International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 01 | Jan - 2026 SJIF Rating: 8.586 ISSN: 2582-3930

Design and Fabrication of 5Ton Hydraulic Hand Press Machine

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Abstract - A hydraulic press is a machine using a hydraulic cylinder to generate a compressive force. Frame, hydraulic cylinder and press table are the main components of the hydraulic press. In this project press frame, cylinder and press table are designed by the design procedure. They are analyzed to improve their performance and quality for press working operation. Using the optimum resources possible in designing the hydraulic press components can effect reduction in the cost by optimizing the weight of material utilized for building the structure. An attempt has been made in this direction to reduce the volume of material. So in this paper we consider an industrial application project consisting of mass minimization of H frame type hydraulic press. This press has to compensate the forces acting on the working plates and has to fulfill certain critical constraints. Here we use implementation for analysis and optimization of hydraulic press. The aim of this paper is to integrate the mechanical system of hydraulic press with hydraulic system to facilitate the ease of operation to manufacture the smaller parts in a bulk. In the present scenario, time constrain is a crucial part for completion of any production process. Thus with the aid of automization, the production time can be reduced as well as higher degree of accuracy can be achieved as the human efforts will be alleviated. Thus an attempt has been made to provide the smooth and rapid functioning of press work with the help of hydraulic system.

Key Words: Hydraulic press, Frame Structure, Press work, Hydraulic cylinder, Optimization, Automation

1. INTRODUCTION

Hydraulic press is a tool to produce compressive force by means of fluid. It depends upon Pascal's principle that the pressure throughout an enclosed entity is constant. By means of hydraulic system larger forces can be produced in contrast with mechanical and electrical systems. Such forces can be used for the press work application such as blanking, punching, piercing, coining, trimming etcetera. Press work is a method of mass production involving the cold working of metals, usually in the form of thin sheet or strip. Press working is one of the extensively employed methods of fabricating parts of intricate shapes with thin walls. Press working processes make use of large forces by press tools for a short time interval which results in cutting or shaping the sheet metal. Since, press working does not involve heating of the parts, close tolerances and high surface finish can be obtained on the part. Since presses can produce components at fairly fast rates, the unit cost of labor for operating the press is fairly low.

Press working forces are set up, guided and controlled in a machine referred to as a Press. Thus an attempt has been made to atomize the process of press work using Hydraulic mechanism in press machine. The inputs and outputs of the control system including hydraulic mechanism are solely mechanical such as rotating shaft or reciprocating plunger. The prime remuneration of implementing this system is the movement of the mechanical devices can be operated by means of hydraulic components such as actuators to initiate the movement which could be in the form of lever to apply manually or by means of switches to operate automatically. Furthermore, direction control valves have been implemented to control the directions of piston movements and regulate the same. Thus the whole mechanism have been simplified with the use of hydraulic equipment's. Moreover, the use of pressure control valve and direction control valves, makes it easier to regulate the forces and control the speed of the setup.

2. Body of Paper

2.1WORKING PRINCIPLE

Hydraulic press is a system where a liquid, usually crude oil, is pumped down hole under high pressure to operate a reciprocating pump or a jet pump. This is a very flexible pumping system and can be used to produce low- to high-volume wells. This system is capable of producing a higher volume of fluid than the mechanical lift pump. Hydraulic lift uses a pump and pumps oil very high pressure. The pump pressure is usually between 300-400 pounds per square inch and pushes the liquid to the bottom of the piston to lift it from its seat which relatively lifts the load connected to the head of the piston-cylinder assembly. The required power oil or produced water is reclaimed and reused to continue operating the wells. The pump produces oil on both the upstroke and the down stroke. The pump stroke speed is not easily adjustable due to varying load. The two cylinders, and the pipe connecting them, are filled with a liquid. At this point, the function of the hydraulic press depends on Pascal's Principle.

Pascal's Principle states that when pressure is added to a liquid at rest, there is an identical increase in pressure at all points. Applying this principle to the hydraulic press means that any force that is added to the piston in the smaller cylinder will be transferred to the piston in the larger cylinder, in a proportionally increased level of force. This allows a hydraulic press to produce a great deal of force from the application of a small amount of force to the small piston. The increase of the force produced by the larger piston is proportionally larger than the force exerted on the small piston. The amount of increase depends on the ratio of the

sizes of the pistons. The ratio of the areas of the two pistons is multiplied by the amount of force applied to the small piston to determine the amount of force that the large piston can produce. For example, if the ratio of the sizes of the two pistons is 10, and the amount of force applied to the small piston is 50 N, the amount of force that the large piston will produce is 500 N. Hydraulic presses can be used in any task that requires a large amount of force. These can include any type of lifting as well, since the hydraulic press can work as a type of lever. These presses are the most efficient contemporary press, as well as the most common.

Fig 1. Operations of Hydraulic press machine

Fig: 2. Manual Hydraulic Press Machine

The piston in this cylinder is pushed so that it compresses the fluid in it that flows through a pipe into the larger cylinder. The larger cylinder is known as the master cylinder. The pressure is exerted on the larger cylinder and the piston in the master cylinder pushes the fluid back to the original cylinder.

2.2 Methodology

In achieving the aim of this work, component parts of the machine were designed using various design equations. The design results were used to select materials for various components. The detailed drawing of the developed hydraulic press machine was done using SOLIDWORKS software. In fabricating the machine, mild steel was used as the locally sourced material. The use of mild steel is due to the fact that its strength, rigidity and Mach inability falls within the design specifications. It is also available and cost effective.

3. LITERATURE SURVEY

Using the optimum resources possible in designing the hydraulic press components can effect reduction in the cost by optimizing the weight of material utilized for building the structure. An attempt has been made in this direction to reduce the volume of material, cost of the press and to make is portable. Errol et al. presented a 2D nonlinear magneto-mechanical analysis of an electromagnetic actuator based on finite elements. The presented method enables the simulation of the complete switching cycle off a switching, short stroke solenoid actuators with sufficient accuracy. This could be achieved by considering nonlinear magnetic, eddy current induction and a physical correct implementation of the contact mechanics, which are relevant for the complex dynamics of this valve types.

Today I'd like to discuss Hydraulic presses. Yes I know a broad subject so we are going to take it down to the basics give you a layman's description and give you a little history. After searching the web and showing my findings to my techs the most basic description of a Hydraulic press which is a machine tool and used in the manufacturing industry was found on wiseGeek.com here it.

"A hydraulic press is a mechanical machine used for lifting or compressing large items. The force is generated through the use of hydraulics to increase the power of a standard mechanical level. This type of machine is typically found in a manufacturing environment"

4. Problem Statement and Objective: Problem Statement:

1. Problem Statement Oil Leaks

One of the most reported problems is an oil leak; you will notice oil around the ram, the hose end fittings and hydraulic lines. Make sure you are using the recommended oil for your hydraulic press and that all fittings are tightened.

2. Overheating

Overwhelming pressure and friction, and contaminated or degraded hydraulic fluid, can cause your press to overheat. Hydraulic presses should never reach a higher temperature than 150° F, as overheating can cause damage to sealing compounds. Make sure you don't overwork your press, and regularly replace the oil and clean the filters.

3. Slow Pressure Build-Up

Normally, hydraulic presses should reach required pressure levels in around one second, any longer than this means that there is a problem with the pump; the fluid is not being funneled to the ram quickly enough. This may be caused by leaks or dirt caught in the fluid, so make sure you examine the pump, as well as surrounding mechanisms like the relief valve and motor, to make sure everything is working properly and clean.

5. Objectives:

According to the problem statement, our objectives are as follows.

- Design of special purpose hydraulic power press machine of capacity 5 Ton according to customer requirement.
- Modeling of hydraulic press using suitable CAD software.

- Fabrication of hydraulic press.

6. CONCLUSION

1. The design and fabrication of a 5-ton hydraulic hand press machine has been successfully completed with a focus on simplicity, safety, cost-effectiveness, and reliability.

2. Structural components such as the frame, base plate, ram, and support columns were designed based on strength and stability criteria, and fabricated using mild steel, which provides adequate strength, ease of fabrication, and economic viability.

3. The fabricated hydraulic hand press demonstrated stable operation, precise control, and repeatable performance during testing. It is well-suited for small-scale industrial applications, workshops, laboratories, and educational institutions, particularly for operations such as press fitting, bending, straightening, punching (light duty), and assembly work.

4. Overall, the project validates that a 5-ton hydraulic hand press can be effectively designed and fabricated using locally available materials and standard manufacturing processes. The machine meets functional requirements while maintaining low cost, ease of maintenance, and operational safety.

5. The project achieves its objective of developing a robust, economical, and user-friendly hydraulic hand press, demonstrating strong potential for practical industrial use and serving as a valuable learning platform in mechanical design and fabrication

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