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Design, Characterization and Testing of Hand operated Hydraulic Press

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***Abstract*— Hydraulic Press is one of the oldest basic machine tools. In its modern form, is well adapted to press work ranging from coining jewelry to forging aircraft parts. A hydraulic press is a machine using a hydraulic cylinder to generate a compressive force.**

In this paper the components like frame, cylinder, pillar and plates 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 consideration for an industrial application consisting of mass minimization of H frame type hydraulic press.

Keywords*— *Hydraulic Press, H-frame, Design, Die

I. INTRODUCTION

The hydraulic press depends on Pascal's principle: the pressure throughout a closed system is constant. One part of the system is a piston acting as a pump, with a modest mechanical force acting on a small cross-sectional area; the other part is a piston with a larger area which generates a correspondingly large mechanical force. Only small-diameter tubing (which more easily resists pressure) is needed if the pump is separated from the press cylinder.

A fluid, such as oil, is displaced when either piston is pushed inward. The small piston, for a given distance of movement, displaces a smaller amount of volume than the large piston, which is proportional to the ratio of areas of the heads of the pistons. Therefore, the small piston must be moved a large distance to get the large piston to move significantly. The distance the large piston will move is the distance that the small piston is moved divided by the ratio of the areas of the heads of the pistons. This is how energy, in the form of work in this case, is conserved and the Law of Conservation of Energy is satisfied. Work is force times distance, and since the force is increased on the larger piston, the distance the force is applied over must be decreased.

The pressurized fluid used, if not generated locally by a hand or mechanically-powered pump, can be obtained by opening a valve which is connected to a hydraulic accumulator or a continuously-running pump whose pressure is regulated by a relief valve. When it is desired to generate more force than the available pressure would allow, or use smaller, higher-pressure cylinders to save size and weight, a hydraulic intensifier can be used to increase the pressure acting on the press cylinder.

When the pressure on the press cylinder is released (the fluid returning to a reservoir), the force created in the press is reduced to a low value (which depends on the friction of the cylinder's seals. The main piston does not retract to its original position unless an additional mechanism is employed.

The principle of the hydraulic press is used in lift jacks, earth-moving machines, and metal-forming presses. A comparatively small supply pump creates pressure in the hydraulic fluid. The fluid then acts on a substantially larger piston to produce the action force. Heavy objects are accurately weighed on hydraulic scales in which precision-ground pistons.

II. WORKING PRINCIPAL OF A HYDRAULIC PRESS

A hydraulic press is a machine that uses pressurized liquid to create force. These machines are composed of a simple cylinder and piston mechanism. The press consists of a large cylinder, with a large piston, and a small cylinder and a small piston. The large cylinder and the small cylinder are connected to one another by means of a pipe. 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.

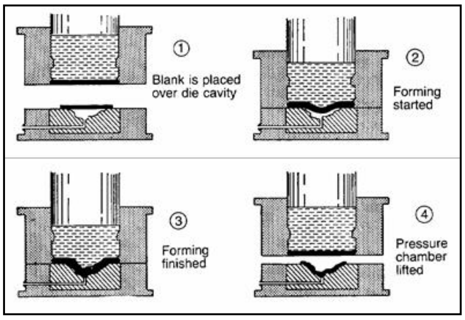

Fig.1 Working of hydraulic press.

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

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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.

Since the hydraulic press works on the basis of Pascal's Law, its working is similar to the one of the hydraulic system. A hydraulic press consists of basic components used in a hydraulic system that includes the cylinder, pistons, the hydraulic pipes, etc. The working of this press is very simple. The system comprises of two cylinders, the fluid (usually oil) is poured in the cylinder having a small diameter. This cylinder is known as the slave cylinder

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.

The force applied on the fluids by the smaller cylinder results in a larger force when pushed in the master cylinder. The hydraulic press is mostly used for industrial purposes where a large pressure is required for compressing metals into thin sheets. An industrial hydraulic press uses the material to be worked upon along with the help of the press plates to crush or punch the material into a thin sheet.

III. DESIGN APPROACH

Table I includes details of all components required for building the actual model of hydraulic press.

TABLE I. DETAILS OF COMPONENTS

SR NO	NAME OF PART	MATERIAL USED
1	Base	Mild steel
2	Movable plate	Mild steel
3	Upper plate	Mild steel
4	Pillar road	Mild steel
5	Washer	Mild steel
6	Nut	Mild steel
7	Spring	Mild steel
8	Jack	-
9	Spindle	Stainless steel
10	Body	Cast iron
11	Die	Mild steel (Case hardened)
12	Punch	Mild steel (Case hardened)

Specification:

❖ Pillar Rod:
- Height: 510 mm
- O.D: 20 mm
- Tapping: 3 mm
- Thread: 18 mm

❖ Spring: Compression Type
- No. of Quantity: 2
- Free length: 230 mm

❖ *Base Die:*
- O.D: 95 mm
- I.D: 65 mm
- Height: 40 mm

❖ *Washer:*
- I.D: 20 mm
- O.D: 40 mm
- Thickness: 1 mm

Design procedure:

1. Design of ram:

$$F = \frac{\pi}{4} {D_r}^2 p$$

Dr = 65 mm

2. Design of cylinder:

$$t = \frac{d_n}{2}\left[\sqrt{\frac{\sigma_t + p}{\sigma_t - p}} - 1\right]$$

$d_{ci} = d_{ro} + clearence$

d_{ci} = 65.04 mm

outside diameter of cylinder,

$d_{co} = d_{ci} + 2t$

$d_{co} = 70\ mm$

3. Design of pillars:

Load on each pillar = $\frac{\pi}{4} {D_r}^2 \sigma_t$

= 39240 N (σ_t = 56 for M.S.)

d_p = 22 mm

4. Design of spring:

Solid length: $L_s = n'd$

n' =15, d = 8 mm

∴ L_S = 120 mm.

Free length: $L_f = n'd + \delta_{max} + 0.15\ \delta_{max}$

= 238 mm

Spring index: $C = \frac{D}{d}$

= 5.875

Stiffness: $k = \frac{W}{\delta}$

=10.51

5. Design of plate:

Top plate: $t_c = a \times b \sqrt{\frac{p}{2f_t + (a^2 + b^2)}}$

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P= intensity of pressure = 1.66 N/mm^2

t_c = 16 mm

Bottom plate:

t = 10 mm

Movable plate:

t = 10 mm

IV. MANUFACTURING PROCESS

Hydraulic presses are available in many types of construction which is also true of mechanical presses. Following construction details just gives the basic idea of dimensions of different parts used in the design module.

Base plate is manufactured from 430x110x10 mm plate by drilling of ϕ18 at each corner using vertical drilling machine. The die used for a particular given shape is welded at the bottom plate as shown in figure 2.

The dimensions of Top and Middle plate is 430x110x17 mm. Pillar having diameter of 20 mm and height 510 mm, which is allowed to pass through the holes of the plates.

After that spring having free length 230 mm is passed through the pillar which is fixed between middle plate and base plate so as to get the flexible movement of the Movable plate. Punch is welded at the bottom of the movable plate. Jack is mounted in between the top and middle plate. The basic Manufacturing process is shown in below figure 2.

Fig. 2. Assemble parts of Hydraulic press.

V. CONCLUSION

The machine was tested to ensure conformability to design objectives and serviceability. By performing experiment for different thicknesses of sheets, it is concluded that moulding operation is performed up to 5 mm. It is a multi-purpose machine as it can be used for performing different tasks. By changing the die different operation like bending, blanking etc. can be performed on a hydraulic press machine.

The design has main focus on reducing operator fatigue and increase safety, improving the flexibility and makes operation more convenient, and to achieve dimensional and positional accuracy. Components of press are designed to avoid bending failure due to applied load. Mild steel is selected as material based on its properties such as high bending & tensile strength, it compatibility with operation like machining, welding, finishing, cutting etc. and cost as economic factor.

REFERENCES

[1] Bhandari, V.B. (2009), “Design of Machine element”, Tata McGraw-Hill Education.

[2] Khurmi, R.S. and Gupta, J.K. (2005), “A Textbook of Machine Design”, Eurasia Publication House (P.V.T.) Ltd. 14th Edition, 1230pp. ISBN: 81-219-2537-1.

[3] R.K. Bansal, Fluid Mechanics and Hydraulic Machines, Edn. 8, Laxmi Publications P. Ltd., 22 Golden House, Daryaganj, New Delhi 110 002 – 2003.

[4] A Text Book of Fluid Mechanics and Hydraulic Machines – By, R. K Rajput and S. Chand & Co, Ram Nagar, New Delhi – 110 055.

[5] Brian S. Elliott (2006), "Air-Over-Hydraulic Jacks", Compressed Air Operations Manual, McGraw-Hill Professional, Pp. 56–58, Isbn 978-0-07-147526-6

[6] S. Zhigiang, “Variations of Hydraulic Jack”, Auto Universal press, Shangai publication no. US8348237, 2013.

[7] Manar Abd Elhakim Eltantawie, “Design, manufacture and simulate a hydraulic bending press”, International journal of mechanical engineering and robotics research, Vol. 2, No. 1, January 2013.

[8] Jarmai. K and Farkas.J. “Optimal design of Hoist structure frame”. Department of Mechanical Engineering, University of Miskolc, H- 3515 Miskolc Egytemvanoc, Hungary. May 2003.

[9] Muni Prabaharan and V.Amarnath “Structural Optimization of 5Ton Hydraulic Press and Scrap Baling Press for Cost Reduction by Topology”, International Journal of Modeling and Optimization, Vol 1, pp 185-190, 2011.

[10] Dr.Ing T. Hong, Dr. Richard K., “Computerized Design Analysis of Machine Tool Hydraulic System Dynamics”, FES/BarDyne Technology Transfer Publication.

[11] ManarAbdElhakimEltantawie, “Design, manufacture and simulate a hydraulic bending press”, International journal of mechanical and robotic research, 2013.