Subject :- H & P
Class - Diploma (4th sem) - Mechanical Engg.

Hydraulic Machines

((4).

Description, operation and application of -
Hydraulic press, hydraulic jack, hydraulic accumulator, hydraulic brake, hydralic ram, hydralic door closer.

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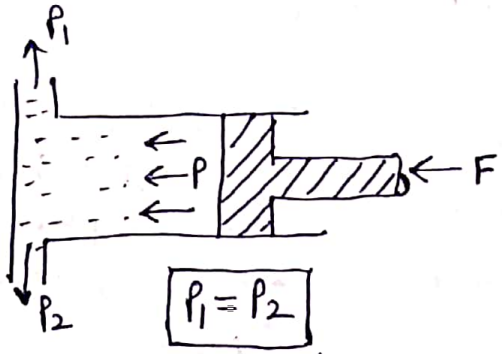
*Hydratic machines :- the machines in which power is transmitted with help of fluid (Water, oil, gas) under pressure.

-these machines are based on principles of fluid statics and fluid kinematics. eg. hydralic press, hydraulic jack hydraulic brakes etc.

* Operation :- Hydraulic machine like pneumatic system are based on pascal's law.

* Pascal's law :- "It states that any pressure applied to a fluid inside a closed system will transmit that pressure equally everywhere and in all direction".



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* Application of hydraulic machines :-

1. Hydraulic lift
2. Hydraulic Brakes
3. Air lift Pump
4. Hydraulic Crane
5. Gear wheel, Pump
6. Hydraulic Coupling etc.

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1. Hydraulic Press

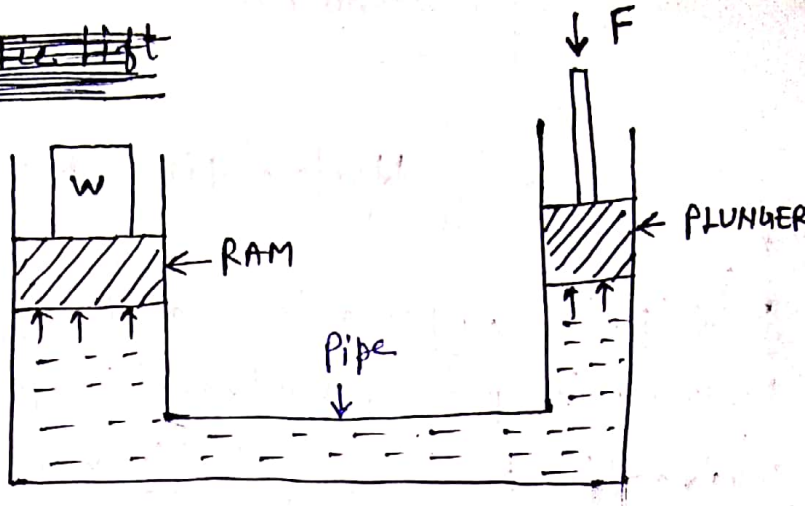


fig- (Hydraulic Press)

Hydraulic Press is a device used for lifting heavy weights by application of a much smaller force.

Principle :- Pascal's law

"The intensity of pressure in static fluid is transmitted equally in all directions".

Working :- Hydraulic Press consist two cylinder. one of the cylinder is of larger diameter contains ram while other cylinder of smaller diameter and contains a plunger as shown in figure. Both cylinder connected through pipe, contain a liquid through which pressure is applied.

when small force F is applied on plunger in downward direction, a pressure is produced on the liquid in contact with plunger. This pressure is transmitted equally in all direction and act on ram in upward direction. the heavier weight placed on ram is then lifted up.

A = Area of of ram
a = Area of plunger

Pressure Produced by Force F

$$p = \frac{F}{a} \quad \text{——①}$$

Pressure at ram

$$p = \frac{W}{A} \quad \text{——②}$$

Acc. to Pascal's law

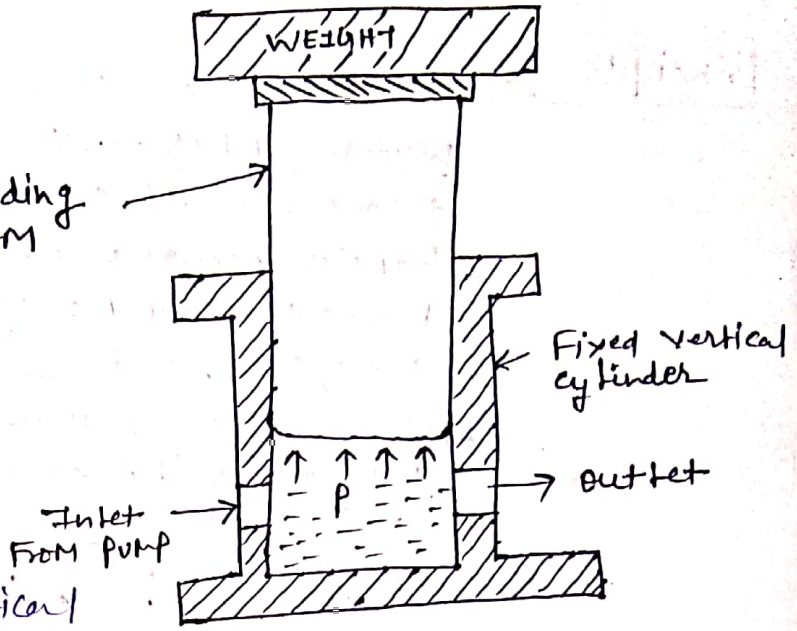
$$\frac{F}{a} = \frac{W}{A} \Rightarrow \boxed{W = \frac{F}{a} \times A}$$

mechanical advantage :- The ratio of weight lifted to force applied on the plunger is called mechanical advantage (MA).

$$\boxed{M.A = \frac{W}{F}}$$

2. Hydraulic Accumulator

A device used for storing the energy of a liquid in form of pressure energy, which may be supplied for any sudden or intermittent requirement.



Working:-

It consist of a fixed vertical cylinder containing a sliding ram. A heavy weight is placed on ram. The inlet of cylinder is connected to pump, which continuously supplies water under pressure to the cylinder. The outlet of the cylinder is connected to the machine. When ram is at lowermost position in beginning: The pump supplies water under pressure continuously. This will raise the ram on which a heavy weight is placed. When ram is at upper most position, the cylinder is full of water and accumulator has stored the maximum amount of pressure energy.

Capacity of Hydraulic accumulator

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A = Area of sliding ram
L = Stroke length
P = Water Pressure supplied by pump.
W = weight placed on ram

$W = P \times A$

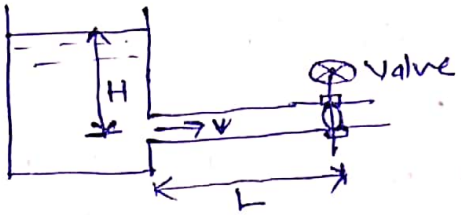
Work done in lifting the ram = $W \times L$
" = $P \times A \times L$

Capacity of accumulator = work done in lifting the ram

3. **Hydraulic RAM** :- It is a pump which raises water without any External power for its operation.

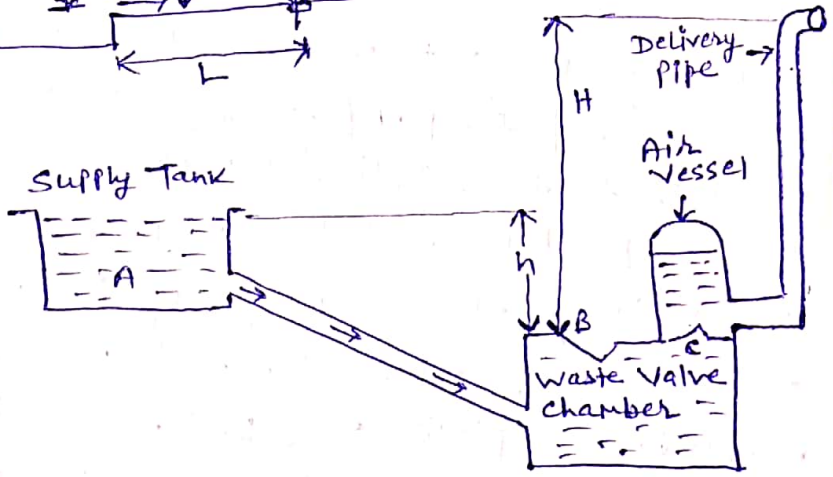
Principle :- It works on the principle of water hammer.

water hammer — It is a shock wave transmitted through fluid contained in a piping system. water hammer occurs when fluid in motion is suddenly forced to stop moving. The momentum of fluid abruptly stopping create a pressure wave. The wave of High pressure transmitted along pipe with a velocity equal to velocity of sound wave and create noise called knocking.



working

Inlet Valve fitted to Supply pipe is opened, water start flowing from supply tank to chamber which has two valve B & C i.e B = waste valve, C = delivery valve, valve C is fitted to air vessel. level of water rises in chamber and waste valve B starts moving upward. A stage comes when waste valve B suddenly closes. This sudden closure of waste valve create high pressure inside the chamber. This high pressure force open delivery valve C. The water from chamber enter the air vessel and compresses the air inside the air vessel. This compressed air exerts force on the water in air vessel and small amount of water raised to a greater height. when momentum loses, waste valve B open in downward direction & flow of water from supply tank flowing to chamber.



(Hydraulic RAM)

Energy Supply by Supply Tank to RAM = wt. of water Supply × Height of Supply water = $w \times h$

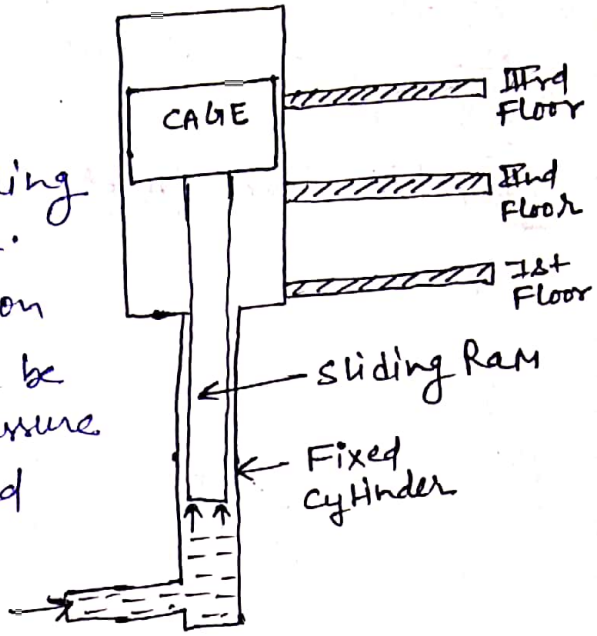
Energy delivered by RAM = wt. of water raised × Height through which raised = $w \times H$

$$\eta = \frac{w \times H}{W \times h}$$

4. Hydraulic lift – A device used for carrying Passenger or goods from one floor to another in multi-storeyed.

Principle – Pascal's law

working – It consist of a ram, sliding in fixed cylinder as shown in fig. At the top of sliding ram, a cage (on which persons may stand or goods may be placed) is fitted. The liquid under pressure flow into fixed cylinder. This liquid exerts force on the sliding ram, which moves vertically up and thus raises the cage to required height.



The cage is moved in downward direction, by removing the liquid from the fixed cylinder.

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5. Hydraulic brakes

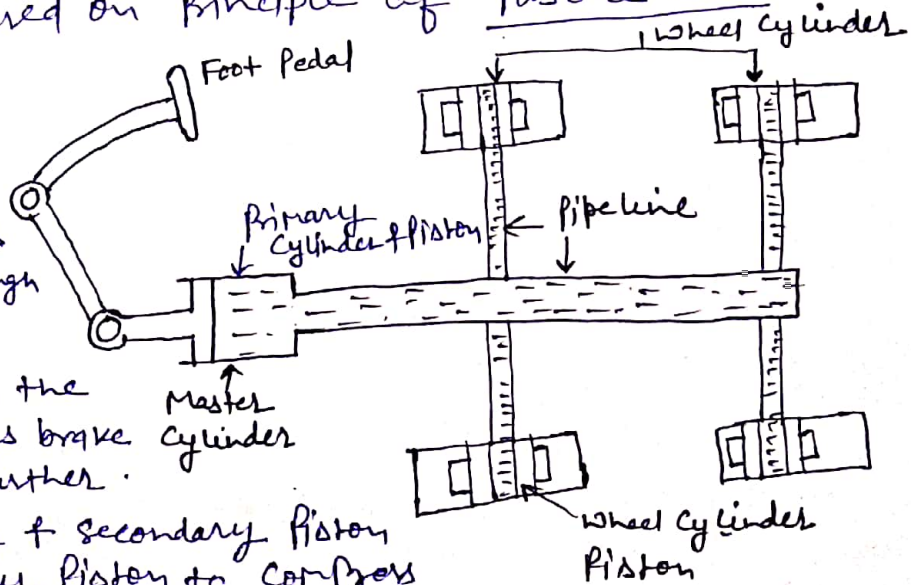
The brakes which are operated by means of hydraulic pressure are called hydralic brakes.

Principle – Based on Principle of Pascal's law

working

When we press the brake pedal, it pushes on primary piston through a linkage.

- Pressure is built in the cylinder and lines as brake pedal is depressed further.
- The pr. b/w primary & secondary piston forces the secondary piston to compress the fluid in its circuit.



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- If the brakes are operating properly, the pressure will be same in both the circuits.
- If there is a leak in one of circuits, that circuit will not be able to maintain pressure.

Hydralic door closer