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Abstract

Puncture, it's a common word to express everyone, Nowadays, Four-wheeler vehicles are constantly growing up. All vehicle owners are facing the issues and problems of a tire puncture. Beginning of jack assembly into the vehicle is the easy way, but the lifting of the vehicle is much more difficult, because the jack is working manually and the material is not that much of harden material, so it led to a bend during the lifting process. That time the vehicle driver faces the consequences of mental stress, time lagging, and physical stress. The flack jack system compromised the all consequences of the existing jack system. This system is working fully automatically by controlling of vehicle dashboard and it fits into the vehicle chassis in-built. Hydraulic application is used in the flack jack system and telescopic pistons are also used in the main part of lifting objects the power has taken to the vehicle battery itself. When the puncture gets into the vehicle, the driver can operate the flack jack by the dashboard, they need not get the jack and assemble it into the vehicle chassis, and the car will be lifted automatically during the command

Keywords: Flack jack, Hydraulic, Vehicle, Puncture,

I. Introduction

In the present day, everyone gets the awareness of automation, in the automobile sector. Our research survey in this regard revealed that in several automobile garages, revealed the facts that most difficult methods were adopted in lifting the vehicles for repair and maintenance. This fabricated model has mainly concentrated on this difficulty. There are mainly three types of jacks in existing, Hydraulic jacks, pneumatic jacks, and Mechanical jacks. Considering the automation, we found the flack jack system, which applies to all types of four-wheeler vehicles. The flack jack is a closed object only the telescopic piston comes apart from the closed part. The components are assembled into systems a piston, cylinder, motor, pump, and sensors are assembled, and the Piston extends into four to six stages, with the help of a pump and motor. The motor work with the help of battery power, consuming 12V power. In the assembled side of the vehicle at a vertical angle, each vehicle has a two-flack jack system. One jack system will lift the two wheels at a particular time, so the two systems can lift the vehicle fully. In existing, when the car tire has punctured, the driver will use the manual jack or hydraulic jack equipment to lift the car. Some drivers and vehicle owners are familiar to fix the jack system in the car, but some drivers and vehicle owners are not familiar to fix the jack, that time it might be difficult to fix the jack system. The flack jack system compromised the above difficulty. This system is mostly useful to women and old age people, they can't put effect to fix the jack system into the vehicle.

II. Literature

This technique's setup is as follows: the hydraulic jack will be installed close by the suspension system of the car. All older folks, physically challenged individuals, and notably females who realized it difficult to set off the jack manually in any tyre crash situation would benefit greatly from this jack[1]. Method of making hydraulic jack Axel jacks as that term is commonly used are vertically operating jacks which comprise a hydraulic cylinder mounted on a base, the cylinder being short enough to permit the jack to be slid between a supporting surface and the axel of an automotive vehicle[2].



This jack is modified and made in such a way that it can be fitted to the frame of the vehicle. The jack operation is made possible with the buttons fitted to the dashboard of the vehicle. The system is user-friendly such as in case of the power window. The rocker switch is used to enable the reverse operation of the jack too[3]. The system actuate separately for either side of four wheeler as per the breakdown condition. The v gets is lifted and load is distributed on three point's. The inbuilt hydraulic jack will be valuable to the senior residents and for women who discover it incredibly hard to work the jack physically in any breakdown of the vehicle[4]. Presently available jacks further require the operator to remain in prolonged bent or squatting position to operate the jack which is not ergonomic to human body. It will give physical problems in course of time. Moreover, the safety features are also not enough for operator to operate the present jack[5]. This system can be placed in every in automobile under any operating condition, this will not only maintain the correct tyre pressure but also increase tyre life, mileage and safety. so to inflate and deflate the tyre automatically by using control unit we have fabricated system[6]. This paper is regarding the inbuilt hydraulic car jack which is integrated with the existing braking system of the car and can help in overcoming the disadvantages of the existing mechanical jack provided in the vehicle. Till now there is no such machine or device which can help overcome the problem faced by a driver when the tyre gets punctured, like the one which is described through this paper which not only saves human effort but also reduces the replacement time. [7].

Blaise Pascal was French scientist. He is discovered a law of hydraulics is known as Pascal's law and Pascal's principle of hydraulics. The law of Pascal's is that a change in pressure at any point in an enclosed fluid at rest is transmitted undiminished to all points in the fluid [8]. To retain the efficiency of the screw jack, it must be used in ambient temperatures, otherwise lubricants must be applied. There is oil lubricants intended to enhance the equipment's capabilities. Apart from proper maintenance, to optimize the capability and usefulness of a screw jack it is imperative to employ it according to its design and manufacturers instruction. Ensure that you follow the speed, load capacity, temperature recommendation and other relevant factors for application[9].

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 analyzing design of prototype[10]. In order to implement this idea, we have designed and developed a system called motorized jack operating through switch by having full control of the jack, we can easily lift it up and down by using the on/off .this helps to reduce the burden of the worker. The main reason to fabricate the motorized screw jack is to avoid the fatigue of human during lifting of the load[11].

The scissor jack is used to extend or position a plate. As the turning movement is applied to the lead screw the lower and upper arm of screw jack move towards each other and top & bottom face move opposite to each other cause to lift the load. The Square threads most commonly used, as this thread provide more surface area and is very strong and can resist the large load imposed on it. These threads have self-locking property[12]. The incorporated hydraulic jack reduces the dependency on service stations to help us in changing tires during an event of puncture. The system is very compact and fit in the chassis itself. The pistons protrude upon activation and help lift the automobile over the ground level[13]. The Major Project entitled "Inbuilt hydraulic jack in automobile vehicle" Worked on the principal of hydraulic power and operated by 12 Volt DC current, solves the all major problem of maintenance of all automobiles specially the heavy vehicles like truck and bus[14].

III. Proposed system

The proposed system for a flack jack system includes the following components.



3.1 Main components of the flack jack system

- Telescopic Actuator
- Reservoir
- Pump
- Motor
- Control unit

3.2 Telescopic actuator system

The telescopic actuator will be raised six stages maximum from the bottom surface. It worked under the hydraulic application. While the flow of incompressible oil passes into the telescopic actuator through the pump, the actuator is raised stage by stage, and up to the last part gets arrived in the required position. Double-acting actuators are used in this system. The cylinder is designed so that all the stages extend at the same time. In the double-acting feature, additional [hydraulic seals](#) are added to internally seal off the individual stages. In addition, internal oil passageways are machined so that as each stage completes retracting, a passage is open to supply the next stage with pressurized fluid to retract. Cast iron material is used for this application to lift the heavy load. The outermost stage of the actuator has a screw thread for the extent of the length.



Figure 1 - Assembly part diagram

3.3 Reservoir

Incompressible oil is stored in the reservoir; it's also called the storage tank. 1 liter of oil can be stored in the reservoir. Whenever the operation can take place, that time the oil passes into the telescopic actuator through the pump. The telescopic actuator is directly connected to the stored tank, so the connection of the pump and actuator is the easy way, this process ignored the extra connecting procedures. Mixed rubber materials are used to store the oil, because of reducing the weight of the product.

3.4 Pump system

The pump will be allocated in between the motor and storage tank, also the pump and storage tank integrated with the pump. It acts as a rotary motion with the help of a motor. When the operation will take place, the pump runs through the motor, the oil passes through the pump into the actuator. While the pump rotates clockwise the actuator moves forward and the pump rotates Anti-clockwise the actuator moves backward. The actuator moves in the direction through the pump rotation.

3.5 Motor system

The 12-volt capacity motor is used for this application. The motor will be connected directly to the vehicle battery, during puncture time the jack works to lift the car. That time the car is in the idle position, the battery won't charge. It couldn't affect the jack system because the motor won't need that much electricity. The motor will run for 1 hour with the vehicle battery power.

3.6 Power source

The flack jack system is powered by the vehicle battery. Vehicle battery power can withstand for 7 to 8 hours. Our flack jack system consumes power for very less, and the stability of the jack system to 2 hours.

3.7 Control system

Controlling of the flack jack system will allocate in front of the vehicle dashboard. While the puncture occurred, the driver controls the jack system into the dashboard. It obtained an easy way to control the jack system, so the driver didn't confuse to control the jack system. Driver gives the command to jack for forward motion, the jack comes down to the vehicle bottom, the operations are done the reverse command will proceed, so the jack comes back to its original position.



Figure 2

IV. Working procedure

A hydraulic lift is a device for moving objects using the force created by pressure on a liquid inside a cylinder that moves a piston upward. The jack system is fixed into the car by the position upside down, which means inverse position. Jack will come out into the vehicle under the chassis body. The incompressible fluids are stored in the tank, pumping operation will work by the motor. The fluid will be pumped through the motor to the tank into the cylinder, fluids started to fill the gap into the telescopic actuator, constant flow of fluid travel to the telescopic actuator so, the piston moves upward direction, that time the requirements get fulfilled, one side of the vehicle can be lifted through the piston. When the work is done, the telescopic piston gets back to its original place, and the fluids are restored into the tank. The piston, cylinder, motor, pump, and sensors are assembled, and the Piston extends into four to six stages. The motor work with the help of vehicle battery power, consuming 12V power.

V. Methodology

- Identified the problem statement in the automobile sector
- Analyzed the proposed solution.
- Developed the design of the flack jack system, which can be applied to the problem statement.
- Purchase the required components.
- Developed the flack jack system, with the assembly of required components.
- The output of the inbuilt jack system comes from an external part.
- The product test has been completed through the simulation part

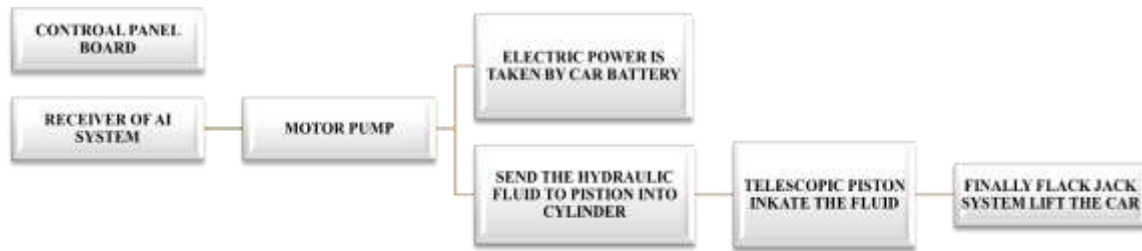


Figure 3 - Opened jack system

VI. Design calculations

6.1 Design of flack jack system

Dimensions of the outer structure

Length of jack = 300mm

Width of jack = 140mm

Height of jack = 170mm

Unaided weight of the car = 400kg or 4000N

6.2 Specification of the telescopic master cylinder

Outer dimension of cylinder = 100mm

Inner dimension of cylinder = 80mm

Thickness of cylinder = 20mm

Material of cylinder = Stainless Steel

6.3 Specification of reservoir

Capacity to store = 1 litter

Material = Rubber

6.4 Specification of telescopic piston

Outer piston dimension = 100mm

Inner piston dimension = 60mm

Strock number = 3

Per Strock length = 130mm

Thread rod dimension = 40mm

Thread rod length = 130mm

Piston material = Stainless steel

Thread rod material = Stainless steel

Overall length = 520mm



6.5 Calculation of jack

Pascal's Law Formula shows the relationship between pressure, force applied, and area of contact

$$P = F/A$$

$$F = PA$$

Where, P= Pressure, F=Force and A=Area of contact

Material strength = 2 ton

Force Required to Lift the Wheel in Vehicle

The weight lifted = 500 kg or 5000N

$$5000N = P * 45000\text{mm}^2$$

$$P = 0.111\text{N/mm}^2$$

The force required at the working piston:

$$F = P \times A$$

$$F = 0.111\text{N/mm}^2 * 2500\text{mm}^2$$

$$F = 277\text{N}$$

VII. Results and discussion

This flack jack system is contained to the left of the vehicle, it is tested through the type of external jack product.

It lifted a weight of around **450kg**.

The time consumed to reach the lower stage to the upper stage position is **1.46 mints**.

We planned to fix the jack into the car, it was done through the simulation part. The figure of the simulation has attached below.



Figure 4 - Isometric view of flack jack assembled into the chassis

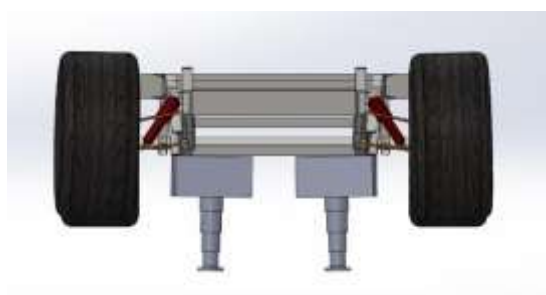


Figure 5 - Right view of flack jack system.



VIII. Conclusion

This design of the flack jack system considers an inbuilt lifting mechanism that can easily be fitted in all four-wheelers and heavy vehicles in automobiles. The objects can replace the manual jack and hydraulic jack with complete automation. This project is designed above statement procedure. Application of hydraulics and Telescopic pistons are used to lift the vehicle to the bottom. The power consumed by the battery. Maintenance and service of the product can be done through a vehicle's service. With this project, the usage of the automobile can be made easy for women and old people. The inbuilt jack is operated by a battery so it can also be used when the vehicle engine is not started.

- To help Women and elderly people to lift their cars effectively.
- To reduce the manpower to lift the vehicle.
- To avoid the accident happening during fixing the external jack equipment in the carchassis, at the busy time.
- To reduce the time and mental pressure during the puncture rectifying process.
- To lift the car on any land surface comfortably.

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