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FABRICATION OF HYDRAULIC PRESS MACHINE FOR USE IN FITTING SHOP

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ABSTRACT
Fabrication of a hydraulic press machine is the aim of this construction work and is a machine used in the workshop. A hydraulic press machines aid operators in many aspects right from fitting, bending, assembling of metal parts, removal of bearings from shafts, dismantling and fixing of equipment during assembly and servicing. The machine brings the concept of hydraulic systems closer to students that are pursuing engineering-related courses. This reviews the literature of existing hydraulic press machines, the principle involved, and the rationale behind this invention. Because of its being common and having high strength. Mild steel was used as the major material for the construction of different components of the press machine. The hydraulic press machine consists of a hydraulic jack, a stand, columns, movable base, spindle, locking pins, cylinders, supporting rods, tension springs, release valves, and a structural frame that was fabricated and formed. The methods applied in the fabrication of the machine are marking out, cutting, bending, assembling, and welding of parts together using electric arc welding. The machine was tested in the removal of bearing from a casing without any damage to the case using less effort.

Keywords: Hydraulic press, Fabrication, Components

INTRODUCTION

A hydraulic press is a device that utilizes fluid to create pressure. The constant pressure throughout a contained entity is based on Pascal's premise. In comparison to mechanical and electrical systems, hydraulic systems may create greater forces. Hammering, piercing, coining, shearing, and other pressure work applications can all benefit from such forces. The cold rolling of metals, typically in the form of thin sheets or strips, is used in press work as a means of mass production. One of the most often used processes for producing parts with complicated forms and thin walls is press work. During press working processes, significant forces are applied by press tools for a short period of time, resulting in sheet metal cutting or shaping. Because press work does not require the parts to be heated, precise tolerances and a high surface polish can be achieved. The unit cost of labor for operating a press is relatively low since presses can create components at a relatively fast rate. In a mechanism known as a press, working forces are set up, guided, and controlled.

As a result, an attempt has been made to automate the process of press work by utilizing the hydraulic mechanism in the press machine. The control system's inputs and outputs, including the hydraulic mechanism, are entirely mechanical, such as a rotating shaft or a

reciprocating plunger. The primary benefit of implementing this system is that the movement of mechanical devices can be initiated by hydraulic components such as actuators, which could be in the form of a lever to be applied manually or by switches to work instantly. Furthermore, direction control valves have been installed to control and regulate the directions of piston movements. As a result of the use of hydraulic equipment, the entire mechanism has been simplified. Furthermore, the application of pressure control. (Akshay Vaishnav, Path Lathiya & Mohit Sarvaiya, May 2016).

Due to the delicate nature of fabrication and repair work in the workshop and the safety of the worker and the component they are working on, such as the separation of rusted parts, straightening of bent parts, compression of unneeded materials in the workshop, and pressing out of bearings for the equipment, there is a lost hour that is encountered when manually performing the aforementioned operations, as well as injuries due to the large amount of energy that is required in manufacturing.

By optimizing the weight of the material used to build the structure and using the best resources feasible in designing the hydraulic press components, cost savings can result. A move has been made in this manner to lower the amount of material used, the cost of the press, and make it portable as well as movable. Using the most efficient resources feasible when developing hydraulic press components can save money. Reducing the weight of the materials used in the construction. An endeavor has been made to reduce the amount of waste, volume of material, cost of press, and transportability.

LITERATURE REVIEW

A hydraulic press is a mechanical device that lifts and compresses various equipment. The force is produced by exerting pressure inside the cylinder with hydraulic systems. Pascal's principle governs the hydraulic press machine. A hydraulic press machine is made up of basic hydraulic system components such as a hydraulic cylinder, piston, ram, fluid flow pipelines, oil reservoir, and controller. The fluid pressure pushes the piston inside the cylinder, causing the piston to move. The material is subsequently compressed by a ram attached to a piston. As a connection for conveying hydraulic pressure, an incompressible fluid such as oil with the right density and viscosity is utilized. The hydraulic press is used for practically all industrial uses. It is also used in various industries for thinning glass, creating powders in the cosmetics business, and manufacturing tablets for medical usage. Forging, moulding, blanking, punching, deep drawing, and other metal forming operations are all popular uses for hydraulic presses. The press's working drive has progressed from mechanical to hydraulic to pneumatic. Technological advancements have made it possible to integrate electronics and electrical devices with mechanical devices. These modern hydraulic and pneumatic presses offer a higher capacity, are more reliable, and are simpler to maintain. These presses are widely used and favoured over mechanical presses owing to their high operating capacity. One of the most important aspects of these presses' proper operation is their maintainability. (Yan, X., Nie, S., Ji, H., Ma, Z., & Chen, B. 2023).

The present hydraulic press was not created until the latter half of the 18th century. Bruno used the power of the press in 1775, and it was known as the Bruno press. The first hydraulic press was invented in 1795 by English bookbinder Joseph Bramah, who used it to extract fruit juices and even make paper. He used his idea to start a hydraulic press manufacturing firm to create large amounts of paper. The creation of the hydraulic press, which is used in the steel and other sectors, was his most important invention, though. His concept differed greatly from the conventional one in that, after being utilized to create force, the hydraulic fluid leaked into a different container. This was referred to as a "static" hydraulic press. The capacity of the hydraulic press to evenly distribute pressure throughout the die's whole length and width was one of its main benefits over mechanical presses. Bramah's machine was far more powerful than a mechanical press of the same size because of its greater working area. Throughout the 19th and 20th centuries, hydraulic press technology expanded rapidly throughout a range of industrial domains. The contemporary period of hydraulic press research and innovation started as soon as the machine was created. Modern presses have advanced in their historical development thanks to new technologies like the digital revolution. With the capacity to exert thousands of tons of force and maintain accuracy to the thousandth of an inch, these devices are more powerful and productive than before. Hydraulic press machines become essential research and development instruments as the study of fluids and pressures starts to spur innovation across many sciences and fields. It is generally acknowledged that the science created by Bramah and Pascal centuries ago yields the most precise and reliable presses. (Cohen, S. R., Kok, C., Luberda, B., & Tunney, S., 2023)

In the late 1990s, studies on some hydraulic press designs revealed the usage of molecular techniques. (S.P. Sinha *et al.* 1998) proposed a computer-aided design for a press. The in-plate membrane behavior and out-of-plane bending were modelled using shell elements with six degrees of freedom. For this study, the allowed deformation was set to 0.5 mm/m. The use of the finite element approach to machine tool construction has accelerated research. The systematic technique for investing the performance and design study of the welded structure of a 150-ton hydraulic press is described by (Mohamad M. S. 1992). The goal of modelling the construction of this press is to develop an empirical technique of calculation for determining the stiffness and strength of the press structure. The research examines the machine's theoretical and experimental models in order to determine an accurate optimal design analysis and future development of the current machine in the shortest possible time and at the lowest possible cost.

For the design of a mechanical press bed, (Cătălin I. 2013) contrasted the analytical and FEA methodologies. We employed open section frames with a closed contour section. CAD tools were used to create the 3D model, which was then simulated using a FEA tool. Stress readings are often minimal when compared to the traction-compression strength of the bed material, with larger values only recorded locally. The stress values obtained by classical calculus are larger than those obtained by FEA, confirming the premise that utilizing simply a calculation based on the simplified structure leads to an oversized structure.

Ankit, P., Kinnarraj, P. Z. & Ankit, R. P. (2014) demonstrated the use of finite element analysis to design and optimize the main component of a hydraulic press machine. The top plate, movable plate, and column design are the most important components. The weight of the load was estimated to be 300 tons. Every time a simulation is run, the design is tweaked. This project uses the sizing optimization method. Various size criteria, such as plate thickness and bar cross sectional areas, are varied in this work in order to construct the structure under safe settings. The mass of the bottom plate was lowered from 2263 kg to 1303 kg in the final concept. The distortion is raised from 0.055 to 0.22 mm, which is still within the acceptable range. The Von-misses stress is raised from 104 to 141 MPa, which is within acceptable limits and under safe operating conditions

In the design of press machines, size optimizing is a rather useful strategy. (Pritesh, P & Ankit, P. 2014) reported study on hydraulic press design. Stainless steel was used for the plate and framework, with a maximum permitted deformation of 5 mm/m. The optimization approach reduces plate weight significantly, but increases deformation and stress values.

MATERIAL AND METHOD OF FABRICATION

Materials

Details of the components and materials used for the fabrication of the hydraulic press machine parts.

Table 1. Details of components

S/No.	Name of part	Material
1.	Base	Mild steel
2.	Moveable plate	Mild steel
3.	Springs	Mild steel
4.	Upper plate	Mild steel
5.	Hydraulic Jack (30 tons)	Mild steel
6	Body	Mild steel
7	Frame	Mild steel
8.	Punch	Mild steel (Case hardened)

Specification:

Frame: The height will be 725 mm and width 380mm.**The C- channel** Width is 72x40mm The **Spring: Elastic** Type and the number. Of Quantity: 4 its free length: 230 mm. **Hydraulic Jack:** Capacity: 30 tons and its height: 300 mm

The method of fabrication started from:

1. Selection of materials. Suitability of materials for the fabrication depends upon the function the designed part would perform considering the physical and chemical properties of the materials.
2. Measurement to the required length of each part fabricated.
3. Marking out: Marking out was carried out and according to the dimension of the parts fabricated.
4. Cutting of the individual part of the hydraulic press parts using hacksaw and shear machine.
5. Drilling of holes for the use of bolt and nut in mounting to the frame.
6. Joining of the components together with the used of electric arc welding.
7. Filing of the edges of the metal components or protruding left in the cause of welding or cutting
8. Assembling of all the components to form a single whole component.

Construction details.

The following construction details just give the basic idea of the dimensions of different parts used in the design hydraulic press machine. The base is manufactured from 75x40 mm and two c-channels of length 380 mm welded together. The height can be adjusted using rods. The die used for a particular given shape is welded to the bottom plate. The dimensions of the frame are 725x380 mm of c-channel and 75x40 mm with two supports of c-channel. A spring having a free length of 230 mm is fixed between the middle plate and the frame so as to get the flexible movement of the movable plate. A punch is welded at the bottom of the movable plate. Jack is mounted in between the frame and the middle plate.

Slide 1: Materials for the fabrication

Slide 2: Marking out of the parts ready for fabrication

Slide 3: Fabrication of the main frame of the hydraulic press

Slide 4: Fabricated frame (Stand)

Slide 5: Coupled parts to the main fame

Slide 6: Front view of the assembled Machine

Side view of the hudraulic pressing machine

RESULTS

When testing the machine, different parts and components were detached, removed, and extracted with minimal effort. The machine was used in removing bearings, which was successfully done without any damage to the component where it was coupled, and it was also used in compressing some springs to detach the shock absorber of a motorcycle. These make it very vital and easy to operate by both skilled and unskilled persons.

CONCLUSION

The primary benefit of fabricating this machine is that the movement of mechanical devices can be initiated by hydraulic components such as actuators, which could be in the form of a lever to be applied manually and to work instantly. Conclusively, the machine can be used in carrying out compression of springs, removal of bearings, and also in detaching some components that may be difficult to either remove or extract with less effort and safety.

RECOMMENDATIONS

This fabrication is aimed at reducing the dangers being exposed to students and technicians in the mechanical workshops during the assembly, dismantling, or compressing of springs when performing different operations. It is recommended that the gauge be incorporated into the machine in order to know the amount of force that can be applied when carrying out certain operations with the machine.

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