

GOVERNMENT POLYTECHNIC, BOLANGIR



LARKIPALI, BOLANGIR

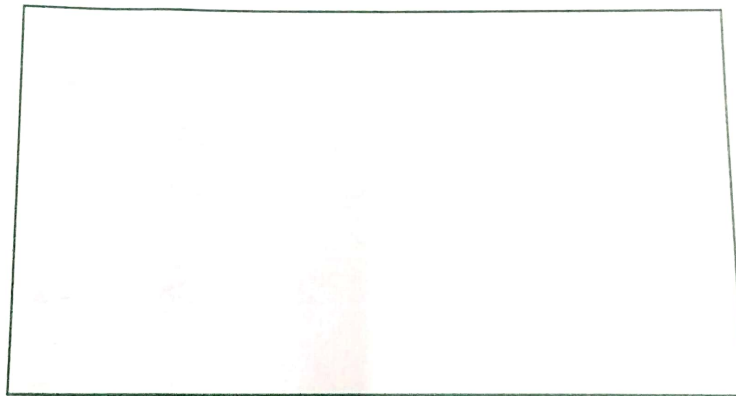
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GOVERNMENT POLYTECHNIC, BALANGIR



LARKIPALI, BALANGIR



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GOVERNMENT POLYTECHNIC, BALANGIR
DEPARTMENT OF Mechanical Engineering



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Aim of the experiment :-

To study about the automobile chassis.

Equipment required :-

A model of chassis of automobile.

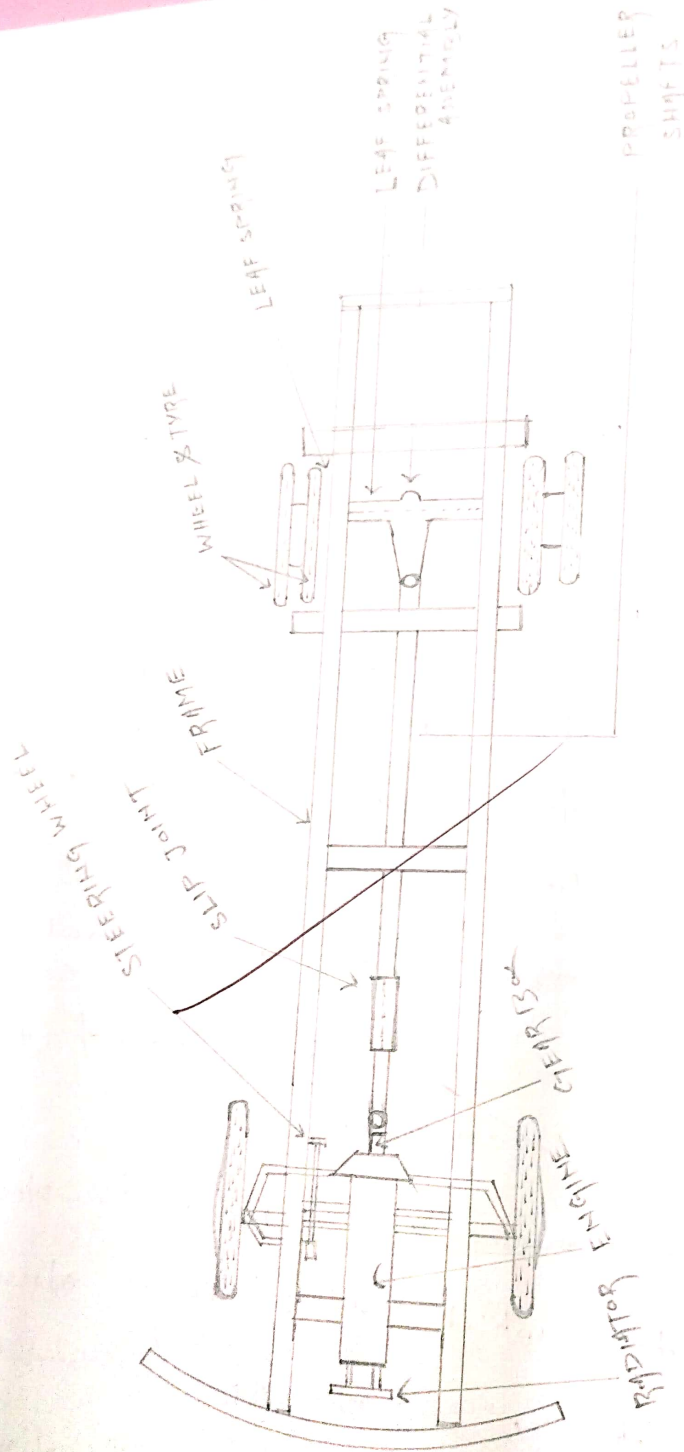
Theory :-

1.) Basic structure -

This is the unit on which are to be built the remainder of the unit to turn it in to power operated vehicle. It consist of frame, suspension system, axles, wheel and tyres.

Frame - There are two distinct form of construction.

1.) The conventional pressed steel frame to which the body structure is so design as to combine the function of body & frame, unit normally attached to frame being





attached directly to the body.

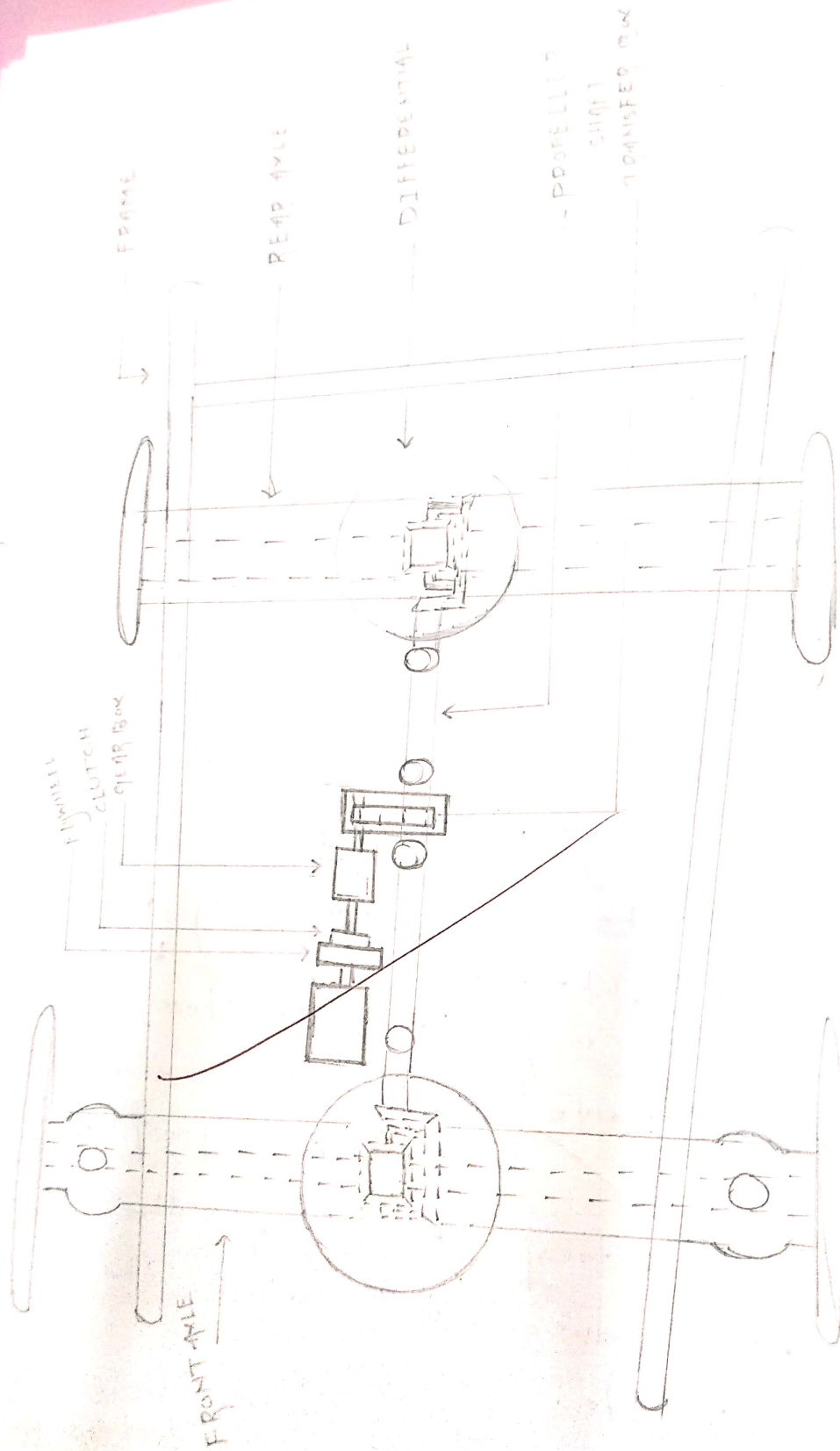
Suspension system:- Function of suspension system are :-

- i.) To prevent the road shock from being transmitted to the vehicle component.
- ii.) To safeguard the component from road shock.
- iii.) To preserve the stability of vehicle in pitching or rolling, while in motion. There are two types of suspension system.

Axles :- The weight carrying portion of axles, whether it may be front or rear may be considered as beam supported at the ends, load at two intermediate point.

- i.) The vertical load at the spring centre due to which the weight of vehicle.

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2.) Force and at the spring centers due to driving or braking effort.

3.) Torque reaction due to the drives or brakes.

Wheels :- Wire spoked wheel have been used mainly on sport cars, primarily on account of their light weight and quickness in changing the wheel. However the passed steel wheel has displaced these all ordinary purposes. Light alloy wheel are currently used in case of luxury & sport cars.

2.) Power plant -

The power plant provides the motive for all various function which the vehicle or any part of it, may be called upon to perform. The powerplant generally consist of an internal combustion engine which may either

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of spark - ignition and of compression ignition type.

3.) Transmission system -

Function of transmission system :-

- 1.) To disconnect the engine from the road wheel when desired.
- 2.) To connect the engine to driving wheel without shock.
- 3.) To reduce the speed gradually in fixed ratio.
- 4.) To turn drive through right angle.

Clutch - Its purpose is to enable the driver to disconnect the drive from road wheel instantaneously and to engage road wheel gradually while moving vehicle from rest.

Gear box (Transmission) - The gear box or transmission provides the necessary leverage variation between

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and road wheel.

Universal joint :-
They provides for relative movement between the engines and driving wheel due to flexing of road spring.

Differential :-
While taking turn the driving wheel must run at different speed. This done with help of differential. In ~~stead~~ of using long propeller shaft & transmitting power from engine to steer axle.

Conclusion :-
From above experiment we have ~~about~~ about the chassis of an automobile.

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12/2/24

Submitted by

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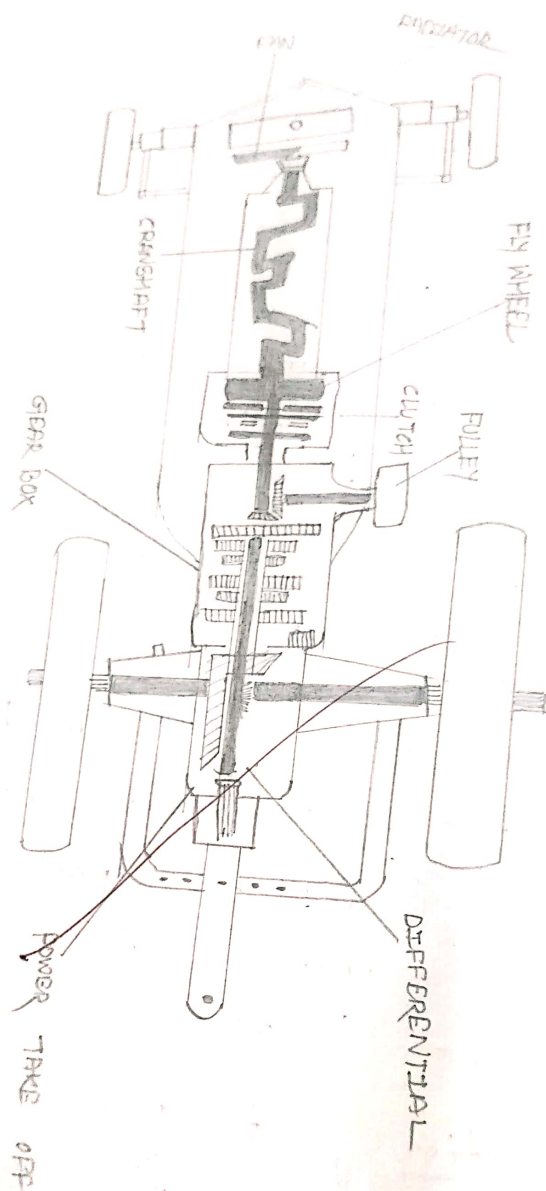
Aim of the experiment :-
To study the differential mechanism of tractor.

Theory :-

Transmission is speed reducing mechanism equipped with several gear. It may be called sequence of gear & shaft through which engine power is transmitted to the tractor wheel. The system consist of various devices that causes forward & backward movement of tractor to suit different field condition. The complete path of power from the engine to wheel is called power train.

Function of power transmission system :-
to transmit power from engine

- i.) To tractor wheel of tractor.
- ii.) To make reduced speed available to tractor wheel of tractor.





iii.) To alter the ratio of wheel speed & engine speed in order to suit the field condition.

iv.) To transmit power through right angle drive, because the crankshaft and rear axle are normally at right angles to each other.

It consists of :-

a) Clutch

b) Transmission gear

c) Differential

d) Final drive

e) Rear axle

f) Rear wheel

Clutch and fluid coupling is a device used to connect and disconnect the tractor engines from transmission gear & drive wheel. Clutch transmits power by means of friction between driving members & driven members.

Necessity of clutch in tractor is essential for following reasons :-

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- i) Engine need cranking by any suitable device. For easy cranking engine is disconnected from the rest of the transmission unit by suitable clutch.
- ii) In order to change the gear, the gearbox must be kept free from engine power, otherwise gear teeth will be damaged & engagement of gear will not be perfect.
- iii) When the belt pulley of tractor work in field.

Types of clutch :-

- 1.) Friction clutch
- 2.) Dog clutch
- 3.) Fluid clutch

Transmission gear and Torque converter

A tractor engine run at high speed, but the rear wheel of tractor requires power at low speed & high torque. That why it becomes essential to reduce

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to reduce the engine increase torque available at rear wheel of tractor because

$$BHP = \frac{2\pi NT}{4500}$$

→ Common gears used on tractor are two types :-

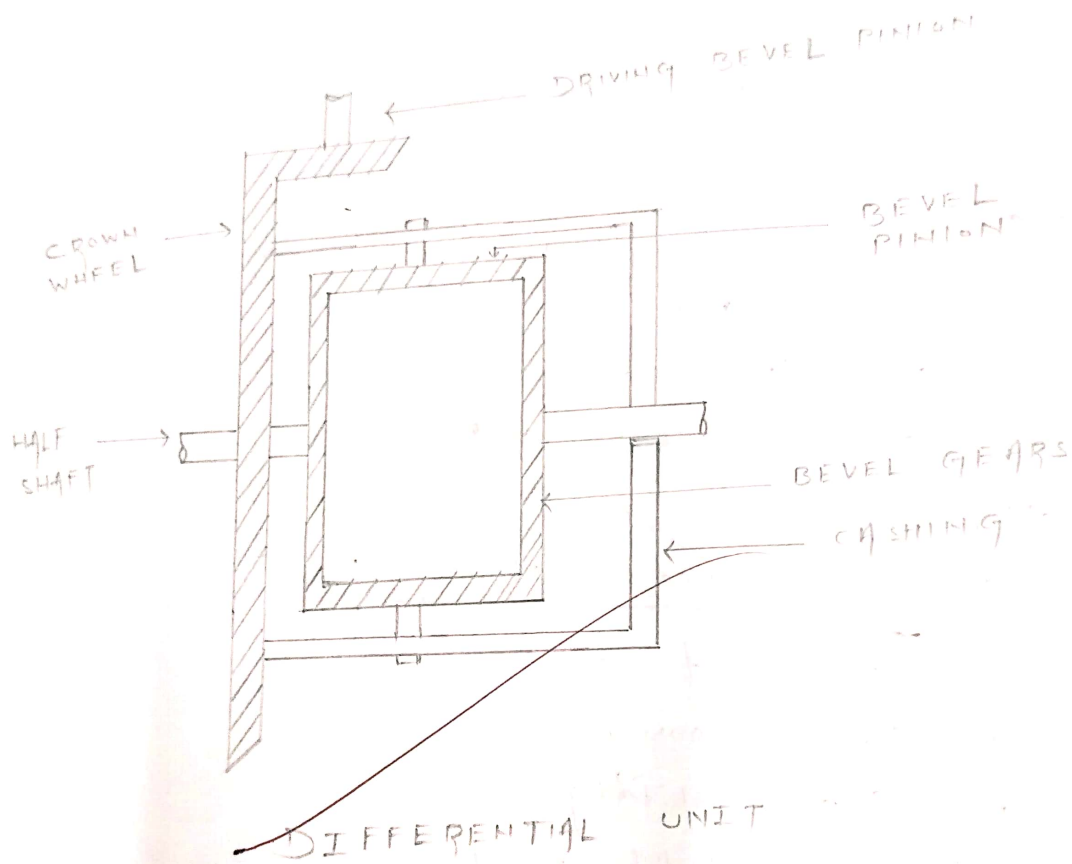
- i.) Selective gear sliding
- ii.) Constant mesh type

Selective gear sliding :- The gear box consists of -

- i.) Gear housing
- ii.) Gear shifting
- iii.) Main shaft or input
- iv.) Output shaft
- v.) Lay shaft or counter shaft

Constant mesh type :- These gears are always in mesh. Usually the gears are helical in shape.

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Differential unit & final drive :-

Differential unit is a special arrangement of gear to permit one of rear wheel of tractor to rotate slower or faster than other. While turning the tractor on a curved path, inner wheel has to travel lesser than tractor to move faster than other at turning point. The output shaft coming from gear box is provided with bevel pinion at the end of shaft. The main function of crown wheel :-

- i.) to transmit power through right angle drive to the tractor.
- ii.) to reduce the speed of rotation.

The differential unit consist of :-

- i.) Differential casing
- ii.) Differential pinion
- iii.) Crown wheel
- iv.) Half shaft & bevel gear

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Differential lock :-

Differential lock is device to join both half axes of tractor so that even if one wheel is under less resistance the tractor comes out from mud etc both wheel move with same speed & apply equal traction.

Final drive :-

Final drive is gear reduction unit in the power train betⁿ the differential and drive wheel. Final drive transmits power finally to rear axle & wheel. The tractor rear wheel are not directly attach to the half axes shaft but drive is taken through pair of spur gear. Each half shaft terminates in small gear which mesh with a large gear called bull gear. The bull gear is mounted on the shaft



carrying front or rear wheel.

Steering system & Brake steering system

The system governing the angular movement of front wheel of front or is called steering. This system steering wheel minimizes the effort of the operator in turning front wheel with the application of leverage. The different components of system are :-

- i.) steering wheel
- ii.) steering shaft
- iii.) steering arm
- iv.) pitman arm
- v.) king pin
- vi.) Tie rod

When the operator turn the steering wheel the motion is transmitted through gear. The steering shaft to set of pitman arm. The angular movement of pitman arm is further angular movement of

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transmitted to steering arm through set of gears & tie rod. The movement of steering arm affect angular movement of front wheel.

Brake :- used to stop or slow down the motion of tractor. It is mounted on driving axle & operated by two independent pedals. Each pedal can be operated independently to assist the turning of tractor during field work or parking. Locked together.

classification :-

- i.) Mechanical brake
- ii.) Internal expanding brake
- iii.) External expanding brake
- iv.) Disc brake
- v.) Hydraulic brake

Hydraulic control system :-

The working principle of hydraulic system is based on pascal law. This law states that pressure applied to an enclosed fluid is transmitted equally in all directions. Small force acting on small area can produce higher forces on larger area.

Basic component of hydraulic system :-

- i.) Hydraulic pump
- ii.) Hydraulic cylinder
- iii.) Hydraulic tank
- iv.) Safety valve
- v.) Hose pipe & fitting

Conclusion :-
From the above experiment, we have studied differential Mechanism of transmission.

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A. Babu
13/3/24

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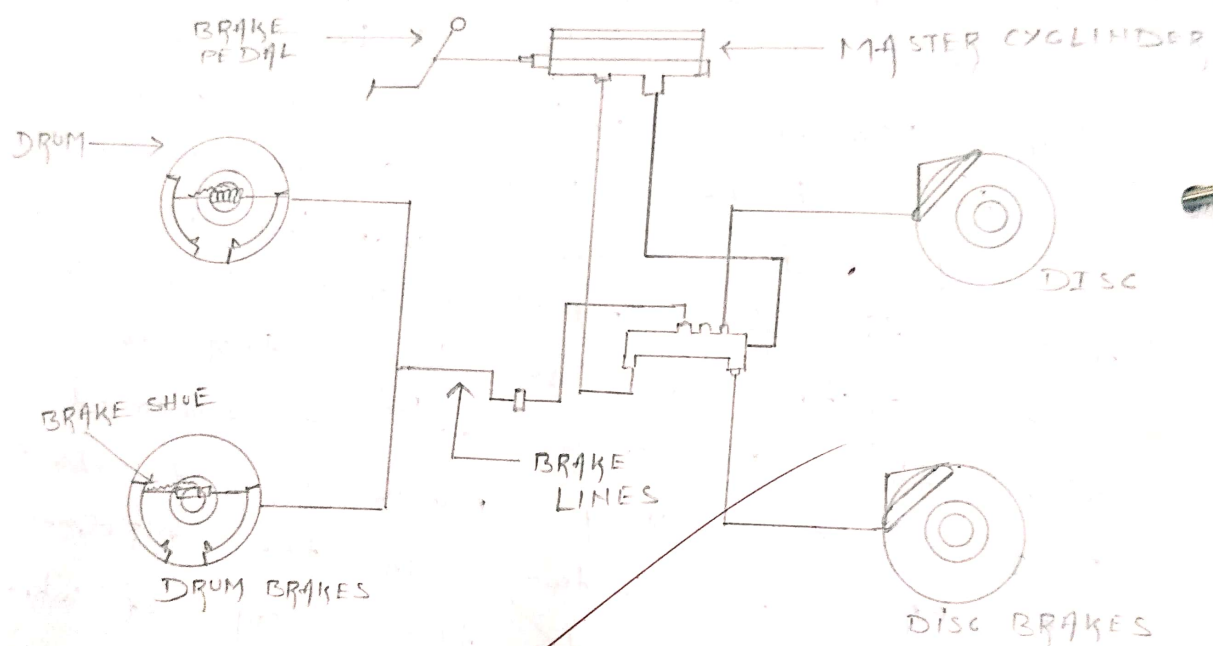
aim of the experiment :-
To study of braking system (hydraulic)

Theory :-

There types of brakes consist of master cylinder, which contains hydraulic brake fluid. Master cylinder is operated by the brake pedal & is further connected to wheel cylinder in each wheel through pipelines, union & flexible. The system is so design that even when the brakes are in released position a small pressure of about 50 kPa is maintain in the pipelines to ensures that the cup of wheel cylinder are kept expanded.

Working principle :-

The hydraulic brakes are applied by the liquid pressure. The pedal force is transmitted to the brake shoe by mean of confined liquid through system of forces.



HYDRAULIC BRAKING SYSTEM



The force applied to the pedal is multiplied & transmitted to all the brakes shoe by force transmitting system. This system is based upon Pascal principle which states that the confined liquid transmit pressure without loss equally in all direction.

Hydraulic brake system is essentially consist of two main components cylinder & wheel cylinder. The system is filled with liquid under slight pressure when the brake is not in operation. The liquid is known as brake fluid & usually mixture of glycerine & alcohol. The center shoes are fitted with hard & wear resisting surface lining on the

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The brakes pedal is connected to the master cylinder piston by means of a rod. When the brakes are to be applied the driver depresses the pedal the piston is forced into master cylinder. This increasing the pressure of the fluid in master cylinder & in entire hydraulic system. This pressure is conducted instantaneously to the wheel in each of four brakes, where it forces the wheel cylinder piston outward. These piston, in turn, forces the brakes shoes out against the brake drum. Thus, the brake are applied.

Types of hydraulic brake system :-

- 1.) Disc :- Disc brakes utilise brake pads & calliper & rotor.
- 2.) Band :- Band & drum brakes represent the



straight forward brake type.
iii.) Drum :- Drum brakes engage shoes against a rotating drum surfaces.

Conclusion :-

From the above experiment we have successfully studied about hydraulic braking system.

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13/3/24

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Aim of the experiment :-
To study about Solex type carburetor or manufacture

Theory :-

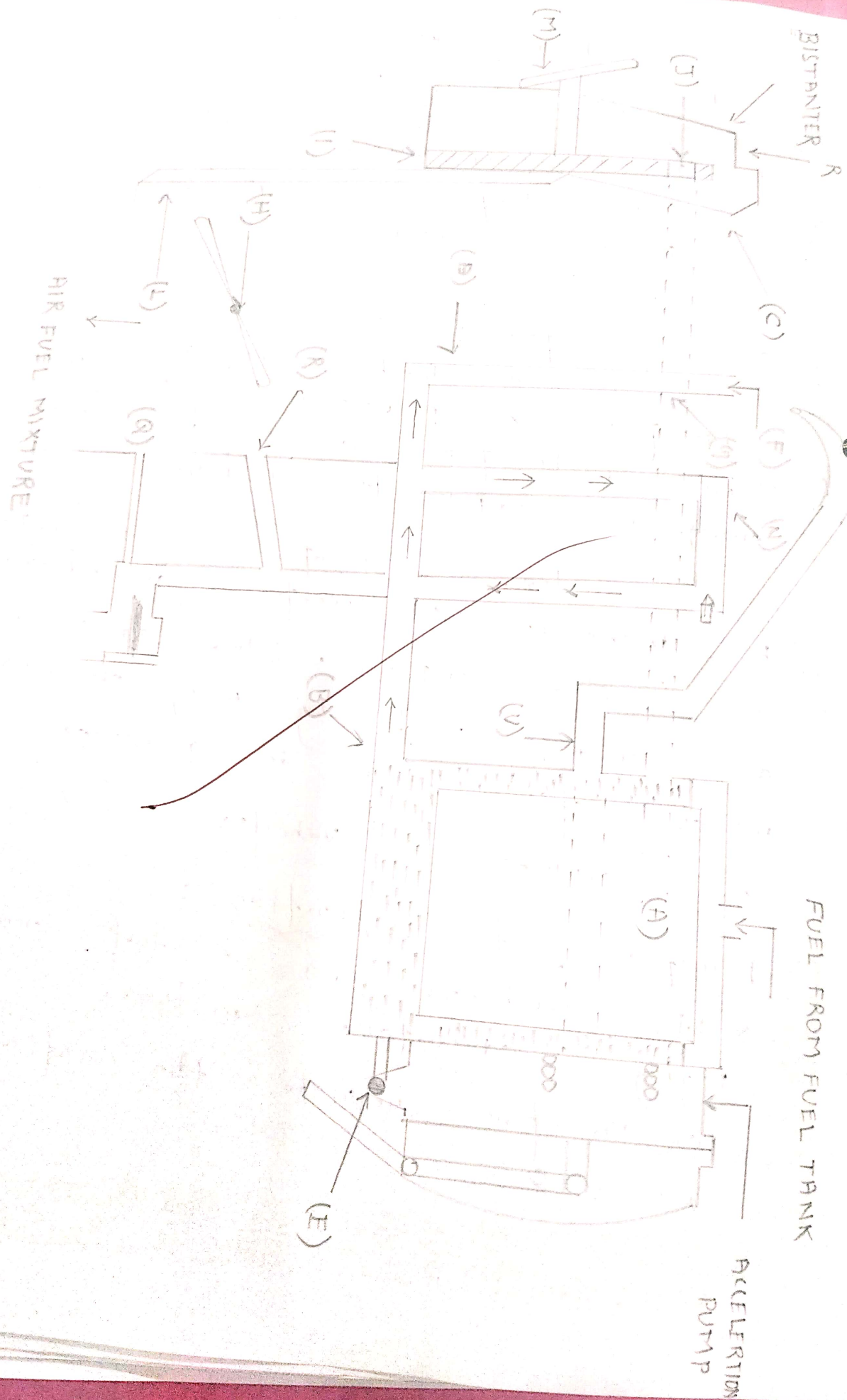
Solex carburetor :-

Solex is a bench manufactured or carburetor & powered bicycle velocity. This carburetor is used in many European automobile industries.

Solex carburetor are invented by menesser & made gaudend founder or Solex company. Solex carburetor are widely used by many European makes also used in passenger cars & commercial vehicles.

Function of combustion :-

→ It combines air & fuel creating combustible mixture.
→ Carburetor regulate the ratio of air &





→ carburetor control the angle of speed by controlling the flow of air fuel mixture entering the cylinder.

Description of Solex carburetor
Solex carburetor is a down draught type carburetor. It consists of three devices for steering, idling, normal running & acceleration. These are described in brief as follows:

A starting valve in the form of a flat disc having holes of different sizes. These valves connect the starter jet & pass the jet into the passage which slides to the air horn before the throttle valve.

Working of the Solex carburetor
In the Solex carburetor the fuel chamber is the part that



collect the ~~starfare~~ fuel from fuel tank & stores. It is the carburetor to form an air fuel mixture. This fuel chamber has float valve which is used to maintain the fuel level in fuel chamber. There is main line through which fuel venturi-meter.

Types of Solex carburetor :-

1) Solex carburetor are three types :-

- Solex type
- The bore of throttle chamber
- It model.

2) Solex carburetor are classified according to three description :-

- Up draught carburetor
- Horizontal carburetor
- Down carburetor

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The direction of air flow is

In sports car & racing car the horizontal carburetor is used for up draught carburetor where the fuel is gravity fed.

The number of carburetor is
usually it is determined by type of engine whether one or more carburetor are used. Generally in sports cars

& racing car more than one carburetor are used. It is used to reduce length of the intake manifold & hence passage of the air fuel mixture.

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Conclusion :-

From the above experiment we
have successfully studied the solenoid
carburator.

A. Babu
13/3/24

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Aim of the experiment :-

To study of the cut section of fuel pump.

Theory :-

Fuel pump - A fuel pump is a component in motor vehicles that transfers liquid from the fuel tank to the carburetor & fuel injector of the I.C engine.

The basic way modern electrical fuel pump works by utilizing a DC motor in pump assembly which works in the fuel system in your gas tank from then it so sends it up fuel into cylinder.

Types of fuel pump :-

- 1.) Mechanical fuel pump.
- 2.) Electrical fuel pump.

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1) Mechanical fuel pump :-

A mechanical fuel pump is a device that delivers fuel to engines. Due to the fact that mechanical fuel pumps generally work best on carburetor engines, they are typically found only on older vehicles fuel injection systems supply fuel directly to cylinders of vehicles engines.

Mechanical fuel transfer pump :-

→ A can & shaft cam are side of the lever to move up or down.

→ A rubber diaphragm is attached to the lever.

→ When enough fuel is sucked into the pump through fuel pipe, the lever pulls down diaphragm and air is forced to flow.



2.) Electric fuel pump & working :-

An electric fuel pump supplies the fuel to the injector at desired pressure. The injector spray fuel into intake manifold or directly into combustion chamber with manifold injection. Electric fuel pump, converts fuel out of the tank.

Working :-

The basic way modern electric fuel pump works is by utilizing DE motor in pump assembly which draws in fuel sitting in gas tank, from there it sends it up fuel line & into fuel rail where it can be injected & cycle here.



Advantages of electric fuel pump :-

- produces almost inst ant pressure
- produces smoother flow than mechanical pump.
- Head high pressures increases.

Conclusion :-
From the above experiment we have successfully study and see of fuel pump.

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13/3/24

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Experiment - 6

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Aim of the experiment :-

To study about gear box.

Theory :-

Gear box - It is a contained gear train or mechanical unit or component consisting of series of integrated gear in housing.

Construction :-

The gear box housing is the outer casing usually made of cast iron, that houses the various shaft and gear inside.

Parts :-

- 1.) clutch shaft
- 2.) countershaft
- 3.) Main shaft
- 4.) Bearing
- 5.) Gear

clutch shaft :-

It is a component of gear box. Since it is splined shaft to hub.

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or clutch part, which is sliding on it
 one end of clutch shaft attached
 to the crankshaft or flywheel
 & the other end connect to gear.

→ Counter shaft :-

A mechanism used to transmit motion
 and power from main driving shaft
 to an individual machine, typically
 mounted by hangers on ceiling
 by one belt from the main
 shaft & in turn driving
 the m/c.

→ Main shaft :-

The line of shafting that receive
 its power directly from engine
 or motor & transmit power
 to other parts.

→ Bearing :-

A bearing is m/c element that
 construction separate motion to only
 desired motion & reduces friction
 betⁿ moving parts.

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→ Gear :-

A gear is rotating circular m/c part having cut teeth on case of gears wheel is called teeth which mesh with one then through parts.

Working principle :-

The input gear are fixed on the counter shaft making them single which drives individual gear on the m/c shaft, which rotate freely on bearing. Thus, gear box passes to drive to aheads depending upon gear which engages on main shaft.

Types :-

- 1.) Manual transmission
- 2.) Automatic transmission

Manual transmission :-

A manual transmission is also known as manual gear box standard transmission.

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are stick shift or multi-speed motor vehicle transmission ~~or stick~~ transmission system, where gear changes

- a) Sliding gear transmission
- b) Synchronised gear box.
- c) Constant mesh transmission
- d) Power-select transmission

Advantages :-

- Low price
- Better gas mileage.
- Lower repair cost
- Fewer distraction

Dis-advantages :-

- Power availability to U.S. fewere automobile shipped with manual transmitt. are coming in traffic
- Driving
- Learning case.

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Automatic transmission :-

An automatic transmission is multi-speed transmission used in motor vehicles that doesn't require any driver input to change forwards gears under normal driving condition.

a) Torque converter :-

A torque converter is type of fluid coupling that transfers rotating power from prime mover like an internal combustion engine to rotating driver load in vehicle with an automatic transmission.

b) Automated manual :-

Automated manual transmission is type of transmission for motor vehicles. It is essentially conventional manual transmission but uses automatic actuation to operate.

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d) Continuous variable transmission :-
A CVT is an automatic transmission that can transfer through continuous range gear ratios.

Advantages :-

- Easy to drive, simplest.
- Acceleration speed.
- More powerful than manual.

Dis-advantages :-

- Maintenance is costly.
- Addition of gear for increase condition.

Application / Necessity of gearbox :-

The following application are necessary of gearbox :-
The gear box is to do high torque at the time of turning on engine at will climbing & acceleration to prevent slipping movement between the engine & wheels during.



Conclusion :-
We have successfully studied about
the gearbox.

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20/3/24

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Experiment - 07

Aim of the experiment :-

To study about car engine.

Theory :-

How cars engines work :-

The engine consist of fixed cylinder & moving piston. The expanding combustion gases push piston which turns the crankshaft. It ultimately drives vehicle through the system in the power motion drives vehicle train wheels.

Four stroke engines :-

A four stroke engine is internal combustion engine in which piston completes four separate strokes while taking turning to fuel & expel stroke or piston along the cylinder in opposite direction. The four strokes turned internally.

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also known as indirect or suction

Types of engines in combustion engine

- i.) Internal combustion engine
- ii.) External combustion engines
- iii.) Reaction engines

Internal combustion engines is an internal combustion engine where heat engines internally receive heat by fluid contained in an external heat source, through the engine wall or heat exchanger.

External combustion engines is an external engine where heat engines receive heat and are internally heated by source, through the engine wall or heat exchanger.

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Reaction Engines :-
A reaction engine is an engine or motor that provides thrust by expelling reaction mass in accordance with Newton's third law of motion.

Conclusion :-
We successfully studied about engines.

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21/3/24

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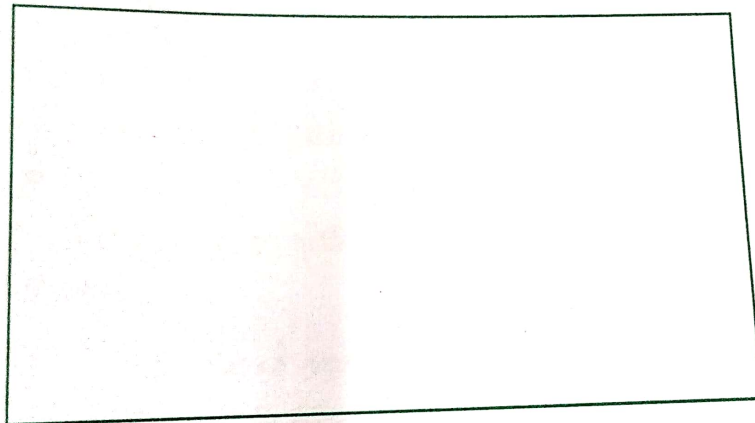
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Subject..... Power station Engineering Lab

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AIM OF EXPERIMENT :-

To study of modern steam power plant.

Objective :-

study about the layout of steam power plant.

THEORY :-

Modern steam power plant and its operating cycle.

The general layout of the modern power plant consist of mainly four circuit which are :-

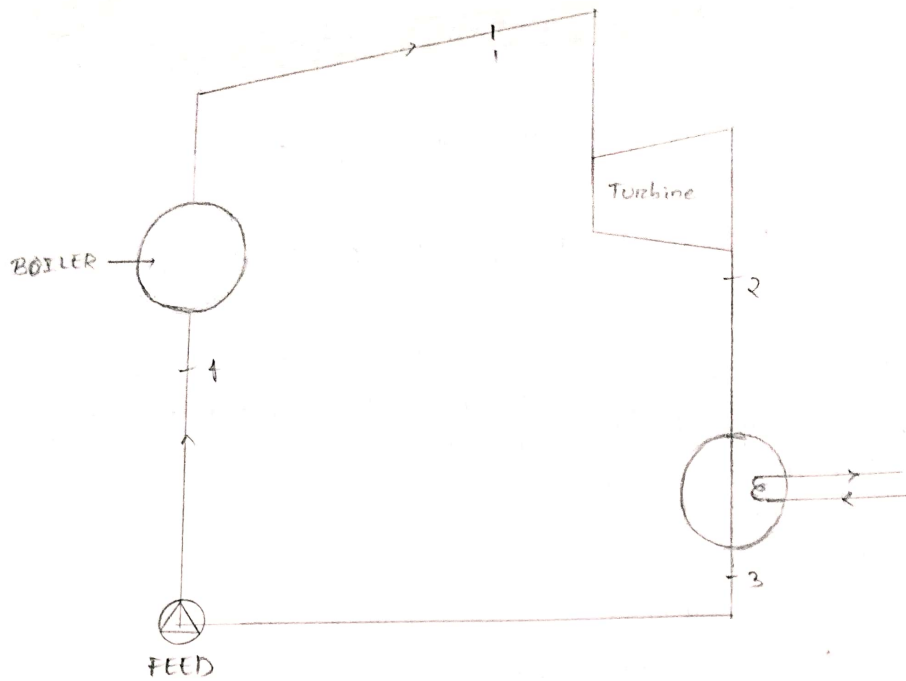
- coal and ash circuit
- Air and gas circuit
- Feed water and steam flow circuit
- cooling water circuit.

A thermal power station using steam as working fluid works basically on the "Rankine cycle". steam is generated in a boiler, expanded in prime mover and condensed in a condenser and fed into the boiler again with the help of pump. However in practice there are numerous modifications and improvements in this cycle with the aim of affecting heat economy and to increase the thermal efficiency of the plant.

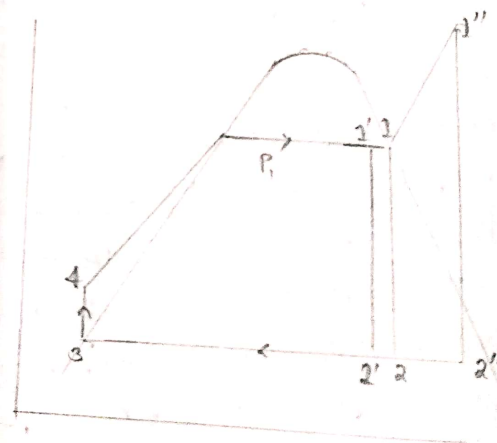
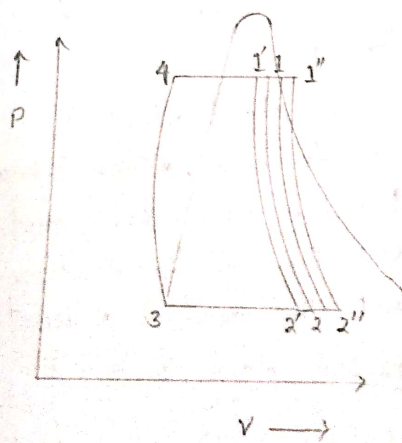
We have studied that : It is the power plant which is generate electricity by the use steam turbine. water is heated turn into steam and spins a steam turbine which drive and electrical generator. After it passes through the turbine, the steam is condensed in a condenser. The greatest variation in the design of steam, electric power plant is due to different fuel sources.

Almost all coal, nuclear, geothermal, solar, thermal electric power plants. waste incineration plant as well as many natural gas ^{power} plant are steam electric. Natural gas is frequently combusted in a gas turbine can be used to raise steam in a

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SIMPLE RANKINE CYCLE



P-v AND T-s DIAGRAM OF SIMPLE RANKINE CYCLE

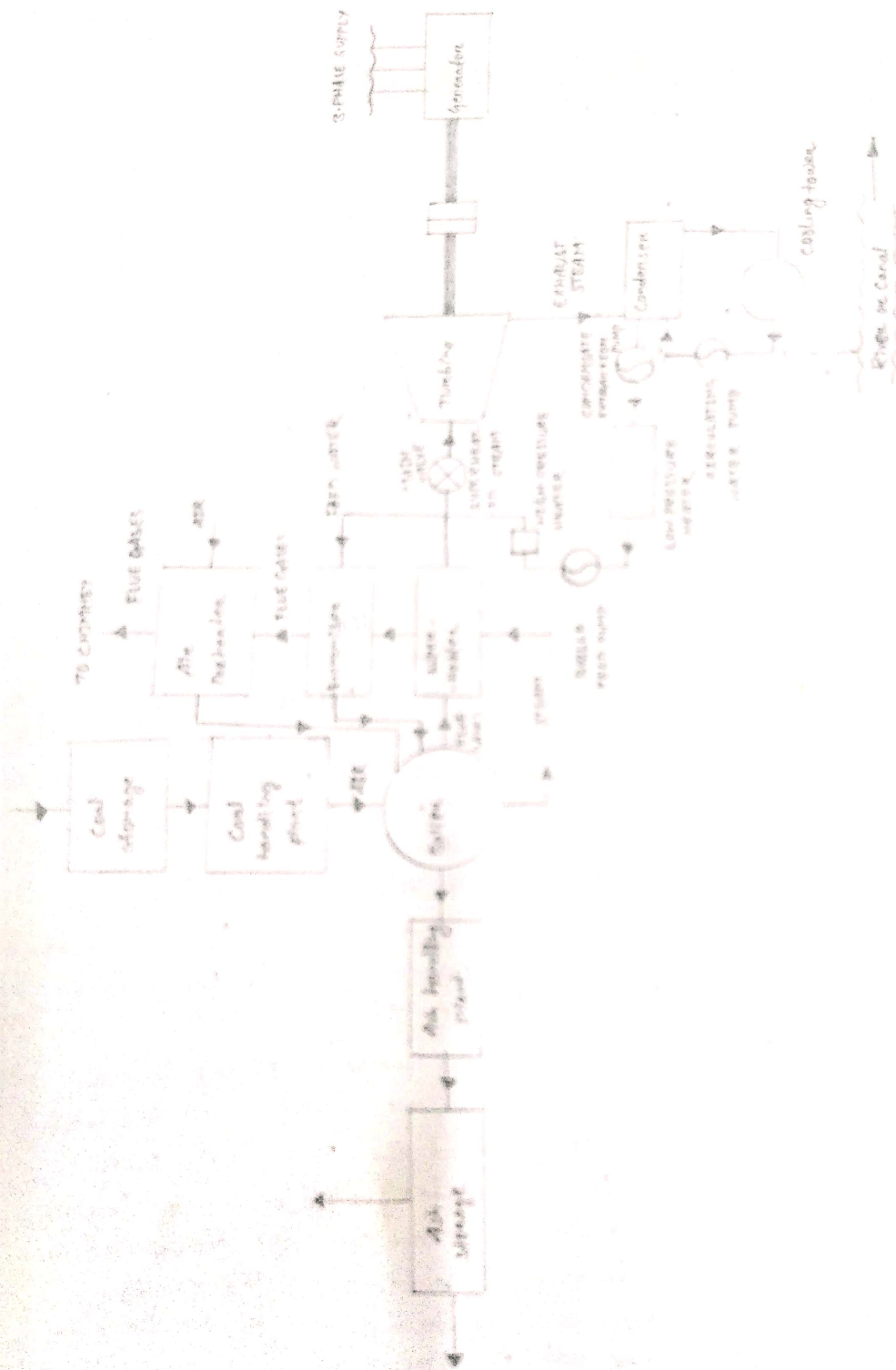


combined cycle plant that improves overall efficiency.

Working Mechanism :-

- The pulverised coal is fed into the boiler where the pulverised coal is burnt into the furnace.
- Due to heat from the furnace, the water present in the boiler drum changes to the high pressure steam.
- From the boiler this high pressure steam is passed to the super heater where it is again heated up to its dryness.
- After that this super heated steam strikes the turbine blades start rotating to at high speed. Then the stored potential energy to the steam is converted into mechanical energy.
- A generator is coupled with the turbine rotor. As the turbine rotates, the generator also rotates with same speed & mechanical energy of the turbine gets converted into electrical energy.
- Steam after heating the turbine blades ~~lost its~~ most of the energy & leaves the turbine with the low pressure steam.
- This low pressure steam enters into the condenser cold water circulate in the condenser from the cooling water. Here the low pressure wet steam is converted into water.
- After that condensed water with the feed water passed to the economiser where it is gets heated up by the economiser and finally the feed water enters into the boiler by a feed water pump to repeat the cycle.
- The burnt flue gases from the furnace passes through the super heater, economiser and air pre-heater. This heat of the flue gases is use to heat the steam in the super heater to its dryness to feed water in the economiser before entering in the boiler and to heat air from the atmosphere in the air pre-heater before it enters into the furnace.
- The ash from the furnace is transported to ash handling plant & finally to the ash storage.

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Layout of a steam power plant



Conclusion -

From the above experiment we have successfully studied the modern steam power plant.

16/2/27

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Aim of Experiment : - To study the cooling tower

Apparatus - cooling tower setup.

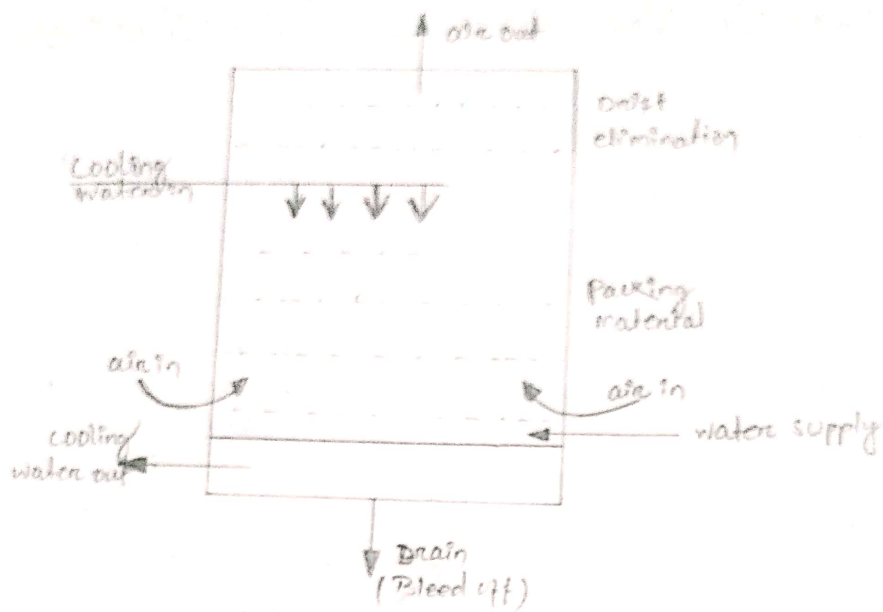
Theory - cooled water is needed for, for example air conditioner, manufacturing processes or power generation. A cooling tower equipment use to reduce the temperature of water steam by extraction of heat from water and emitting it to the atmosphere. cooling tower make use of evaporation whereby some of the water is evaporated into moving air stream & subsequently discharge into atmosphere. As a result the remainder of the water is cooled down significantly. Cooling tower are able to lower the ^{water} temp. more than device that use only air to reject heat, like the radiation in a car, and are therefore more cost-effective & energy efficient.

cooling tower use the evaporative cooling principle to cool the circulated water, and they can achieve water temp. below the dry bulb temp. tdb of air cooling air & they are in general smaller & cheaper for the same cooling load than other cooling system. cooling tower are rated in terms of approach & range, where the approach is difference in temp. betⁿ the cooled water temp. & entering air wet bulb twb temperature the range is the temp. difference betⁿ the water inlet & exit states. Since a cooling tower based on evaporative cooling the maximum cooling tower efficiency is limited by wet bulb temp. of cooling air. The water consumption - the make up water of a cooling tower is about 0.2 - 0.3 liter per min. & for refrigeration. compared with the use & waste of city water the water consumption can be reduced with about 90 - 95%.

There are two main types of cooling towers.

- Natural draught
- Artificial draught (Mechanical draught)
 - a) Forced draught
 - b) Induced draught

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Natural draught



Air circuit -

Air from the atmosphere (with temp. t_1), enters the fan at a rate which is controlled by the intake damper setting. The fan discharges into the distribution chamber & the air passes wet & dry bulb sensors (which measure the temp. t_2 & t_1 respectively) before entering the packed column. As the air flows through the packing, its moisture content increases & the water is cooled. On leaving the top of the column the air passes through the droplet arrest, which traps most of the entrained droplets & returns them to the packing. The air is then discharged to the atmosphere via an air measuring orifice & further wet & dry bulb sensors (which measure the temp. t_4 & t_3 respectively).

Droplets of water may become entrained in air stream & then lost from the system. This loss does not contribute to the cooling, but must be made good by "make-up" water. To minimize this loss, a "droplets arrest" or "eliminator" is fitted at the tower outlet. This component causes droplets to coalesce, forming drops which are too large to be entrained & these fall back into the packing.

Under the action of the fan, air is driven upward through the wet packing. It will be seen that the change of dry bulb temp. is smaller than the change of wet bulb temp. & that at air outlet there is little difference betⁿ wet & dry bulb temp. This indicates that the air leaving is almost saturated, i.e. Relative humidity - 100%. This increase in the moisture content of the air is due to the conversion of water into steam & the "latent heat" for this accounts for most of the cooling effect. If the cooling load is now switched off & the unit allowed to stabilise, it will be found that the water will leave the basin close to the wet bulb temp. of air entering. According to the local atmospheric condition, this can be several degrees below the incoming air (dry bulb temp.). With no load, the water would be cooled to the incoming wet bulb temp. but

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this condition can not be attained since the pump transfers about 100 W to the water.

→ Flow through the column may be observed through the transparent casing.

Specification -

Base unit - All components are mounted on a robust GFR base plate with integral instrument panel. components

- include;
- i) Air distribute chamber.
 - ii) A tank with heaters to stimulate cooling loads of 0.5, 1.0 and 1.5 KW.
 - iii) A make-up tank with gauge mark & float operated control valve.
 - iv) A centrifugal fan with intake damper to give 0.06 kg/s max air flow.
 - v) A bronze & stainless ^{steel} glandless pump.
 - vi) A water collecting basin.
 - vii) An electrical control panel.

Conclusion -

From the above experiment we successfully studied about the cooling tower.

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Aim of Experiment:-

To study about the Lancashire boiler.

Apparatus:-

model of Lancashire boiler

Theory:- Lancashire boiler consist of a cylindrical shell inside which two large tube are placed. The shell is constructed with several rings of cylindrical form & it is placed horizontally over a brick work which forms several channels for the flow of hot gases. These two tubes are also connected with several rings of cylindrical form. They pass from one end of the shell to other end all covered with water. The furnace is placed at the front end of the each tube & they are known as furnace tubes. The coal is introduced through the fire hole into the grate. There is a low brick work fire bridge at the back of the grate to prevent the entry of burning coal & ashes into interior of the furnace tubes. The combustions from the grate pass up to the back end of the furnace tube & then in downward direction. There after they move through the bottom channel or bottom flue upto the front end of the boiler where they are divided & pass upto the side flues. It is commonly used in sugar mills & textiles industries where along with the power steam & steam for the process work is also needed.

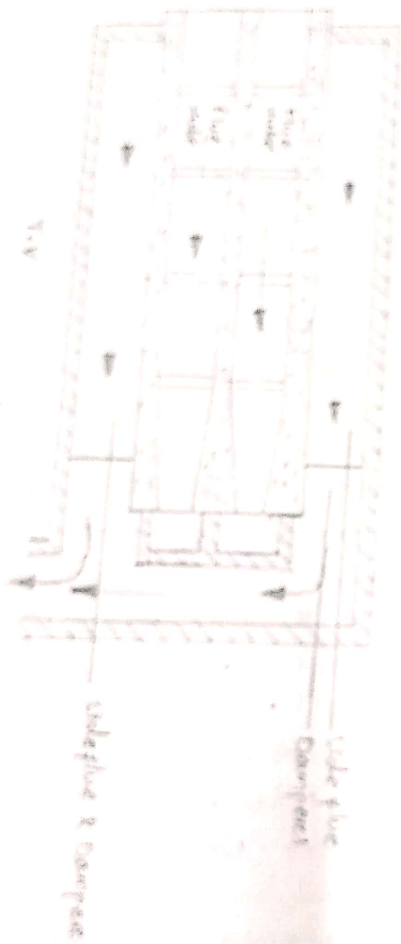
Specification - It is a stationary fire tube, internally fired, horizontal, natural circulation boiler.

- i) Diameter of shell - 2 to 3 m.
- ii) length of shell - 7 to 9 m.
- iii) Max^m working pressure - 16 bar
- iv) steam capacity - 9000 kg/h
- v) efficiency - 50 to 70%.

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GOVERNMENT POLYTECHNIC, BALANGIR



Exhausting Fan



Aim of experiment :

To study about vertical water tube boiler.

Theory :-

A simple vertical boiler produces steam at low pressure in small quantities. It is, therefore, used for low power generation or at place is limited. The construction of this type of boiler is shown include.

Ash pit :- The purpose of ash pit is to collect fuel ash after burning the fuel.

Grate :- The grate usually consists of cast iron bars which are spaced aside so that the air (required for combustion) can pass through them. It is a platform, in the combustion chamber, upon which the fuel is burnt.

Feed check valve :- The purpose of feed check valve is to regulate the flow of water from the feed pump. The firehole is hole provided at the air near end of the boiler. The solid fuel is inserted and burned into the furnace through this hole.

Fire box :- The fire box is a type of box in this burning of the solid fuel takes place.

Handhole :- The handhole is provided in the shell opposite the end of each cross tube for cleaning the cross tube.

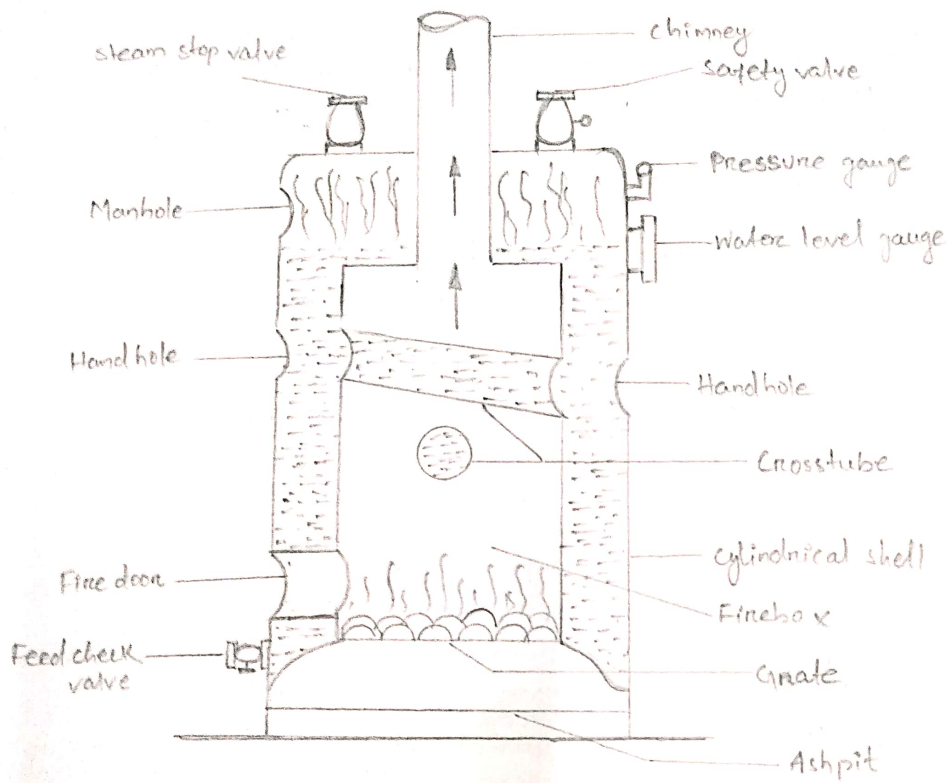
Fusible plug :- The function of fusible plug is to put off in the furnace of the boiler when the water level falls down on unsafe level and thus avoid the explosion which may take place due to overheating of the tubes & the shell.

→ The function of steam stop valve is to regulate the flow of steam from within the boiler and stop it completely when required.

Safety valve :- The safety valve is an important type instrument which prevents the boiler pressure from rising above its normal working pressure by automatically opening when the boiler pressure exceeds the normal working pressure. Thus allowing excess steam to escape into the atmosphere until the pressure comes down to its normal value.

Chimney :- The chimney is located on the top of the boiler. It is employed to throw the exhaust smoke & gases to the environment.

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Simple vertical Boiler



Working of simple vertical boiler :-

It consist of a cylinder shell surrounding a nearly cylindrical rebox. The firebox is slightly tapered towards the top to allow the ready passage of steam to the surface. At the bottom of the rebox, is a grate. The rebox is provided with two or more inclined cross tube F, F.

The inclination of the cross tube is provided to improve the heating surface as well as to increase the circulation of water. An uptake tube passes from the top of the firebox to chimney. The hand hole is fitted opposite to the end of each water tubes for cleaning the depositions.

A manhole is located at the top portion of the boiler for a man to enter and to clean the boiler. A mudhole is provided at the bottom of the shell to remove the mud that settles down. The space betⁿ the boiler shell and firebox is filled with water to be heated.

Advantages of vertical boiler :-

- 1) The initial cost is low because of fewer parts.
- 2) Maintenance cost is low.
- 3) Work is simple.
- 4) It is easy to install & replace.
- 5) These type of boilers have water level tolerance.

Disadvantages of vertical boilers :-

- 1) The vertical design of this boiler limits its work in many place.
- 2) Steam production is limited because of the limited grate area.
- 3) The impurities settle at the bottom & thus prevents the water from heating up.

Conclusion :-

From the above experiment we successfully studied about vertical tube boiler

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GOVERNMENT POLYTECHNIC, BALANGIR



Aim of the Experiment:

To study about the Babcock and Wilcox boiler.

Apparatus: Model of Babcock and Wilcox boiler.

Theory: Babcock and Wilcox boiler is a horizontal shell, water tube, multitubular, externally fired, natural circulation boiler.

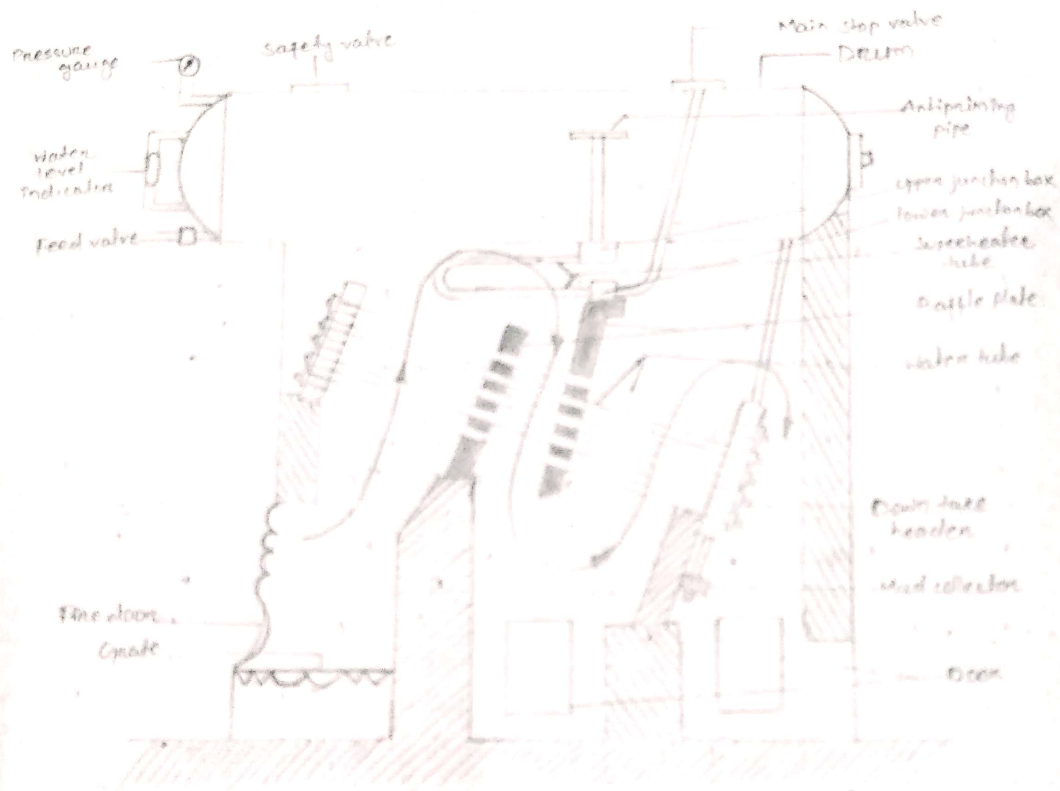
Construction:-

A Babcock & Wilcox water tube boiler is consist of a drum, mounted at the top and connected by upper header & down take header. A large number of water tubes connect uptake & down take header. The water tubes are inclined at an angle of $5-15^\circ$ to promote water circulation. The heating surface of the unit is the outer surface of the tube & half of cylindrical surface of the water drum which is exposed to flue gases.

Below the uptake header the furnace of the boiler is arranged. The coal is fed to the chain grate stoker through the fire door. There is a bridge wall deflector which deflect the combustion gases upward. Baffles are arranged across the water tube to act as deflectors for the flue gases and to provide them with gas pass. Here 2 baffle are arranged which provide 3 passes of flue gas. A chimney is provided for exit of the gases. A damper is placed at the inlet of the chimney to regulate the draught. There are superheating tubes for producing superheated steam. connections are provided for other mounting & accessories.

Working: The hot combustion gases produced by burning of fuel on the grate rise upwards & are deflected by the bridge wall deflector to pass over the front portion of water tubes & drum. By this way they complete the first pass. With the provision of baffles they are deflected downwards and complete the second pass. Again, with the provision of baffles they rise upwards & complete the third pass & finally come out through the chimney. During their travel they give heat to water and steam is formed. The flow path of the combustion gases is shown by arrows outside the tube.

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Babcock and Wilcox boiler



The circulation of water in the boiler is due to natural circulation set-up by convective current (due to gravity). Feed water is supplied by a feed check valve.

The hottest water & steam rise from the tubes to the uptake header and then through the riser it enters the boiler drum. The steam vapour escape through the upper half of the drum. The cold water flow from the drum to the rear header and thus the cycle is completed. To get the super heated steam, the steam accumulator in the steam space is allowed to enter into the super heater tubes which are placed above the water tubes. The flue gases pass through the flue tubes produce super heated steam. The steam thus super heated is finally supplied to user through a steam stop valve.

Boiler mounting:-

The mounting includes the component which are fitted on the surface of the boiler for complete safety and control of steam generation process are known as boiler mounting. The following are the various important mounting of a boiler.

Steam stop valve :- A valve placed directly on a boiler & connected to the steam pipe which carries steam to the engine or turbine or is called stop valve or junction valve. It is the largest valve of the steam boiler. It is usually, fitted to the highest point of the shell by means of a flange.

The principle of a steam stop valve;

- 1) To control the flow of steam from the boiler to main steam pipe.
- 2) To shut off the steam completely when required.

The body of stop valve is made of cast iron or cast steel. The valve seat and the nut through which valve spindle work, are made of brass or gun metal.

CONCLUSION :

From the above we successfully studied the details about Babcock & Wilcox boiler.

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GOVERNMENT POLYTECHNIC, BALANGIR



Aim of Experiment :-

To study of De-lavel turbine.

Theory :- Steam turbine:-

The steam turbine is a prime mover in which the potential energy of steam is transformed into kinetic energy and latter in its turns is transformed into the mechanical energy of rotation of the turbine shaft.

Types of steam turbine with respect to action of steam.

1) Impulse turbine

2) Reaction turbine

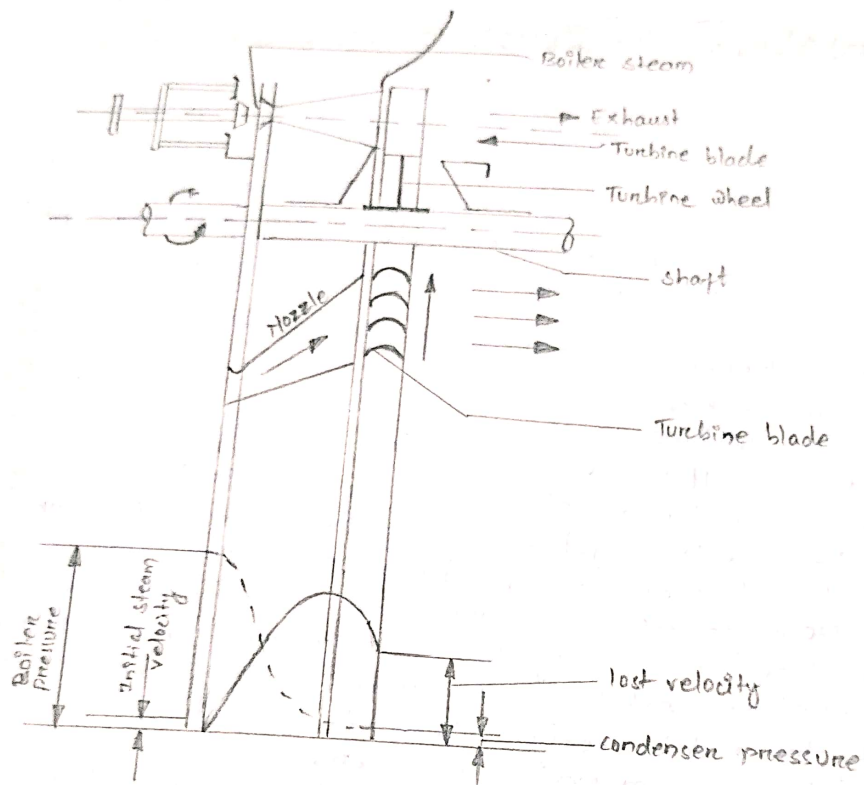
1) Impulse turbine:- It is a turbine, which run by the impulse of steam jet. In this turbine, the steam is first made to flow through a nozzle. Then the steam jet impinges on the turbine blade with are curved like bucket and are mounted on the circumference of wheel. The steam jet after impinges glide over the concave surface of blades, and finally leave the turbine. The top portion of impulse turbine exhibits a longitudinal section through the upper half, the middle portion shows the one set of nozzle which is followed by ring of moving blades, while lower part indicate changes in press & velocity during the flow of steam through the turbine. The principle equation of the turbine is the well known "De-lavel" turbine.

2) Reaction turbine :- In a reaction turbine, the steam enters the wheel under pressure and flow over the blade, The steam while gliding proper the blade and then makes them to move. The turbine runner is rotate by the reactive forces of steam jet. In this, there is a gradual pressure drop take place continuously over the fixed and moving blades, The fuel of fixed blades is that they after allow it expand to a larger velocity as the steam passes over the moving blades. Its K.E is absorbed by them a three stage.

Introduction :-

The steam turbines are widely used as a prime mover in power plants, refineries, petrochemical industries, food processing industries.

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Simple impulse turbine



Steam turbine operation principle

The impulse turbine consist of a casing containing stationary steam nozzle and a rotor with moving or rotating buckets. When the steam passes through the stationary nozzles and its direct towards rotor bucket with high velocity. There by rotor bucket start to rotate at high speed.

Event takes place in the nozzle :-
The following are the event takes place

- > The steam pressure decrease.
- > The enthalpy of steam decrease
- > The steam velocity increase
- > The volume of steam increase.

In nozzle, the pressure energy of the steam converted into K.E. They are two type of nozzle used in the steam turbine.

- i.e - convergent nozzle
- convergent - divergent nozzle

● Principle of impulse turbine :-

The steam at high pressure enters through a stationary nozzle of a steam turbine, as a result, the pressure of the steam decrease with an increase in steam velocity. As a result of increase steam velocity steam pass through the nozzle in the form of a high-speed jet. The high-velocity steam hit the properly shaped turbine blade, as a result, the steam flow direction changed. The effect of this change in direction of the steam flow will produce an impulse force. This force causes the blade to move, thereby the rotor will start to rotate. As per Newton's 2nd Law of motion (change of momentum). The change of direction of steam flow in the blade produces the impulse force, this force tends to rotate the turbine rotor. Hence it is called "Impulse turbine".

● Working of impulse turbine :- In an impulse turbine, the steam pressure drops & the velocity increase as the steam passes through nozzle. When the steam passes through moving blade the velocity drops but remaining pressure is same. The fact that the pressure does not drop across the moving blades, hence the pressure at the inlet of moving blade equal the pressure at the out let of moving blades.

● Conclusion :-

From the above we studied about the De-laval turbine

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GOVERNMENT POLYTECHNIC, BALANGIR



Aim of experiment:

To study about jet condenser.

Theory: It is a device or an appliance in which steam condenses and heat released by steam is absorbed by water.

Classification of condenser

- 1) Jet condenser
- 2) Surface condenser.

Jet condenser :- The exhaust steam and water come in direct contact with each other and temp. of the condensate is the same as that of cooling water leaving the condenser. The cooling water is usually sprayed into the exhaust steam to cause, rapid condensation.

Surface condenser :- The exhaust steam and water do not come into direct contact. The steam pass over the outer surface of tubes through which a supply of cooling water is maintain.

Jet condenser also 3 type

- 1) Parallel flow type
- 2) Counter flow - type
- 3) Ejector flow-type

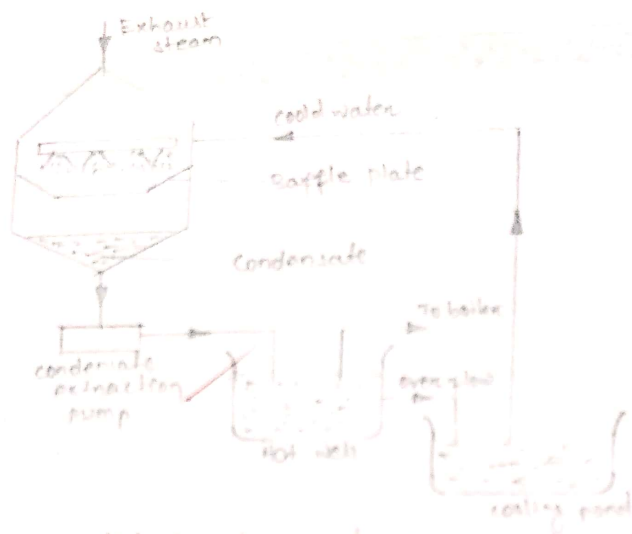
1) Parallel flow type jet condenser :- The exhaust steam & water find their entry at the top of the condenser & then flow downwards and condensate & water are finally collected at the bottom.

2) Counter flow type jet condenser :- The steam & cooling water enter the condenser from opposite direction. Generally, the exhaust steam travels in upward direction & meets the cooling water which flow downwards.

Low level Jet condenser (counter-flow type) :-

The steam moving upwards comes in contact with water & gets condensed. The condensate & water mixture is sent to the hot well by means of an extraction pump & the air is removed by an air suction pump provided at the top of the condenser.

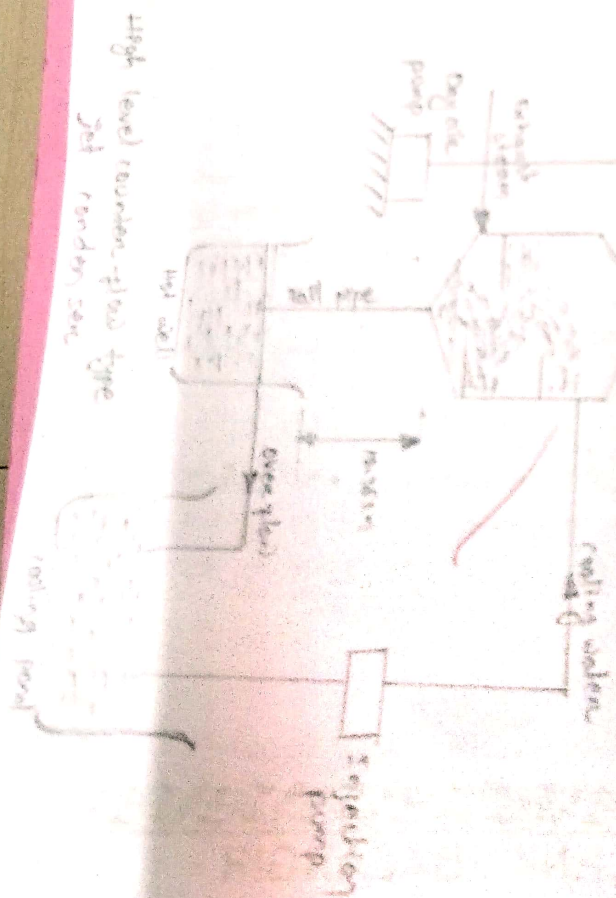
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Parallel flow type condenser



Low level counter flow type jet condenser



High level counter flow type jet condenser



High level jet condenser (counter-flow type) :
It is also called barometric condenser. In this type the shell is placed at a height about 10.363 m. above hot well and thus the necessity of providing an extraction pump can be obviated. However provision of own injection pump has to be made if water under pressure is not available.

Ejector type jet condenser : Here the exhaust steam & cooling water mix in hollow truncated cones. Due to this decreased pressure exhaust steam along with associated air is drawn through the truncated & finally lead to diverging cone. In the diverging cone, a portion of kinetic energy gets converted into pressure energy which is more than the atmospheric so that condensate consisting of condensed steam, cooling water & air is discharged into hot well. The exhaust steam inlet is provided with a non-return valve which does not allow the water from hot well to rush back to the engine in case a failure of cooling water supply to condenser.

Conclusion :

From the above experiment we successfully studied the jet condenser.

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GOVERNMENT POLYTECHNIC, BALANGIR



AIM OF EXPERIMENT:-

To study about various efficiency of steam turbine.

Theory:-

1. Blade or diagram efficiency (η_b):- It is the ratio of work done on the blade per second to the energy entering the blade per second.

2. Stage efficiency (η_{stage}):- The stage efficiency covers all the losses in the nozzles, blades, diaphragms and disc that are associated with that stage.

Net workdone on shaft per stage

$$\eta_{stage} = \frac{\text{Per kg of steam flowing}}{\text{Adiabatic heat drop per stage}}$$

Net workdone on blades

$$\eta_b = \frac{\text{Disc friction \& windage}}{\text{Adiabatic heat drop per stage}}$$

3. Internal efficiency ($\eta_{internal}$):- This is equivalent to the stage efficiency when applied to whole turbine, & is defined as

$$= \frac{\text{Heat converted into useful work}}{\text{Total adiabatic heat drop}}$$

4. Overall or turbine efficiency ($\eta_{overall}$):- This efficiency covers internal & external losses: For exp. bearings and steam friction, leakage, radiation etc.

work delivered at the turbine coupling

$$\eta_{overall} = \frac{\text{In heat units per kg of steam}}{\text{Total adiabatic heat drop}}$$

5. Net efficiency or efficiency ratio (η_{net}):- It is the ratio of Brake thermal efficiency Thermal efficiency on the Rankine cycle

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Also the actual thermal efficiency

$$= \frac{\text{Heat converted into useful work per kg of steam}}{\text{Total heat in steam at stop valve - water heat in exhaust}}$$

Rankine efficiency

$$= \frac{\text{Adiabatic heat drop}}{\text{Total heat in steam at stop valve - water heat in exhaust}}$$

$$\eta_{\text{net}} = \frac{\text{Heat converted into useful work}}{\text{Total adiabatic heat drop}}$$

Hence $\eta_{\text{net}} = \eta_{\text{overall}}$

Conclusion :-

From the above experiment we successfully studied about the various types of efficiency of steam turbine.

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GOVERNMENT POLYTECHNIC, BALANGIR



AIM OF EXPERIMENT :-

To study the spring loaded safety valves.

THEORY :-

Pressure relief valve (PRV) is a term used to describe a category of valves designed for use in overpressure protection application. You may have heard a lot of different terms for PRVs; Safety valve (SV), relief valve (RV), safety relief valve (SRV) or pilot-operated safety relief valve (PSRV). They all operate similarly but are not exactly same, depending on who you talk to and the level of pressure relief valve knowledge one has. Like any other type of equipment, whenever you look from the outside in everything seems to be same. If you start to dig a little bit deeper into the details, you will discover the differences. So, let's get right into the details. First we will cover some term & definition & then we will get into the details of how a spring-loaded safety relief valve operates.

Pressure relief valve :-

A device designed to open and relieve excess pressure, then close & prevent the further flow of fluid after normal condition have been restored.

Relief valve :-

A spring-loaded pressure relief valve actuated by the static pressure upstream of the valve. A relief valve is used primarily with incompressible fluids.

Safety relief valve :-

A spring-loaded pressure relief valve that may be used as either a safety or relief valve, depending on the application.

Pilot-operated safety relief valve :-

A pressure valve in which the major relieving device or main valve is combined with & controlled by a self-actuating auxiliary pressure relief valve called a pilot valve.

Safety valve :-

A spring-loaded pressure relief valve actuated by the static pressure upstream of the valve and characterized by rapid

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opening or pop action. A safety valve is normally used on compressible fluid, primarily steam.

Features :-

Adjusting ring - The adjusting ring in a safety relief valve is set to predetermined positions before the valve is put into service. presetting makes it less necessary to pop the valve in service to ascertain that the ring has been set properly to achieve the necessary lift & relieving capacity.

Conclusion :-

From the above experiment we know about the spring loaded safety relief valve.

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