DESIGN & MANUFACTURING OF HYDRAULIC PRESS FOR STUFFING OPERATION

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Abstract: The development of engineering over the years has been the study of finding ever more efficient and convenient means of pushing and pulling, rotating, thrusting and controlling load, ranging from a few kilograms to thousands of tons. Presses are widely used to achieve this. The aim of this project is to integrate the mechanical system of hydraulic press with hydraulic system to facilitate the ease of stuffing operation Insertion process for inserting the stuffing assembly in outer shell of carried out by substrate assembly. The substrate assembly is formed by wrapping the insulating mat around the stuffing body prior to insertion into the shell structure. The assembly is then stuffed into the shell structure such that the mat is compressed between the shell structure and the substrate body. So for this process we have to design and develop the hydraulic power press machine to achieve the 15-ton pressure as per the company's requirement. During the assembly process, the pressure exerted against the substrate body must be high enough to achieve a desired retention pressure level between the substrate body and the mat, but cannot be too high such that the substrate body becomes cracked or otherwise damaged. Moreover, while inserting the stuffing assembly in outer shell of the silencer of engine it may be cause to generate the friction between side wall of the outer shell and stuffing assembly. It may be cause to serious damage to the stuffing assembly. Main objective is to reduce this damages and effects.

Index Terms **- Design, Hydraulic press, Stuffing, Automation**.

I. INTRODUCTION

A. Hydraulic Press

The Hydraulic press depends on Pascal's principle-the pressure throughout a closed system is constant. One a part of the system is a piston acting as a pump, with a modest mechanical force working on a tiny low cross-sectional space; the opposite half could be a piston with a bigger area that generates a correspondingly large mechanical force. solely small-diameter conduit (which a lot of simply resists pressure) is required if the pump is separated from the press cylinder. Pascal's law: Pressure on a confined fluid is transmitted unmitigated and acts with equal force on equal areas and at ninety degrees to the instrumentality wall. A small effort force acts on a tiny low piston. This creates a pressure that is transferred through the hydraulic fluid to an oversized piston. With the expansion and importance of light-weighting within the part and automotive business, a lot of applications area unit gift in Thermoplastics, Composites, SMC Sheet wrought Composites, RTM rosin Transfer Moulding, Greenwich Mean Time Glass Mat Transfer and Carbon Fibre Moulding. All of those applications need precise management and repeat-ability.

B. Stuffing Operation

Insertion process for inserting the stuffing assembly in outer shell of engine carried out by substrate assembly. The substrate assembly is formed by wrapping the insulating mat around the stuffing body prior to insertion into the shell structure. The assembly is then stuffed into the shell structure such that the mat is compressed between the shell structure and the substrate body. A certain amount of pressure is required to retain the substrate assembly within the shell structure.

During assembly of the substrate assembly, the mat is compressed against the substrate, and then the substrate assembly is further compressed within the shell structure during a subsequent shrinking operation. During the assembly process, the pressure exerted against the substrate body must be high enough to achieve a desired retention pressure level between the substrate body and the mat, but cannot be too high such that the substrate body becomes cracked or otherwise damaged. Moreover, while inserting the stuffing assembly in outer shell of the silencer of engine it may be cause to generate the friction between side wall of the outer shell and stuffing assembly. It may be cause to serious damage to the stuffing assembly.

C. *Problem Statement*

We have to manufacture a hydraulic press which assembles stuffing assembly into a cylinder vertically. A hydraulic press should apply a specific required amount of pressure on assembly parts for nit and fixed assembly. So in order to avoid all the circumstances the hydraulic power press machine should achieve the 15-ton pressure as per the requirement.

D. Objective

- Cost savings.

- High productivity Rate.
- Simple and smooth process.
- Increase the production rate.
- Reduction in inventory.
- Reduced labour cost.
- Increased machine utilization.
- Make machine structure simple for easy mounting.

II. INTRODUCTION TO MUFFLER ASSEMBLY

Muffler is component connected to exhaust of an internal combustion engine to reduce the sound generated at exhaust. Muffler is also called as silencer.

- Reactive muffler
- Absorptive muffler
- Combination muffler/silencer
- Heat recovery muffler/silencer
- Active silencer

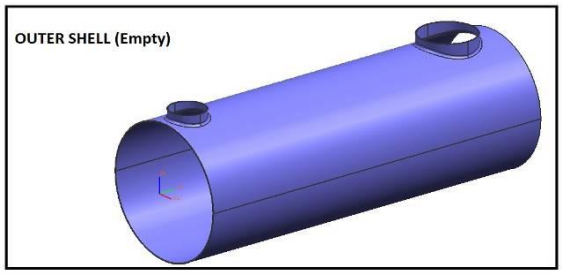

Fig.1 Outer shell

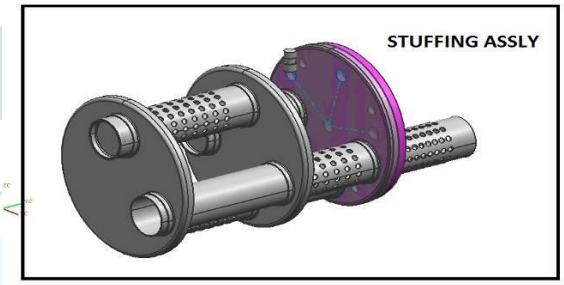

Fig.2 Stuffing Assembly

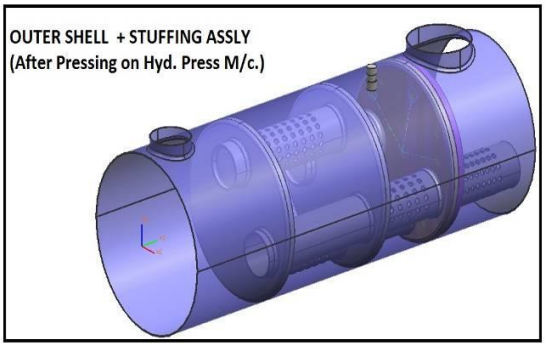

Fig.3 Final Assembly

III. DESIGN OF HYDRAULIC PRESS FOR STUFFING OPERATION

This Machine consists of various manufactured and standard parts. Their construction and working, with its function, are as follows.

A. Cylinder

It is fluid containing part. This is fabricated out of MS (ST52) & dully stress relieved & machined; has a stroke length of 1400mm.

Discharge/ Vane pump flow rate

$Q = 40$ liters per min. $= 40\times10^{-3}$ m^2/s

$Q = A \times V$

$V = 5092.95$ m/min

$V = 0.848$ m/sec

Stroke=0.8488×15

Stroke=1.2732 m

For safety purpose we have selected standard stroke length.

Stroke =1400mm

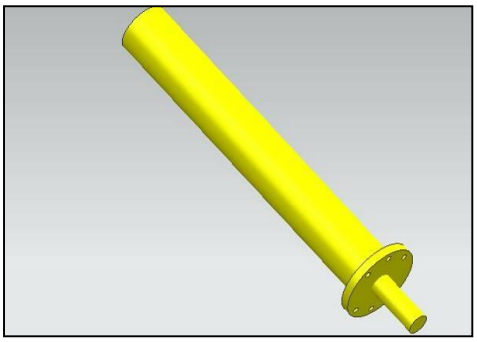

Fig.5 Cylinder

B. Base Plate

It is fabricated out of MS Plates (E250) & duly stress relived & machined; four holes are drilled at four corners centrally aligned for fixing of four support pillars one at each.

Assume, $N_f = 1.2$

Allowable bending stress

$$(\sigma b) = \frac{S_{yt}}{N_f}$$

390/1.2

$\sigma b = 325$ N/mm^2

According to stuffing assembly dimension we have selected dimension of plate.

L=1150mm

B=700mm

Functional requirement:

Length =1150mm and width=700mm of base plate is required for easy mounting of all components and easy pressing operation.

Total load acting on the plate =

150 kg (upper cylinder) + 400 kg (top plate) + 45 kg (1 pillar) + 380 kg (sliding plate) + 16 kg (toggle) + 3.50 kg (1 Bush) + 40 kg (support pipe) + 840 kg (Bottom plate) + 150 kg (slotting plate) + 35 kg (Base plate of fixture mfg.) + 147150 (Force by Cylinder)

= 1691734 N

Taking Moment at C:

Maximum moment = $\frac{WL\text{^}2}{8}$

$= \frac{(1691.734*10^{-3})\times(1000)\text{^}2}{8}$

= 21466.81 KN-mm

Moment of Inertia (I):

$I = \frac{b*t\text{^}3}{12}$

$= \frac{600\times t\text{^}3}{12}$

= $50\times t^3$ mm^4

b) Thickness of Plate:

By using Bending formula:

$$\frac{M}{I} = \frac{\text{Bending stress}}{y}$$

$$\frac{211466.81*10\text{^}3}{50\times t\text{^}3} = \frac{325}{t}$$

$t^2 = 13013.34$

t = 114.07 mm

$t \approx 115$ mm

t = 115 is selected for safe design.

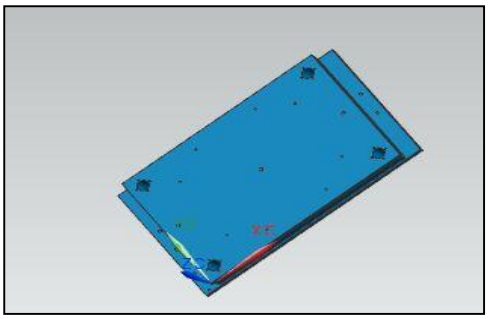

Fig.6 Base Plate

C. Side Support Pipe

In Hydraulic press side support pipes are used for supporting machine structure and taking all the stress generated to give the machine stability. Vibrations generated are also absorbed by the support pipes. This side support pipes are manufactured by Mild Steel. They have 60mm diameter and 1500mm length.

Maximum pressure = 210 bar

210 bar = 21 N/mm^2

$$Preure = \frac{\text{Force}}{\text{Area}}$$

Force = pressure × Area

$$= 21 \times \left(\frac{\pi}{4} \times 100^2\right)$$

Force = 1649336.143 N

Assume $N_f = 1.5$

Allowable stress:

$$\sigma_c = \frac{\text{Sut}}{\text{Nf}} = \frac{390}{1.5}$$

σ_c = 260 N/mm^2

$$Stress = \frac{\text{Force}}{\text{Area}}$$

$$26 = \frac{1649336.143}{\frac{\pi}{16} \times d^2}$$

d = 59.87 mm

d≈60 mm

d = 60 mm is selected for safe design.

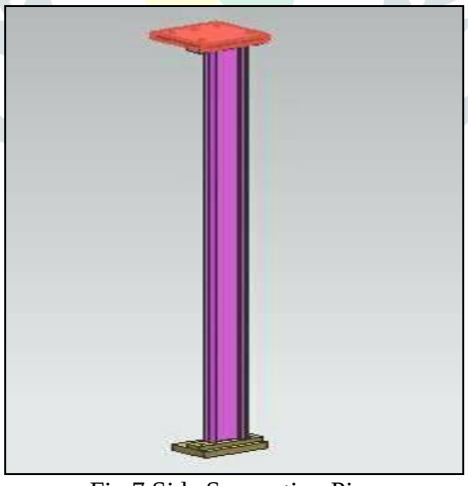

Fig.7 Side Supporting Pipe

D. Top Plate.

This plate is similar to the base plate. It is fabricated out of MS Plates (E250) & duly stress relived & machined; four holes are drilled at four corners centrally aligned for fixing of four support pillars one at each. Difference in Base and Top plates is position of the plates. As per name Top plate is located at the top of the machine while Base plate is fixed on the frame of machine.

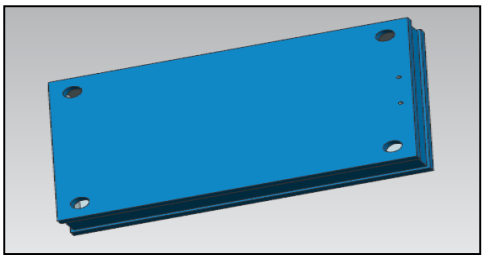

Fig.8 Top Plate

E. Sliding Plate

It MS plate fixed on the four pillars. It can move vertically upward and downward. It is attached to the cylinder piston for movement and movement of the sliding plate gives required work. Stuffing substrate is attached to the sliding plate. As with cylinder piston Sliding plate moves or slides downward substrate assembly gets stuffed into a cylinder shell.

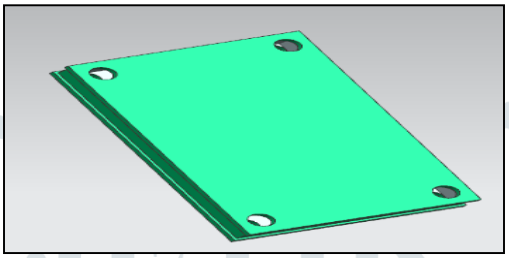

Fig.9 Sliding Plate

F. Pillar

Four Pillars are fixed at four holes on Base plates. Top plate is fixed at top of the Pillars. This Pillars are centrally aligned. Main objective of the Pillars is to give support to the sliding plate and allow its vertical motion smoothly. Diameter of pillar is 60mm.

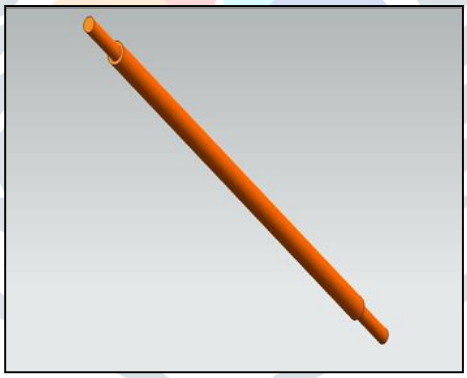

Fig.10 Pillar

G. Frame

Frame is lowest portion of the Machine. It is manufactured and attached to give support and rigidity to Machine. Dimensions are 1250*700 mm.

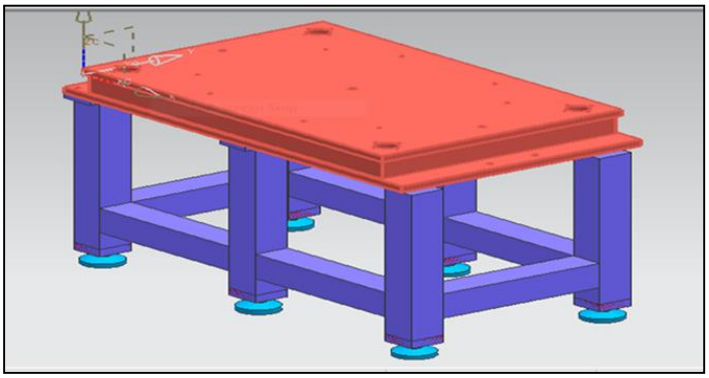

Fig.11 Frame

H. Power Pack Unit

It is a power source of a hydraulic press. Power Pack Unit includes Gear pump driven by electric motor of required brand, control valves, connecting hoses and pipes etc.

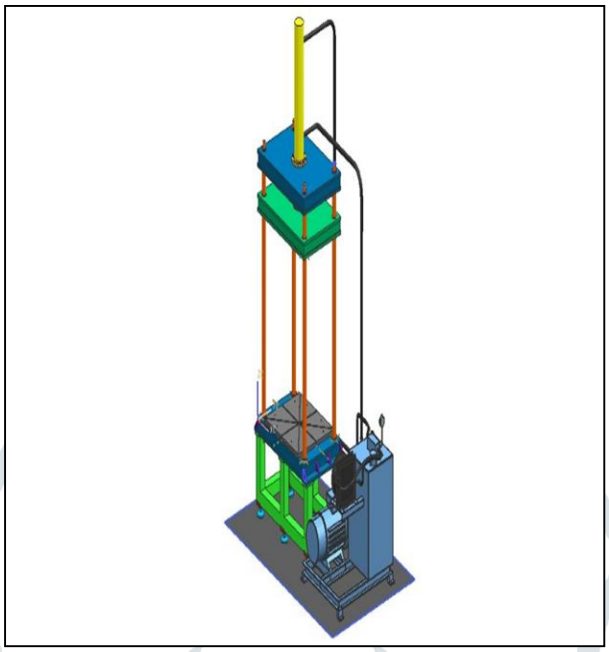

Fig.12 Hydrualic Press with Power Pack Unit

Safety instruments are fixed on the power pack like flow control valve, check valve, direction valve, pressure control valve, oil filters, etc.

IV. RESULT AND DISCUSSION

Fig 13. Final Product

- After the trial of the machine it was found that, the machine successfully archived the 15ton pressure with some vibrations.
- The machine can smoothly insert the stuffing assembly in outer shell without any friction between the walls of outer shell and stuffing assembly.
- Thus, the machine has reduced the time of production, hence it is more efficient.
- The machine can operate at both auto and manual mode, therefore operator efficiency also increases

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