Design and Fabrication of Mini Hydraulic Jack

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Abstract –
Integrated with the car's current brake system, this article discusses the inbuilt hydraulic jack that may assist overcome the drawbacks of the mechanical jack that comes with the vehicle. The built-in hydraulic jack allows us to extend the side of the car with a punctured tyre by welding piston cylinders to the chasis, using the pressure of the brake fluid that was previously only employed for braking. In a piston cylinder system, when the brake pedal is pressed, pressurised brake fluid travels via non-returning valves and extends the piston, raising the pierced side of the car. Compared to previous ways, this not only saves a lot of time to change the flat tyre, but it also minimises the mechanical effort needed to move the car. In this context, "key words" refer to hydraulic fittings and pipes, a master cylinder, a ball valve, a non-return valve, a five-way directional control valve, and the chassis.

1. INTRODUCTION

A hydraulic jack involves a fluid usually oil to push against a piston in a cylinder to lift load. Theworking of hydraulic jack is based on Pascal's principle. The jack uses compressible fluid, that isforced into a cylinder by a plunger. Oil is mostly used for the liquid because it is self-lubricating andhasstabilitycompared withothers.

1.1 Pascal'slaw-

In the middle of the 17th century, Blasé Pascal came up with the first law of hydraulics. He found that pressure on a fluid had the same effect in either direction. According to his law, the pressure within a closed fluid remains constant regardless of its direction of travel and exerts an equal and perpendicular force on all surfaces inside the container.

1.2 HydraulicJack

To raise a weight, a hydraulic jack uses a pressurised fluid, often oil, to press against a cylinder's piston. A plunger is used to drive the compressible fluid into a cylinder. The liquid is often made of oil because to its stability and self-lubricating properties. The plunger draws in the liquid as it rises.

by use of a suction pump with a check valve. Once again, a cylinder is filled

with liquid while the plunger is lowered via another valve. When a suction ball is employed within the cylinder, the cylinder is sealed and pressure builds up inside. Every time you pull the plunger on the jack, the suction valve opens. When oil is pumped into the cylinder, the discharge valve, which is located outside the jack, opens. The gadget can lift bigger weights thanks to the pressure of the liquid. In recent years, the reliance on hydraulics has grown substantially across several sectors. There is a pressing need to become proficient in the art of oil hydraulic system applications and maintenance since this method of power transmission in contemporary machines only emerged a few decades ago in the West, but has only recently found favour in Indian industries. In this critical area of contemporary engineering, there is a significant skills gap between the supply and demand for qualified workers in India.

ITERATURE REVIEW

2.1P.S.Rana etal. (2012)[2]

In this research paper they have come up with the idea of Integrated Automated Jacks for 4-wheelersin which the jack is provided on both the sides of the vehicle and can be easily operated with the helpof a button placed at the dashboard of the vehicle. This jack is specially designed to overcome thedifficultiesfacedbytheseniorcitizensandladies whofinditdifficultto manuallyoperatethejack.

2.2 MohammedAbuzaidet al.(2013)[3]

This study primarily examined an integrated hydraulic jack system that is fastened to the front and rear sections of a vehicle's chassis. A hydraulic jack for the front suspension is typically located between the vehicle's front wheels and situated in the middle of the front suspension. Also, between the car's back wheels is where you'll find the hydraulic jack for the rear suspension. A reservoir tank for pressurised fluid powers the system; it connects to the outputs of the front and back automobile jacks. 2.4 The Agrawal, Mayank, and colleagues (2018) [4]The advantages of an in-built hydraulic jack system over a conventional mechanical jack system are shown in this research. By examining the prototype's design, we were able to study and modify the integrated hydraulic jack to the required extent. There are controls on the dashboard that make using the vehicle's built-in hydraulic jack mechanism a breeze. The vehicle's chassis is where the jack will be mounted. The increased power output and relative simplicity of this technology make it an attractive alternative to more traditional mechanical systems. In contrast to pneumatic systems, which use compressible air, hydraulic oil has an incompressible nature, allowing for a greater lifting capability.

2.3 ParthM.Patelet al.(2013)[5]

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 justpressthe buttonandthejackwhichisfitted inthe car itself will liftthe car.

2.PROBLEMSTATEMENT

Nowadays, driving an automobile is normal and simple; the troubles emerge when you have to replace or repair it. Despite the fact that the automotive industry has seen tremendous technological advancements in recent decades, many individuals still encounter significant challenges while trying to replace a flat tyre in an isolated area where it is impossible to locate a repair shop. The driver's sole option is to dismount the vehicle, gather the necessary equipment, and change the tyre by hand, a process that may be very arduous, exhausting, and time-consuming. This issue has been somewhat, but not entirely, remedied by the introduction of tubeless tyres. After a few kilometres of driving, you will also need to change the tubeless tyre if it becomes punctured. But with the concept of an integrated hydraulic auto jack, changing a flat tyre takes less time and requires less effort. While the built-in hydraulic auto jack does have an upfront expense, it will ultimately benefit the driver by making their work easier when the car has a flat tyre.

3. FIELDSURVEY

Up until now, there hasn't been a machine or equipment that can solve the issue of a punctured tyre, like the one described in this article, which not only saves time but also minimises the effort required to change the tyre. We have conversations with folks who drive often and go great distances to determine the real demand for this concept in the field. The following are some key pieces of advice and insights shared by frequent drivers:- A Conversation with a typical OLA taxi driver in the Delhi NCR area. He claims that even while driving slowly, tyres might acquire punctures in certain parts of Delhi because of the poor and uneven roads. The fact that his vehicle has tubeless tyres doesn't make it any easier when he has to change a flat tyre in the middle of the hot sun while his passengers are inside, all in a rush to get where they're going. Following his advice, one should create a device that requires less human labour. At Arjun Marg, DLF Phase -2, Gurugram, I had an interaction with another female employee. If you're like her and you're in a rush to get home after a hard day at the office, you could be in for a rude awakening if your tyre blows out while you're on the road and there's no repair in the area. Because it requires so much

physical work, changing a tyre may be particularly challenging for a woman, especially if she is already tired. She claimed to live in a technologically advanced future when fixing a flat tyre would be a breeze and would need little to no human intervention.

Figure1:-https://carfromjapan.com/article/drivingtips/drive-short-distance-with-flat-tire/

4. OVERLOOKATCURRENTTECHNIQUES

Somecurrent techniquesare:-

1. FloorJack

2. ScissorJack

3. HydraulicBottleJack

4. Hi-LiftJack

Thesemanuallyoperatedjacksinvolesmorehumaneffortandaretimeconsuming.Theoperator also needs to identify the current position where the jack needs to be placed in order to safely lift thecar which sometimes become a quite difficult job. Therefore, there is a need for an alternative methodinthemodernworldwherethedisadvantagesofthe earlierdiscussedjackscanbeovercomed.

6.DESIGNMETHODOLOGY

The following procedures were involved in the machine's design and fabrication: -

1. The evaluation of the market was located.

2. Designed the first model prototype.

3. The plan was assessed.

4. We made note of the component specifications.

5. The following were noted: computations were performed.

Step 6: The machine's main parts were put together.

7. The built-in hydraulic vehicle jack was manufactured.

After that, we did some testing and trial runs.

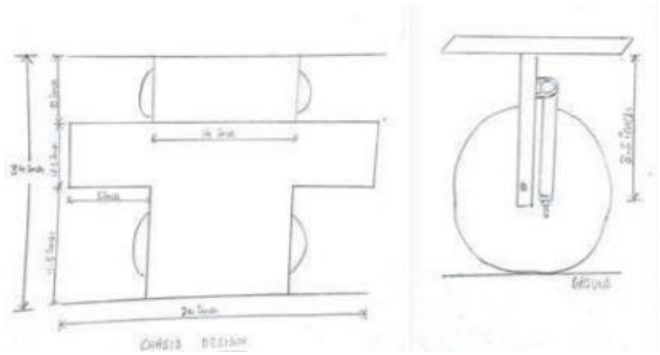

Figure3:-Designof thechasisand wheelbasemade on paper.

Figure4:-Completelywelded chasis.

7.MAINCOMPONENTSUSEDINTHEPROTOTYPE

1. Singleactinghydrauliccylinderorjack

2. Manifold

3. Mastercylinder

4. Nonreturnvalve

5. Ballvalves

6. Hydraulicfittingandpipes

7. Fivewaydirectionalcontrolvalve

8. Diskbrakes.

Figure 5:- Main components used in the prototype.

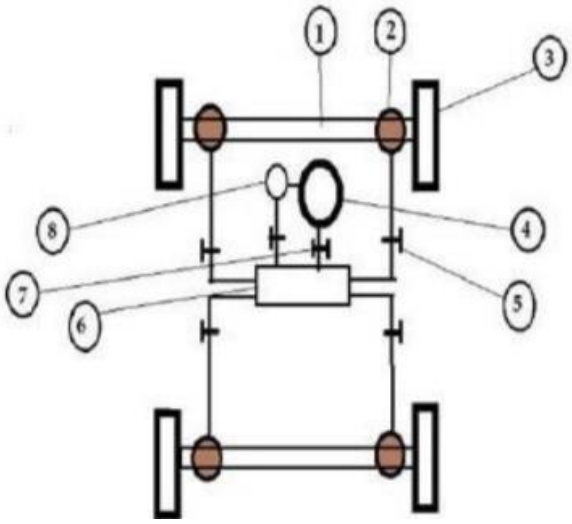

Figure6:-Componentsused intheprototype [MayankAggarwal 2018]

8. WORKINGANDPRINCIPLES

8.1 HydraulicBrakeSystem

Working

A hydraulic brake is a type of brake system that uses a reservoir of brake fluid—typically ethylene glycol—to transmit pressure from the master cylinder, which is activated when the driver presses the foot pedal, to the brake mechanism, which is typically located at or near the vehicle's wheels, allowing the vehicle to come to a stop or slow down.

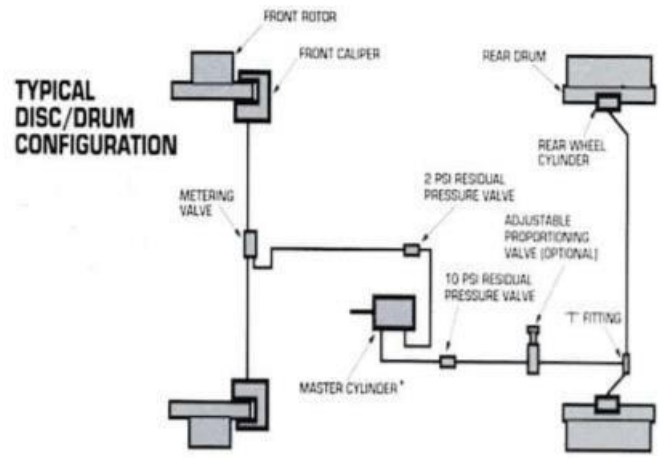

Figure 7:- Hydraulic Braking System (http://st.hotrod.com/uploads/sites/21/2015/03/ecitypical-dic-drum-configurationdiagram.jpg?interpolation=lanczosnone&fit=around%7C596%3A372)

8.2 WorkingofInbuiltHydraulicJack

Figure8:-Completelyprojectphoto

Through a series of unions, ball valves, a master cylinder, and a five-way directional control valve that are separated by pipe arrangements, the jack is now integrated into the vehicle's chassis through the braking system. First things first: if the vehicle's tyres ever go flat, we'll direct the five-way valve handle towards the flat tyre jack. By pressing down on the brake pedal with the handle pointing in the direction of the left front jack marking on the cover plate, the left front jack will be activated. Yeah, it's going to. The master cylinder's fluid will flow through the five-way valve and towards the valve's handle as soon as we press the brake pedal.

As the hydraulic cylinder's piston reaches

the ground, more pushes cause the tyre to start lifting, which causes the hydraulic cylinder to lower.

CONCLUSIONS

Not only will this idea save time and effort, but it will also do away with the need to bring a bulky mechanical jack on a trip, which is very helpful in emergency situations. This idea has a lot of potential and, with careful consideration, will gain traction quickly. The built-in hydraulic jack has many benefits, such as making vehicle maintenance easy and inexpensive, allowing one person to go on a long drive without getting stuck, and being especially helpful for elderly people and women when dealing with flat tyres. One drawback of this technology is that it will add a little more weight and expense to the car. If the aforementioned concept works in compact passenger cars, it may be expanded to heavy-duty vehicles in the future.

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