

Design and Development of Hydraulic Press: A Review

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Abstract: The project title is “Design and Development of Hydraulic Press.” A hydraulic press is a machine that works on Pascal’s Law, which states that when pressure is applied to a liquid in a closed system, it spreads equally in all directions. A hydraulic press is used to produce compressive force with the help of fluid pressure. The main parts of the hydraulic system are hydraulic power pack, control valve, actuator and other accessories. Hydraulic systems can produce very large force compared to mechanical and electrical systems. Because of this, they are used

for press work operations such as blanking, punching, piercing, coining and trimming. In this machine, a small piston pushes the fluid with high pressure into a larger cylinder, which increases the force. The aim of this project is to combine the mechanical system with the hydraulic system to make the press work easy and to produce small parts in large quantity. In modern industries, time is very important, so with the help of automation, production time can be reduced and accuracy can be improved. It also reduces human effort and makes the press operation smooth and fast

Keywords: Hydraulic Press, H-frame, Design, Press work, Automation etc.

INTRODUCTION

Hydraulic press works on Pascal’s principle, which states that when pressure is applied to a fluid in a closed system, the pressure is transmitted equally in all directions. In this machine, one piston with a small area acts like a pump and applies a small force, while another piston with a larger area produces a much bigger force. Because of this, a small input force can generate a large output force. Thin pipes are usually used to connect the pump and the press

cylinder because they can easily handle high pressure. Press working is a manufacturing method used for mass production of metal parts, especially thin sheets or strips. In this process, large forces are applied for a short time to cut or shape sheet metal. Since the metal is not heated during press working, the parts produced have good surface finish and accurate dimensions. Press machines can produce parts very quickly, so the labor cost per part is low. In this system, the press machine controls and guides the forces used in press work. To improve efficiency,

the process can be automated using a hydraulic system. The hydraulic mechanism helps operate mechanical parts such as shafts, plungers, or levers either manually or automatically using switches. Direction control valves are used to control the movement of the piston. This makes the machine easier to control and operate. The same hydraulic principle is also used in many machines such as hydraulic jacks, earth-moving equipment, and metal forming presses. A small pump creates pressure in the hydraulic fluid, which then acts on a larger piston to produce a strong force. Hydraulic systems are also used in hydraulic weighing scales to measure heavy loads accurately.

II. Literature Review

Tejas Patel explained that a hydraulic system can be used to develop a press machine for mass production of washers. The use of a hydraulic press improves productivity and accuracy in manufacturing. The system can also be automated using electro-hydraulic concepts, where a solenoid-operated direction control valve helps in creating a closed-loop system, which increases the production rate.

Mr. K. Shravan Kumar described a multi-purpose hydraulic press machine that can perform different operations such as bending and blanking by simply changing the die. The design mainly focuses on reducing operator fatigue, improving safety, and increasing flexibility of operation. It also helps in achieving better dimensional accuracy and positioning. The components are designed carefully to avoid bending failure due to load. Mild steel is

selected as the material because it has good strength, easy machinability, weldability, and low cost.

Mr. Piyush T. Patel studied the performance of the hydraulic press by testing it with sheet metals of different thicknesses. The results showed that molding operations can be performed up to 5 mm thickness. The machine can also perform multiple operations such as bending and blanking by changing the die. The design improves safety, convenience, flexibility, and accuracy while reducing operator effort. Similar to other designs, mild steel is used due to its high strength and good manufacturing properties.

Neville Saches discussed the causes of mechanical failure in machine components. The study explains different types of failures such as ductile fracture, fatigue failure, and stress concentration. It also describes how different types of loads like internal pressure, bending, torsion, or combined loads can lead to failure in machine parts.

LeRoy Fitzwater, Richard Khalil, and Ethan Hunter explained the use of topology optimization in engineering design, especially in aircraft structures. This method helps engineers design parts more efficiently by reducing weight, improving load distribution, and increasing fatigue resistance. It also helps visualize the load path and improve the overall performance of engineering products.

III. Problem definition

A problem definition for a hydraulic press means identifying the common problems that occur during

its working. These problems may include low force generation, leakage of hydraulic oil, overheating of oil, improper pressure control, misalignment of piston or cylinder, wear of seals and parts, slow working speed, vibration, noise, and safety risks during heavy load operations. These issues can affect the smooth working of the hydraulic press, reduce production efficiency, and may damage machine parts or affect the quality of press work operations such as blanking, punching, bending, and forming. Therefore, proper design, maintenance, and control of hydraulic components are important for safe and efficient working of the hydraulic press.

Specifications of 100 Ton Hydraulic Press

- **Machine Type:** Hydraulic Press (H-Frame type)
- **Capacity:** 100 Ton
- **Hydraulic Pressure:** Approx. 250–300 bar
- **Cylinder Type:** Single acting / Double acting hydraulic cylinder
- **Piston Diameter:** About 220–250 mm (depends on design)
- **Stroke Length:** 300–500 mm
- **Frame Material:** Mild Steel / Structural Steel
- **Bed Size:** Approx. 1600mm (as per design requirement)
- **Hydraulic Fluid:** Hydraulic oil
- **Control System:** Direction control valve

- **Applications:** Blanking, punching, bending, forming and other press work operations.

V. Components Of System

Support structure

It is an assembly of support frame and bed. Both the channels bolster each other with the help of a supportive plate welded at the top of the structure. Further it is welded at the foundation to give the whole assembly a framed structure. The bed which holds a die is clamped on the holes as shown in the figure.

Bed:

Bed is a flat plate on which the die is fixed. It is used to support and hold the die at the correct position on the frame of the press machine. The bed has holes on its sides so that it can be clamped or fixed properly to the support frame. This helps to keep the die stable during press operations.

Die:

A die is a tool used to give the required shape to a material during manufacturing. In this project, a compound die is used to produce a washer from sheet metal. The washer has 30 mm outer diameter and 10 mm inner diameter. The die cuts the required shape in a single operation.

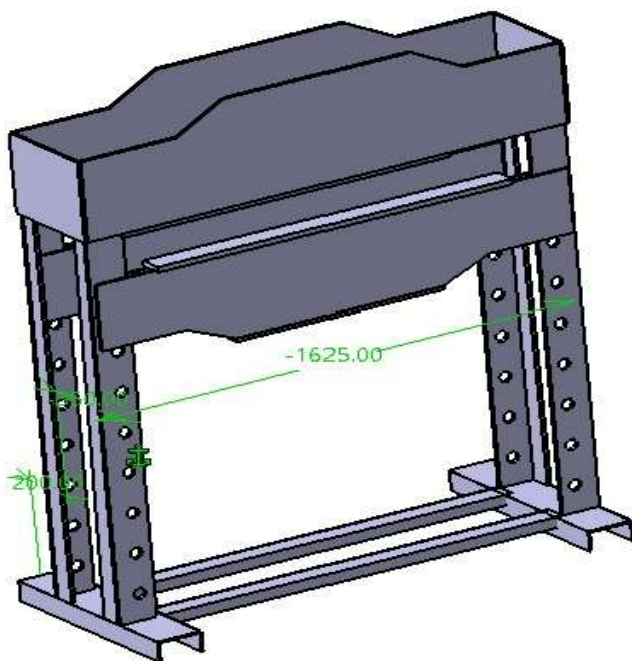
Punch:

Punch is the male part of the die used for cutting the material. Two punches are used in the compound die. One punch cuts the inner diameter of the washer and the other cuts the outer diameter. The outer punch is connected to the hydraulic cylinder rod.

Plunger and Hydraulic Cylinder:

The plunger is used to create the required hydraulic pressure in the system. The hydraulic cylinder works with pressurized oil to move the piston. The piston moves back and forth inside the cylinder, which produces linear motion and force for press operations.

CAD Model:



VI. Methodology

The work is planned in following phases:-

Phase I – Topic Selection

Selection of the project topic “Design and Development of 100 Ton Hydraulic Press” based on the industrial need for machines that can produce high compressive force for operations like punching, bending, blanking and forming.

Phase II – Literature Review

Study of research papers, books and previous designs related to hydraulic presses, hydraulic systems and press work to understand the working principle, components and design requirements.

Phase III – Design Stage

Preparation of the conceptual design and calculations for the hydraulic press. This includes designing important parts such as frame (H-frame), bed, hydraulic cylinder, piston, punch and die, and calculating required pressure, force and dimensions for a 100-ton capacity press using CAD or modeling software.

Phase IV – Selection of Different Components

Selection of suitable components such as hydraulic pump, cylinder, valves, pipes, frame material and other accessories based on strength, performance and cost.

Phase V – Testing of Hydraulic Press

Testing the hydraulic press to check force generation, pressure control, speed of operation and safety of the system.

Phase VI – Finding the Final Result

Evaluation of the performance of the machine to ensure that the 100-ton hydraulic press works efficiently, safely and provides the required force for press operations.

Benefits:

No need of conventional grid electricity, long working life, reliable and durable system, easy to

operate and maintain, eco-friendly operation, and safe to use.

Limitations:

Working speed is low, skilled operator is required, and the size of the operation bed limits very heavy objects.

Applications:

Easy to operate machine used in small workshops for multiple operations, works at low speed similar to manual work, allows bidirectional movement, has detachable rod, timing control, and easy handling.

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CONCLUSION

A hydraulic system using pressurized oil is used to develop the press machine for industrial mass production. It helps to increase productivity and improve accuracy of manufactured parts. The machine can perform different operations like bending, blanking, punching, forging and metal forming by changing the die. The design focuses on reducing operator effort, improving safety and flexibility, and mild steel is selected as the material because of its good strength, machinability and low cost.

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