A Project Report on Fabrication of Mini Hydraullic Jack

M.Hemanthkumar[1], Mr.P.Vidyasagar [2], M.Rakesh[3], S.Nikhilesh[4], A.Sivanandhana[5], Mr.M.Talpagiri [6], Mr.G.Ashok[7]

[1,2,3,4,5] *UG Scholar, Mechanical Engineering, Gokula Krishna college of engineering, sullurupeta, India*

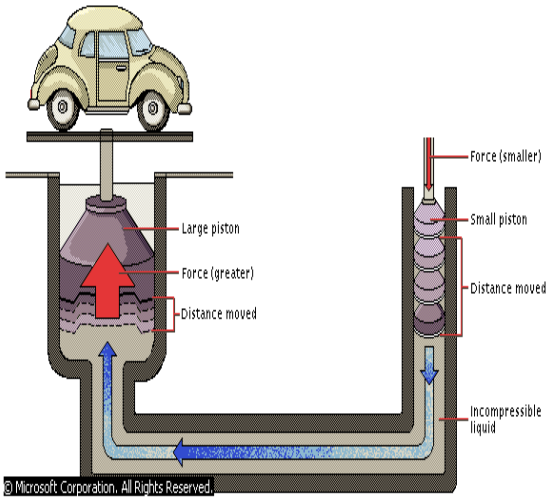
[6,7] *Assistant Professor, Mechanical Engineering, Gokula Krishna college of engineering, sullurupeta, India*

***Abstract*— Here we study the fabrication of a mini hydraulic jack that uses hydraulic power to operate the jack in vertical movement. Our system consists of a smartly designed hydraulic jack that is capable of lifting relatively heavy weights as compared to its size. The system consists of a lifting jack mechanism made out of light weight but strong materials. This mechanism is then powered by a syringe in a way as to achieve the most weight lifting mechanism as compared to its size. The system consists of a bed mounted on top of the mechanism where the car or weight to be lifted is to be placed.**

Keywords: **hydraulic jack, syringe.**

INTRODUCTION

The word hydraulics is based on the Greek word for water, and originally covered the study of the physical behavior of water at rest and in motion. Use has broadened its meaning to include the behavior of all liquids, although it is primarily concerned with the motion of liquids. Hydraulics includes the manner in which liquids act in tanks and pipes, deals with their properties, and explores ways to take advantage of these properties. Although the modern development of hydraulics is comparatively recent, the ancients were familiar with many hydraulic principles and their applications. The Egyptians and the ancient people of Persia, India, and China conveyed water along channels for irrigation and domestic purposes, using dams and sluice gates to control the flow. The ancient Cretans had an elaborate plumbing system. Archimedes studied the laws of floating and submerged bodies. The Romans constructed aqueducts to carry water to their cities. Torricelli, French physicist, Edme Mariotte, and later, Daniel Bernoulli conducted experiments to study the elements of force in the discharge of water through small openings in the sides of tanks and through short pipes. During the same period, Blasé Pascal, a French scientist, discovered the fundamental law for the science of hydraulics. Hydraulic jack is based on the Pascal's law which states that increase in pressure on the surface of a confined fluid is transmitted undiminished throughout the confined vessel or system.



It is a short stroke hydraulic lift which is fed from hand pump. The hydraulic jack may be portable. This is extensively used for lifting automobiles usually to facilitate and repair. And for replacing the punctured wheels. The hydraulic jack is perhaps one of the simplest forms of a fluid power system. By moving the handle of a small device, an individual can lift a load weighing several tons. A small initial force exerted on the handle is transmitted by a fluid to a much larger area. The operation of hydraulic jack depends on ―Pascal's law which states that when a fluid is at rest in a closed vessel and if a certain pressure is applied at any point the pressure will be transmitted equally in all direction. Mechanical advantage is obtained by a practical application of Pascal's law of transmission of fluid pressure. Two pistons of different sizes operate inside two cylinders

suitably connected with a pipe so that pressure in each is the same. If 'P' is the pressure and 'A_1' 'A_2' are the cross sectional area of cylinder 1 and 2 respectively, then a force 'F_1' applied to the smaller plunger will lift the load (W).

Here,

P= pressure of the fluid

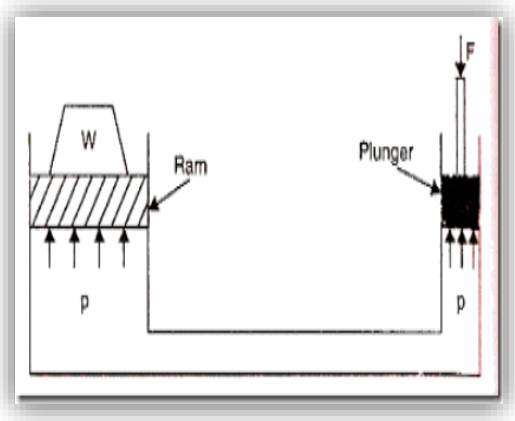
A_1 = small cylinder area

A_2= larger cylinder area

F_1 = force acting on smaller plunger

W = load lifted

If the volume of liquid is constant. The displacement of large piston will be proportionate to smaller plunger.



LITERATURE REVIEW

P.S. Rana et al. (2012)

In this research paper they have come up with the idea of Integrated Automated Jacks for 4-wheelers in which the jack is provided on both the sides of the vehicle and can be easily operated with the help of a button placed at the dashboard of the vehicle. This jack is specially designed to overcome the difficulties faced by the senior citizens and ladies who find it difficult to manually operate the jack.

Mohammed Abuzaid et al. (2013)

In this research paper they have focused on an inbuilt hydraulic jack system which is attached to automobile vehicle on front and rear part of the chassis. There is a front suspension hydraulic jack that is mounted centrally to the front suspension of an automobile between its front wheels. There is also a rear suspension hydraulic jack that is mounted centrally to the rear suspension of the automobile between its rear wheels. The system operates from a compressed fluid reservoir tank that has connections for the front and rear car jack outlets.

Mayank Agrawal et al. (2018)

This paper represents a study over in- built hydraulic jack system and shows its benefits over traditional mechanical jack system. The design of inbuilt hydraulic jack is also studied and modified to require extent which can be seen by analysing design of prototype. An Inbuilt hydraulic jack system can be easily operated by buttons provided on the dash board of the vehicle. The jack will be installed on chassis of the vehicle. The motive behind using this system instead of a conventional mechanical system is the more power produced by the system and simple in design as compared to a conventional design. As the hydraulic oil is incompressible so the lifting capacity is more in comparison with the pneumatic system which operates on air which is compressible.

Parth M. Patel et al. (2013)

This paper describes Implementation of Automatic hydraulic jack Mechanism in a four-wheeler itself. The jack will be powered by the battery. So, at a time of puncture to replace the wheel one has to just press the button and the jack which is fitted in the car itself will lift the car.

METHODOLOGY

Fabrication is an important industry that involves cutting, manipulating and assembling materials to produce desired structures. And while different fabrication companies use different techniques, most rely on three basic processes: cutting, bending and assembling.

Cutting

The first process of fabrication is cutting. During this process, the metal fabrication company cuts one or more pieces of raw metal for use in the creation of a new metal structure or product. Whether it's steel, aluminium, iron or any other common type of metal, though, cutting metal requires special tools. Some metal fabrication companies use torches to cut metal, whereas others numerical control (CNC) machines involving lasers or water jets. When finished, the company will have clean, appropriate-sized sheets or sections of metal with which to work

Bending

After cutting raw metal, metal fabrication companies must bend it. Again, there are different ways to bend metal after cutting it. Some metal fabrication companies hammer the metal sheets or sections into the desired shape. Hammering can be done by hand, or it can be done using a machine (power hammering). Recently, though, many metal fabrication companies have begun using press brakes to bend their metal. This heavy industrial machine automatically presses metal sheets and sections into a specific shape when engaged. It essentially clamps the metal between a punch die, forcing the metal into the desired shape.

Assembling

The third and final process of metal fabrication is assembling. As the name suggests, this process involves assembling the metal sheet or sections into the desired finished product. Assembling is typically performed via welding, though other steps may be included in the process as well. In addition to welding, for example, metal fabrication companies may crimp seams, apply screws or other fasteners, and apply glue. After assembling the metal, the company will finalize the product before shipping and selling it to its customers.

Metal fabrication is a driving force behind the country's ever-growing manufacturing sector. Although there are countless machines and techniques used by metal fabrication companies, must rely on a three-step process that consists of cutting, bending and assembling. These three processes allow metal fabrication companies to transform raw metal materials into new products.

DESIGN CONSIDERATION

Several structural design considerations should be taken into account for economical and efficient manufacturing. Many of these apply to other joining methods, and all apply to both subassemblies and the complete structure.

1. The device should be suitable for local manufacturing capabilities.
2. The attachment should employ low-cost materials and manufacturing methods.
3. It should be accessible and affordable by low-income groups, and should fulfill their basic need for mechanical power
4. It should be simple to manufacture, operate, maintain and repair.
5. It should be as multi-purpose as possible, providing power for various agricultural implements and for small machines used in rural industry.
6. It should employ locally available materials and skills. Standard steel pieces such as steel plates, iron rods, angle iron, and flat stock that are locally available should be used. Standard tools used in machine shops such as hacksaw, files, punches, taps & dies; medium duty welder; drill press; small lathe and milling machine should be adequate to fabricate the parts needed for the dual-purpose bicycle.
7. It should make use of standard parts wherever possible.
8. The device should adapt easily No permanent structural modification should be made
9. Excessive weight should be avoided, as durability is a prime consideration.

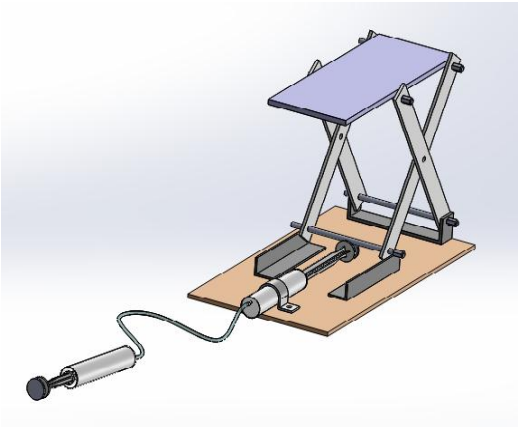
DESIGN PROCEDURE

1. Definition of problem
2. Synthesis
3. Analysis of forces
4. Selection of material
5. Determination of mode of failure
6. Selection of factor of safety
7. Determination of dimensions
8. Modification of dimensions
9. Preparation of drawings
10. Preparation of design report

MANUFACTURING CONSIDERATIONS IN DESIGN

- Minimum total number of parts in a product
- Minimum variety of parts
- Use standard parts
- Use modular design
- Design parts to be multifunctional
- Design parts for multiple use
- Select least costly material
- Design parts for ease of manufacture
- Shape the parts for minimizing the operations.

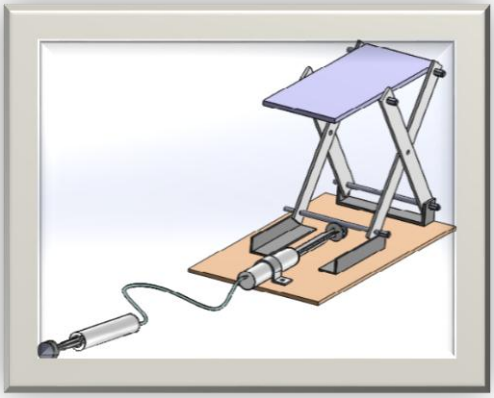
DESIGN DRAWING AND PICTURES



COMPONENTS

Syringe
Pipe
Lifting frame
Base Frame (Bed)
Supporting frame
Joints & screws

PARTS DESCRIPTION



We have used syringe as plunger.

Material used-
Base plate – acrylic – 150mm x 250mm, thickness – 6mm
Top plate – acrylic – 80mm x 180mm, thickness – 6mm
Screw – M6 for all the joints
Arms – MS plate 2mm thickness – 15mm x 180mm

RESULTS

Successfully we achieved the desired result by using "Design and Fabrication of Mini Hydraulic Jack" that uses hydraulic power to operate the jack in vertical movement.

Let,
F_1 = Force applied on smaller plunger
F_2 = Output Force (Ram side)
A_1 = Surface area of piston (Plunger side)
A_2 = Surface area of piston (Ram side)
Now, since the interacting fluid is incompressible fluid, the pressure inside the system will remain constant.
i.e. $P_1 = P_2 = P$ ….(1)
we know, $P = \frac{Force}{Area}$
From eq. (1),

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

Suppose, $D_2 = 4D_1$
Then,

$$\therefore F_2 = F_1 \frac{A_2}{A_1}$$

$$\therefore F_2 = F_1 \frac{\frac{\pi}{4}(D_2)^2}{\frac{\pi}{4}(D_1)^2}$$

$$\therefore F_2 = F_1 \frac{16(D_1)^2}{(D_1)^2}$$

$$\therefore F_2 = 16F_1$$

i.e., Output force F_2 will be 16 times input force F_1.

CONCLUSION

An efficient Hydraulic Jack lifting Mechanism is fabricated with help of Mild Steel, Acrylic material, liquid water, screws and bolts. Fabrication processes of marking, cutting, assembling and joining we employed.This project work was tested and it worked appropriately. Sizes of loads lifted were determined by the specifications from their manufacturers.

REFERENCES

[1] M.M. Noor, K. Kadirgama and M.M. Rahman, Analysis Of Auto Car Jack, National Conference in Mechanical Engineering Research and Postgraduate Students, FKM Conference Hall, UMP, Kuantan, Pahang, Malaysia, 26-27 May 2010, 198-203.
[2] MohdAbuzaid, Mohd Hasnain, ShabajAlam, Sohail Khan and Surendra Agarwal, Inbuilt Hydraulic jack in Automobile vehicles, International Journal of Innovations in Engineering and Technology, 2(2),2013,76-84.
[3] Tarachand G. Lokhande, Ashwin S. Chatpalliwar and Amar A. Bhoyar, Optimizing Efficiency of Square Threaded Mechanical Screw Jack by Varying Helix Angle,

International Journal of Modern Engineering Research,.2(1), 2012, 504-508.

[4] P.S. Rana, P.H. Belge, N.A. Nagrare, C.A. Padwad, P.R. Daga, K.B. Deshbhratar and N.K. Mandavgade, European Journal of Applied Engineering and Scientific Research, 1 (4), 2012,167-172.

[5] Prashant Kumar Srivastav, Vipin Kumar Pandey, Shailesh Kumar Maurya, Ajit Tiwari, Jawed Rafiq and S.K. Dwivedi, Highly Efficient Motorized Screw Jack, International Journal of Computational Engineering Research, 3(5), 2013, 35-41.

[6] A. S. Akinwonmi and A. Mohammed, Modification of the Existing Design of a Car Jack, Journal of Emerging Trends in Engineering and Applied Sciences, 3 (4), 2012, 581-588.