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Research Article

Design and Modification in the Existing Model of Trolley Jack 20261

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Abstract

A Jack is a device which can lift heavy loads with an application of a small force. This scheme is followed to lift cars with the help of car jacks. Hydraulic powered jacks are more influential than other jacks. The present work is focused on the design and modification in the existing model of trolley jack 20261. The former model was carefully studied in terms of the design features, specifications, capacity and with the help of new methodology an attempt was made to fabricate a new design that can produce greater capacity within the economic range. The work consists of the fabrication of the new model and projects the advantages of the new design. The new design was successfully made and was able to fulfill all the required objectives. The following work can be a new eye opener for the design engineers dealing with design of jacks.

Keywords: *trolley jack, bottle jack, hydraulic jack*

1. Introduction

An automotive jack is used to lift whole vehicle or just a section of it to make the repair work facile.

Today, many people are familiar with the jack that is included with their vehicle. Some vehicles bear screw jacks and others carry a hydraulic jack. Automotive jacks are of three types mainly:-

1. Screw Jacks
2. Trolley Jacks
3. Bottle Jacks

Each has its own advantages and disadvantages. Screw jack is lesser in cost, as compared to trolley jacks and bottle jacks. While trolley jack and bottle jack can provide a greater lift with lesser application of force. Blaise Pascal studies fluid hydrodynamic and hydrostatics, centralized on principles of hydraulic fluid. His inventions includes the hydraulic press which multiplied smaller force acting on a larger area into the application of a large force totalled over a smaller area transmitted through the same pressure at both locations (Blaise Pascal,1623-1662).

One of the exceptional feature of a hydraulic jack is it can lift heavy loads despite it itself has a light weight and is portable. Joseph Bramah was working on a press. William Geroge Armstrong (sir-1st Baron) a contemporary of Bramah, was an industrialist and the founder of Armstrong Whitworth. He first designed a rotary engine from the concept but later moved it to a hydraulic piston type of design that could move a crane. At a time when the scientific field of hydraulic engineering was not yet recognized Armstrong and Bramah were applying Pascal's laws to their inventions. Joseph Bramah got a patent for his inventions of the hydraulic press in 1795.(Joseph Bramah, 1785).

Hydraulic Jack works on the principal of Pascal. It states that pressure on a interned liquid is conveyed evenly in all the directions. The jack is operated with the help of liquid that is preferably oil as it can lubricate the parts of the jack as well.

When the plunger is pulled upwards, the fluid is pulled from the reservoir through a check-valve suction pump. When the plunger is pressed, it sends fluid through another valve into the main cylinder. The suction valve opens when the plunger is pulled again. A document was compiled which includes research information pertaining to portable and stationary lifting devices that could be found in most mechanic shops. The purpose of this research is to gain information related to the development of a belly pan jack to aid in the removal and installation of belly pans on large excavating equipment. This research includes information on current state of the art developments in this field as well as related patents and subsystems thereof. The areas covered give a good base of information on which to develop new ideas (Gibbs et al, 2010).

The force exerted by the fluid in the main cylinder aids in the movement of piston in the upward direction.

2. Material and Methods

In an existing **Trolley/Floor jack -Model No. 20261** (Fig. 1) a bottle jack was placed horizontally whose piston pushes on the short end of a bell crank with the longer lifting arm providing the vertical motion to a lifting pad or

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the saddle, kept horizontal with a horizontal linkage. Floor jack usually include castors and wheels, which are able to bear the load placed on the lifting pad. This mechanism provides an arrangement which is low profile when collapsed, for easy maneuvering underneath the vehicle, while allowing appreciable reach.

Fig. 1: Floor jack -Model No 20261 (Trolley Jack)

2.1. Methodology adopted for the proposed design

The proposed design had the following Objectives

i. To enhance the capacity of the existing model
ii. To increase the maximum height of the lifting arm of the existing Jack
iii. To make the Jack more firm to bear greater amount of load.

For that purpose the following relations were used for design calculations

a) Length of stroke = 1.25 x D
Where D = diameter of cylinder

b) Length of cylinder = 1.15 x Length of stroke

c) Area of cylinder = $\pi/4\ D^2$

d) Pressure = Load/Area

∴ Load = Pressure x Area

Table 1 Material used

S. No.	Name of Part	Material
1	Wheels	Cast Iron
2	Extending Rod	Mild Steel
3	Extending Plate	Mild Steel
4	Spindle Lifting Arm	Mild Steel
5	Anchor Bolt	Mild Steel
6	Nut And Bolt	Mild Steel
7	Saddle	Mild Steel
8	Saddle Base Plate	Mild Steel
9	Cylinder	Mild Steel

The material used is mild steel as it is one of the common and least expensive steel used. It can be weld easily and is relatively hard.

The oil used is highly viscous, dense and stands for a high evaporation point.120°F(50°C) - 140°F(60°C) is the optimum working temperature for the oil in the jack.

2.1.1. Specifications of the proposed design

i. Hydraulic cylinder
ii. Piston
iii. Valves
iv. Hydraulic oil

Fig. 2: Modified Design of existing Model 20261 (Trolley Jack)

Fig. 2 shows the **Modified Design** of the existing Model 20261 (Trolley Jack).

After the Changes adopted, following were the findings: -

- The capacity of the jack was increased by replacing the existing piston with a piston of larger capacity.
- A detachable extension rod was provided for increasing the maximum height of the lifting arm.
- Six legs (three on each side member) were installed for proper fixture of jack on the ground and to make the jack capable of bearing greater load.

Conclusions

1. The Stands provided in the Jack made the jack to stand firm when it was engaged.
2. Load placed on a greater height could be lifted properly.
3. The final size of the jack was compact.
4. Less effort was applied to lift a heavy load.
5. Less maintenance was required.
6. The Jack was economical in cost.

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