

E-CONTENTS OF HYDRAULICS AND PNEUMATICS

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DESIGNATION : LECTURER (MECH. ENGG.)

**SUBJECT : HYDRAULICS AND
PNEUMATICS**

BRANCH : MECH. ENGG.

SEMESTER : 4TH (2ND YEAR)

CHAPTER-1

1.1 FLUID:-A fluid may be define as a substance which is capable of flowing and offer partically no resistance to the change of shape.

1.2 TYPES OF FLUID:-

- 1- Ideal fluids –The fluids which are in compressible and have no viscosity and surface tension.
- 2- Real fluids- The fluids which possess properties such as viscosity and surface tension.

1.3 PROPERTIES OF FLUIDS:-

- (a) Mass density-Mass density of fluid may be defined as mass of fluid per unit volume. It is denoted by (ρ).
- (b) Specific weight-Specific gravity of fluid may be defined as the ratio of specific weight of fluid to the specific weight of standard fluid at a standard temperature.
- (c) Specific volume-Specific volume of a fluid may be defined as the volume occupied by he fluid per unit mass.
- (d) Viscosity-Viscosity is the property of the fluid by virtue of which it offer resistance to the movement of one layer of fluid over an another layer of fluid.
- (e) Vapour pressure-Vapour presssure of liquid is partial pressure exerted on its surface by vapours of the same liquid which gather's into the container containg the liquid above the surface of the liquid due to evaporation.
- (f) Cohesion- It is the property of liquid by virtue of which it can withstand slight tension
- (g) Adhesion-Adhesion is the property of liquid by virtue of which it adheres to the solid body which it is in contact.
- (h) Surface tension-The property of liquid by virtue of which the free surface of liquid acts as a stretched elastic membrane capable of bearing a slight amount of tension.
- (i) Capillarity-Capillarity is the phenomenon by which rise up or falls down in a thin glass tube in comparison to the general liquid level in the vessel, when a glass tube is dipped into a mass of a liquid.
- (j) Compressibility-Compressibility of liquid may be defined as the property by virtue of which the fluid undergoes a change in volume under the action of external pressure

Chapter- 2 (PRESSURE AND ITS MEASUREMENT)

2.1 PRESSURE OF A LIQUID – When a liquid is contained in a vessel, it exerts force on the sides and bottom of the vessel due to its weight. The force is known as pressure of the liquid.

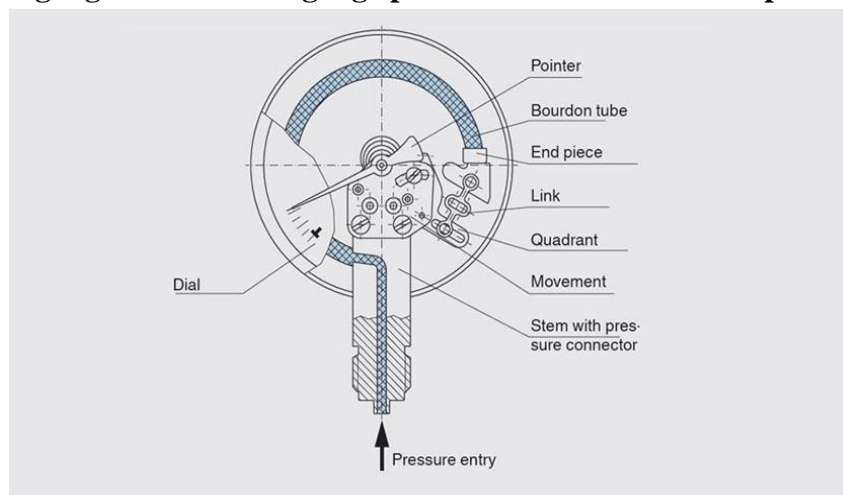
2.2 INTENSITY OF PRESSURE – The pressure exerted by the liquid per unit area is called Intensity Of pressure. The SI unit of Intensity Of Pressure is N/m^2 .

2.3 MECHANICAL GAUGES – The pressure measuring device which embody an element which deflects under the action of applied pressure are called mechanical gauge.

IMPORTANT TYPES OF MECHANICAL GAUGES

1. Bourdon's tube pressure gauge,
2. Dead weight pressure gauge,
3. Diaphragm pressure gauge,
4. Bellow's pressure gauge

2.4 BOURDON'S TUBE PRESSURE GAUGE- A Bourdon's tube pressure gauge can measure gauge pressure as well as vacuum pressure.



2.5 DEAD WEIGHT PRESSURE GAUGE- The water pressure move the piston in the plunger upward.

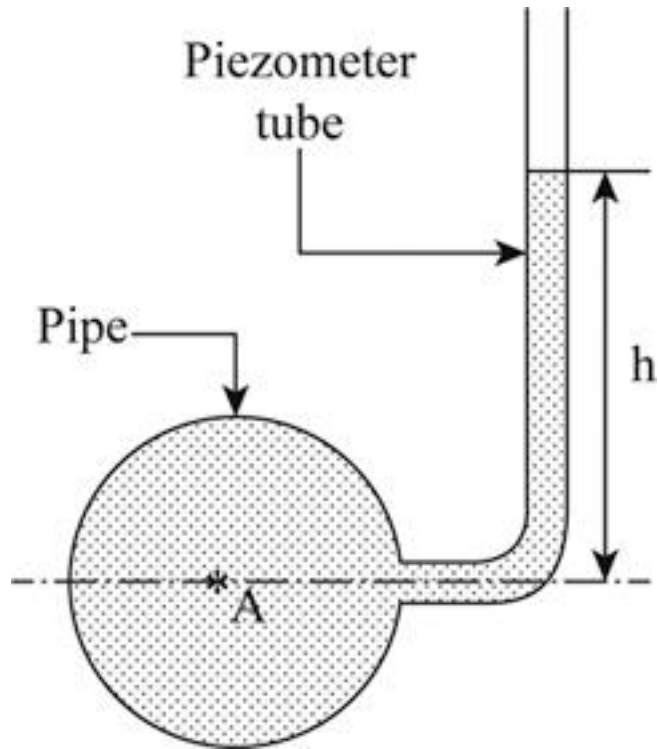
The pressure gauge is the most accurate pressure gauge and is generally used for calibrating other gauges.

2.6 Diaphragm pressure gauge- Diaphragm pressure gauge is quite similar to bourdon's tube pressure gauge with the difference that in diaphragm pressure gauge, a corrugated diaphragm is used in place of bourdon tube.

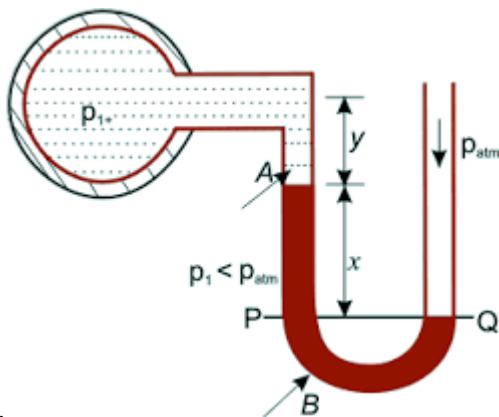
2.7 PASCAL'S LAW- Pascal's law is also known as law of transmissibility of liquid pressure. This law states that the liquid at rest transmits pressure with equal intensity in all the directions and the direction of liquid pressure is always perpendicular to the surface on which it acts.

2.8 GAUGE PRESSURE – In fluid mechanics the pressure of liquid is measured by the instruments known as gauges. The pressure measured with the help of these gauges is always above atmospheric pressure and is called gauge pressure.

2.9 PEIZOMETER -Peizometer is a simplest form of manometer which is used to measure gauge pressure



7. U- TUBE MANOMETER- A consists of glass tube bent in U shape, one end of which is conncted to a point where pressure is to be measured and other end remains the



atmospheric.

CHAPTER– 3 (FLOW OF FLUIDS)

3.1 TYPES OF HYDRAULIC ENERGIES

(A)PONTENTIAL ENERGY OR ELEVATION ENERGY- The energy possessed by a liquid body by virtue of its position above arbitrary datum is called potential energy.

(B)KINETIC ENERGY- The energy possessed by a liquid body by virtue of its motion or velocity is called kinetic energy.

(C)PRESSURE ENERGY- The energy possessed by a liquid body by virtue of its existing pressure is called pressure energy.

3.2 BERNOULLI'S THEOREM – The theorem state that is a continuous stream of flowing mass of liquid, the total energy at any section of flow remains constants provided that there is no addition or subtraction of energy at any point.

3.3 VENTURIMETER- It is a device is used to measure the rate of flow or discharge of a liquid flowing throw a pipe.

It consists of three parts :

- 1 .A short converging part
- 2.Throat
3. Diverging part

3.4.PITOT TUBE- A pitot tube is a device used to determine the velocity of the flow at any point in a pipe or channel.

3.5.ORIFICE METER – Orifice meter is a device used to measure discharge through a pipe .It work on the same principle as that of venturimeter.

3.6.TYPES OF FLOW –

- (1)Steady and unsteady flow
- (2)Uniform and non-uniform flow
- (3)Laminar and turbulent flow

CHAPTER– 4 (FLOW THROUGH PIPES)

4.1 INTRODUCTION – A pipe is a closed conduit of circular cross-section carrying fluid under pressure. When the liquid completely fills the pipe and there is no free surface of liquid i.e. flow is under pressure, the flow in pipe is termed as pipe flow.

4.2 CRITICAL VELOCITY - The velocity at which the flow changes from laminar to turbulent is called critical velocity. There are two types

(1) LOWER CRITICAL VELOCITY- The velocity at which the flow enters from laminar flow to transition period is known as lower critical velocity.

(2) UPPER CRITICAL VELOCITY- The velocity at which the flow enters from transition period to turbulent flow is upper critical velocity.

4.3 MINOR HEAD LOSSES- Losses of head other than loss of head due to friction are called minor head losses. The minor head losses are very small as compared to loss of head due to friction.

4.4 HYDRAULIC GRADIENT LINE -The line obtained by joining the tops of all the vertical ordinates showing the pressure head of a flowing liquid in a pipe from the center of pipe is called Hydraulic Gradient Line.

4.5 TOTAL ENERGY LINE - The line obtained by joining the tops of all the vertical ordinates showing sum of pressure head and kinetic head of a flowing liquid in a pipe from the center of pipe called Total Energy Line.

4.6 NOZZLE - Nozzle converts the pressure head of liquid into velocity head. Thus nozzle used where high velocity of flow is required.

4.7 WATER HAMMER- This causes a wave of high pressure to be transmitted along the pipe with a velocity to the velocity of sound wave which creates noise known as knocking. Also this wave of high pressure has the effect of hammering action on the walls of the pipe known as Water Hammer.

4.8 PIPE- A pipe is closed conduit of circular cross-section carrying fluid under pressure.

CHAPTER-5 (HYDRAULIC MACHINES)

5.1 HYDRAULIC PRESS – Hydraulic press is the partial application of Pascal's Law. It is a device which is used to lift very heavy weight by the application of much smaller force.

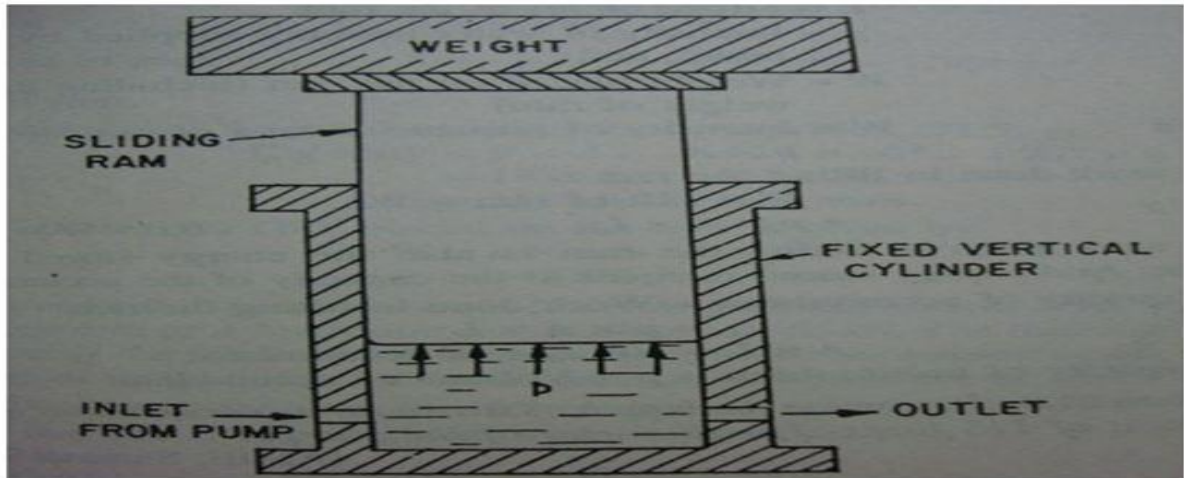


5.2 HYDRAULIC JACK- A hydraulic jack is a device which is used to lift very heavy load by the application of much smaller force applied by hand.



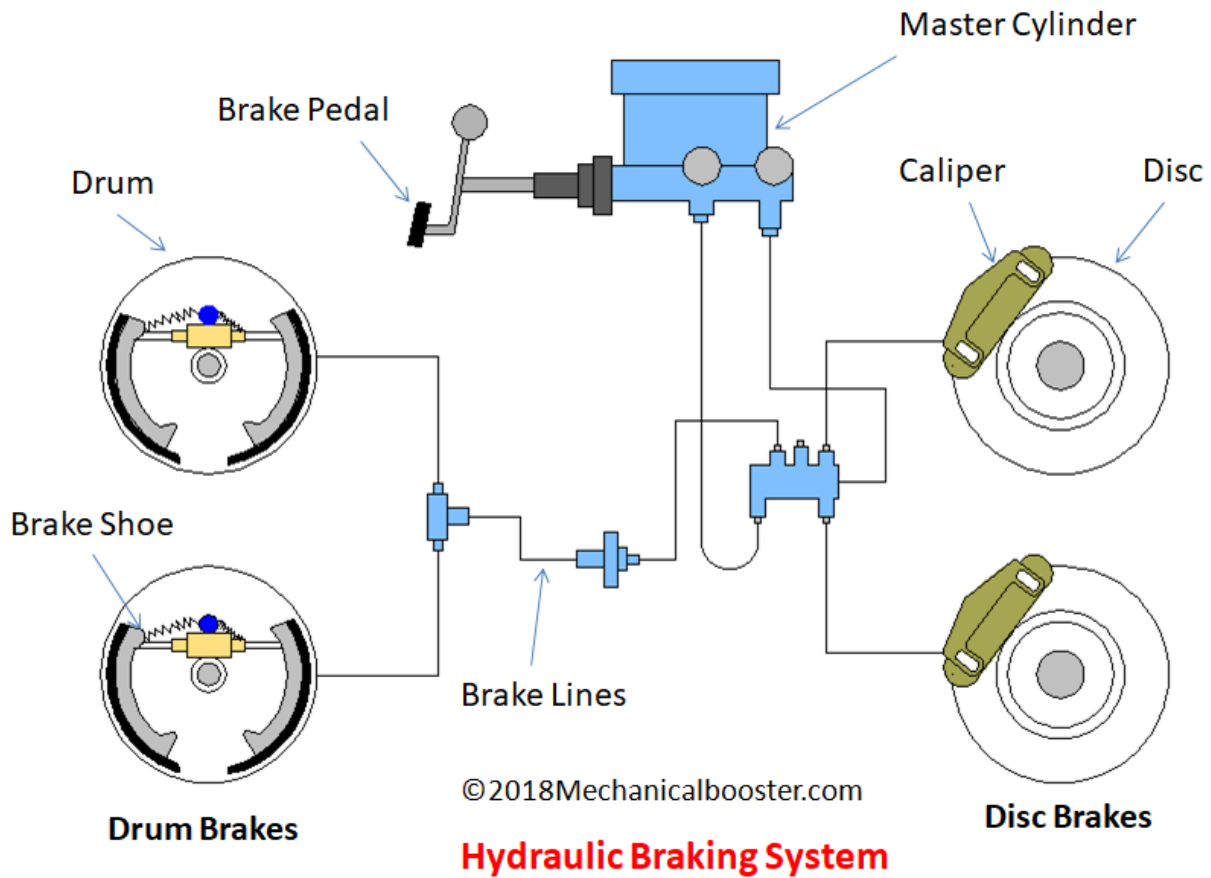
5.3 HYDRAULIC ACCUMULATOR- It is device used for storing the energy of a liquid in the form of pressure energy which may be supplied for any sudden or intermittent requirement.

Hydraulic Accumulator

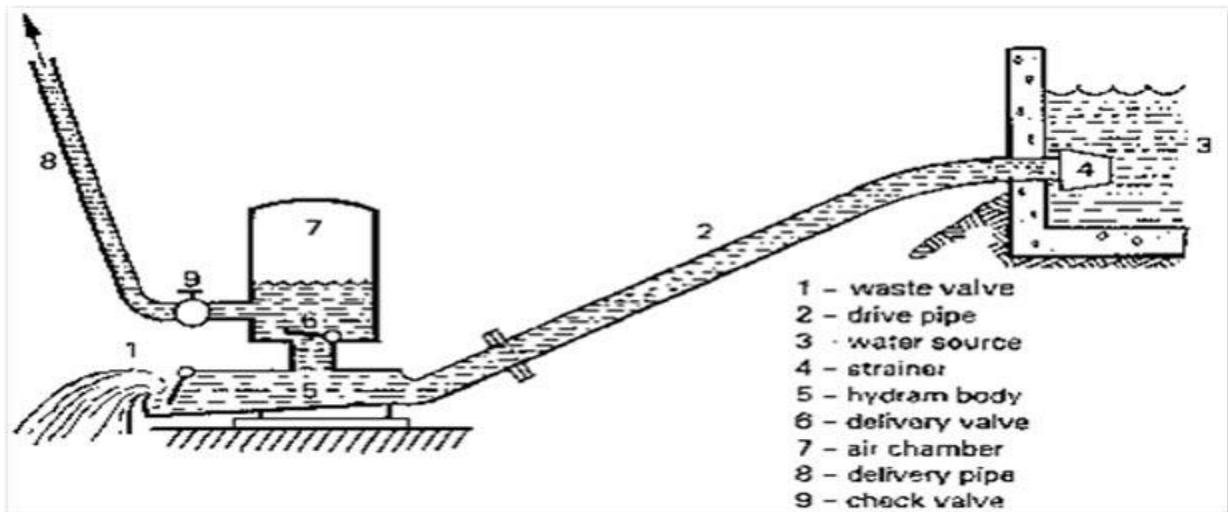


5.4 HYDRAULIC BRAKE- Hydraulic brake system is provided in automobile to stop them or to reduce their speed when required. Hydraulic brake system works on the principle of

Pascal's Law.



5.5 HYDRAULIC RAM- A Hydraulic Ram is a pump which lift a small quantity of water to a greater from a large quantity of water at a small high. It work on the principle of Water Hammer.



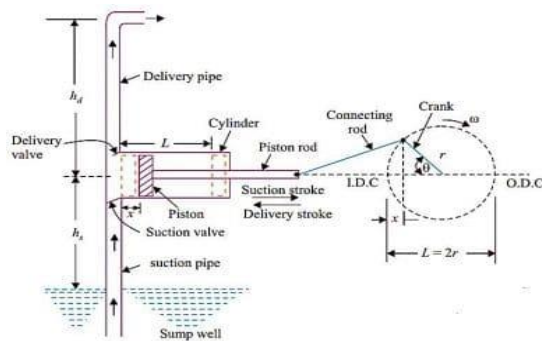
5.6 HYDRAULIC DOOR CLOSER – A Hydraulic Closer is a Hydraulic device which closes the door automatically after it is open and released.



CHAPTER – 6 (PUMPS AND WATER TURBINES)

6.1. THE HYDRAULIC PUMP- The Hydraulic Machine which convert mechanical energy into hydraulic energy is called hydraulic pump.

6.2. RECIPROCATING PUMP- Reciprocating pump is a positive displacement pump as its such and lift the liquid by actually displacing it with the help of piston reciprocating in a closely fitted cylinder.

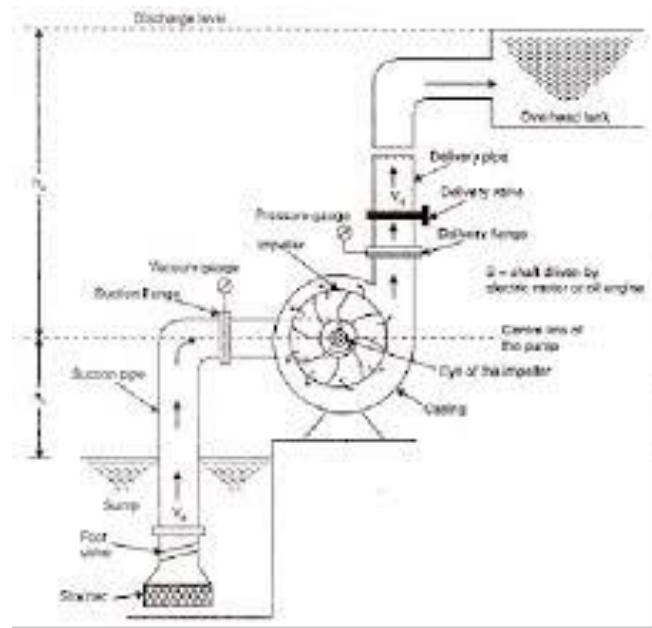


6.3-ROTARY PUMPS- These are the positive displacement pumps with rotary motion. These can pump thick viscous liquid as well as light liquids.

These are following types

1. Vane Pumps
2. Screw Pumps
3. Gear Pumps

6.4. CENTRIFUGAL PUMP- The hydraulic machine which convert mechanical energy into pressure energy by mean of centrifugal force acting on the liquid is called centrifugal pump. The centrifugal pump work on the principle of forced vortex flow which means that when a certain mass of liquid is rotated by an external torque, the pressure head of rotating liquid rises.



6.5-PITTING:-The erosion of pump material on the inside surface due to repeated hammering action caused by collapsing vapour bubbles at high pressure region is called Pitting.

6.6-CAVITATION:-The phenomenon of formation of vapour bubbles in a flowing liquid in the region where the pressure of liquid falls below its vapour pressure and then sudden collapsing of these vapour bubbles in the region of high pressure is called Cavitation.

6.7-TURBINE:-A turbine is a hydraulic machine which converts the hydraulic energy into mechanical energy.

6.8-PRIMING:-The operation of filling the suction pipe, casing and a portion of delivery pipe of the centrifugal pump from outside source with the liquid to be lifted by the pump before starting the pump is called Priming of centrifugal pump.