



DESIGN AND DEVELOPMENT OF DC OPERATED PORTABLE HYDRAULIC SCREW JACK

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Abstract

The aim of this paper is to develop a hydraulic jack with DC supply which can be used in automobile workshops as well as jack to be carried with the vehicle. We had made a system which can convert conventional hydraulic jack into portable DC operated hydraulic jack by using link mechanism with the help of DC motor such that vehicles can be elevated or lifted up without the application of bearing force. In other modes we lift jack by manual force but in this case we are using DC supply to lift up the vehicle, which reduces manual work. Mostly the hydraulic jacks are used in automobile workshops. A hydraulic Jack is a device which uses force of hydraulic cylinder to lift heavy loads. Hydraulic jack lifts load using the force created by pressure in the cylinder chamber. These hydraulic jack uses pump plunger to push fluid which is incompressible into cylinder. The oil we are using has the property of lubrication and stability. The oil present in the reservoir draws out through suction valve to the pump chamber when we plunger backwards and when plunger is pushed forward, cylinder draws oil from discharge check valve. The suction valve ball is within the chamber and opens with each draw of plunger. When the oil moves into the cylinder, discharge valve ball present outside the chamber opens. At this moment suction ball inside chamber is forcedly closed and pressure of oil develops in the cylinder. In this particular jack the arrangement of piston is vertical and it supports the bearing pad which lifts the object. In a single action piston the lift is half of the collapsing height of the jack, which makes suitable for vehicle with high clearance. The Hydraulic interconnection of various jacks with the help of valves gives the equal distribution of forces which can be used for close control of lift. Here we are providing an electric actuation to the jack for reducing human effort and it will be beneficial for women and adolescents. The DC motor with internal gear assembly is used for this project, The releasing screw is used for tightening and releasing of lifting pad. This project can be widely used in various low cost automation industries and production industries. The weight lifting is quick and effortless, which reduces the tiredness and fatigue felt by the worker.

Key Words: Hydraulic Jack, Cylinder Chamber, DC Motor, etc.

1. INTRODUCTION

This paper deals with the design and development of DC operated Hydraulic Screw Jack for existing automobiles using power from DC motor. This project helps in reducing the efforts as well as time taken to lift the load in comparison to ordinary screw jack. It consists of DC motor, external supply of battery and a Hydraulic jack arrangement. This type of hydraulic

jack will be very helpful for workshops where the loads of vehicle are quite tiredly to lift up with the help mechanical jacks. Electrical actuation is chosen here because the power obtained through this is comparatively higher than pneumatic means. The direction of rotation of DC motor is obtained by pulse modulation from control relay, thus it is considered as a most efficient and easy method to actuate. Hydraulic

jack lifts the load using the force created by pressure in the cylinder chamber. Depending on the forces that they employ jack can be categorized into hydraulic jack or mechanical jack, such as they rated on the basis of lifting capacity hydraulic jack tends to be much stronger and can lift heavier loads.

1.1 Hydraulic Jack

As I said earlier a hydraulic jack is a device used to lift heavy loads by applying forces via hydraulic cylinder. It depends upon force generated by pressure. Essentially, two cylinders (large and small cylinder) are connected and forces applied to one cylinder. Equal pressure is generated in both the cylinders. As we know one cylinder has a larger area. The force the larger cylinder produces will be higher although the pressure in the two cylinders will remain same. Hydraulic jack uses pump plunger to move oil through two cylinders. The plunger is first drawn back which opens the suction valve within and draws oil into pump chamber. When we push plunger forward the oil goes into the cylinder via external check valve and it results in closing of the suction valve.

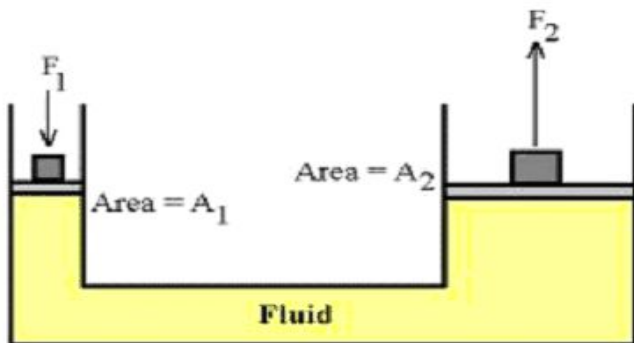


Fig 1- Working of mechanism of Hydraulic jack

1.2 Switch Mechanism

We have used ON/OFF switch in this project; the ON/OFF are interface which control circuit and battery and we are connecting the DC motor which mechanical model for up and down movement. When we switch ON it will send a high pulse to control circuit than the control circuit activates the corresponding relay to rotate DC motor in forward direction so that jack will move up. When we switch it will send a low pulse to control the circuit it activating relay to rotate DC motor in reverse direction so that jack will move down. Using this mechanism we can lift load without human efforts

2. DISADVANTAGES OF MECHANICAL JACK

- 1) Requires manual work.
- 2) Delay in time

- 3) Not useful for women and adolescents.

a) Solution

To increase human comfort and to decrease power consumption the modified existing design thus we brought hydraulic jack actuated electrically to reduce human efforts.

3. LITERATURE REVIEW

P.S. Ranaet.al[1] They have research on "Integrated Automated Jacks for 4-wheelers". An Automobile hydraulic jack can be easily operated by a single push button provided on the dash board. The jack will be installed on both the sides of chassis according to the weight distributions of the car. The system operates on hydraulic drive which consists of three main parts hydraulic pump, driven by an electric motor, hydraulic cylinder to lift the vehicle

ManojPatilet.al[2] presented overview of "Automated Car Jack". An automotive jack is a device used to raise all or part of a vehicle into the air in order to facilitate repairs. An electric car jack works on current supply from the car battery itself making it easy to operate. Operator only needs to press the button from the controller without working in a bent or squatting position for a long period of time to change the tire

Abhijeet [3] did project on "Hydraulic Jack for Heavy Vehicles". Hydraulic jack system is attached to automobile vehicle on front and rear part of the chassis. 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.

Shivrajshetet. al[4] discussed about Design And Fabrication Of Automotive Hydraulic Jack System For Vehicles". An inbuilt jacks have been designed and fabricated which is assembled on the vehicle. With the help of the existing brake pad and fluid arrangement of the braking system we incorporate the jack into to chassis of the vehicle with a set of unions, ball valves, master cylinder, five-way directional control valve, separated by a piping arrangements lifts the incorporated jack to action desired without raising any sweat of the driver.

4. DESIGN AND DEVELOPMENT

A. DC Motor Specifications

Voltage = "12 V" (DC)

Speed = "30 rpm"

Power = "18 W"

Length of the motor = "170 mm"

Outer diameter of motor = "60 mm"

B. Jack Specifications

Lifting Capacity = 2 tons

Lift Range = 6-13 inch

Ram travel = 4-1/2 inch

Screw Extension = 1-3/4 inch

In an experiment the piston diameter is 2 inches, then we multiplied as below for finding piston area

$$=3.14 \times 2 \times 2/4$$

=3.14 square inches

The press offered is 1250, then we multiplied 1250 by 3.14

= 3925 pounds now converting pounds to tons 3925/2

= 1962.5 approximately equals to 2 Tons.

4.1 Construction and Working

First we have made a base frame in which there is a capacity to hold all of the apparatus such as hydraulic bottle jack, motor, arm and power supply. Then the hydraulic jack is assembled in the basement of the model which is one of key parts. Hydraulic jack is can carry enormous masses with solicitation of lesser forces. It works on the principle of Pascal's law. This law states that the force applied on the fluid is dispersed likewise to all parts in very direction in a hydraulic system. The arm is fixed to the jack which gives to and fro motion to the jack. The arm has been made from iron which gives it stability to carry discs. There is a slit to one end of the arm. One of the split ends of the arm is linked to the knob of the jack. The disc is connected to the end having slit. The arm is connected to the disc. The arm is associated to a disc which revolves on the indication of the motor. The disc is made up of steel. It has a rounded cross sector, it comprises of a handle. Handle is also made up of steel. The handle is linked to the slit of the arm. The disc is connected to the motor. When the motor is switched on the disc rotates. This gyratory motion of the disc is transformed into the linear motion of the arm. The disc is connected with a motor.

The external supply of battery is used to drive DC motor. The DC motor shaft is connected to the cam wheel. If the power is given to the Dc motor, it will run so that cam wheel also runs to the same speed of the DC motor. The cam shaft movement is up and down due to cam mechanism. The cam shaft of other end connected to the hydraulic pump handle. The hydraulic handle moves up and down according to the movement of cam shaft. So pressurized oil goes to the hydraulic jack and

moves the piston upward, so that vehicle lifts from the ground.

4.2 Experimental Setup

Here we are converting the rotary motion into linear motion for lifting the vehicle using the jack which is fixed in the bottom of the axles by means of a frame. The motor is operated by the control unit. It gets power from the battery. The bearing pad of hydraulic jack is arranged under the vehicle body. One shaft is connected to the commanding moving shaft. During upward and downward movement the link is used for ease in operation. After supplying power to the motor it gets rotated. Then the cam revolves the supportive shaft moves up which makes the arrival spring shaft to move downcast by touches the ground and buzzes the front wheels of the automobile. After vehicle puncture or any other fault the wheels are grounded safely. We had made a system which will convert the conventional hydraulic jack in to automated electro hydraulic jack by using linkage mechanism with a help of an electric motor. Such that the automobiles can be elevated from the floor land without the use of bearing force. This whole system consists of bottled jack, DC motor and DC supply of power. In this development we are stimulating the jack by a dc motor using a link mechanism. In this the elevating action of jack is done by rotary motion of DC motor.

5. Results and Conclusions

We had made a system which will convert the conventional hydraulic jack in to automated DC operated hydraulic jack by using linkage mechanism with a help of an electric motor. Such that the automobiles can be elevated from the ground terrestrial without the solicitation of bearing force. The system consists of bottled jack, dc motor and dc power supply. In other modes we lift the jack manually but in this project we are lifting it by the solicitation of DC supply. The pumping action of jack is done by revolving motion of motor. The capacity of electro hydraulic jack is 2 tones. We had tested our DC operated Hydraulic jack in the Maruti Alto, Hyundai santro and Toyota innova and it was successful. The vehicle is lifted without application of the man Power. The advantages are of the followings :-

1. It requires simple maintenance cares
2. The weighted down light vehicles can be smoothly lifted.
3. Inspection and maintenance are easy, because of the main parts are screwed.
4. Handling is easy.
5. Manual power not required
6. Repairing is easy.
7. Replacement of parts is easy.

6. FUTURE SCOPE

Issue

We are currently working on small commercial vehicles but in future it can be used for heavy duty vehicle also. Hydraulic pup can be directly connected to engine output instead of hoisting a motor. In future this System can be operated through acceleration pedal. In future we can eliminate use of battery and power can be drawn from Dynamo.

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