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Design Parameters and Fabrication methods of Hydraulic Floor Crane

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Abstract:

This paper deals with the fabrication of Hydraulic floor crane. The aim of this project work is to acquire practical knowledge in tHe field of material handling equipment with the help of hydraulic principle. This machine is very useful for lifting and transporting heavy jobs up to 3 kg for all types of jobs such as automobile repairs and service shops of central workshops, production industries, material handling units etc. In material handling, the cranes play a vital role in modern manufacturing industries. In our project we aim to fabricate a hydraulic operated floor crane for handling various kinds of materials. The hydraulic floor crane consists of truck, hydraulic cylinder, hydraulic tank, hydraulic hoses, DCV, beam and hooks.

Keywords **— material handling, hydraulics, mechanism.**

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I. INTRODUCTION

A crane is a type of machine; it can be widely used to lift the products like less weight or heavy weigh blocks, machines, work pieces and etc. It is an essence of our economic life and growth is dependent in a great part upon the continued improvement and development of the electronic and mechanical field. When water is contained within a pipe we can use it to create motion in a straight line by using a cylinder and piston. The piston is a tight sliding fit in the cylinder and when the water enters the cylinder it pushes the piston along. This method of applying a force and causing motion is called Hydraulics.

II. DESIGN AND ANALYSIS

The transportation of heavy machine parts and equipment within and outside the workshop has been a source of concern and needs urgent attention because of the hazard it exhibits. This negative effect on the health of engineers, led to the invention of the floor jib crane but research shows that contemporary designs of floor jib crane fail over time when these static load is left on it for a prolonged period of time. This project is centered on the design and fabrication of a mobile floor crane equipped with a facility to lock the load at any level as a special feature, to tackle the issue of failure due to static load. The mobile crane is designed to bear a maximum load of about1000 kg, with a counter weight of 2.6 KN which gave the crane a 3.034 factor of safety. The materials employed are; sheet metals, angular iron, bolts, nuts, metal rollers etc. The fabrication processes involved drawing, marking out, cutting, filling, welding and assembling. For permanent joints, the arc welding process was employed. As indicated earlier, the mobile floor crane gains its significance in the transportation of heavy machine parts within and outside the workshop. It can also be used to load and unload machine parts on trucks..

III. PARTS AND SPECIFICATIONS

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A. Hydraulic Cylinder

A Hydraulic cylinder (also called a linear hydraulic motor) is a mechanical actuator that is used to give a unidirectional force through a unidirectional stroke. It has many applications, notably in construction equipment (engineering vehicles), manufacturing machinery, and civil engineering.

Fig.1 photograph of Hydraulic cylinder used for the fabrication

Recommended font sizes are shown in Table 1.

B. Solenoid valve

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold. Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design. Besides the plunger-type actuator which is used most frequently, pivoted-armature actuators and rocker actuators are also used.

Fig.2. photograph of Solenoid valve

C. AC Motor

AC induction motors are the most common motors used in industrial motion control systems, as well as in main powered home appliances. Simple and rugged design, low-cost, low maintenance and direct connection to an AC power source are the main advantages of AC induction motors. Various types of AC induction motors are available in the market.

Fig.3 photograph of AC Motor

Different motors are suitable for different applications. Although AC induction motors are easier to design than DC motors, the speed and the torque control in various types of AC induction motors require a greater understanding of the design and the characteristics of these motors. This application note discusses the basics of an AC induction motor; the different types, their characteristics, the selection criteria for different applications and basic control techniques.

D. Oil Rotor Pump

A rotary vane pump is a positive-displacement pump that consists of vanes mounted to a rotor that rotates inside of a cavity.

Fig.4. photograph of Oil rotor Pump

In some cases, these vanes can have variable length and/or be tensioned to maintain contact with the walls as the pump rotates.

E. Lifting Arm

The arm supports the load carried by the crane setup, it should be designed with proper arrangement that it should be rigidly fixed with the base frame at its one end and its other end is connected with the end effector for performing the operations say load lifting. In order to carry heavy loads there are several kinds of design optimization which is need for designing and manufacturing the efficient model of arm for heavy load carrying purposes. The cross link members are used for providing additional supports to the frame by reducing its actual weight and also by increasing it's over all stability.

F. Bearings

The bearings are pressed smoothly to fit into the shafts because if hammered the bearing may develop cracks. Bearing is made upon steel material and bearing cap is mild steel.

G. Frame

A frame is a basic structure designed to bear a load in a lightweight economical manner. The simplest form of an A-frame is two similarly sized beams, arranged in a 45-degree or less angle, attached at the top. These materials are often wooden or steel beams attached at the top by rope, welding, gluing, or riveting. Because they have only two "legs", frames are usually set up in rows so that they can have good stability. A saw horse is a good example of this structure. More complex structures will have a cross member connecting the two materials in the middle to prevent the legs from bowing outwards under load.

H. Wheel

A wheel is a circular component that is intended to rotate on an axle bearing. The wheel is one of the main components of the wheel and axle which is one of the six simple machines. Wheels, in conjunction with axles, allow heavy objects to be moved easily facilitating movement or transportation while supporting a load, or performing labor in machines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel, potter's wheel and flywheel. Common examples are found in transport applications. A wheel greatly reduces friction by facilitating motion by rolling together with the use of axles. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity, or by the application of another external force.

IV. WORKING PRINCIPLES

Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. The barrel is closed on one end by the cylinder bottom (also called the cap) and the other end by the cylinder head (also called the gland) where the piston rod comes out of the cylinder. The piston has sliding rings and seals.

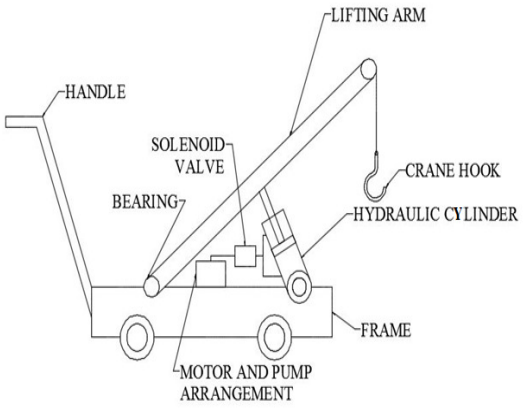

Fig.5. Schematic illustration of Hydraulic crane

The piston divides the inside of the cylinder into two chambers, the bottom chamber (cap end) and the piston rod side chamber (rod end / head end). Flanges, trunnions, clevises, Lugs are common cylinder mounting options. The piston rod also has mounting attachments to connect the cylinder to the object or machine component that it is pushing / pulling.

A hydraulic cylinder is the actuator or "motor" side of this system. The "generator" side of the hydraulic system is the hydraulic pump which brings in a fixed or regulated flow of oil to the hydraulic cylinder, to move the piston. The piston pushes the oil in the other chamber back to the reservoir. If we assume that the oil enters from cap end, during extension stroke, and the oil pressure in the rod end / head end is approximately zero, the force F on the piston rod equals the pressure P in the cylinder times the piston area.

When the ac motor is turned on it tends to activate the rotor pump which is directly coupled to the motor shaft with the help of coupling. Due to the activation of pump the oil from the reservoir is raised with the help of suction pressure created by the pump to reach solenoid valve. The solenoid valve is coupled to the hydraulic cylinder which is mounted between frame and lifting arm. When the valve is activated by means of lever by the operator, then the pressurized fluid enters the cylinder, which tends to retracts the piston outwards. Due to this arm is lifted to a certain extent with the load. When the portal is reversed with the help of hand lever, then the cylinder tends to retract backwards there by lowering the arm for lifting and shifting the load carried from one place to another.

Advantages

- Hydraulic implementation increases high load carrying capacity.
- Simple in construction.
- Less maintenance.
- Initial cost is less.
- The materials used for fabrication is easily available in the consumer markets.
- Non skilled labours can easily handle this system.
- Space consumption is less, so it can be used for small scale applications too.

Disadvantages

- Possibility of leakage of oil
- Load can't be carry an angle
- Hydraulic fluid is highly corrosive

Applications

Used for load lifting, carrying and shifting operations in small, medium and large industries like, Foundry, Welding workshops, Automobile workshops, Construction sites, etc.,

V. CONCLUSIONS

In this paper we found that Hydraulic Floor crane mechanism is capable of lifting load. We analyse that design and fabrication was a great success both in terms of strength and stiffness.

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