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HYDRAULIC PAPER PLATE CUTTING PRESS WITH MULTIPLE DIE

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Abstract - *Comfort coupled with safety and simplicity is what man strives for. Our project has been to bring about both the eliminate human efforts in the industry our effort has resulted in development of a new "Hydraulic Paper Plate Cutting Press with Multiple Die". The project present a basic as well as very professional treatment of the subject in a very comprehensive, based on learning effort and understanding capability of today as per their levels. The process is simple and comfortable. Basic calculation, drawing, designing is included in the project. The salient features of our process can be listed as the mechanism used is very simple, easy for operation.*

INTRODUCTION

Linear actuators that transform fluid into mechanical power are called cylinders. They go by the names JACKS and RAMS as well. High pressure is applied to hydraulic cylinders, which result in significant forces and accurate movement. As a result, they are built to endure great forces and are made of sturdy materials like steel. Pneumatic cylinders can only be used at pressures of about 10 bar since using them at higher pressures can be hazardous due to the expanding nature of gas. As a result, they are made of lighter materials like brass and aluminum. It is challenging to accurately control the velocity of a pneumatic cylinder since a gas is a compressible material. Pneumatic and hydraulic cylinders operate on the same fundamental theories. The mechanical press work was done by this equipment.

It is made up of a hydraulic cylinder. According to the hydraulic circuit, oil passes through each component and begins to flow outward when the hand pump lever is pulled. This oil is connected to the P-port of the direction control valve, which drives the cylinder piston rod forward. The direction control wall conspiring of "P" port to "t" port, which is in the generally assisted position direction, can be changed, as can the direction of the fluid flowing, using the hand-operated direction control valve. The oil is connected from port "P" to port "T" when the lever is pulled outside, changing the valve's direction. Reversing the direction of oil flow causes the piston to go backward.

This completes the forward movement. The primary function of the press is to bring the ram to the home position. To do this, the hand lever of the direction control valve is pushed inside, changing the direction from P to B and A to T.

OBJECTIVES:

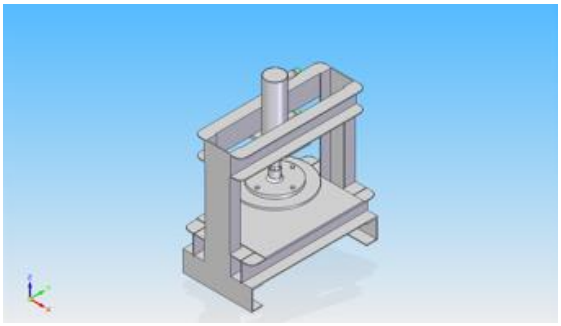
I. To make a device which is suitable economical for small Scale industries: taking in to consideration the cost factor this device is suitable for small scale as well as big scale industries

II. Taking safety as prime consideration: This device is safer in all respects.

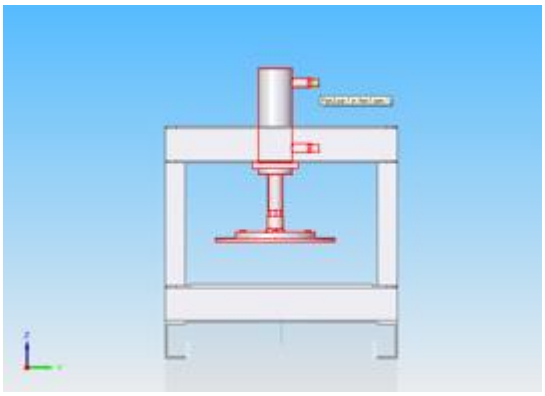
III. To build a device which can bend, cut, shape etc without applying greater force

METHODOLOGY:

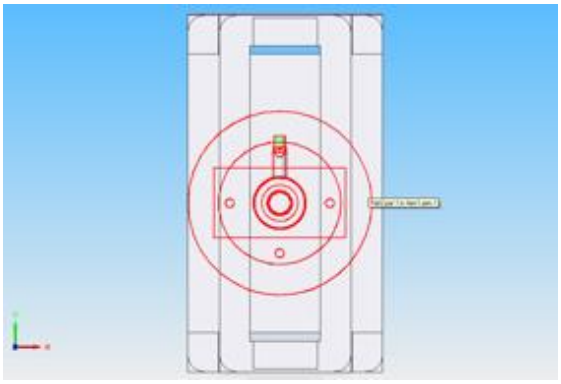
In achieving the aim of this work, parts of the machine were designed using various design equations. The detailed drawing of developed hydraulic press machine was done using solid edge software. In fabricating the machine, mild steel was used as the locally used sourced material. The use of mild steel is because its strength, rigidity, and machin ability fall within the design specification. It is also available and cost-effective. Apply principles of fluid dynamic to design a hydraulic system that optimizes power transmission, pressure control, and fluid efficiency. Consideration should be given to pump selection, and hydraulic circuit design.



Design of Hydraulic press machine



Side View



Top View

CALCULATION:

Determination of Volume of Hydraulic Tank is **V=LWH.**

The diameter of bolt was determined from equation according to Khurmi and Gupta at 2005 is **P=π4(dc)2σtn**.

Where P=External load acting on Cover plate

d_c=is the core diameter of the belt

but, **P=π4(D)2p**P**=π4(**D**)2**p**(3)**

Determination of tensile stress due to stretching of bolt is Pi=2840d(N) $Pi=2840d(N)$.

Determination of stress area on the belt is

Area=π4(dp+dc2)2

D=Pitch diameter

DETERMINATION OF WEIGHT OF THE PISTON OF THE HYDRAULIC PRESS:

The weight of piston was determined from Equation (6)

Density of metal (ρ)=Mass of metal(m) Volume of piston(V)p

The weight of piston was determined from Equation

Density of metal(ρ)=Mass of metal(m)Volume of piston(V)p /Mass of metal(m) Volume of piston(V)p.

But density of metal ρ_m **= 7850 kg/m^3**

Volume of piston **(Vp)=πr2h** **(**Vp**)=π**$r2h$**.**

Mass of Piston, **Mp = ρmVp**$Mp=\rho mVp$**.**

And Weight of Piston**(Wp)=mpg.**

Determination of the Weight of Press Cylinder:

The weight of press cylinder was determined by applying Equation.

Weight of cylinder **(Wc)=ρmVcg (**Wc**)=**ρmVc**g.**

where V_c=is the volume of cylinder.

Vc=π(r22−r12)h.

DETERMINATION OF OIL FLOW RATE:

Oil flow rate of the pump was determined using Equation

Q=AV$Q=AV$.

where Q is the flow rate in m^3/s, V is the velocity of flow in m/s, A is the area of pipe in m^2.

Equation (12) was used to determine the hydraulic power of the machine

Hydraulic Power **Ph=Qρgh**$Ph=Q\rho gh$**.**

where Q is the flow rate in m^3/s, ρ is the density of oil in kg/m^3, g is the acceleration due to gravity in m/s^2, h is the differential head in meters (m).

SPECIFICATION OF FRAME:

Height: 740 mm.

Width: 350 mm.

C-channel: 100x50mm.

Capacity: 10 tons.

Height of the cylinder: 260 mm.

MATERIALS USED IN PROJECT:

i Hydraulic Cylinder 10ton.

ii Hose pipe's coupling & Fitting

iii Paper Plate dies

iv Hydraulic Hand Pump

v Iron Road

WORKING PRINCIPLE: Oil circulation is there through all components as per hydraulic circuit, after operating the lever of hand pump, the oil coming from inlet to outlet of hand pump and outlet port is connected to port of direction control valve and direction control valve conspiring port to port normally aided position of direction control valve. When pulling the lever outside, the change of direction of valve from port to port, where one port is connected to another port connected to forward line of cylinder at that time ram moves down and shears sheet metal.

The cylinder is 40*25*130 stroke. 40mm is cylinder bore 25mm is piston rod diameter size. For sheet press pressure required is 234 Kg/cm^2 in tons 1075 ton capacity of six cylinder required 75*40 and stroke is 150.

DESIGN PROCEDURE:

i Functional Design.

ii Product Design.

iii Engineering Design.

A designer may take the following steps while creating a new product or one of its components:

i Provide a thorough description of the issues at hand, being as specific as possible. Include the reason behind the machine's design.

ii Choose the potential mechanism that will provide the desired motion.

iii Ascertain the force applied to it and the energy that each machine component transmits.

iv Choose the material that fits each machine component the best.

v Calculate the permissible or design stress while taking into account every element that influences the machine part's strength.

vi Determine the machine's significance,necessity, and application.

vii Issues with the machine's current requirements

DESIGN OF BOLT:

Bolt is to be fastened tightly also it will take load due to rotation. Stress for C-25 steel ft=120N/mm^2 Std nominal diameter of bolt is 8mm.

Let us check the strength:-

Also initial tension in the bolt when belt is fully tightened.

P=1420dN

P=1420*8N

P=1420dN

P=11360N

Therefore the total load on bolts

P=11360/500N

P=11860N

Being the four bolts the load is shared as

P=11860/4

=2965N.

2965=(Pi/4 dc^2)*ft

2965=(Pi/4) (8*0.84^2)*ft

Ft=83.59 N/mm^2

DESIGN OFCYLINDER BODY:

Material Used - Mild Steel. The chosen Bore diameter of the cylinder is 40mm The cylinder Bore diameter has finished attaining the capacity of machine under safe working stress. Since the Hydraulic pressure is 16Mpa We know that

P = F / A Where

Pressure in N/mm

F-Force in N

A- Area in mm

Therefore

16 - F / (pi / 4 * 40 ^ 2)

F = (pi / 4 * 40 ^ 2 * 16)

F = 20.10619KN

To find the thickness of the cylinder body

For closed end cylinder- Clavarino's equation (D/2) {[(ft+ (1-2p) P/(ft. (1-p) P) 1-11

Where 1 thickness of cylinder body D, Inner diameter of the cylinder body 40mm Working pressure 16 Nirah F, Allowable working stress 461 N/mm^2 Fos Factor of Safely Therefore - 461/4 115.25 N/b

μ = Possion ratio = 0.3 =(D/2)(sqrt(V) * \{(ft + (1 - 2mu) * P / (ft - (1 - mu) * P)) - 1\}=(40/2)(v\ (112.25 + (1 - 2 * 0.3) * 16 / (115.25 - (1 + 0.3) * 16) - 1) t = 20sqrt(121.65/94.45) – 1.

t = 2.695mm

For safe thickness adopted is 15mxn

Outer diameter of cylinder

D{g} - D{ I} + (2t)

D{9} = 40 + (2 * 5)

D{0} = 40 + 10

D{6} = 50mm

The cylinder 50/40 is used.

DESIGN OF RAM:

Material Used-Mild SteelGrade EN-Sbar (carbon % 0.45) In order to overcome frictional resistance more force must be exerted on top of the ram by fluid

- \{(pi / 4) * d ^ 2 * 16\}

- ((pi / 4) * 40 ^ 2 * 16)

F = 20.106KN

Load-F-AxP The tensile stress of the material is 135.5N / m * m ^ 2 Also F-Ax 20.106 x 10 = ((x/4)xd,x135.5) d, (20.106 x 10'x4)/(x 135.5) d{p} - 13.74mm But for safe and standard rods, therefore the diameter of piston is d_{2} + 25mm

To check for shear stress E - 26

The threads of M20 with 1. Som pitch is chosen

Core diameter of 25it - 18.093s

tmp/2

15/2

0,75mm

number of the For EN-3 bar 10 25MPa (from mushar wall in data t{y} = 20106.19 / (pi * 16.933 * 0.75n) n=20106.19/ \ pi * 16.933 * 0.75 * 90.25)5.58 6 Length of threads np = 6 * 1.5 9mm But the length chosen is 20mm.

Let t, be thickness of end cover Force on cylinder end cover

F-Dxtxa

Where tensile sets for mild steedc-107.5Mpa

F-2010619N

Therefore F-DxLx20106.19-40x14x107.5

L-2010619/(40 x 107.5) 4-4675mm

But due to threading and welding corrections of the end cover the thickness has to be particularly maintained

Hence 242.7 Piston Head

The design of piston head is designed where dieter of pitch<-39.970/39.94

Clearance of 0.004 for dimensions and clearance between and put head is 01026 which is kept for sliding

THE OTHER TWO FACTORS ARE

1) Stroke length of 150mm has to be inter coal.

2) Seals are to be fixed for no leakage To check buckling of piston rod. The piston has two ats

1. Piston head

2 Ram

The length of ram is 165mm Using the rankine's formula.

P(A)/(1+(1/K))

radius of gyration (B/A)

d, compressive stress

1. effective length

For one and fixed &other end free

1-212x165330mex

280 Nmand25ms

A-x/4(d)x/4 (25)4903875mm2x/(64 x 15"

-19174.75mmKH/A)19174759 490873)

6:25

Where Young's Modulas-207x10 m

A-280x207x10)-1.3708x10

Therefore

P-1250x400573) (11.3705410(330/6251)

Since the critical load for buckling455&pping 2016 which is less and hence so sala.

DESIGN OF TIE ROD-4 NO'S:

When material is being pressed the toe rod is in direct tension, using 4 tie rods.

F = F / 4

= 20.10619 * 10 ^ 3 / 4

= 5.0265 * 10 ^ 3 * N

F = A*sigma

Where tensile stress 100.25N/mm^2

5.0365x103 - (π/4 x d^2) x 100.25

d(5.0365x10x 4) / (πx100.25)

d_{1} = 7.99mm

To find the nominal diameter

d{1} = 7.99/0.84

d{1} = 9.511mm

As the weight of upper frame cylinder assembly has to be supported by pillars and must be stable and rigid

Therefore take d, 10mm

The cylinder tie rod is taken as 10mm.

PUMP SPECIFICATION:

MODLE: Hp-3

FLOW RATE: Flow capacity -3liters

TANK CAPICITY: Oil tank-30 liters.

PRESSURE: Max Working Pressure-350bar.

ADVANTAGES:

i The ability to process several pieces at once using multiple dies boosts overall productivity and cuts down on production time.

ii The hydraulic press's application range is expanded by the use of different dies for shaping, cutting, and punching, among other activities.

iii Higher production rates and enhanced efficiency can lower the total cost per item even with the initial investment in several dies.

iv Every die can be made for a particular task, guaranteeing excellent accuracy and uniformity in the pieces that are produced.

v Because numerous dies may be set up at once, manufacturing runs can be completed with less downtime, which boosts output.

vi The hydraulic press can generate a larger volume of parts in a given amount of time if it has many dies.

DISADVANTAGES:

i Managing multiple dies in a hydraulic press setup increases the complexity of the system. This complexity can lead to more maintenance requirements, higher chances of malfunction, and increased downtime for troubleshooting and repairs.

ii The initial cost of setting up a hydraulic press with multiple dies can be higher compared to a single-die system. Additionally, the cost of maintaining and replacing multiple dies adds up over time.

iii Accommodating multiple dies within the workspace of the hydraulic press requires more space, which might not be feasible in all manufacturing environments. This can limit the scalability of the operation or necessitate a larger facility.

iv Changing between different dies can be time-consuming, especially if each die requires significant adjustments or calibration. This setup time can reduce overall productivity and increase production lead times.

v Although having several dies increases versatility, in some situations it might also reduce the hydraulic press's adaptability. Changing out dies frequently might not be appropriate for small-batch manufacturing or quick production adjustments.

vi Every extra die increases the workload for maintenance. Regular inspection, cleaning, and possible repairs are necessary to keep numerous dies operating at peak efficiency. These tasks might raise operating expenses and downtime.

vii Operating a hydraulic press with multiple dies may require more specialized skills and training for personnel. This can add to the training costs and may limit the pool of qualified operators.

viii With multiple dies, there is an increased risk of misalignment, which can result in defective products, material waste, and potential damage to the press itself.

CONCLUSIONS

We have taken this project up as a real challenge, as we were not experienced in the hydraulics field. We began our work on this project, initially facing new hurdles. After the completion of the project, we tried to work in our college machine shop, and we were pleased to note that it meets the requirements for what it is meant. It can easily cut the bolts and nuts without applying much force

The maneuverability of the device is good, and its handling is simple. For commercial purposes, the efficiency of the device can be effectively improved by increasing its size.

To maximize the commercial potential of a device, there are several other ways to increase its efficiency, including upgrading its components and optimizing its software.

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REFERENCE:

i T. Patel, S. Sheth, P Patel, "Design and semi-automatic hydraulic blanking machine using PLC", 3rd national conference on innovation & emerging technology.

ii W. Boltan, Programable logic controller, Elsevier's science & technology.

iii M. Cechura, J. Stanek, M. Cirek, J. Hlavac, V. Kubec, Z. Chval, Final Report of Activity in Year 2008, Pilsen: ZČU, 2008.

iv S. Mrazek, Production of Forgings for Wheel sets- as a Part of Czech Forging Indurstu, Kovarenstvi, ISSN 1213-9289 Brno, 2013, pp.79-83.

v http://www.cvts.zcu.cz, (2013), University of West Bohemia, Accessed on: 2013-07-15.

vi H. S semakula, Manufacturing of Heavy Rings and Large Copper Canisters by Plastic Deformation, Stockholm, 2003, pp. 6–22.

vii M..Cechura, J. Smolik, Development and Innovations of Existing Design Solutions of Forming Machines, research report, CK-SVT-WP11, CVTS, Pilsen, 2012.