehicle's engine and collects your engin's emissions. Basically the exhaust manifold acts as a funnel and is used to collect all of the engine's emissions

14 **Spark Plug:**

The function of a sparkplug is to produce a spark at the required time to ignite the combustible mixture. The plug is connected to a high voltage generated by an ignition coil or magneto

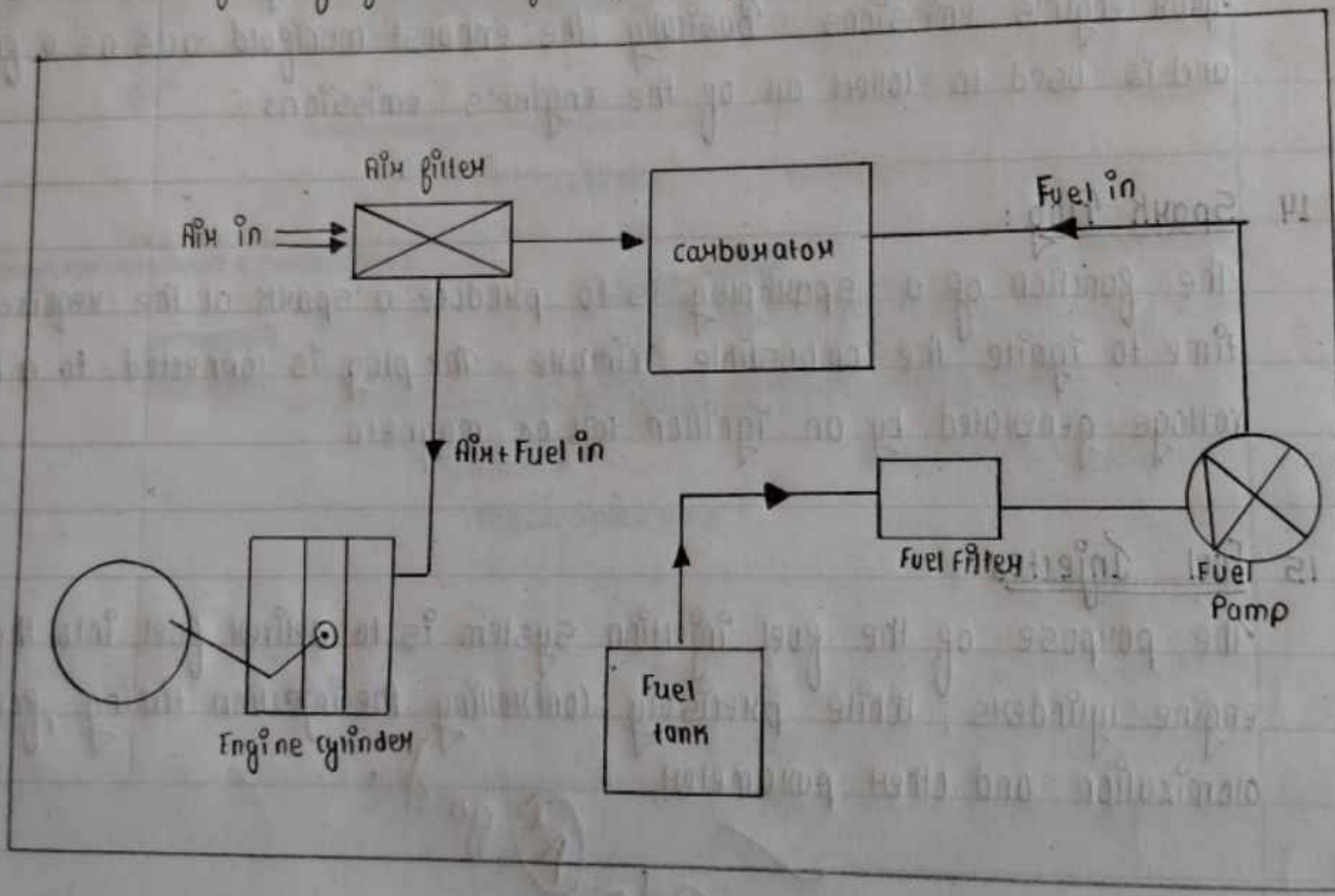
15 **Fuel Injector:**

The purpose of the fuel injection system is to deliver fuel into the engine cylinders, while precisely controlling the injection timing, fuel atomization and other parameter

(A1) good.

16/10/23

Layout of fuel supply system of petrol Engine



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Date ..16..10..2023.... Experiment No. ..... P. No...17.....
Name ...Hemo..Rajput..... Faculty No. .....Class.B.E.1st year Batch(A1/A5)

Objective:

To study layout of the fuel supply system of Petrol Engine

(b) A.C Mechanical Fuel Pump

(c) Simple Carburetor

Theory:

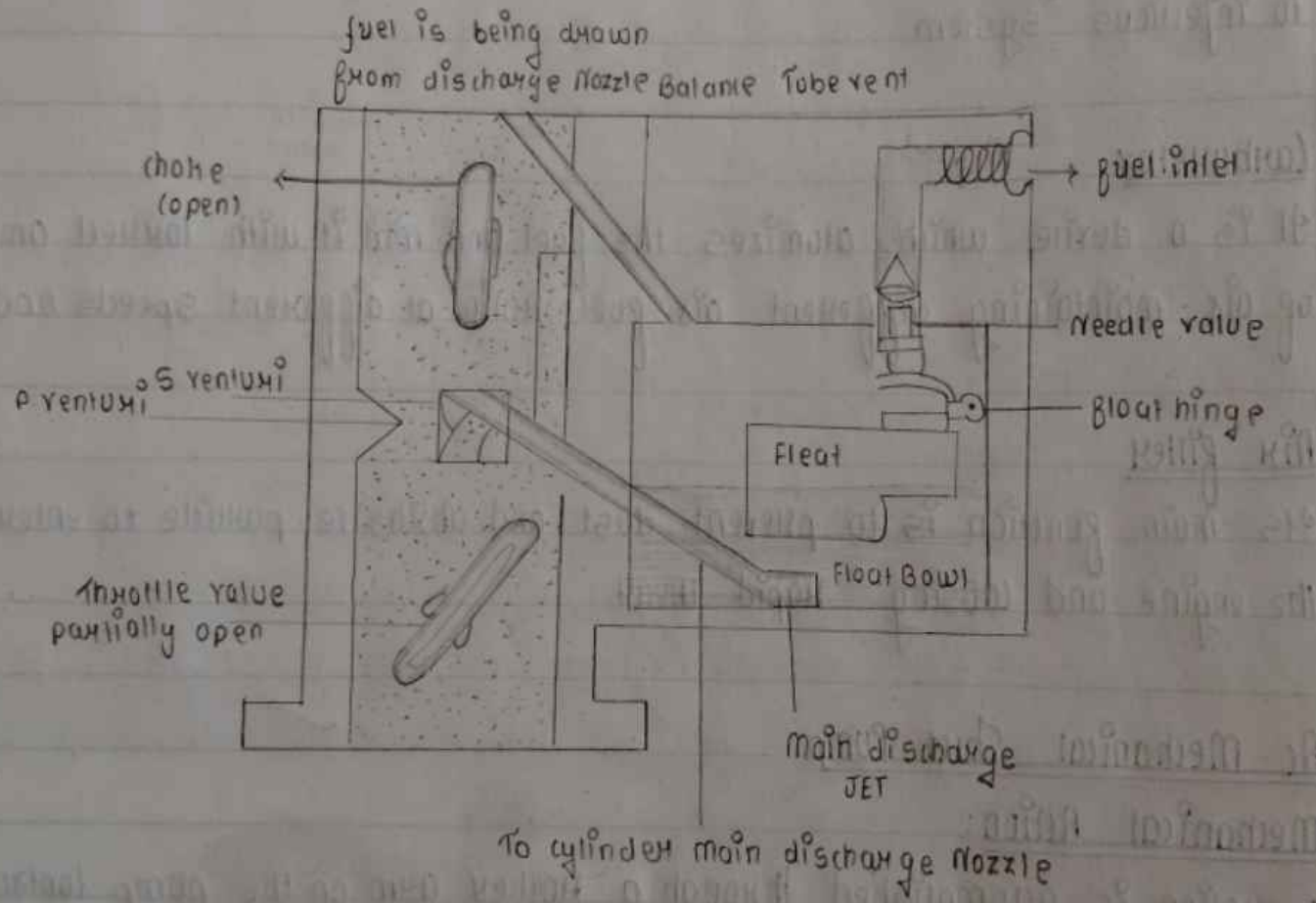
Here shown the line diagram of layout of a fuel supply system of petrol engine

Fuel Tank:

The fuel tank stores the entire fuel until it is needed for operating of the vehicle. The fuel tank has an inlet pipe and an outlet pipe. The outlet pipe has a fitting for fuel line connection and may be located in the top or in the side of the tank. The bottom of the tank contain a drain plug

Fuel Filter

To ensure this cleanliness, fuel filters are installed in the fuel line Fuel filters can be located at any point between the fuel tank and the carburetor. One may be in the tank itself, in the fuel pump or in the carburetor. Any water or solid material which is trapped by the filter will fall to the bottom of the glass bowl



Simple Carburetor ✓

into the fuel chamber. On the return stroke of the rocker arm, the diaphragm spring forces the diaphragm upward, the inlet valve closes, and the outlet valve is forced open, allowing fuel to flow through the outlet to the carburetor

Link Action:

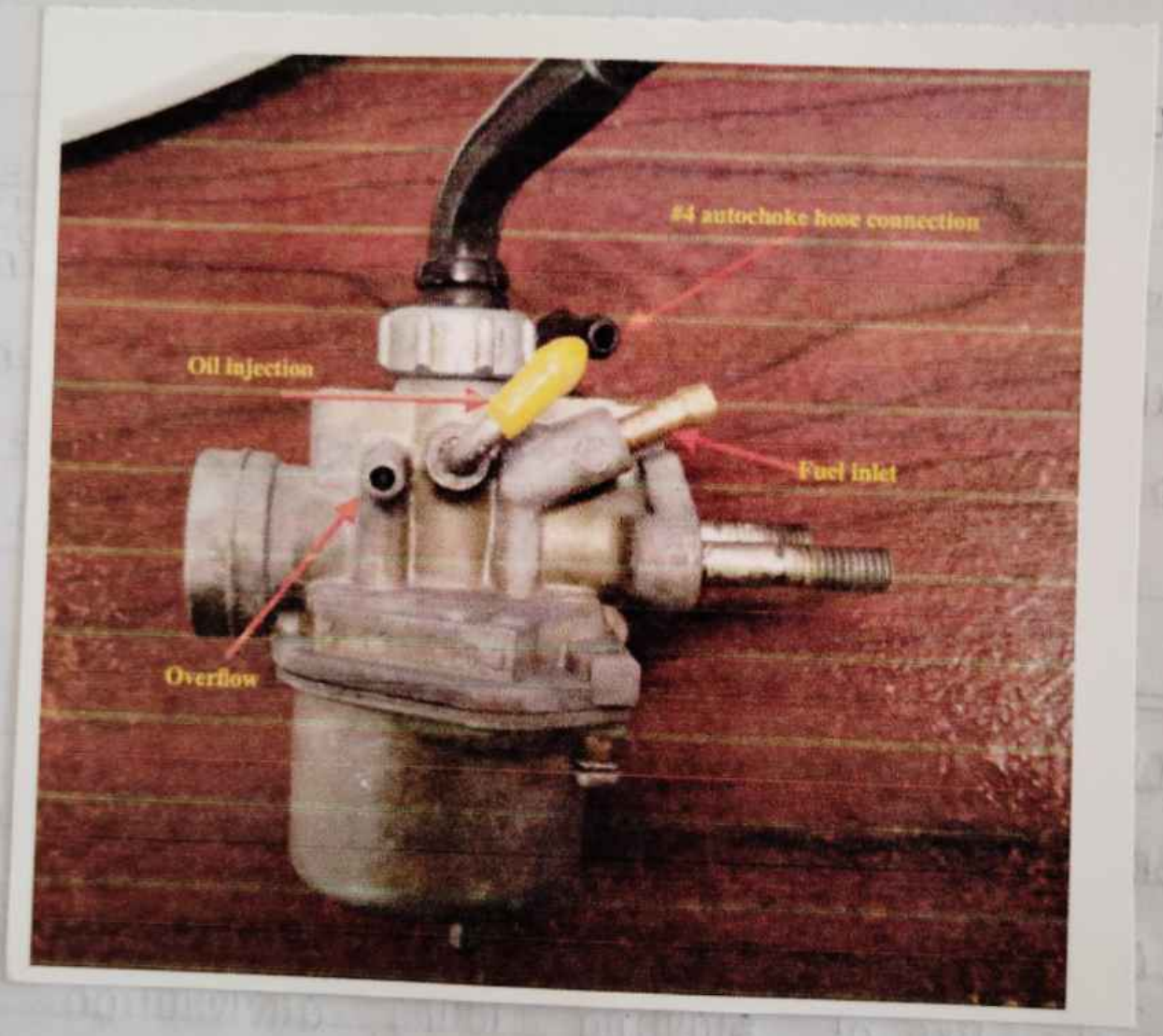
When the carburetor float bowl becomes full of fuel, the carburetor inlet valve closes due to which pressure in the line leading to pump increases this block pressure is transmitted to the pump diaphragm due to which it remain in the lower position against the pressure of diaphragm spring

Simple Carburetor:

Carburetor is the device that used to mix air and fuel in an internal combustion engine. The main objective of the carburetor is to provide quality air - fuel mixture for cruising range and for other special requirements like at starting, idling, acceleration, variable load, and speed operation condition

Construction

The float chamber is vented to the upstream side of the venturi or to the atmosphere float and needle valve maintain the constant gasoline / petrol level inside the float chamber. The float chamber goes down as a result of the decreasing amount of fuel inside


#4 autochoke hose connection
Oil injection
Fuel inlet
Overflow

Carburetor

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When the fuel level goes down the designed level, the floats go down, actuate the fuel supply valve and admits fuel into the chamber when fuel reached the designed level, float closes the fuel supply valve the tip of fuel discharge nozzle from the float chamber is located to the throat of venturi. The tip will be slightly above the level of fuel in the float chamber to avoid overflow. The throttle valve is regulated by the mechanical linkage (cable) or pneumatic link to the accelerator pedal of the vehicle

Working:

Simple carburetor work on the Bernoulli's principle During the suction stroke, air is drawn into the cylinder through venturi (also know as choke tube). Venturi tube is designed in such a way that it offers minimum resistance to the air flow. When air passes through the venturi the velocity of air increases and the pressure decreases [Head venturi meter working principle]. At venturi throat the velocity of air reach maximum and the pressure reach minimum. There will be a pressure difference between the float chamber and venturi throat This pressure difference is known as carburetor depression. Because of this pressure difference fuel is discharged to air steam through fuel discharge nozzle. The amount of fuel discharged depend upon the size of fuel discharge nozzle / fuel discharge jet

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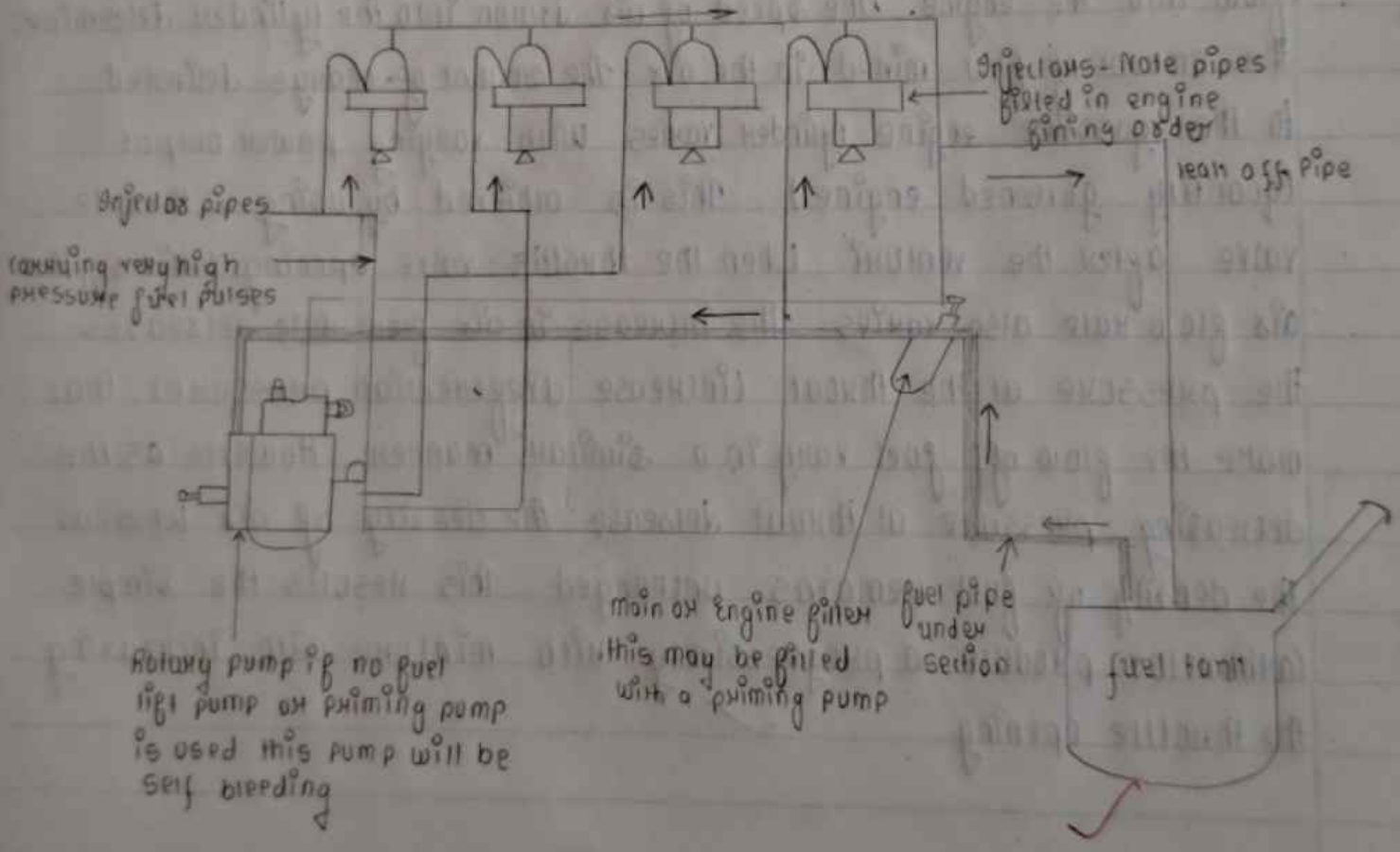
Date ....16.10.2023.... Experiment No. ..... P. No..21.....
Name ..Hema.Rajput..... Faculty No. .....Class.B.E.1st year.Batch.G1.I(I.S.)

How carburetor maintains different air-fuel ratio??

The accelerator (throttle) of a vehicle does not directly control the fuel supply. Instead, it actuates a mechanism that controls the air flow into the engine. The speed of air drawn into the cylinder determines the amount of fuel mixed in the air. The amount of charge delivered to the gasoline engine cylinder varies with varying power output (quantity governed engine). This is achieved by using a throttle valve after the venturi. When the throttle valve opening varies, the air flow rate also varies. The increase in air flow rate decreases the pressure at the throat (increase differential pressure) that make the flow of fuel vary in a similar manner. However as the decreasing pressure at throat decrease the density of air whereas the density of fuel remains unchanged. This results the simple carburetor produce a progressively rich mixture with increasing the throttle opening.



Layout of fuel supply system of diesel engine

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Date 14.10.2023 Experiment No. ..... P. No. 22

Name Heena Rajput Faculty No. ..... Class B.E. 1st year Batch (A1) (15)

Objective :

To study layout of
Fuel supply system of a diesel engine
Diesel fuel pump
Diesel fuel injector

Theory :

Layout of the fuel supply system of a diesel engine
Fuel supply system is a separate system used to delivery diesel at correct time in correct quantity to a diesel engine for smooth and efficient operation. The operation of diesel engine is different from that of petrol engine. In a petrol engine air fuel mixture is supplied by a carburetor to the engine at the beginning of the suction stroke but in a diesel engine fuel is supplied at the end of compression stroke by means of a fuel supply system

Working :

During engine operations the fuel is supplied by gravity from fuel tank to the primary filter, where course impurities are removed. From the primary filter the fuel is drawn by fuel transfer pump through second fuel filter. The fuel injection pump supplies the fuel under high pressure to the injector through high pressure pipes

The injector atomizes the fuel and injects it into the combustion chamber of the engine The fuel injection pump is fed with fuel in abundance and the excess fuel is bypass to the intake side of the fuel transfer pump through a relief valve. The main components of the fuel system of a diesel engine are fuel filter atomizer, fuel lift pump. high pressure pipes, fuel injector pump, fuel tank

Two conditions are essential for efficient operation of fuel system The fuel should be clean free of water suspended dirt sand or other foreign materials

The fuel injector pump should create proper pressure such that the diesel fuel may be perfectly atomized by the injector and be injected in proper time and in proper quantity and quality in the engine cylinder fuel should be filtered before filling the tank also. If these precaution are followed 90 % of diesel engine troubles can be eliminated

Fuel tank:

This is supported from the side of chassis. It is located in a position and is sheltered as much as possible from the cool air flow path around the vehicle, so as to protect against wax crystals separating from the fuel due to cooling and blocking the fuel system during severe winter conditions. The fuel tank is usually provided with a course strainer gauze as it filler and a drain plug in its

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Date ...16.10.2023.... Experiment No. ..... P. No. 29.....
Name ..Hema...Rajpur..... Faculty No. .....Class B.E 3rd year Batch (A1/B1)

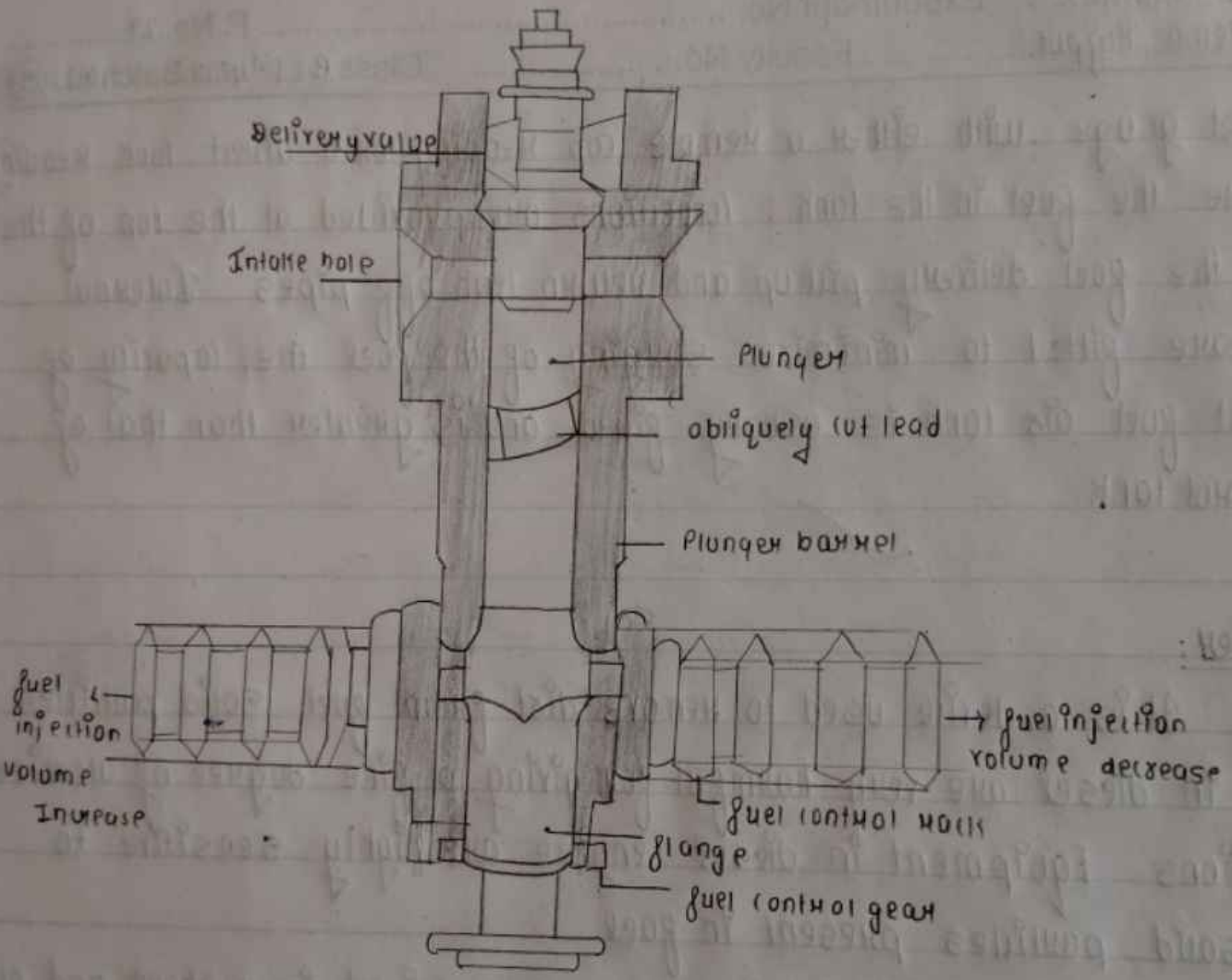
and a fuel gauge with either a remote cap reading or a direct tank reading to measure the fuel in the tank. Connections are provided at the top of the tank for the fuel delivery pickup and return tank off pipes. Internal baffles are fitted to minimize surging of the fuel the capacity of the direct fuel dis tank is usually fined and is greater than that of a car petrol tank.

Fuel filter:

It is a device used to remove dirt from fuel. Solid particles and dust in diesel are very harmful for giving a fine degree of atomized fuel injections. Equipment in diesel engine are highly sensitive to dirt and solid particles present in fuel.

It consist of a hollow cylindrical element contained in a shell and outer space being left between the shell and the element. The filtering element consist of metal gauge in conjuction with various fibres, clothes etc to aid the filtration. Usually there are two types of fuel filters in diesel (i) Primary filter and (ii) secondary filter.

Primary filter are capable of bringing dirt particle down to 30 micron and the secondary filter between 10 to 12 microns. Secondary filter is also available between 3 to 5 microns.



fuel injector

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Date ..16.:10.:2023..... Experiment No. ..... P. No..25.....
Name ...Hema...Rajput..... Faculty No. .....Class. B.E. 1st year Batch. G1 (U.S.)

Fuel lift pump:

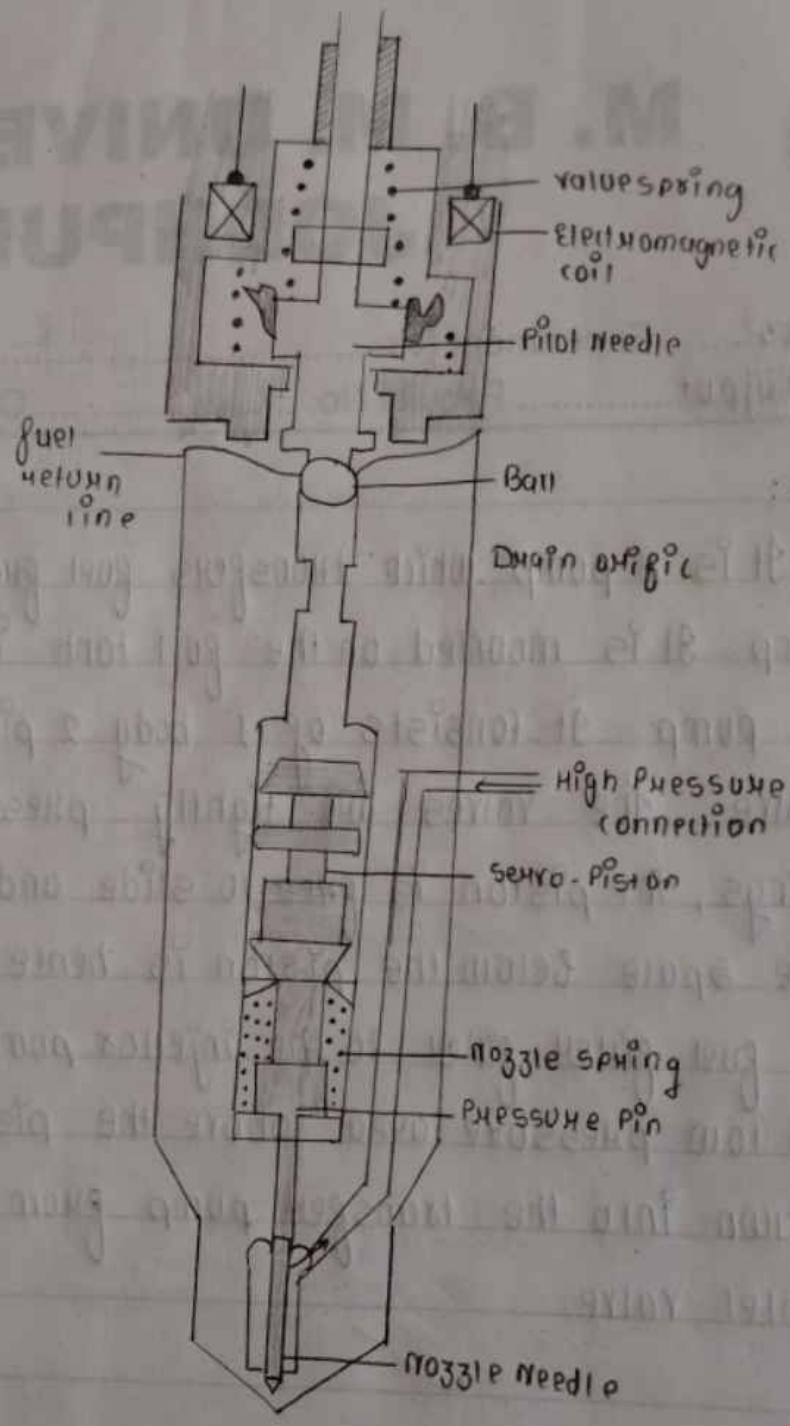
It is a pump which transfers fuel from the fuel tank to the fuel injector pump. It is mounted on the fuel tank. it delivers the fuel to the injector pump. It consists of 1 body 2 piston 3 inlet valve 4 pressure valve. The valves are tightly pressed against their seats by springs, the piston is free to slide and as it move down the fuel in the space below the piston is hence forced to flow through the secondary fuel filter filter to the injector pump. This piston movement also creates a low-pressure area above the piston, which causes the fuel to be drawn into the transfer pump from the primary filter through the inlet valve.

Fuel Injector Pump:

Fuel injector pump pressurizes the fuel to the required level and injects it correctly at the end of the compression stroke during each other cycle of operation of the engine. Injector pump sends fuel to each injector. High injection pressure is required to exceed the compression pressure in the combustion chamber for adequate injection.

There are two type of fuel injector pump

1. Multi- element pump
2. Distributor type pump


valve spring
Electromagnetic coil
Pilot Needle
fuel return line
Ball
Drain orifice
High Pressure connection
Servo-Piston
Nozzle spring
Pressure Pin
Nozzle Needle

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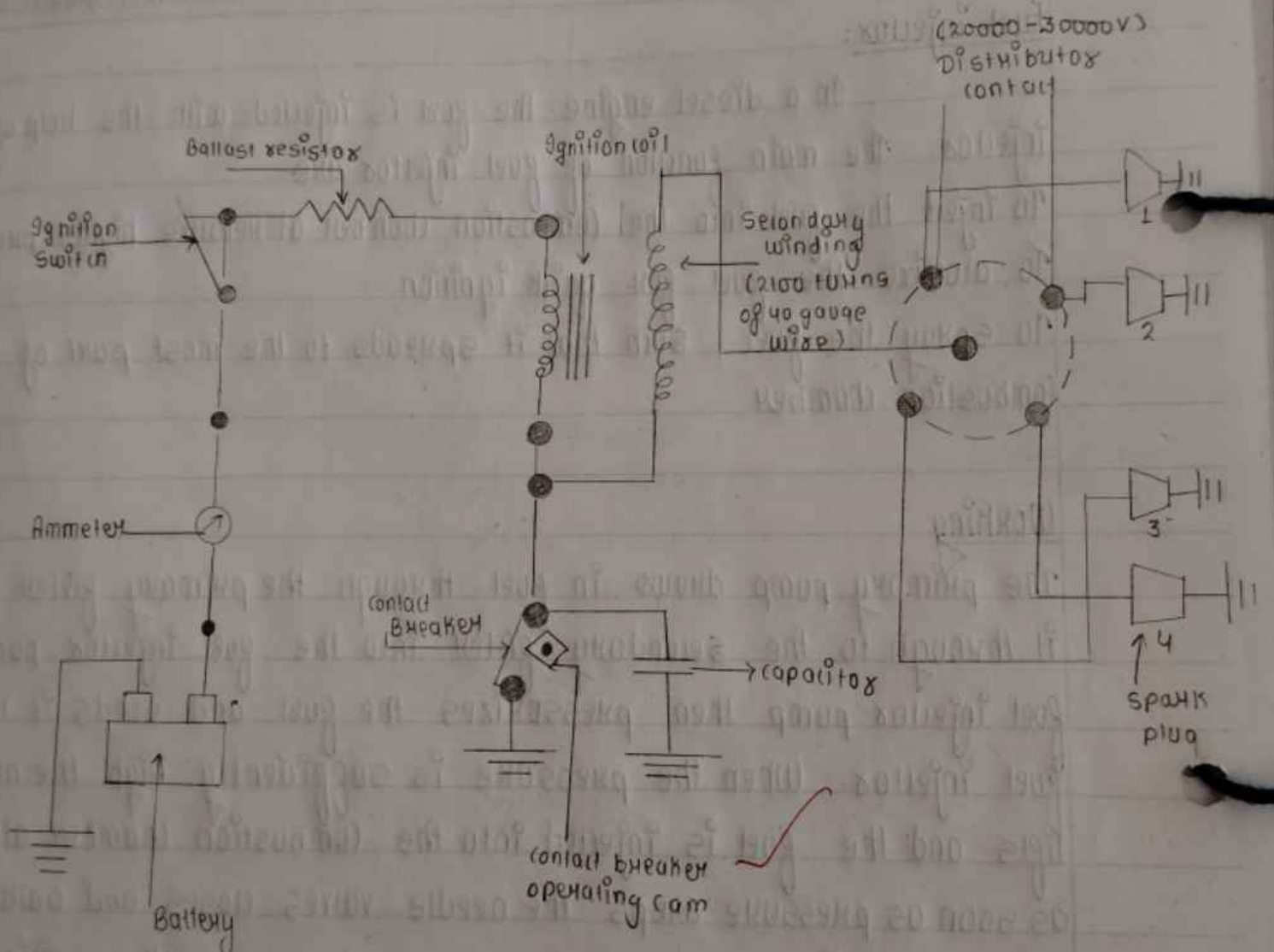
Date ....16.10.2023.. Experiment No. ..... P. No. 26.....
Name ..Hema...Rajput..... Faculty No. .....Class B.E. 3rd year..Batch A.I (15).

Fuel injector:

An a diesel engine the fuel is injected with the help of fuel injector. The main function of fuel injector are
To inject the fuel into the combustion chamber at relative higher pressure
To atomize the fuel for quick ignition
To spray the fuel, such that it spreads to the most part of the combustion chamber

Working

The primary pump draws in fuel through the primary filter and pushes it through to the secondary filter into the fuel injector pump. The fuel injector pump then pressurizes the fuel and sends it to the fuel injector. When the pressure is sufficiently high the needle valve lifts and the fuel is injected into the combustion chamber at high pressure as soon as pressure drops the needle valves closes and back flow is prevented. The amount of fuel supply depends on the position of the helical groove inside the fuel injector pump, if the groove aligns with the spill port early, less amount of fuel will be injected. If the groove aligns with the spill port late, more amount of fuel will be injected. The fuel injector pump is driven by a cam which ensures that the fuel is injected with sufficient pressure and with the accurate timing.



Battery Ignition System

M. B. M. UNIVERSITY JODHPUR

Date ..30..10..2023.. Experiment No. ..... P. No...27.....
Name ...Hemo..Rajput..... Faculty No. .....Class.B.T.1st year Batch(21.1.15

Object:

To study ignition system of an SI engine

(a) Battery ignition system
(b) Magneto ignition system

Theory:

The ignition system is one of the most important system used in I.C engine. The spark ignition engine requires some devices to ignite the compressed air-fuel mixture. The ignition take place inside the cylinder at the end of the compression stroke the ignition system serves this purpose

Ignition System Requirements

It should provide a good spark between the electrodes of the plugs at the correct timing. The duration of the spark must be long enough with sufficient energy to ensure that ignition of the mixture has a chance of occuring. The system must distribute this high voltage to each of the spark plug at exact time in every cycle i.e it must have in it a distributing device. It should function efficiently over the entire range of engine speed.

Battery ignition System

The Primary circuit consist of
Battery - provides the power to run system
Ignition switch - allow the driver to turn the system on and off

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Date ..30.10.23..... Experiment No. ..... P. No..28.....
Name ..Hema.RAJPUT..... Faculty No. Class.B.E.1st year.Batch.G11.15

Breaker switch - a mechanical switch that acts as the triggering mechanism
Condenser - product the points from burning out
Primary coil — produces the magnetic field which creates the high voltage in the Secondary coil
wires - join all the components together

(A) Secondary circuit
The Secondary circuit of the ignition circuit is the high voltage section it consist of the wire and components between the coil output and the spark plug ground. Wiring in the Secondary circuit must have a thicker insulation than that of the primary circuit to prevent leaking (arcing) of the high voltage the Secondary circuit consist of:
Secondary coil — the part of the coil that creates the high voltage electricity
coil wire - a highly insulated wire that make the high voltage from the coil to the distributor cap.
Distributor cap - a plastic cap which goes on top of the distributor to hold the high-tension wires in the right order
Rotor - spins around on the top of the distributor shaft and distributes the spark to the right spark plug
Spark plug wires - another highly insulated wires that takes the high voltage from the cap to the plugs
Spark plugs: take the electricity from the wires and give it an air gap in the combustion chamber to jump across to light the mixture

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Date ..30.:10.:2023... Experiment No. ..... P. No....29.....
Name ..Hema.Rajput..... Faculty No. Class.B.E.1st year.Batch.G1.1.65

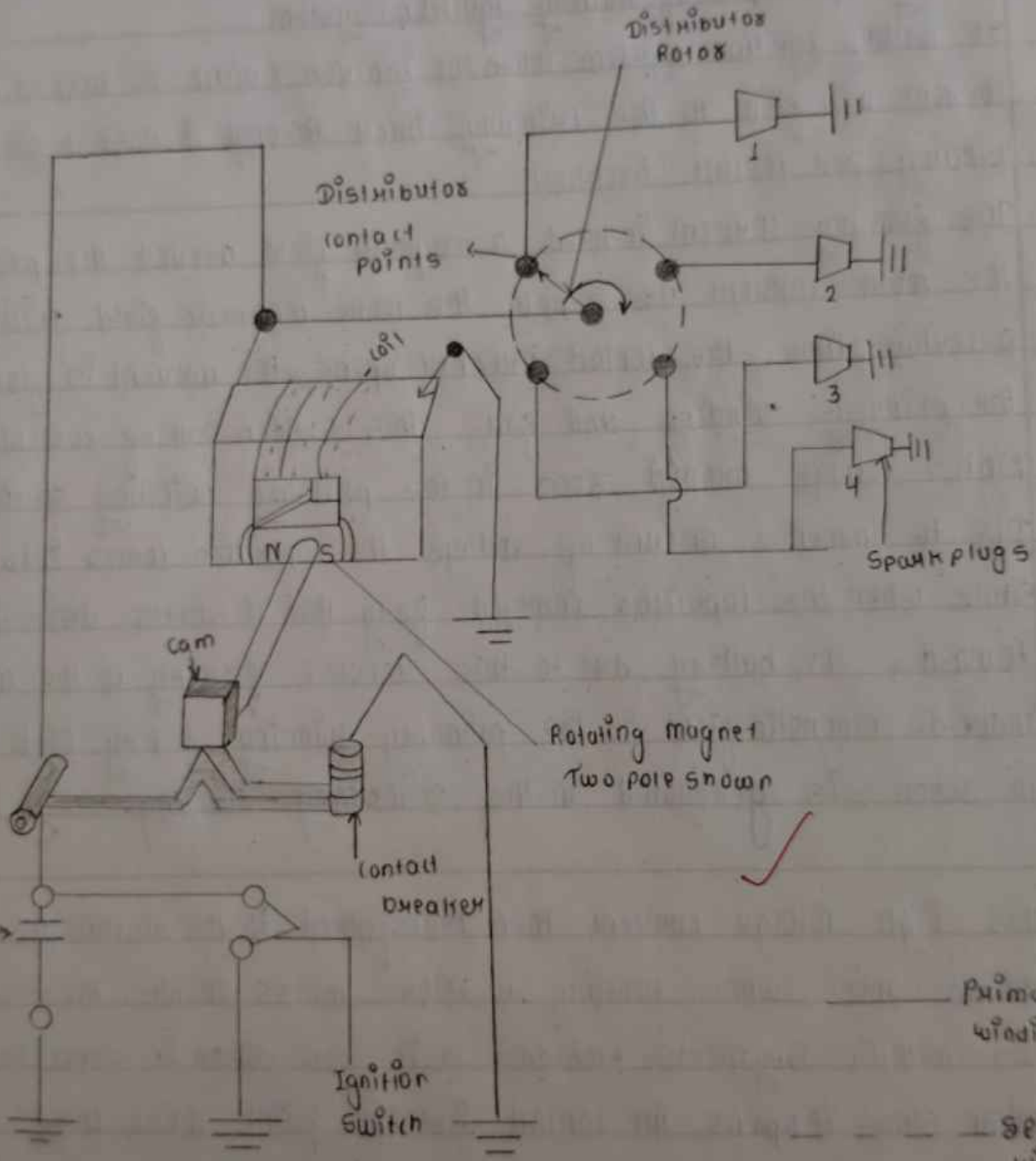
Working principle of battery ignition system

An Battery ignition system When the ignition switch is turned on then the current will flow to the primary circuit through ballast register, primary winding and contact breaker

The flowing current induced a magnetic field around the primary winding the more current we supply the more magnetic field will generate At a certain time, the contact breaker opens the current is flowing through the primary winding and fall. This sudden fall of current generates very high voltage around 300V in the primary winding section.

Due to immense amount of voltage the capacitor comes into the changing state when the capacitor charged fully then it starts delivering the current towards the battery due to this reverse flowing to the current and already induced magnetic field in the primary winding a very high voltage of 15000V to 30000 V is generated in the secondary winding.

This high voltage current then transferred to the distributor via high tension cable, where already a rotor rotates inside the distributor cap and has metallic segments embedded on it. So when it start rotating then at a certain stage it opens the contact breaker point which allows the high voltage current to transferred to the spark plug through the metallic segments so when the high voltage current reaches the spark plug then it generates a high intensity of spark inside the engine cylinder, which allow the combustion fuel to burn



Magneto ignition System

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P. No. 30

Date 30.10.2023 Experiment No. Class B.E. 1st year Batch (A1) (19)

Name Hema Rajput Faculty No.

Advantage of Battery ignition System

The intensity of spark is good

It can also provide a high concentration of spark even in low engine speed or starting of engine

The maintenance of this ignition system is very less compared to others

Disadvantages of Battery ignition System

Efficiency decreased with a reduction in spark intensity

occupies more space

Efficiency decreased with a reduction in spark intensity

Need periodic maintenance is needed for Battery only.

Magneto ignition System

It is an ignition system in which magneto is used (produces high voltages for the generation of electricity and further that electricity is used in several things like to run the vehicles. This is basically used in two - wheeler vehicles (spark ignition engine) nowadays

Parts of Magneto Ignition System

Transformer core

Contact Breaker

Cam

Capacitor

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Date ....30.10.2023.. Experiment No. ..... P. No....31.....
Name ..Hema Rajput..... Faculty No. .....Class.B.E.1st year Batch (A1)(15)

Ignition Switch
Distributor
Spark plug

Transformer coil
There are two types of winding we can see in magneto ignition system those are
Primary winding:
The main function of this winding is to draw the power from the source.
Secondary winding:
This winding has more turns of wire (the number is 1000 of turns of wire) as compared to the primary winding. This is connected to the distributor (which is having 2 rotor)

Contact Breaker:
The contact breaker is regulated by the cam and when the breaker is open current flows throught the capacitor and changes it

Cam:
Cam is connected to the north and south magnet

Capacitor:
The main work of the capacitor is to store the charger. The capacitor

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Date 30.10.2023 Experiment No. ..... P. No. 32

Name Hema Bijpal Faculty No. ..... Class B.E 2nd year Batch (a1 1/5)

The capacitor is used here is a simple electric capacitor

Ignition Switch:

Work for off and on the vehicles and this is set to the parallel of the capacitor because it helps to avoid the damage of excessive air

Distributor:

This is connected to the spark plug and distributor having the rotor

Spark plug:

The main work of the spark plug is giving the explosive mixture in the I C Engine

Working principle of magneto ignition System

In the magneto system, magneto is used when the engine of the system starts it helps the magneto to rotate and thus its producing the energy in the form of high voltage then, one end of the magneto is grounded through a contact breaker and the ignition capacitor is connected to its parallel

The contact breaker is regulated by the cam and when the breaker is open current flows through the capacitor and charges it

Now the capacitor is acting as a charger now the primary current flow is reduced, thus reducing the overall magnetic field generated in the system This increases the voltage in the capacitor. This increased high voltage in

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Date ..30.10.2023.. Experiment No. ..... P. No. 33

Name ..Hemo..Rajput..... Faculty No. ..... Class.B.E.1st year..Batch.G1(U.S.)

In the capacitor will act as an EMF thus producing the spark at the right spark plug through the distributor and at the starting stage, the speed of the engine is low and hence the voltage generated by the magneto is low.
But as the rotating speed of the engine increase is also increase the voltage generated by the magneto thus the flow of the current is also increased

Application of magneto ignition system

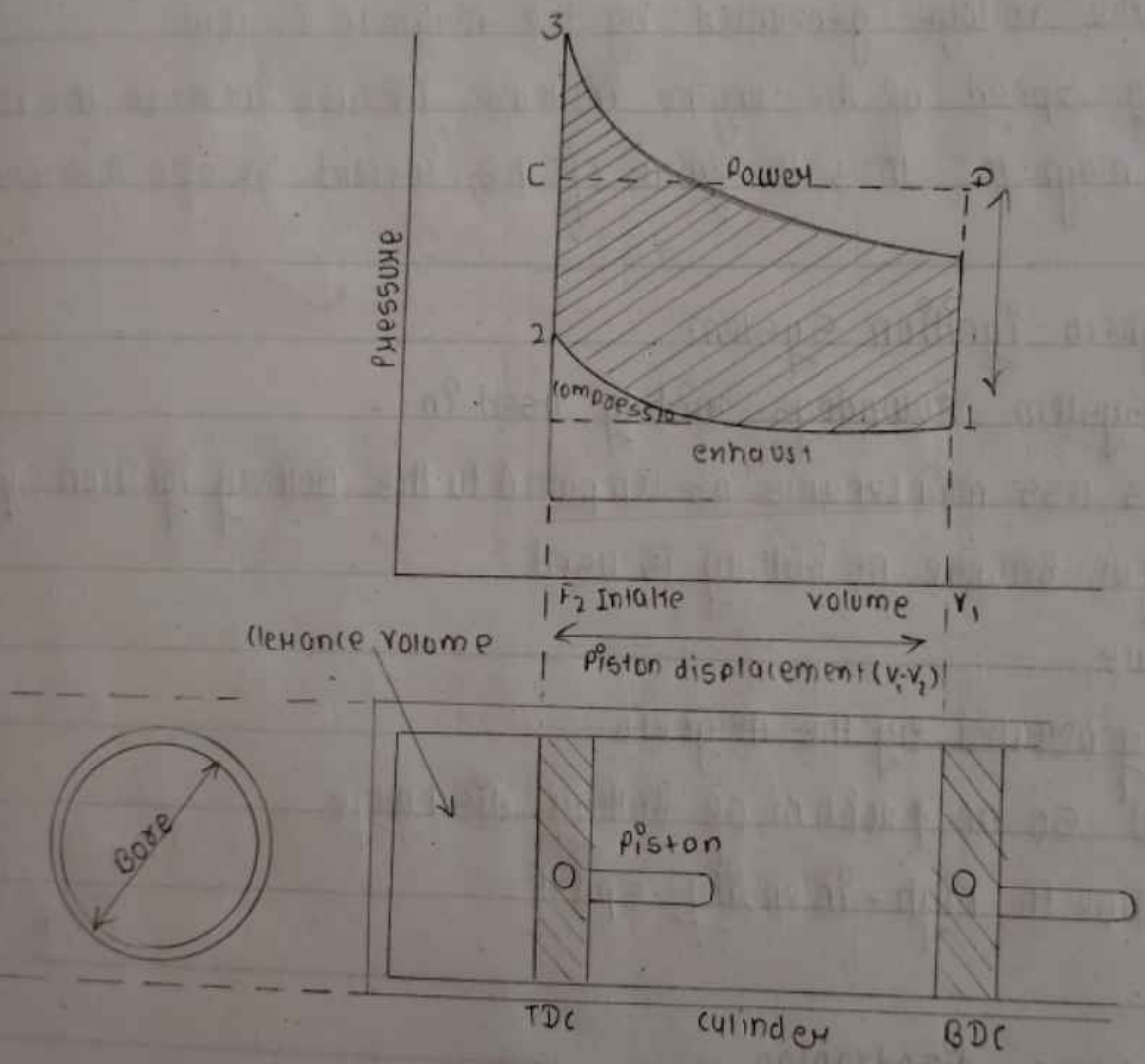
Magneto ignition system nowadays widely used in:-

- This system requires less maintenance as compared to the Battery ignition system
- This is more useful because no battery is used
- It occupies less space
- An electric circuit is generated by the magneto
- No battery is needed so no problem of battery discharge
- Efficiency improves due to high-intensity spark

Although there are some disadvantag

- During starting the quality of spark is poor due to low speed
- This is a little expensive as compared to another ignition system

16/10/23


3
C
Power
D
Pressure
2
compression
1
exhaust
P_2 Intake
volume
V_1
Clearance volume
Piston displacement (V_1-V_2)
Bore
Piston
TDC
Cylinder
BDC

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Date 30.10.2023 Experiment No. ..... P. No. 34

Name Hema Rajput Faculty No. ..... Class B.E. 1st Sem Batch A1 (15)

Objective:

To measure bore, stroke and clearance volume of a given Petrol Engine and find its Compression Ratio

Theory:

Various terminology used on IC Engine are

Bore (d) and stroke (l) -

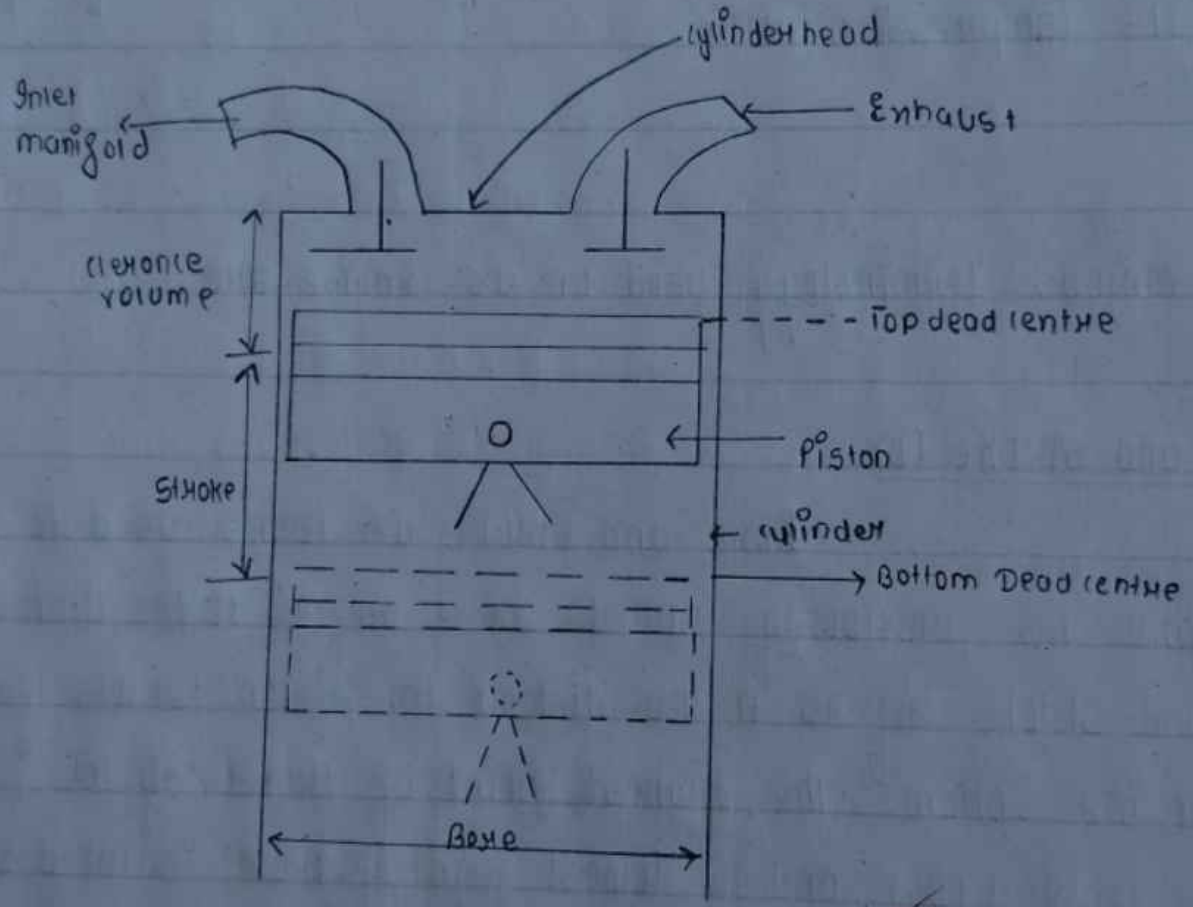
Bore and stroke are terms used to define the size of an engine. As previously stated, bore refers to the diameter of the engine's cylinder and stroke refers to the distance the piston travels from the top of the cylinder to the bottom. The highest point of travel by the piston is called top dead centre (TDC) and the lowest point of travel is called bottom dead centre (BDC). There are 180 degree of travel between TDC and BDC on one stroke

Swept Volume or Displacement Volume (V_s):

Swept volume is the displacement of one cylinder. It is the volume between top dead centre (TDC) and Bottom dead centre (BDC). As the piston travels from top to bottom it 'sweeps' its total volume. This measurement can be listed in cubic inches or cubic centimeter

Clearance Volume (V_c):

Clearance volume is the volume remaining in the


cylinder head
Inlet manifold
Exhaust
clearance volume
Top dead centre
Piston
Stroke
cylinder
Bottom Dead centre
Bore

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Date ..... Experiment No. .....

Name Hema Rajput ..... Faculty No. ..... Class B.E. 1st year Batch [illegible]

cylinder when the piston is at TDC. Because of the irregular shape of the combustion chamber (volume in the head) the clearance volume is calculated empirically by filling the chamber with a measured amount of fluid while the piston is at TDC. This volume is then added to the displacement volume in the cylinder to obtain the cylinder total volume

Compression Ratio (R):

An Engine's compression ratio is determined by taking the volume of the cylinder with piston at TDC (highest point of travel) and dividing the volume of the cylinder when the piston is at BDC (lowest point of travel) as shown in figure. This can be calculated by using the following formula

$$\text{Compression Ratio} = \frac{\text{(Swept volume + Clearance volume)}}{\text{Clearance volume}}$$

Procedure:

Calculate the bore diameter with the help of inside caliper

Calculate the stroke length with the help of depth gauge

Fill the combustion chamber with water. Collect this water in volumetric flask

Measure the volume of water in volumetric flask and note the reading. It will give clearance volume

Calculate the value of V_s by following

$$V_s = \frac{\pi}{4} * d^2 * L$$

Calculation

V_c = 110 ml = 100 cm

$V_S = \frac{\pi}{4} \times 8.2 \times 8.2 \times 9.4$

$= 496.415 \text{ cm}^3$

$= 496.415 \text{ ml}$

$\begin{cases} D = 8.2 \text{ cm} \\ L = 9.4 \text{ cm} \\ V_S = 496.415 \text{ cm} \end{cases}$

Then $V_T = V_c + V_S$

$496.415 + 110$

$= 606.415 \text{ ml}$

$\gamma = \frac{606.415}{110} \approx 5.5128$

$\eta = 1 - \frac{1}{(5.5128)^{0.4}} = 0.4948$

$\eta = 49.48\%$

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Date 30.10.2023 ..... Experiment No. ..... P.No. 36

Name Hema Rajpoi ..... Faculty No. ..... Class B.E. IST YEAR

Observation

S.No	Reading
1	Cylinder base (D) = 8.2 cm
2	Stroke length (L) = 9.4 cm
3	clearance volume (V_c) = 110 ml
4	swept volume (V_s) = 490.415 ml
5	Compression ratio = 5.5128

Calculations: Calculate the value of Compression ratio

Result:

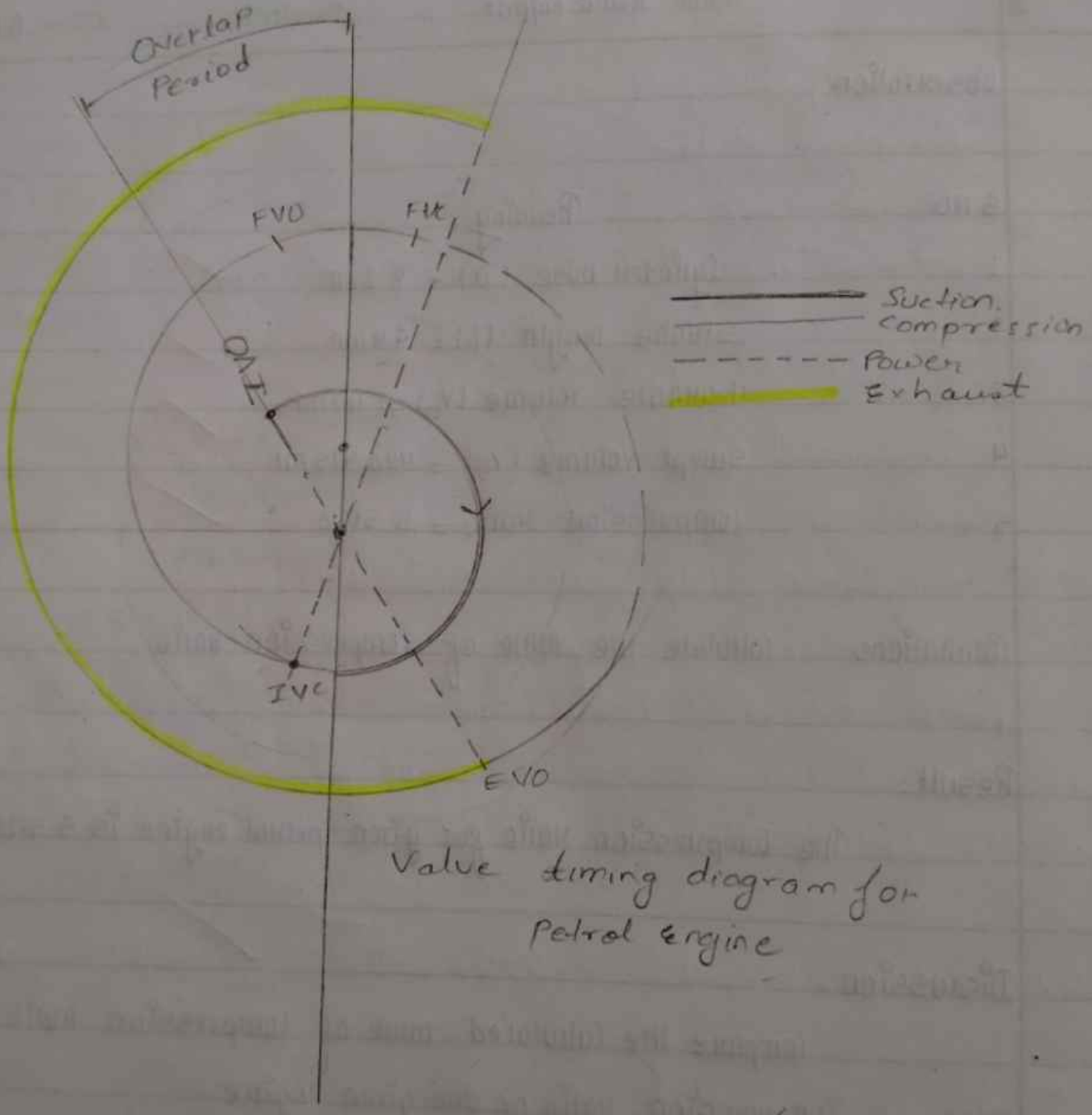
The Compression ratio for given petrol engine is 5.5128

Discussion:

Compare the calculated value of Compression ratio with the actual value of Compression ratio of the given engine

FVO - Fuel Valve open
IVO - Inlet valve opens
IVC - Inlet valve closes

FVC - Fuel valve closes
EVO - Exhaust valve open.



Valve timing diagram for Petrol engine

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Date 30.10.2023 Experiment No. ..... P. No. 37

Name Hema Rajpu Faculty No. ..... Class B.E. 3rd year Batch G1 I+S

Objective

To measure and draw the valve timing diagram for a four stroke single cylinder horizontal compression diesel engine

Apparatus Required

(i) four stroke single cylinder horizontal compression diesel engine (ii) measuring tap (iii) chalk (iv) spring balance (v) piece of paper

Theory and description:

The diagram which shows the position of crank of four stroke cycle engine at the beginning and at the end of suction, compression, expansion and exhaust strokes of the engine are called its valve timing diagram. In an ideal engine the inlet valve opens at TDC and closes at BDC, exhaust valve open at BDC and closes at TDC, the fuel is injected into the cylinder when the piston is at TDC at the end of compression stroke. But in actual practice it will be different.

Procedure:

Mark the TDC and BDC of flywheel. This is done by rotating the crank in usual direction of rotation and observing the piston movement, when the piston is moving downward the point at which the piston begin to move upward mark the BDC on flywheel to find the point make a mark at this position on flywheel. The point diametrically opposite to this point would be the TDC

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Date 30-10-2023 Experiment No. ..... P. No. 33

Name Hema Rajput Faculty No. ..... Class B.E. 3rd year Batch (A) (B)

Insert the paper in tappet clearance of both inlet and exhaust valves
Rotates the crank until the paper is stuck mark this point this position is called IVO or inlet valve open, measure the distance from TDC and tabulate the distance Rotate the crank till the paper is free again mark this point. this point is represented as IVC or inlet valve close, mark this distance from TDC and tabulate Repeat the above process for exhaust valves and fuel valves also

Inlet valve opening and closing

An an actual engine the inlet valve begins to open before the piston actually reaches the TDC at the end of the exhaust stroke this is necessary to ensure that the valve is fully open when piston reaches the TDC, if the inlet valve is allowed to close at BDC the cylinder would receive less amount of air than its capacity and the pressure at the end of the suction stroke will be below atmospheric pressure to avoid this inlet valve is kept open slightly longer after BDC

Exhaust valve opening and closing

Complete removal of burnt gases from the cylinder is necessary, to take in more fresh air into the cylinder, to achieve this exhaust valve opens before piston reaches BDC and closes after piston crosses TDC

Fuel valve opening and closing

The fuel valve opens before piston reaches TDC and closes slightly after the piston crosses TDC better evaporation and mixture of fuel

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Date.....Experiment No.....P.No.....

Name :Hema....Rajput.....Faculty No.....Class.B.E.1st.YEAR.....

Observation table

Circumference = $2\pi x$ = $2 \times 3.142 \times 52 = 327$ cm

Therefore 1 cm of circumference = $\frac{360}{327} = 1.101$

Crank constant = 1.101 degree/cm

S.NO	Valve position	Circumference distance (in cm)	Crank constant (cm)	Crank angle
1	SVO	35 (Before TDC)	1.101	38.53°
2	SVC	23 (Before ODC)	1.101	25.32°
3	EVO	18 (Before TDC)	1.101	19.81°
4	EVC	16 (After TDC)	1.101	17.61°
5	EVO	57 (Before ODC)	1.101	62.75°
6	EVC	14 (After TDC)	1.101	15.41°

Result

1. Suction stroke = 243.85°
2. Compression stroke = 116.15°
3. Expansion stroke = 155.78°
4. Exhaust stroke = 258.16°
5. SVO leads by 38.53°
6. EVC lags by 15.41°
7. Overlapping = 53.94°

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Date ..... Experiment No. ..... P. No. 40

Name Hema...Rajpurohit Faculty No. ..... Class B.E. 3rd Year Batch (A1) (15)

Objective:

To conduct a constant speed load test on a Junkers Diesel Engine and calculate BHP, BSFC, mechanical efficiency and indicated power (using Willian's line method) Plot the graphs also

Apparatus

Two stroke Junkers Engine (working Model)

Dynamometer

Water pump

Theory:

The testing of I.C Engines consist of running them at different loads and speeds and taking suffitient measurements for the performance criterion to be calculated. The item which are included in the energy balance are BP heat to cooling water, the energy of exhaust and unaccounted losses obtain by difference, which include radiation and convection losses. The trial may be carried at variable speed and full throttle or variable load and constant speed.

Energy Supplied by fuel

Energy converted into useful work + Energy rejected with the cooling water + Energy loss in exhaust gasses + heat losses due to incomplete combustion + energy unaccounted for (radiation losses).

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Date ..... Experiment No. ..... P. No. 11

Name ..Heena Rajhat..... Faculty No. ..... Class. B.E. IV Year Batch Cal. (D-5)

Calculation

Brake House Power - The power which is available at crankshaft for doing useful work.

BHP = W * R / K' = W * 1000 / 1000 = W

W - Load on Dynamometer

Fuel Consumption - Amount of fuel consumed per unit hour is called F.C

F.C = fuel used * specific gravity * 3600 kg/hr
1000 * time (sec)

= Specific gravity of fuel = 0.844

Brake Specific fuel Consumption - It is the fuel consumed per unit BHP per unit time.

BSFC = FC / BHP * (kg / BHP. hr)

Fuition Power - The proportion of IP used to overcome fuition of Bearings pistons and other mechanical components of engine is called fuition power

Mechanical efficiency - The ratio of Brake house power delivered by the engine to the IP is called Mechanical efficiency

η_{mech} = BP / IP = BHP / (FHP + BHP)

Thermal efficiency - Overall Brake Thermal efficiency

$\eta_{thermal}$ = BHP * 4500 / (FC / 60) * (Y * J)

CY = calorific value ($C_{10}H_{30}$ = 10,700 kcal / kg

Calculation

fuel C

(i) $F.C = \frac{25 \times 0.844 \times 3600}{78 \times 100} = 9.74$

(ii) $F.C = \frac{25 \times 0.844 \times 3600}{65 \times 100} = 11.69$

(iii) $F.C = \frac{25 \times 0.844 \times 3600}{58 \times 100} = 13.1$

(iv) $F.C = \frac{25 \times 0.844 \times 3600}{46 \times 100} = 16.51$

(v) $F.C = \frac{25 \times 0.844 \times 3600}{38 \times 100} = 19.99$

$n_{meth_1} = \frac{0.667}{0.67+4.5} = 0.129$

$n_{meth_2} = \frac{1.33}{1.33+4.5} = 0.228$

$n_{meth_3} = \frac{2}{2+4.5} = 0.307$

$n_{meth_4} = \frac{2.67}{2.67+4.5} = 0.372$

$n_{meth_5} = \frac{3.33}{3.33+4.5} = 0.425$

$n_{Thermal_1} = \frac{0.67 \times 4500}{\frac{0.974}{60} \times 10700 \times 427} = 0.0406$

$n_{Thermal_2} = \frac{1.33 \times 4500}{\frac{1.169}{60} \times 10,700 \times 427} = 0.672$

$n_{Thermal_3} = \frac{2 \times 4500}{\frac{1.31}{60} \times 10,700 \times 427} = 0.0902$

$n_{Thermal_4} = \frac{2.67 \times 4500}{\frac{1.65}{60} \times 10,700 \times 427} = 0.0956$

$n_{Thermal} = \frac{3.33 \times 4500}{\frac{1.99}{60} \times 10,700 \times 427} = 0.0989$

(i) $BSFC_1 = \frac{9.74}{0.67} = 14.54$

(ii) $BSFC_2 = \frac{11.69}{1.33} = 08.79$

(iii) $BSFC_3 = \frac{13.1}{2} = 0.655$

(iv) $BSFC_4 = \frac{16.51}{2.66} = 0.618$

(v) $BSFC_5 = \frac{19.99}{3.33} = 0.6$

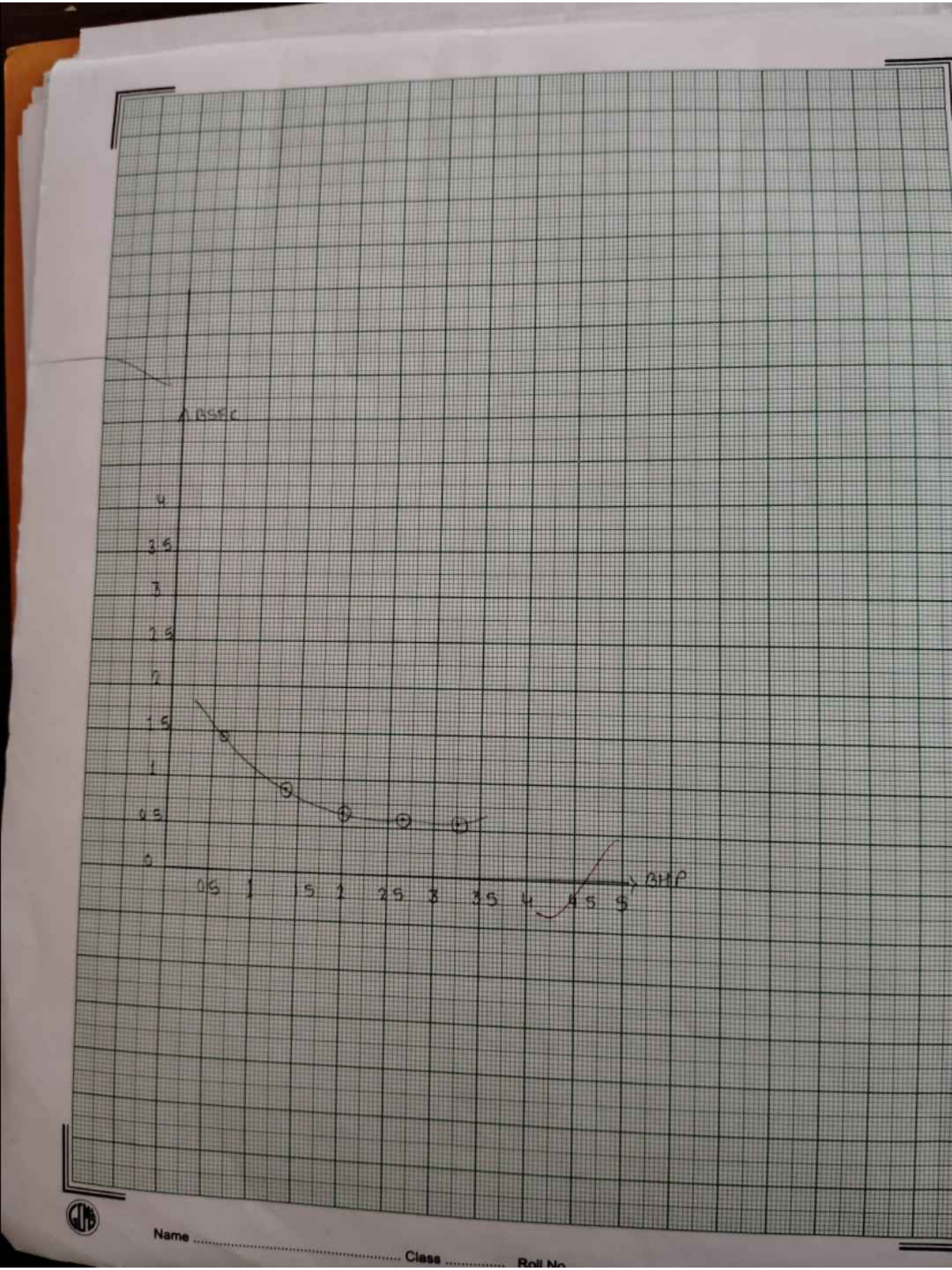
(i) $BHP_1 = \frac{1 \times 1000}{1500} = 0.67 kW$

(ii) $BHP_2 = \frac{2 \times 1000}{1500} = 1.33 kW$

(iii) $BHP_3 = \frac{3 \times 1000}{1500} = 2 kW$

(iv) $BHP_4 = \frac{4 \times 1000}{1500} = 2.66 kW$

(v) $BHP_5 = \frac{5 \times 1000}{1500} = 3.33 kW$



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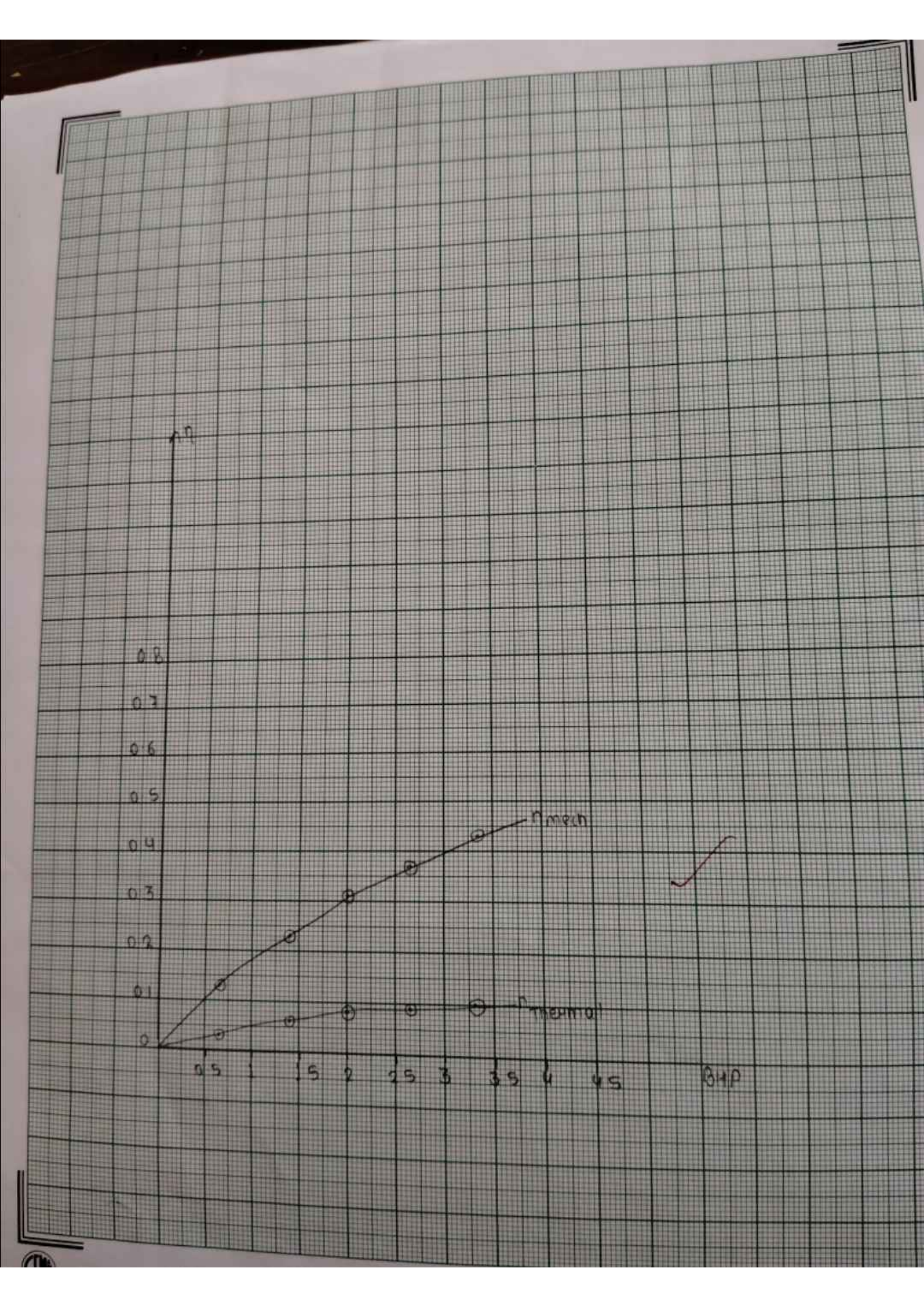
η
0.8
0.7
0.6
0.5
0.4
0.3
0.2
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0
ηmech
ηthermal
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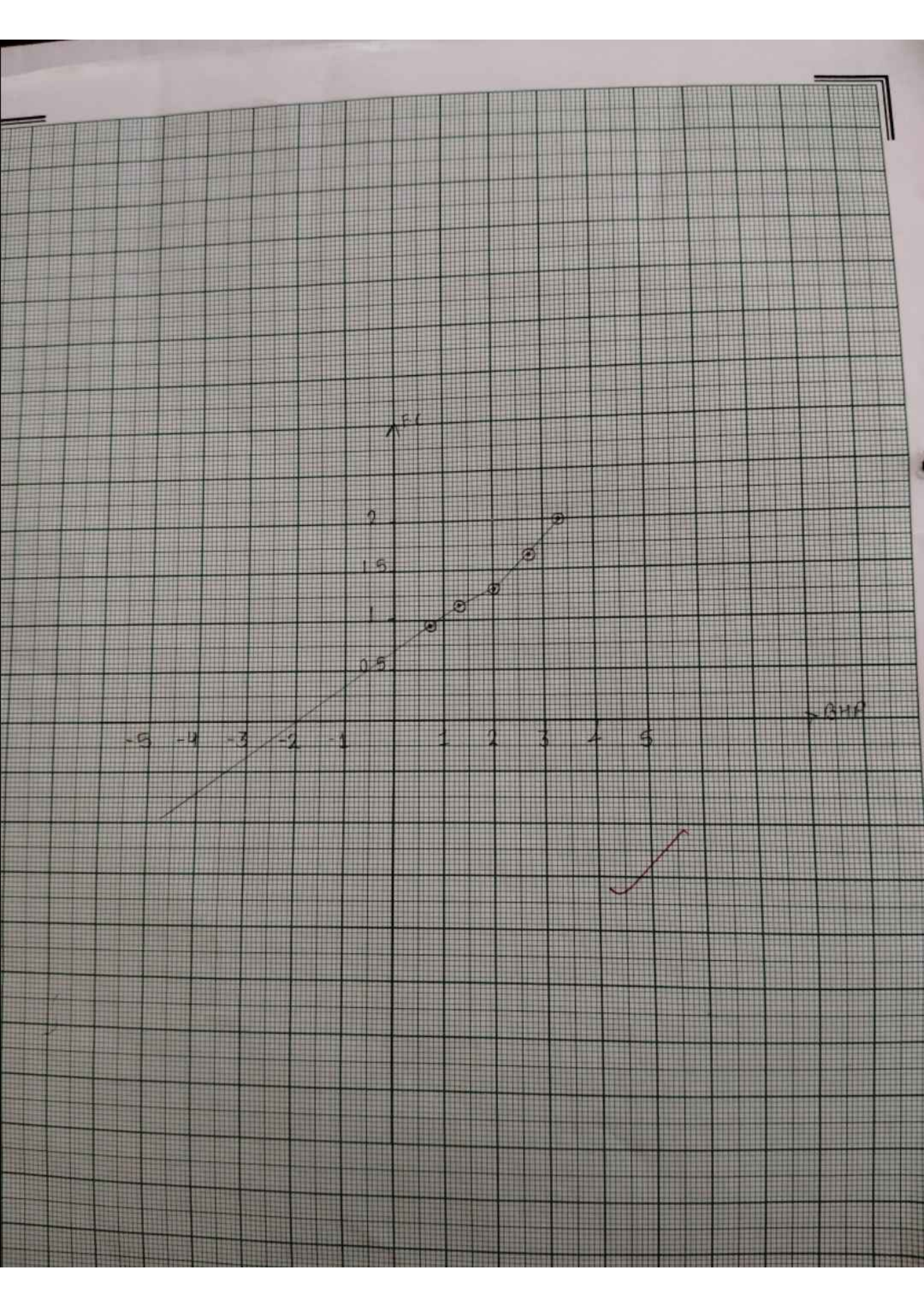
1
1.5
2
2.5
3
3.5
4
4.5
BHP


EC
2
1.5
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-3
-2
-1
1
2
3
4
5
BHP

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JODHPUR

Date..... Experiment No..... P.No.....

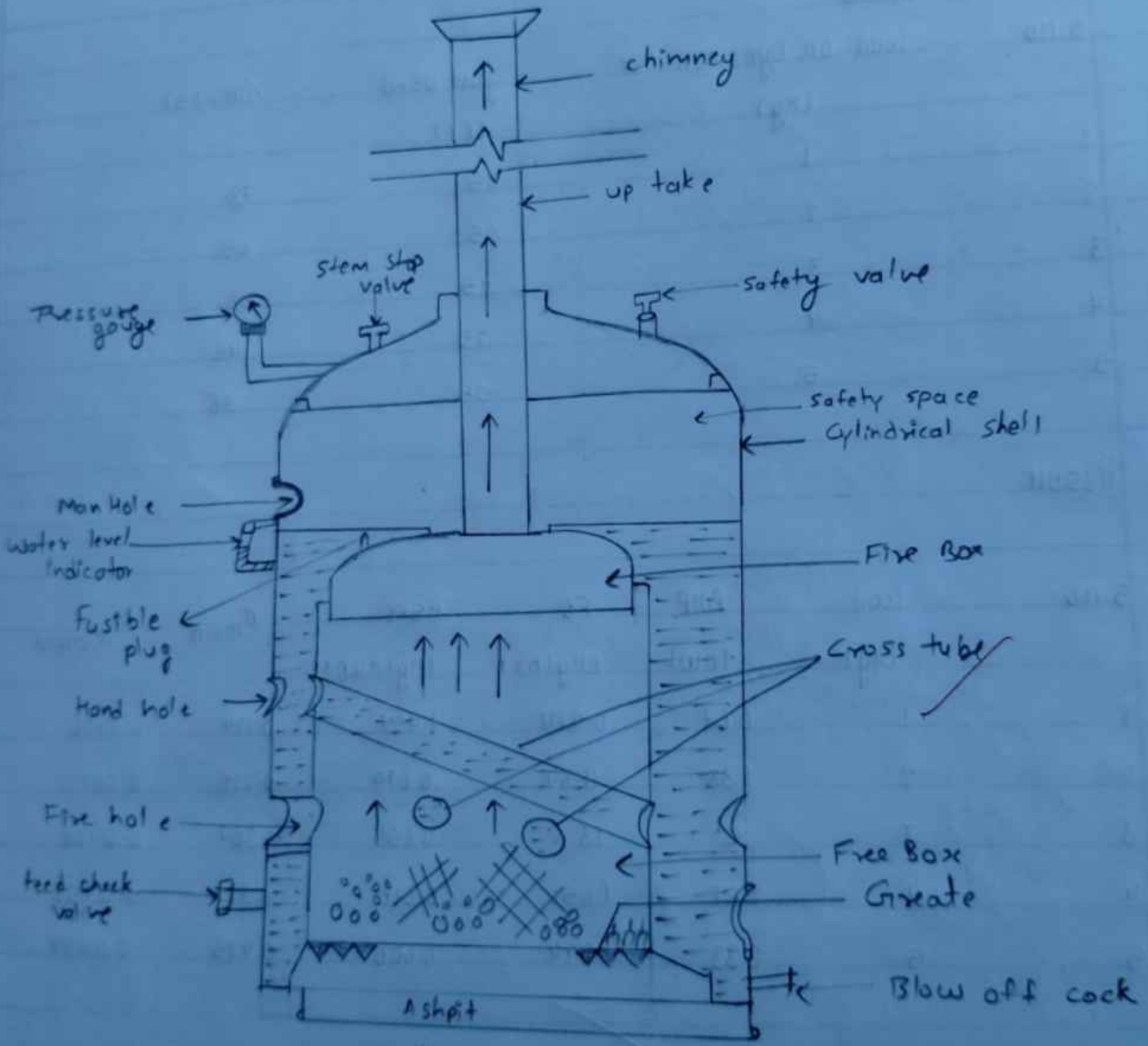
Name ..... Faculty No..... Class.....

Observation table

S.No	Load on Dynamometer (Kg)	fuel used (cc)	Time (s)
1	1	25	78
2	2	25	65
3	3	25	58
4	4	25	46
5	5	25	38

Result

S.No	Load (Kg)	BHP (KW)	FC (Kg/hr)	BSFC (Kg/KWhr)	η_{mech}	$\eta_{Thermal}$
1	1	0.67	0.974	1.454	0.129	0.0406
2	2	1.33	11.69	0.879	0.228	0.0672
3	3	2	13.1	0.655	0.307	0.0902
4	4	2.67	1.651	0.618	0.372	0.0956
5	5	3.33	1.999	0.600	0.425	0.0989



Vertical Gradley Boiler

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Date ..... Experiment No. ..... P. No. 13

Name Hema Rajput Faculty No. ..... Class B.E. I Year Batch A1 (1st)

Objective:

To study construction features and working of a cross tube vertical Cradely Boiler and Babcock and Wilcox Boiler

Cradley Boiler:

Construction:

It is a vertical fire tube boiler made up of mild steel. It has a cylindrical shell (1) surrounding a cylindrical fire box (2) having grate (3) at the bottom. A central pipe called uptake (4) passes from the crown (5) of the fire box to the crown of the shell over which chimney (6) is placed. The fire box is fitted with three cross-tubes to increase the heating surface and to improve water circulation. The cross tubes, slightly inclined for better water circulation are flanged and riveted to the fire box. Hand holes are provided in the shell opposite to the ends of each cross-tube to give access for cleaning. At the bottom of the water space surrounding the fire box, hand holes are provided in the shell for cleaning purpose.

Specification

Power 8 hp

Base to top crown 2.6m

Dia - 1.07m

Water capacity - up to working level - 700 litres

from top to bottom - 1108 litres

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Date ..... Experiment No. ..... P. No. 44

Name Hemraj Rajput Faculty No. ..... Class. B.E. 3rd Year Batch (A) (I)

Grate area - 0.65 m^2

Total heating surface - 5.6 m^2

Maximum continous evaporation capacity at 100°C when burning coal having calorific value 7230 kcal/kg, 304 kg/hr

Working pressure - 24 kgf/cm^2

Safety valve open at 7.15 kgf/cm^2

Babcock and Wilcox Boiler

The Babcock and Wilcox Boiler was discovered by George Herman Babcock and Stephen Wilcox in the year 1867. This Babcock and Wilcox Boiler is a water tube boiler which is a multi-tubular, high pressure and externally fired water boiler used to generate a large amount of steam

The parts of Babcock and Wilcox Boiler is as follow

Steam and water drum

Uptake - Header and Down Take Header

Water tubes

Superheater

Grate

Furnace

Baffless

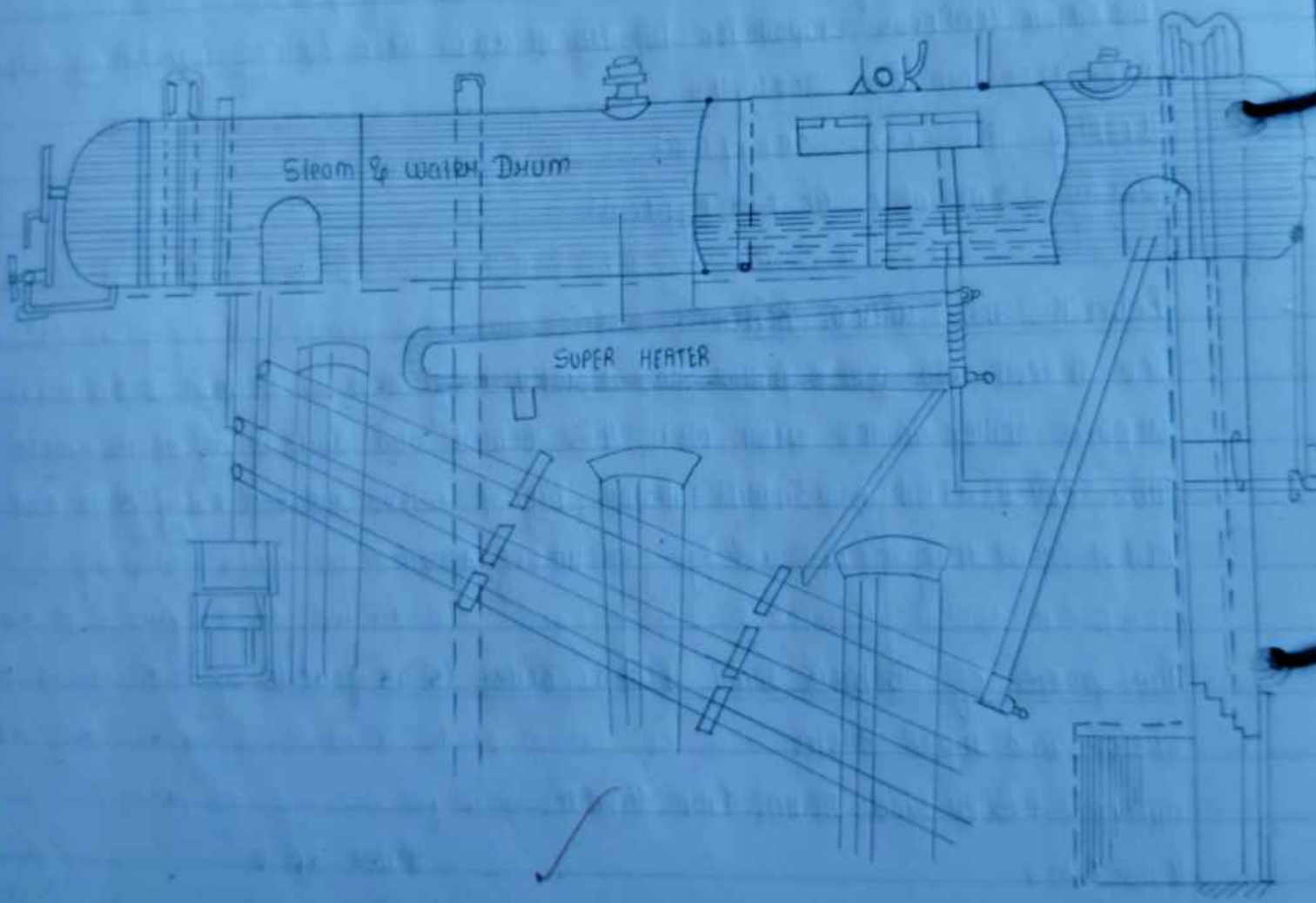
Mud box

Inspection doors

Water Space

Steam Space

Water Level Indicator


Steam & Water Drum
SUPER HEATER

M. B. M. UNIVERSITY JODHPUR

Date ..... Experiment No. .....

Name Heena Rajpurohit ..... Faculty No. ..... Class B.E. 3rd year Batch Mech (D).

Boiler shell:

It consist of one or more steel plates bent into a cylindrical form and riveted or welded together. The shell and ends are closed with the endplates.

Uptake - header and Down take Header:

Boiler shell and water tubes are connected by two tubes. Out of them, one is Up take header and the other is down take header.

Uptake Header:

The steam from the water tubes to the drum flow by means of uptake Header.

Down take Header:

The water flows from the drum to the water tubes by means of down take header.

Water Tubes:

The angle of inclination of the water tubes to the horizontal is about 15 degree. In this boiler, water will flow from the drum by means of tubes only.

Superheater:

It increases the temperature of saturated steam

Grate:

It is the platform in the furnace upto which fuel is burnt

Furnace:

It is a chamber formed by the space above the grate and below the boiler shell in which combustion take place. It is also called a fireBox

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Date ..... Experiment No. ..... P. No. 46

Name Hema Rajput Faculty No. ..... Class. B.E. I st Year Batch C1 (15)

Baffless:

The Baffless are provided to deflect the hot flue gases so that the water tubes experience more amount of heat

mud boxes:

All the impurities which are present in the boiler are deposited at the bottom and are stored in the mud box

Inspection doors:

They are provided for cleaning and inspection of the boiler

Water space:

It is the volume of a shell that is covered by water

Steam space:

The volume of shell enight, the volume of water and tube space is called steam space.

Water Level Indicator:

It is the indicator, which show the level of water in the shell

The Working principles of Babcock and Wilcox Boiler is as follow

The entire boiler enight for the furnace, are hung by means of metallic slings or straps or wrought iron girders supported on pillar This arrangement enables the drum and the tube to expand or contact freely the angle of inclination of the water tubes to the horizontal is about 15 degrees.

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Date ..... Experiment No. ..... P. No. 47

Name Hema Rajput ..... Faculty No. ..... Class B.E. I st year Batch A1.1 (15)

A feed valve is provided to fill the drum and the inclined tubes with the water level of which is indicated by the water level indicator

Through the fire door, the fuel is supplied to the fire grate and it is burnt. The hot gases are forced to move upwards between the tubes by the baffle plates

The system consist of a down take Header (DTH) and uptake Header (UTH) which consist of holes in which a series of inclined water tubes are fixed

The water from the drum flows through the inclined tubes via down-take header and goes back into the sheet in the form of steam and water mixture via UTH (up take Header)

The steam is collected in the steam space of the drum

The steam enters through the APP (Anti-Priming pipe) and flows in the SH (Superheater tubes) where it converts from wet steam to Dry saturated steam and it is taken out from MSV (main stop valve) and feed to the turbine

Advantage of Babcock and Wilcox Boiler

- Generate Steam at high pressure and rate is high (140 bar and 40000 kg/hr)
- For a given output, it occupies less space
- Parts are accessible for cleaning, inspection and repair
- Parts can be separated and transported easily
- Due to the heating surface, fuel is completely burnt

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Date ..... Experiment No. ..... P. No. 48

Name Heena Rajput ..... Faculty No. ..... Class B.E. 1st Year Batch A1 (15)

Disadvantages of Babcock and Wilcox Boiler

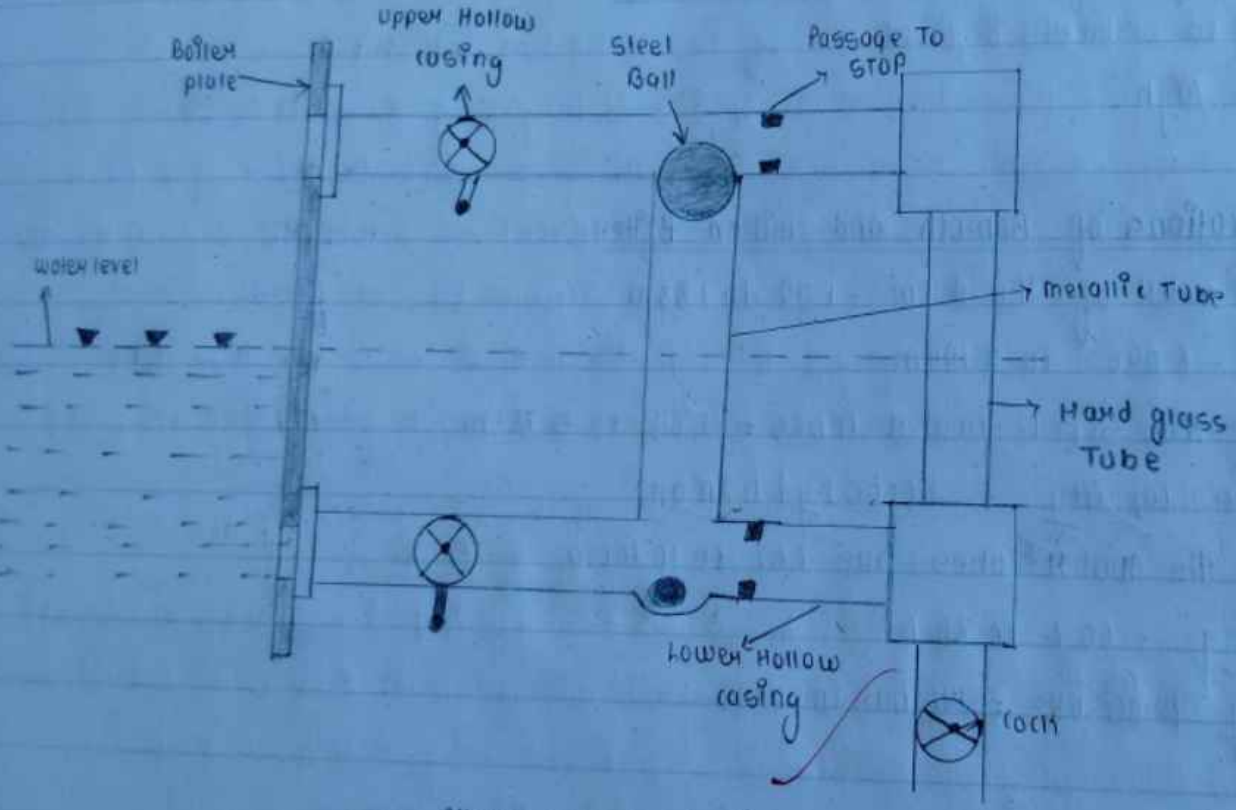
- Pure feed water required
- Cost is high

Specifications of Babcock and Wilcox Boiler

- The diameter of the drum = 1.22 to 1.83m
- Length = 6.096 to 9.144m
- Size of the super-heater tubes = 3.84 to 5.71cm
- Steaming capacity = 45000 kg/h (max)
- Size of the water tubes are 7.62 to 10.16cm
- Efficiency = 60% to 80%
- Working pressure = 140 bar (max)

The Application of Babcock and Wilcox Boiler is as follows

- In power generation industries, the Babcock and Wilcox Boiler is used to produce high pressure steam
- The steam generated is used to produce large amount of electricity



Water level Indicator

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Date ..... Experiment No. ..... P. No. 49

Name Hema Rajput Faculty No. ..... Class ..... Batch M.I.(5).B.E IV

Objective:

To study various boiler mountings and Accessories

Theory:

Boiler mountings

These are the fitting, which are necessarily mounted on the boiler itself and mandatorily required for the safe and proper operation of boiler. Various boiler mountings are being discussed here one by one

1 Water Level Indicator:

Function:

Water level indicator is fitted outside the boiler shell to indicate the water level in the boiler through a glass tube. In any type of boiler water should remain at the designed level. If water falls bellow the level due to change of phase into steam and simultaneously fresh water does not fill in by some reason, the hot surface may expose to steam only and overheat. This is because the heat transfer co-efficient of steam is very less as compared to water.

Construction:

As shown in the figure, two horizontal tube made of gun metal extend from the boiler shell in such a way that top one is connected to steam space and bottom one is connected to water space of the boiler. These are connected at the other end by a vertical glass tube contained in a bronze casing in such a way

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Date ..... Experiment No. ..... P. No. 50.....
Name ....Hema Rajput..... Faculty No. .....Class.....Batch.B.E. 3rd Operation

that water & steam come out in the glass tube & their interface is visible through it. Each gun metal tube is also provided with a cock to control the flow of water to the glass tube. One drain cock is fitted at the bottom for cleaning purpose. The horizontal metal tubes also contain one metal ball each which normally rests on a hemispherical groove in the tube. In case the water / steam rush with high speed.

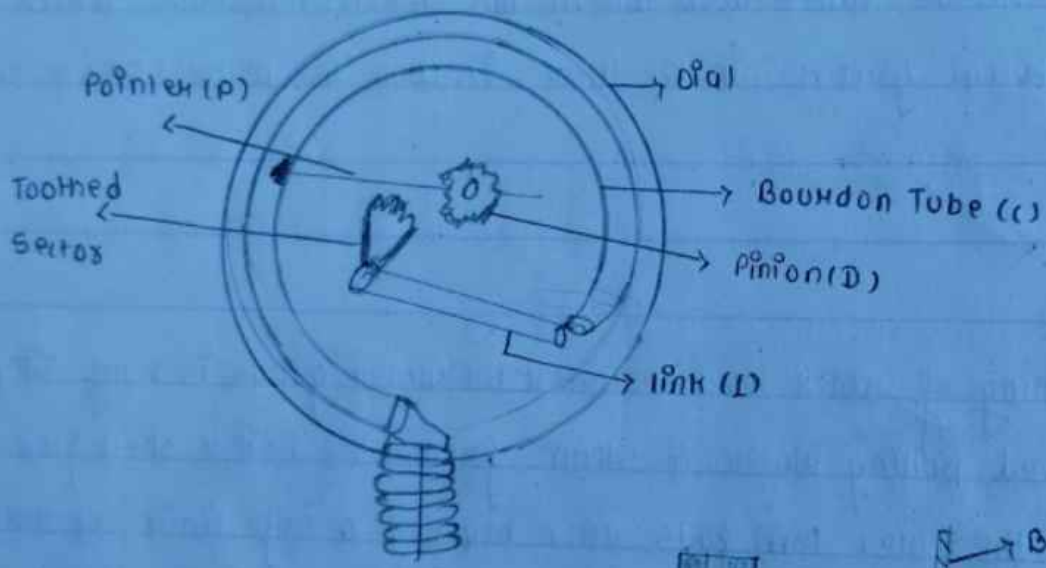
Working:

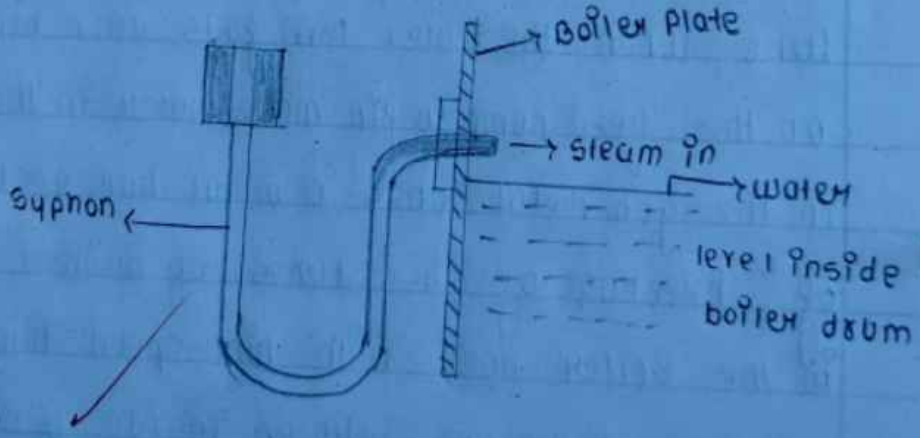
Working of water level indicator or water gauge is very simple when the cocks are opened, boiling water & steam from the boiler shell flow into the glass tube when the water level falls down beyound a safe limit, operator may switch on the feed pump to fill more water in the boiler shell. In the water & steam passages in the gun metal tubes, a metal ball rest in the cavity made in the passage. In case of breakage of glass tubes by accident water & steam contained at high pressure in the boiler rush with high speed towards broken glass tube due to large pressure difference between inside & outside of boiler.

Pressure Gauge

(1) **Function:**

A Pressure gauge is used to indicate the Pressure of steam in the boiler. It is generally mounted on the front top of the boiler. Pressure gauge is of two type (i) Bourdon Tube Pressure Gauge (ii) Diaphagam type pressure gauge


Pointer (P)
Dial
Toothed
Sector
Bourdon Tube (C)
Pinion (D)
link (L)


Boiler plate
Steam in
Water
level inside
boiler drum
Syphon

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Date ..... Experiment No. ..... P. No. 91

Name ..Heena.Rajput..... Faculty No. ..... Class..... Batch B.E. IInd Year (CE)

Some gauges indicate the positive pressure but some are compound & indicate negative pressure as vacuum also. Looking at the gauge, Boiler Operator check the safe working pressure of the boiler & can take necessary steps to keep the pressure within safe limits.

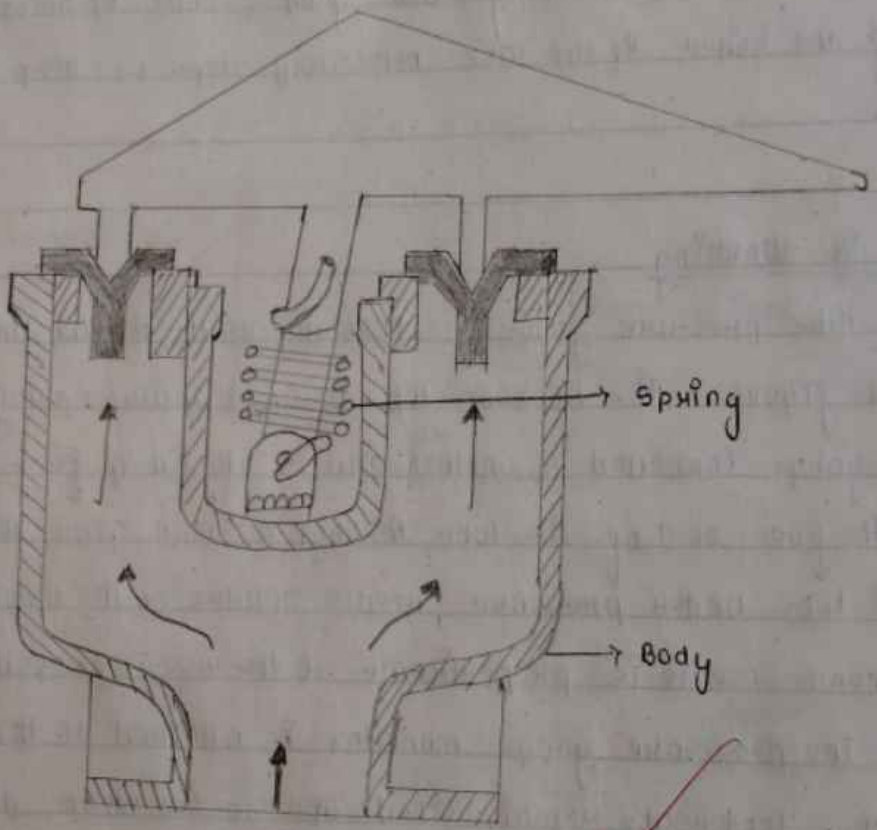
Construction & Working

A bourdon tube pressure gauge is normally used, the construction of which is shown in the figure. The bourdon tube is an elliptical spring material tube is connected to gauge (connected & another end is closed & free to move. A needle is attached to the free end of the tube through a small gear mechanism. With the movement of tube under pressure, needle rotates on the circular tube. The movement of tube & hence needle is proportionate to the rise in pressure and so calibrated with scale. The pressure gauge connector is attached to the boiler shell through an the U-tube, condensate remain filled and so live steam does not come in direct contact of bourden tube but it pushes on equal pressure on the condensate.

Spring loaded safety valve

Function

Spring loaded safety valve is a safety mounting fitted on the boiler shell & is essentially required on the boiler shell to safeguard the boiler against high pressure. It is a vital part of boiler and always to in good working condition to protect the boiler from bursting under high pressure and so to save life & property.



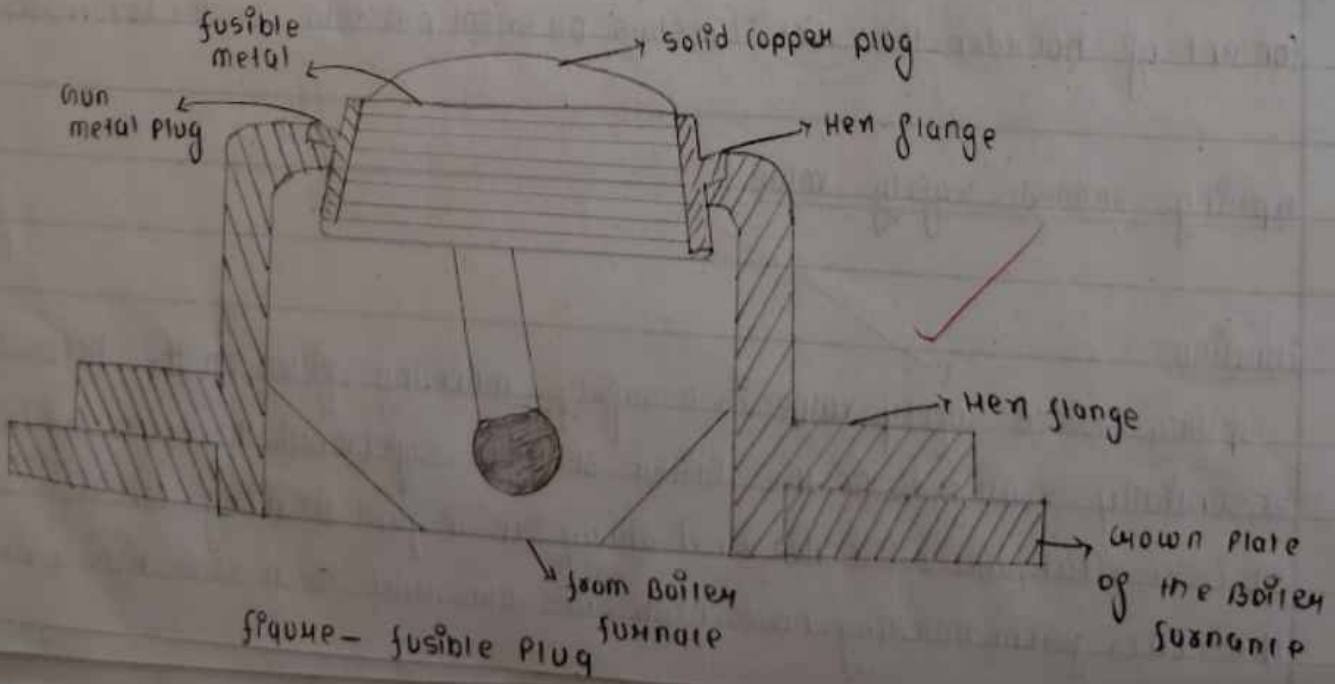


figure- fusible plug

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Date ..... Experiment No. ..... P. No. 52.....
Name ..Hina Rajput..... Faculty No. .....Class.....Batch B.E. 3rd year/Civil

Construction:

As shown in figure, it consists of two opening or valve seats which are closed by two valves attached to a single lever. The lever is pivoted at one end & attached to a spring at the middle. The spring is fixed at bottom end with overall body of valve & lever are lifted & steam escape thus decreasing the pressure below the safe limit on decreasing the pressure valve sit again on their seats & thus stop the steam flow from the boiler

Fusible plug

Function:

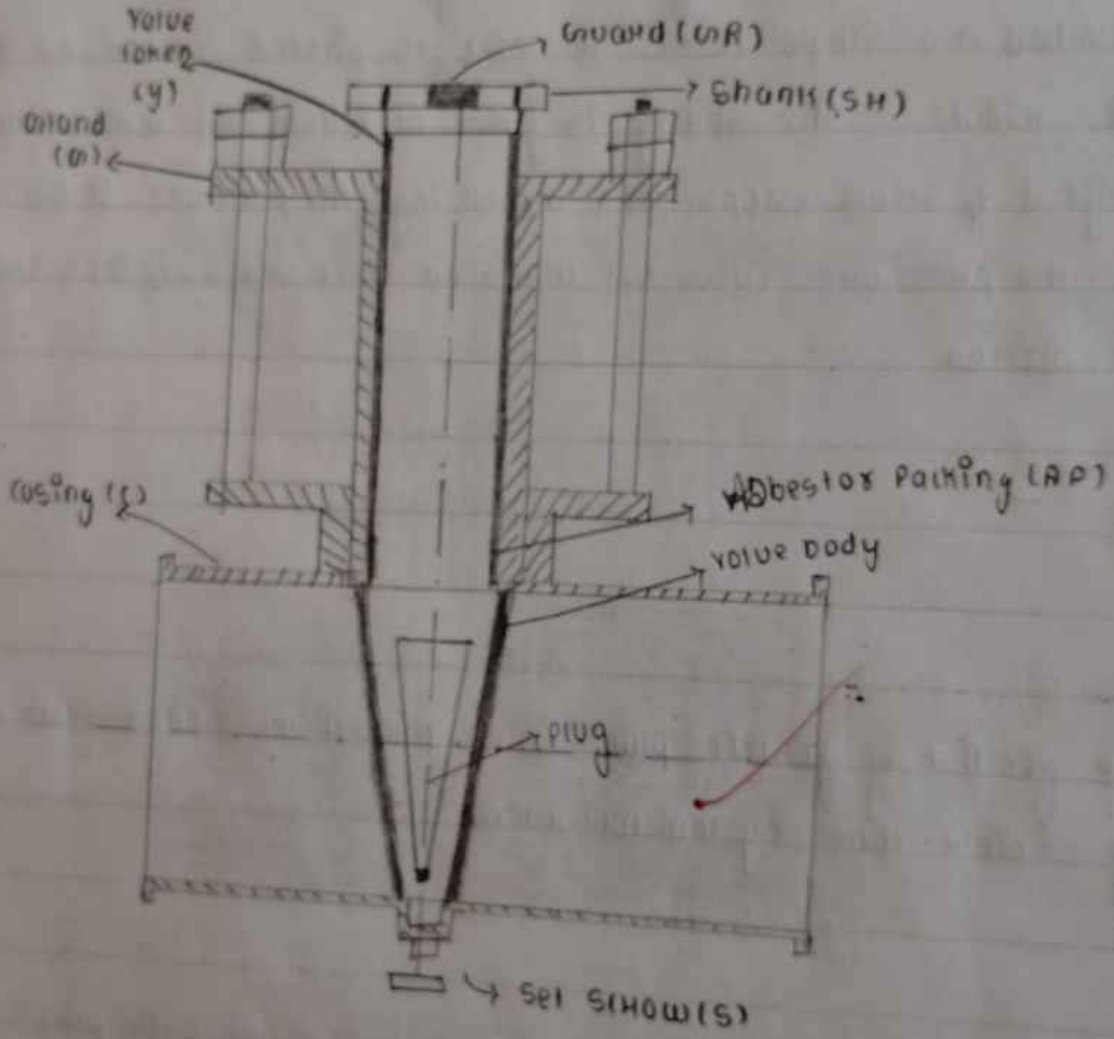
The function of fusible plug is to protect the boiler from damage due to overheating of boiler tube by low water level

Construction:

As shown in figure it is simply a hollow gun metal plug screwed into the fire box crown. This hollow gun metal plug is separated from the main metal plug by an annulus fusible material. This material is used protected from fire side by mean of flag.

working

When the water in the boiler is at its normal level, fusible plug remain submerged in water and its temperature does not exceed its melting temperature



Blow off cock

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Date ..... Experiment No. ..... P. No. 53.....
Name ...Hema Rajput..... Faculty No. .....Class.....Batch B.E. 1st year (civil)

because of heat transferred water easily get. If under some undesired condition, water level comes down to unsafe limit, fusible plug is exposed to steam in place of water

Blow off cock

Function:

It is a controllable valve opening at the bottom of water space in the boiler and is used to blow off some water from the bottom which carriers mud or other sediments settled during the operation of boiler

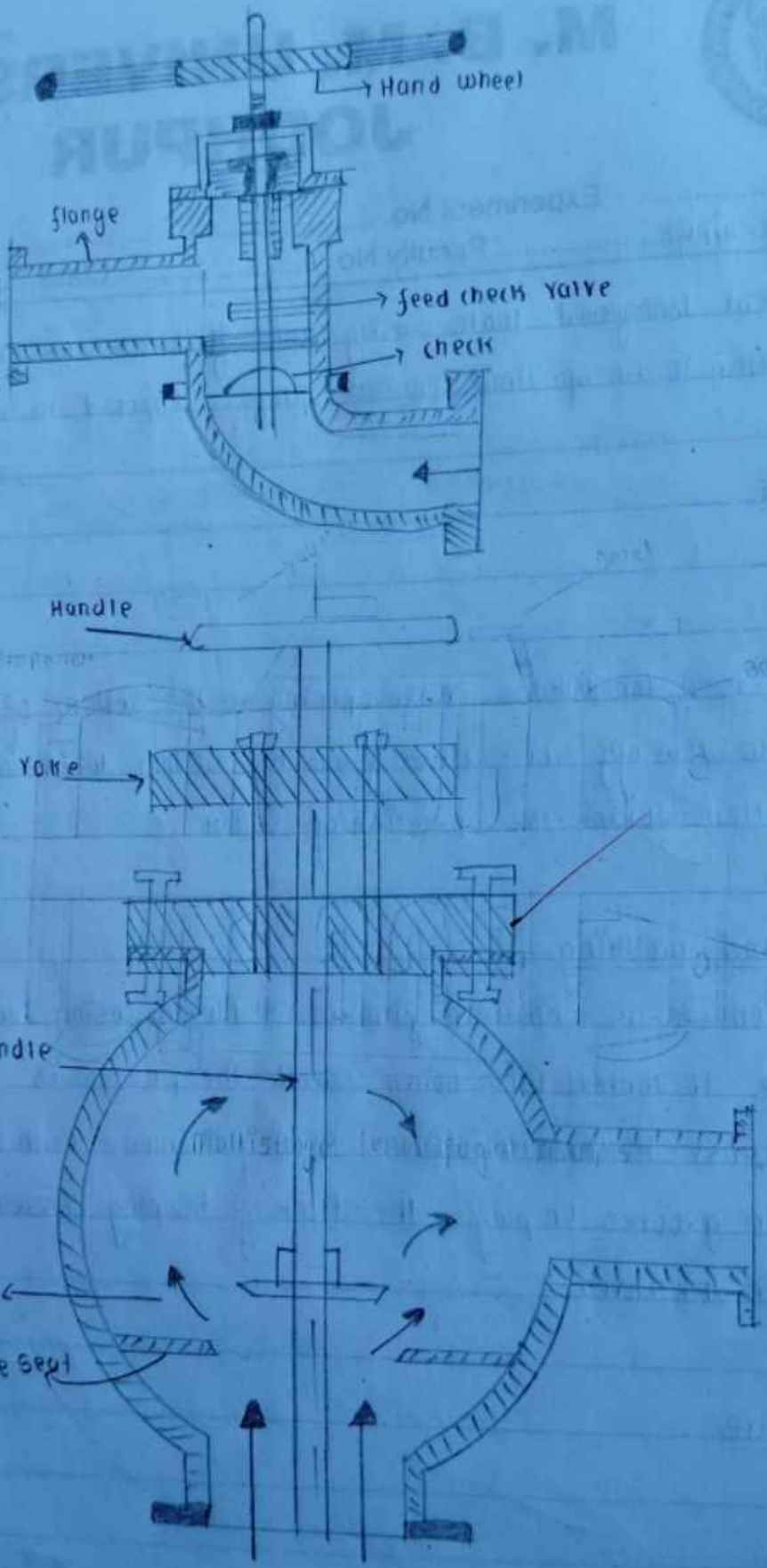
Construction and working

The construction is as shown in figure. It has a casing having a passage with one side flange to connect with boiler shell. The passage is blocked by a cone shape plug having a cross hexagonal tube. Sealing is made with a top & bottom asbestos packing filled in grooves on plug. The shank of the plug passes through a gland & stuffing box in the cover.

Feed check valve

Function:

The feed check valve is fitted in the feed water line of the boiler after the feed pump. It's function is to allow the water to flow in the boiler when the discharge pressure of feed pump is more than the inside steam pressure of boiler


Hand wheel
flange
feed check valve
check
Handle
Yoke
Spindle
valve
valve Seat

M. B. M. UNIVERSITY JODHPUR

Date ..... Experiment No. ..... P. No. 54.....
Name .....Heena Rajput..... Faculty No. .....Class.....Batch B.E. 4th year

and prevent the back flow in the case the feed pump pressure is less than boiler pressure

Construction:

The construction of feed check valve is as shown in figure. In the casing of valve there is a check valve which can move up as down on its seat under the pressure of water. When supply pressure of feed water acting at the bottom check when supply pressure drops by stopping of feed pump the boiler pressure acts on the top of valve & it sits on its gun metal seat

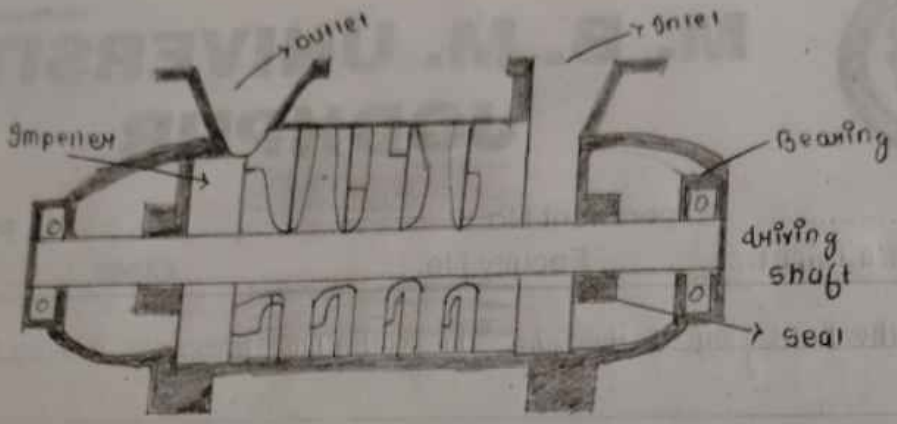
Steam Stop Valve:

Function:

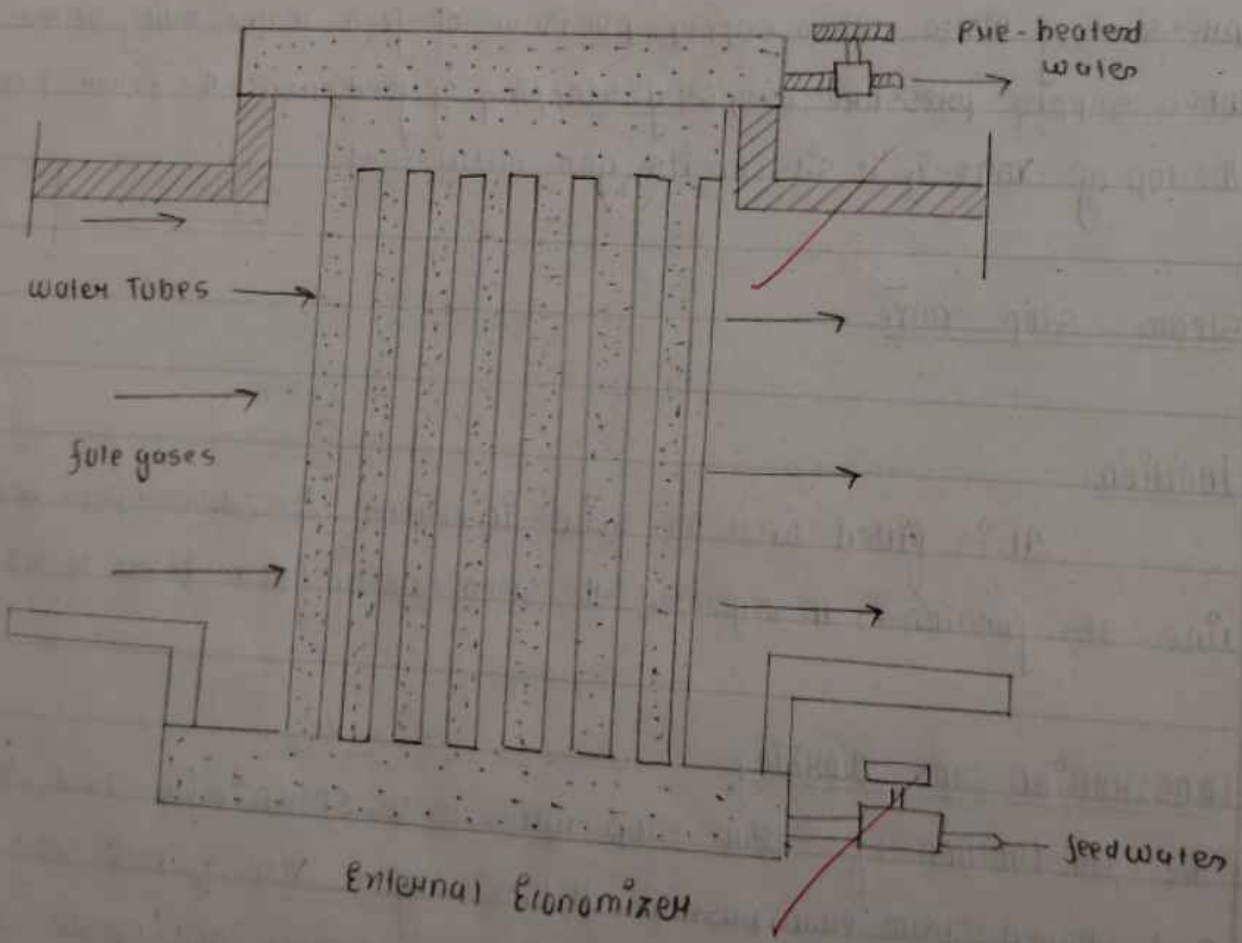
It is fitted over the boiler in between the steam space and steam supply line. Its function is to regulated the steam supply from boiler to the steam line

Construction and working:

The construction of steam stop valve is as shown in fig. 25.7. Its casing has a L-shaped steam flow passage. It consist of a valve & valve seat to stop or allow the steam flow. The valve is attached to a spindle and handle. Spindle passes through packing in the stuffing box to prevent leakage



Multistage Centrifugal pumps



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Date ..... Experiment No. ..... P. No. 55.....
Name ..Hema Gujar..... Faculty No. .....Class.....Batch. B.E.II..year/sem

Boiler Accessories:

Boiler Accessories are the components which are attached to the boiler (not mounted on it) and are essentially for working of boiler & for increasing its efficiency. Various boiler accessories are discussed below.

Feed Pump:

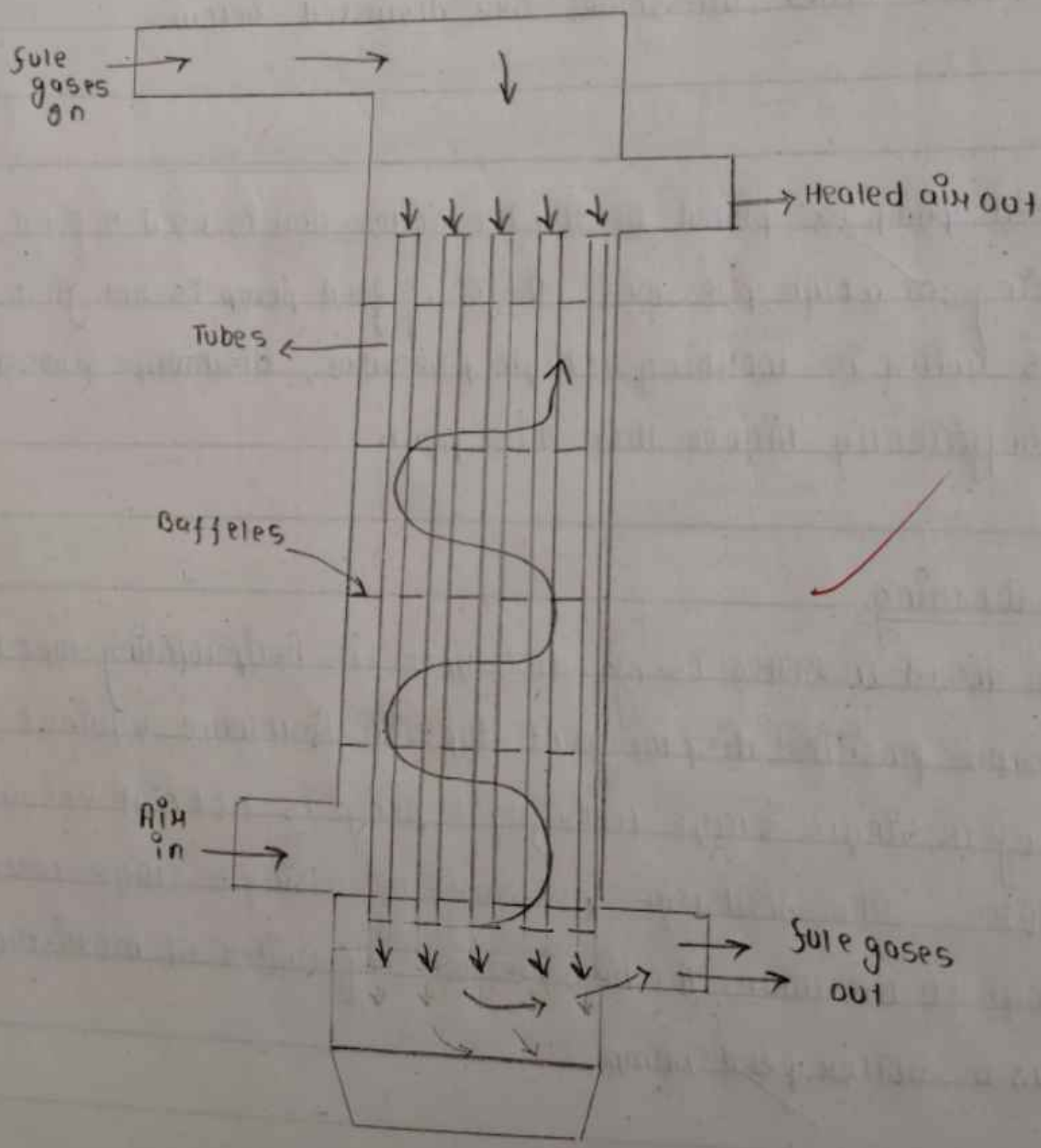
Feed pump is placed nearby the boiler and is used to feed a water to boiler working at a high pressure. The job of feed pump is not just put the water in boiler but as boiler is working at high pressure, discharge pressure of feed pump must be sufficiently higher than this push.

Construction & working

The feed pump used in boiler is of two types (i) Reciprocating type (ii) Rotary type. Both these type are positive displacement type to discharge against high pressure. The discharge of a single stage (centrifugal) pump is not high enough to overcome the high pressure. The discharge pressure of a single stage centrifugal pump is not high enough to overcome the high pressure of boiler so multistage (centrifugal) pump is used as a boiler feed pump.

Economizer

An economizer is a specially constructed that heat exchanges for harnessing the heat engine of outgoing flue gases and utilizing it in preheating of boiler feed water. It saves the heat energy and so the fuel & decreases the operating



Air - Fue heater (Tabular Type

M. B. M. UNIVERSITY JODHPUR

Date ..... Experiment No. ..... P. No. 56

Name ..Hemo. Bajpai..... Faculty No. .....Class.....Batch B.E. Diploma (Co)

cost of Boiler by increasing its thermal efficiency.

Construction & working

Economizers are of two types as (i) External type (ii) Internal The external type economizer is constructed and installed apart from the boiler and the flue gases from the boiler are directed to flow through it before escaping through chimney. A vertical tube external economizer is shown in figure.

It is employed for boiler of medium pressure range. Here a numbers of vertical tubes made of cast iron are connected to common headers at the bottom and top. feed water flow into the bottom header & then through the vertical tube flow out from the top header.

Advantage of Economizer

(a) Stresses produced in the boiler material due to temperature difference of boiler material and feed water and reduced because of increase in feed water temperature

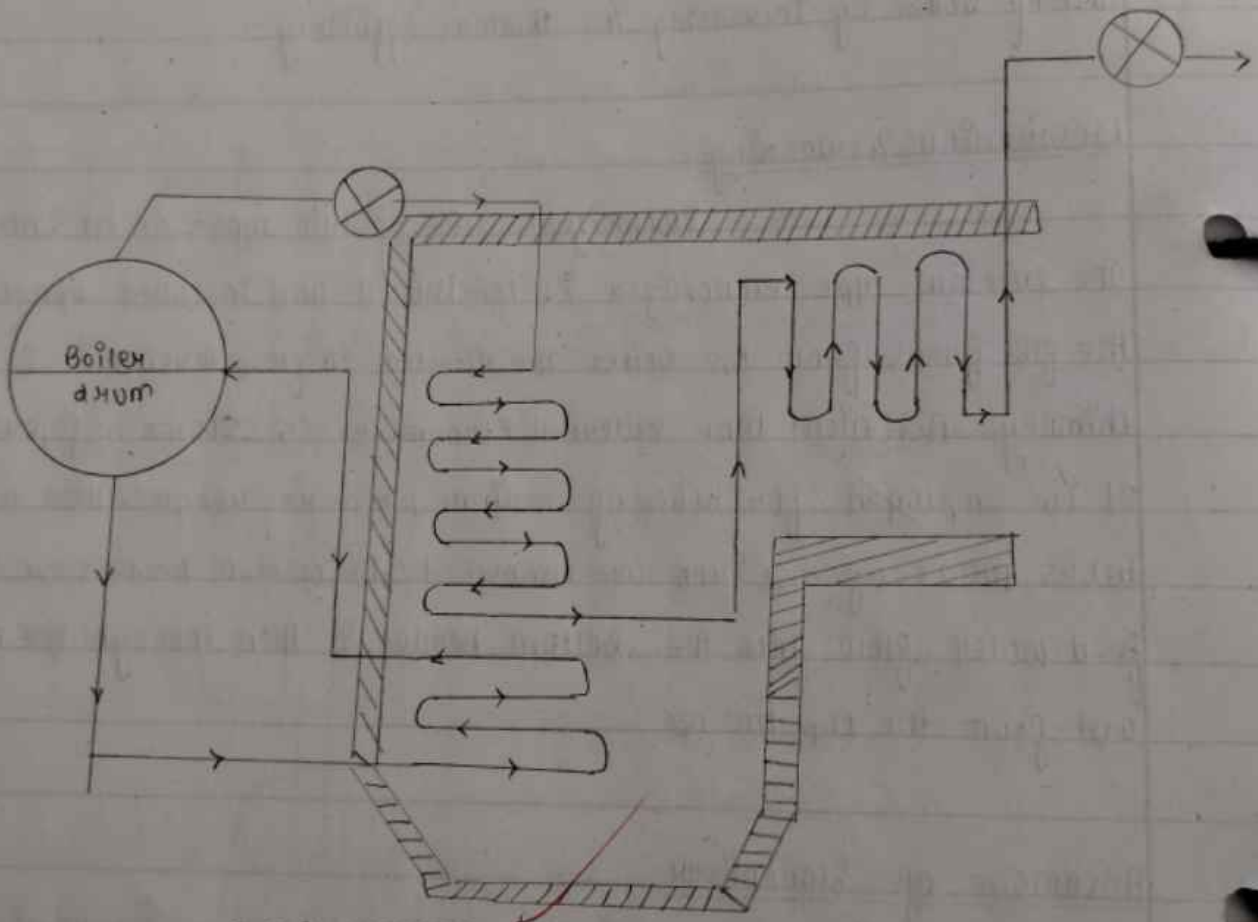
(b) Evaporative capacity of boiler increase as less heat will be required to generate steam if feed water temperature is already high due to preheating

(c) Overall efficiency of boiler increases because of more steam produced per kg of fuel burnt

3 **Air pre heater**

Function:

The function of air pre heater is to further utilize the heat of flue gases after coming out of economizer to preheat the air used in furnace or oil burner.



SUPER HEATER (RADIANT AND CONVECTION

M. B. M. UNIVERSITY JODHPUR

Date ..... Experiment No. ..... P. No. 51.....
Name ..Hema.Rajput..... Faculty No. .....Class.....Batch B.E. III year

Construction:

It is a plate type or tubular type or storage heat exchange in which flue gases pass through the tube on one side of plate & air pass on other side. In storage type a rotor fitted with mesh or matrix alternatively come in the passage of flue gas.

Super heater:

The function of super heater is to increase the temperature of steam beyond its saturation temperature. It is a type of heat exchange. Hot flue gases coming out of burner are first directed through super heater before the boiler. The main advantage of superheating of steam comes in power plants, where steam is expanded through a turbine. But in the processing industry superheating is required only to avoid condensation in pipes. Thus, super heater has less advantage or use in a processing industry and many time not used but not always.

20/4/17

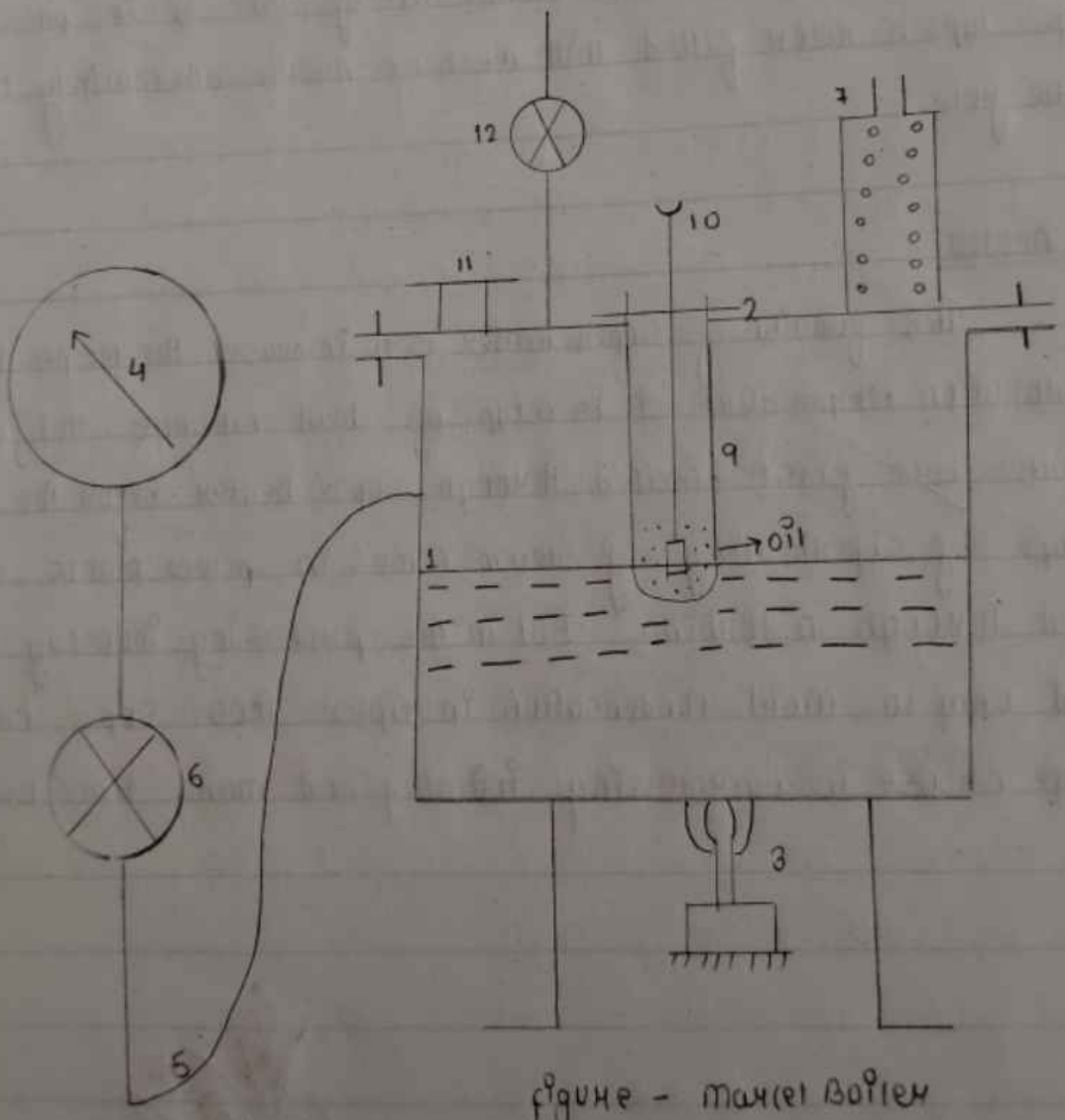


figure - Marcel Boiler

M. B. M. UNIVERSITY JODHPUR

Date ..... Experiment No. ..... P. No. 58.....
Name Hema Rajput..... Faculty No. .....Class.....Batch B.E. III Mechanical

Objective:

To study and conduct a test on Marcet steam boiler and plot the temperature relationship for saturated steam. Compare the measured values with steam table

Theory:

The main aim of this experiment is to obtain a slop of saturated temperature and pressure of the steam, in equilibrium with water between 0 to 14 bar. These result are then compared to the theoritical values obtained from steam tables. The experimental slop of dT/dP is obtained and compared.

Apparatus:

Marcet boiler is a mini boiler to demonstrate the relationship between pressure and temperature of saturated steam between atmospheric pressure and 20 kgf/cm²

(1) Pressure vessel (2) Cover (3) Kerosen stove/gas stove/electric heater (4) Pressure gauge (5) Siphon (6) Cock (7) Loaded safety valve (9) Water level indicator (9) Thermometer pocket (10) Glass thermometer (11) plug (12) Air cock.

Procedure

(i) Prepare the bench top unit as desiabed
(ii) Ignite the burner and heat the boiler
(iii) Log the boiler temperature & pressure values in increments of approximately 0.25 bar.

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Name .Hema.Rajpui..... Faculty No. .....Class.....

(IV) Enter the major values in the diagram in graph.

Observation table

9/12/23