An Introduction to Hoisting Machines

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Abstract: *A mechanical device or apparatus designed for lifting heavy objects or people is known as hoisting equipment. Structurally it is of diverse nature and may be classified based on the construction and application. In this work a brief introduction to these devices has been presented.*

Keywords: *Hoisting machines*

1. Introduction

Three groups of hoisting equipment's are mainly known as [1-10]:
a. Hoisting Machines: a group of periodic action devices designed as self-lifting gear for hoisting and moving loads.
b. Cranes: a combination of separate hoisting mechanism with a frame structure for lifting and/or moving loads
c. Elevating Equipment: a group of periodic action machine intended for raising loads with guide-ways

A device or apparatus designed for lifting heavy objects or people. Three groups of hoisting equipment are as follows. These equipment items help to transfer loads to cover a definite area. They are non-continuous operation so risk of beak down is high.

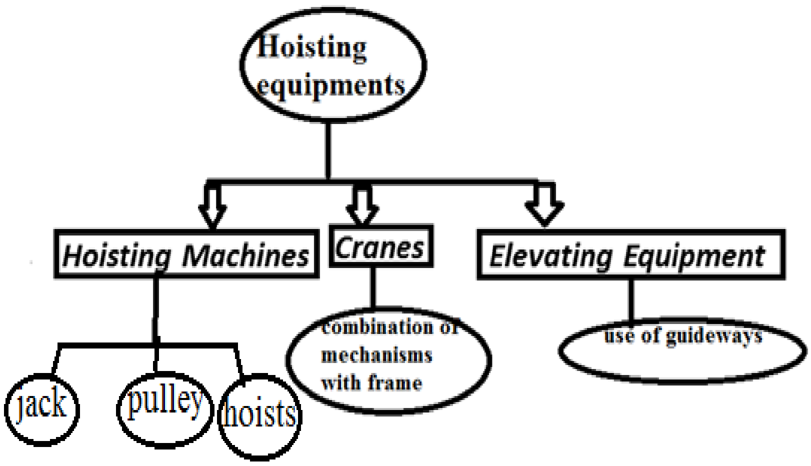

Fig. 1. Types of hoisting equipment

2. Types of hoisting Machinery [11-20]

Jacks-These are directly lifting simple devices suitable for short distance use. Jacks may be categorized as follows:

- Rack and pinion type jack
- Screw jacks
- Lever type jack
- Hydraulic action jack

A) Rack and pinion type jack-They have Significant lifting height as well as ability to operate in vertical and horizontal positions, These have Compact design, excellent ergonomics, ease of operation, High maintainability, Smooth lifting ability and ability to accurately position the load at a certain height. Rotation of handle causes pinion to rotate that in turn causes reciprocating motion of rack (on which load is placed) and hence motion of load.

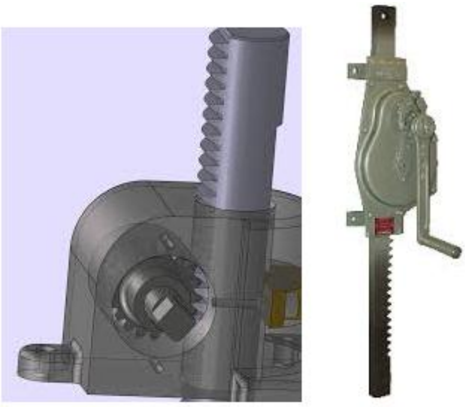

Fig. 2. Rack and pinion jack

B) Screw Jack-This jack has a Spindle and nut mechanism. Rotation of nut causes reciprocating motion of spindle on which load is placed and hence lift of it as seen in next figure. Mechanical advantage of a jack may be written as:

$$\frac{W}{E} = \frac{2\pi L}{P} \tag{1}$$

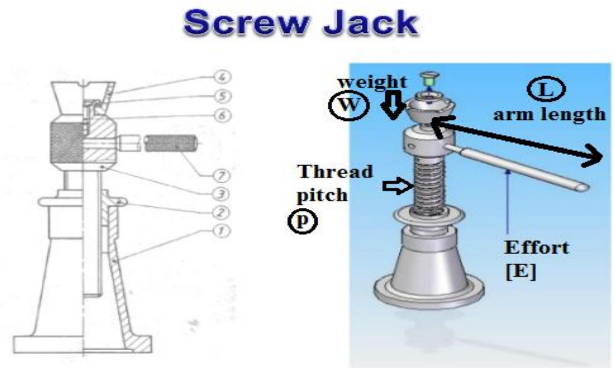

Fig. 3. Screw jack

C) Lever jack

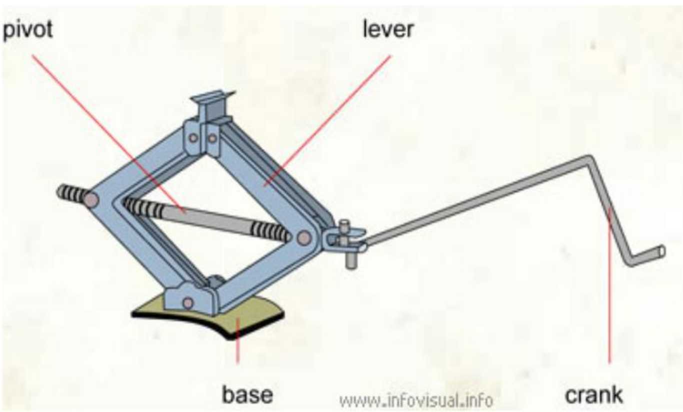

Fig. 4. Lever jack

This jack has following parts:
1. Automobile Jack: a device equipped with a crank that is used to raise an automobile.
Pivot: axis of rotation.
2. Lever: solid movable part attached to a fixed point, used to increase an applied force.
3. Crank: arm perpendicular to an axle, used to create circular motion.
4. Base: foot on which the jack rest.

D) Hydraulic Jack
This type of ram uses hydraulic pressure. A key principle of working with hydraulic systems is that the pressure is the same throughout. The pressure in the motor is the same as the pressure in the pump. Also the hydraulic pressure acts equally in all directions.

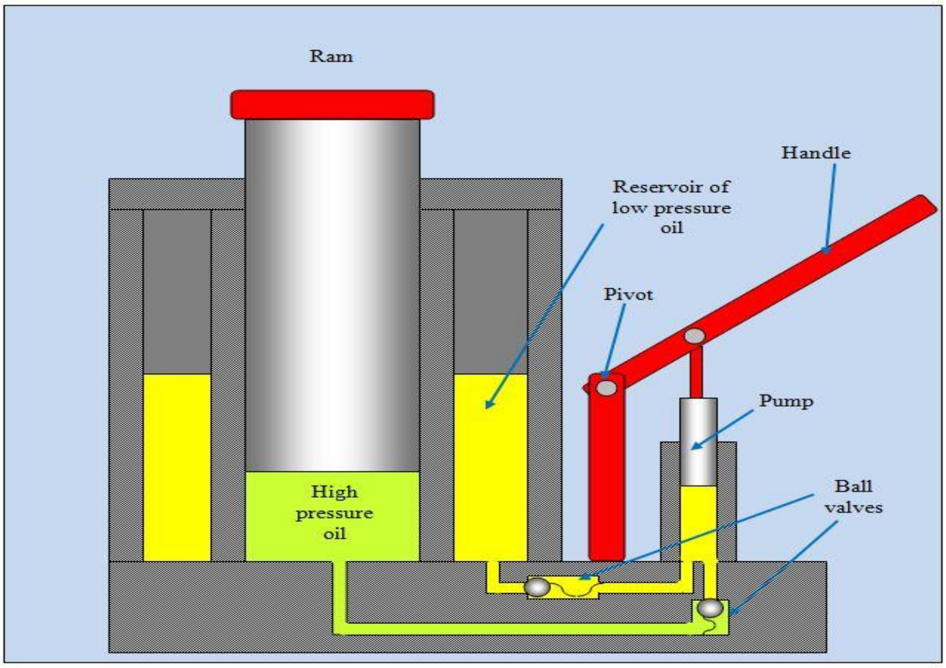

Fig. 5. Hydraulic jack

Hydraulic jack has following parts:
1. plunger cylinder: it is provided with a pivot and handle at the top and fits at the bottom into the bore of jack body filled with fluid.
2. Ram cylinder: feeds the high pressure fluid into the lower portion of the jack body through a system of ports.

Rate of lowering or rising of load is regulating by levels of extra oil present in reservoir. This ram has high Capacity of about 200 ton and efficiency with limited lift height, smaller weight and limited lifting speed.

Application:
Hydraulic system of stackers
Low and high lift trucks
Work levelers
Hydraulic lifts

2. Pulleys [21-24]

A pulley wheel is a mechanism which helps move or lift objects. They have small sheave or wheel with a grooved rim mounted on a pin on which it turns. A frame or block is used to mount sheaves with a flexible rope, cord or chain passing over groove. Three types of pulleys are as follows:

1. Fixed
2. Movable
3. A block and tackle

a) Fixed pulley: - fixed with fulcrum

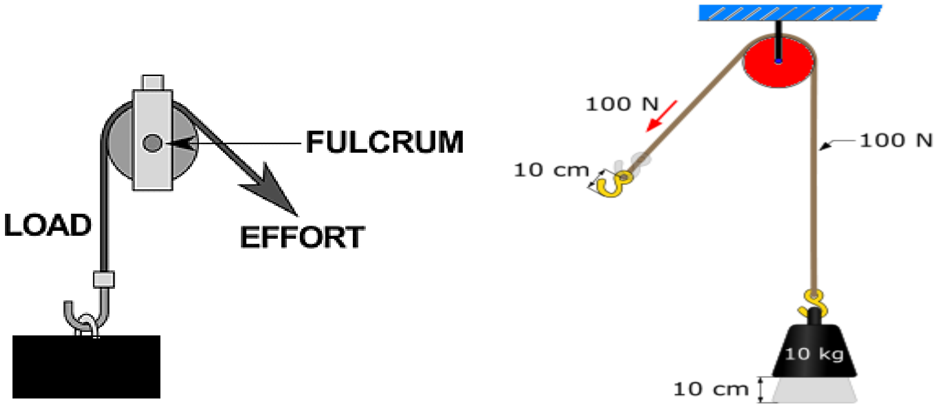

Fig. 6. Fixed pulley

In this simple pulley system, the force is equal to the load, so the
Mechanical Advantage is 1:1 or 1.
The Mechanical Advantage is calculated like so:
Mechanical Advantage = Load / Effort = 100 N / 100 N
Mechanical Advantage = 1:1 or 1

b) Moveable pulleys - rises and falls with the load being moved. Each side of the rope carries half the load. Therefore, the force required by the person to keep the load in equilibrium is also half the load. This system has a Mechanical Advantage of 2:1 or 2.
The Mechanical Advantage is calculated like so:
Mechanical Advantage = Load / Effort = 100 N / 50 N
Mechanical Advantage = 2:1 or 2

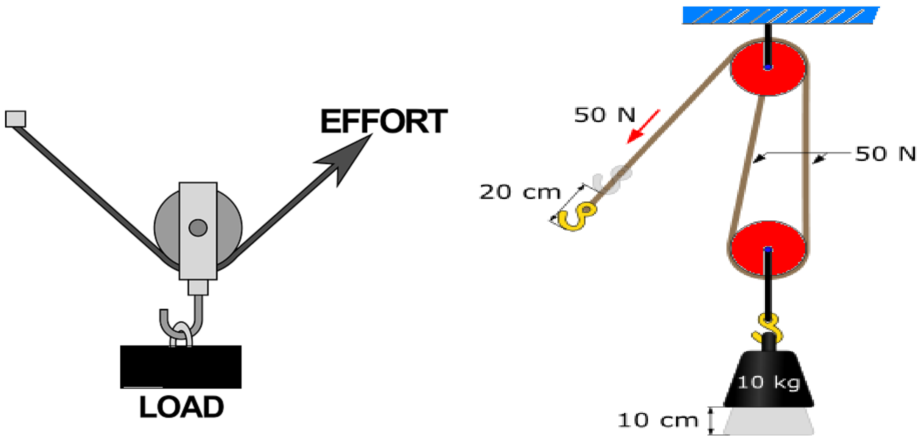

Fig. 7. Movable pulley

c) Block and tackles - Consists of two or more pulleys (fixed and moveable).

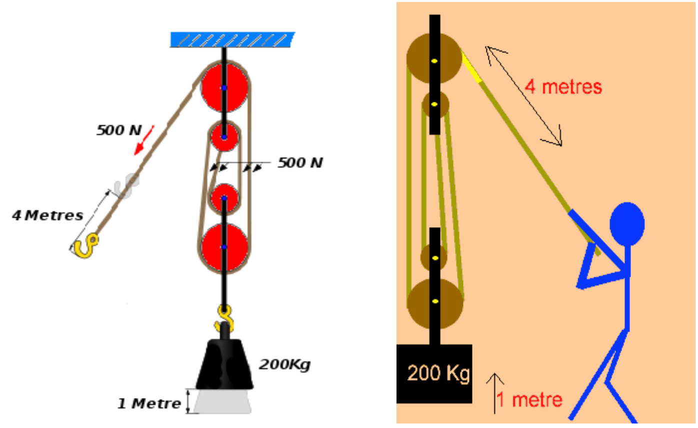

Fig. 8. Block and tackle pulley

This system has a Mechanical Advantage of 4:1 or 4
The Mechanical Advantage is calculated like so:
Mechanical Advantage = Load / Effort = 100 N / 25 N
Mechanical Advantage = 4:1 or 4

The Mechanical Advantage is calculated like so:
Mechanical Advantage = Load / Effort = 2000 N / 500 N
Mechanical Advantage = 4:1 or 4

Multiple Pulley drives can be used with belts, as seen in figure no 9.

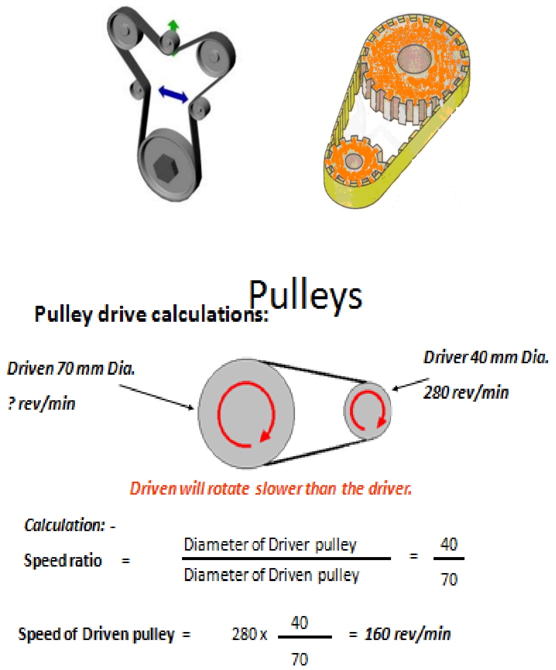

Fig. 9.

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