"DESIGN & FABRICATION OF FOUR WHEELER HYDRAULIC JACK."

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ABSTRACT

With the increasing levels of technology, the efforts are being put to produce any kind of work that has been continuously decreasing. The efforts required in achieving the desired output can be effectively and economically be decreased by the implementation of better designs. Power screws are used to convert rotary motion into reciprocating motion. An object lifting jack is an example of a power screw in which a small force applied in a horizontal plane is used to raise or lower a large load. In this fabricated model, an electric motor will be integrated with the object lifting jack and the electricity needed for the operation will be taken from the d.c battery and thereby the mechanical advantage will be increased.

Key Words: - *Signal to Noise Ratio, Current, Voltage, Gas pressure, Penetration, MS IS2062*

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1. INTRODUCTION:

A jack is a mechanical device used as a lifting devices to lift heavy loads or apply great forces. The most common form is a car jack, floor jack or garage jack which lifts vehicles so that maintenance can be performed. The hydraulic jack is the most common form of jacks used for lifting. Various innovations have been done in the hydraulic jack with different electronic devices. With the help of technology the priorities are given to safety, luxury and comfort. The hydraulic jack is based on the pascal's law. The available jacks in the market are time consuming and also require much efforts which makes use of jack very difficult. As the jack is also required to set at ―jack point‖ which further increases the complications in its application. So need of automatic inbuilt jack in automobiles is inescapable. can be vastly used in light weight to medium weight cars. It can also be used as maintenance purpose. The project can be made highly feasible if considered while designing the vehicle.

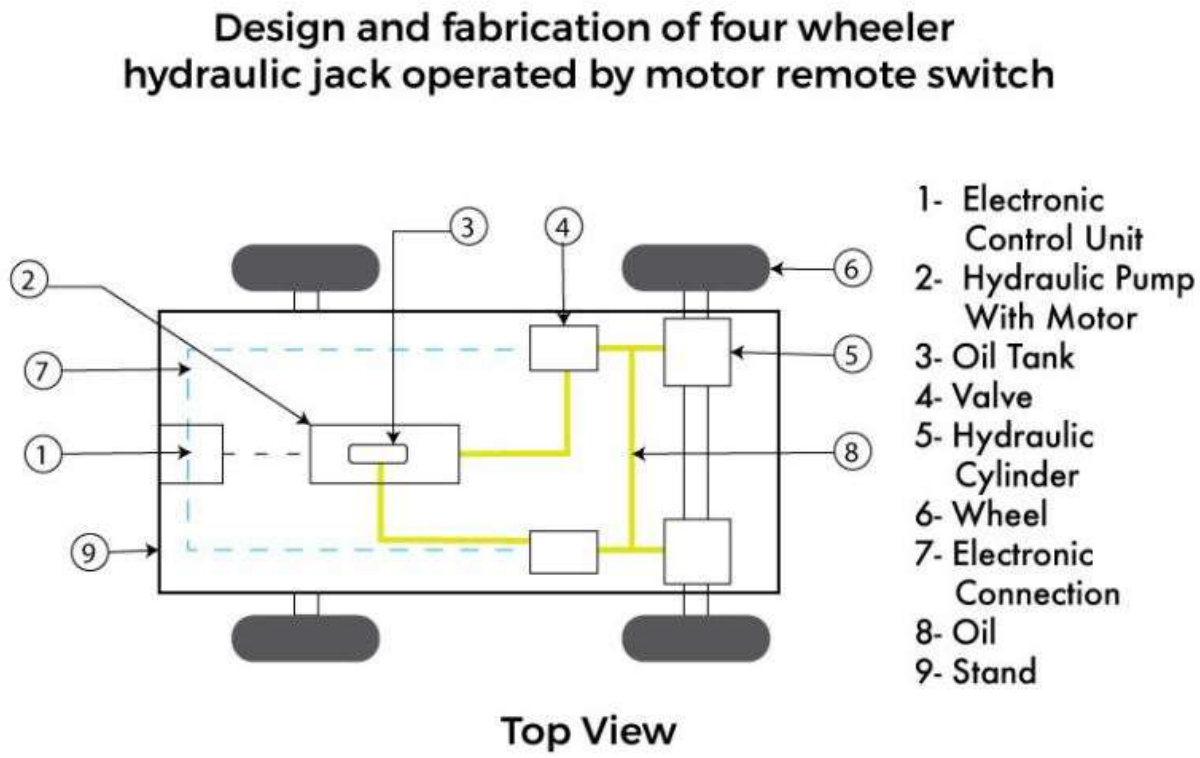

Figure-1: Design of four wheeler hydraulic jack

1.1 Principal of Operation:-

The lead screw is considered as an inclined plane with inclination α. When the load is being raised or lowered, following forces act at a point on this inclined plane.
1.1.1 Load (W): It always acts in vertically downward direction.
1.1.2 Normal reaction (N): It acts perpendicular (normal) to the inclined plane.

1.1.3 Frictional force (μN): It acts opposite to the motion. When the load is moving the inclined plane, frictional force acts along the inclined plane in downward direction and when the load is moving down the inclined plane, frictional force acts along the inclined plane in upward direction.

1.1.4 Effort(P): It acts in a direction perpendicular to the load (W). It may act towards right to overcome the friction and raise the load.
When load is raised,
For an equilibrium of horizontal forces, $P = \mu N \cos\alpha + N \sin\alpha$ ….(1)
For an equilibrium of vertical forces, $W = N \cos\alpha - \mu N \sin\alpha$ ….(2)
Dividing equation (1) by (2) we get,
$P = W (\mu \cos\alpha + \sin\alpha)$ ….(3)
$\cos\alpha - \mu \sin\alpha$
The coefficient of friction μ is expressed as $\mu = \tan\theta$ ….(4)
Substituting equation (4) in (3) we get,
$P = W \tan(\theta + \alpha)$ ….(5)
The torque T required to raise the load is given by, $T = \tan(\theta + \alpha)$ ….(6)

When load is lowered,
For an equilibrium of horizontal forces, $P = \mu N \cos \alpha - N \sin \alpha$ ….(7)
For an equilibrium of vertical forces, $W = N \cos \alpha + \mu N \sin \alpha$ ….(8)
Dividing equation (7) by (8) we get,
$P = W (\mu \cos\alpha - \sin \alpha)$ ….(9)
$\cos \alpha + \mu \sin \alpha$
Substituting equation (4) in (9) we get,
$P = W \tan (\theta - \alpha)$ ….(10)
The torque T required to raise the load is given by, $T = \tan (\theta - \alpha)$ ….(11)

1.2 Advantages:-

- No need of external battery.
- Power consumption is comparably less.
- Does not depend on the petrol level.
- Operating principle is very easy
- Installation is simplified very much
- The safety of driver is ensured
- The cost is low

1.3 disadvantages:-

- Wear of pads and rotors
- Complexity and fuel consumption of power assistance
- Slow response time due to power assistance, especially in trucks, buses and trains
- Complexity of controlling each wheel's braking independently
- Necessity of complex and costly anti-lock controls

1.4 Application:-

These MIGs welding process is broadly utilized as a part of the supposed cutting edge industry applications, for example,

- Automotive and Chemical Industry.
- Large, small, light, or heavy vehicles.
- Robotic welding, Aircraft, Power plant, Conveyors.
- Rail road track, Ship building, Building & bridges works

2. DESIGN SPECIFICATION :

2.1 Ball bearing:

This is a type of rolling element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support and radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the loads through the balls.

2.2 Spur gears :

These are designed to transmit motion and power between parallel shafts which are the most economical gears in the power transmission industry. Two types are used in this model:

2.2.1 Internal spur gear:

These spur gears are turned inside out. In other words, the teeth are cut into the inside diameter while the outside diameter is kept smooth. This design allows for the driving pinion to rotate internal to the gear, which, in turn, allows for clean operation. Intended for light duty applications, these are gears always available only in brass. When choosing a mating spur gear always remember that the difference in the number of teeth between the internal gear and pinion should not be less than 12 or 15.

2.2.2 External spur gear:

Perhaps the most often used and simplest gear system, external spur gears are cylindrical gears with straight teeth parallel to the axis. They are used to transmit rotary motion between parallel shafts and the shafts that rotate in opposite directions. They tend to be noisy at high speeds as the two gear surfaces come into contact at once.

2.3 Limit Switch:

It is a switch operated by the motion of a machine part or presence of an object. It is used for control of a machine, as safety interlocks, or to count objects passing a point. It is a electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object comes into contact with the actuator, the device operates the contacts to make or break an electrical connection. It is used in a variety of applications and environments because of their ruggedness, ease of installation, and reliability of operation. It can determine the presence or absence, passing, positioning and end of travel of an object. It was first used to define the limit of travel of an object, hence the name 'limit switch.'

2.4 Control switch:

It is used in order to start or stop the entire operation of the object lifting jack. The type of switch that is used is known as a toggle switch. The toggle switch is a class of electrical switches that are manually actuated by a mechanical lever, handle, or rocking mechanism. This is designed to provide the simultaneous actuation of multiple sets of electrical contacts, or the control of large amounts of electric current or mains voltages.

2.5 Control cables:

These are used in order to connect the battery to the motor and the switch.

2.6 Base and Frame:

A base for the entire set-up has also been made. The motor is mounted on an inverted U shaped support frame. Ball rollers are attached to four ends of the base for movement and are electrically controlled by switch.

2.7 DESIGN OF HYDRAULIC JACK

2.7.1 Design Parameters

Inner diameter of cylinder = 45 mm

Outer diameter of cylinder = 53 mm

Thickness of the cylinder = 4 mm

Pressure inside the cylinder = 9.43 N/mm²

Maximum tensile strength = 210 N/mm²

Factor of safety = 3

Yield strength = 210/3 =70 N/mm²

2.7.2 Design calculation

Assuming internal diameter = 45mm

Area = ∏r² = ∏*(22.5)² = 1590.43 mm²

Pressure P = F/A

Assuming pressure force (F) = 15000 N P = 15000/1590.43 =9.43 N/mm²

Applying Lame's theory Px = b/x² – a…….

Radial Pressure σx = b/x² + a…….

Hoop stress Where a and b are constant.

Px = b/x² – a 9.43 = b/(22.5)² – a……(1)

σx = b/x² + a 70 = b/(22.5)² + a……(2)

By solving this equation

b = 20105.72 a = 30.28

For external radius of cylinder Px = 0 Px = b/x² – a 0 = 20105.72/x² – 30.28 x² = 664 x = 25.77 mm

Therefore,

thickness of cylinder = 25.77 – 22.5 = 3.27 mm

Therefore, we take the thickness of cylinder is 4 mm.

3. METHODOLOGY:

- STEP 1 The lead acid battery is used to drive the d.c motor. The d.c motor shaft is connected to the spur gear. If power is driven to the d.c motor, it will run so that the spur gear also runs to slow down the speed of the d.c motor. The object moving jack moves the lead screw upwards, so that the vehicle lifts from the ground. The vehicle is lifted by using the lifting platform at the top of the jack. The motor draws power supply from the battery. The lifting and uplifting is done by changing the battery supply to the motor.

- STEP 2 After pressing the DPCO switch, the circuit is completed and from battery power is transferred to the motor that is connected to the roller. Now the roller starts moving. Now controlling the two number of DPCO switch which is connected to the two motors at the base the whole set-up is adjusted below the body which is being lifted.

- STEP 3 Now pressing the DPCO switch to the circuit which is connected to the motor that is coupled to the lead screw, the circuit is completed and voltage from the battery is pass to the motor. When tapping the switch to the positive pole, positive voltage is supplied to the d.c motor moves in clockwise direction and lead screw moves in downward direction.

- STEP 4 When tapping the switch to the negative pole, negative voltage is supplied to the d.c motor moves in anticlockwise direction and lead screw moves in upward direction.

- STEP 5 Now when the lead screw moves to the maximum limit, the limit switch at the upper end gets activated and the circuit gets cut-off. When the lead screw moves to the minimum limit, the limit switch at the bottom end gets activated and the circuit gets cut-off.

4. EXPERIMENTAL SETUP :

4.1 Motor Specification

Motor is of 12 v D.C
Motor power = 300 W = 0.4 HP
Motor rpm = 3000 rpm
Motor torque = 1 N.m

4.2 Pump Specification

Pump type = Gear pump
Flow rate = 15 litre/m^3 and Pressure = 250 bar
Reasons Behind using gear pump High speed High pressure No overhung bearing load Relatively Quite Operation Design accommodates wide variety of materials

4.3 CONROL VALVE

A hydraulic valve properly directs the flow of a liquid medium, usually oil, through your hydraulic system. The direction of the oil flow is determined by the position of a spool. A hydraulic system can only function - as per requirements - by using valves. Thus, you should always look for the correct type of hydraulic valve to serve your intended purpose. Hydraulic valves are available in a variety of sizes. The size required is determined by the maximum flow of the hydraulic system through the valve and the maximum pressure in the hydraulic system. Hydraulic valves are available with different mountings: e.g. mounting in pipe lines, threaded connection as cartridges, sub plate mounting, etc.

5. CONCLUSIONS:

With some design consideration an inbuilt car lifting mechanism can easily be fitted in all light weight automobiles. The project works on hydraulic power provided by battery. Maintenance and service of the vehicle can be easily done by this project. With this project the usage of automobile can be made easy for women and old people. Some extra automation like solenoid control valve can add great value to the project. The inbuilt jack is operated by battery so it can also be used when the vehicle engine is not started.

Hydraulic jacks are the ideal product to push, pull, lift, lower and position loads of anything from a couple of kilograms to hundreds of tonnes. The need has long existed for an improved portable jack for automotive vehicles. it is highly desirable that a jack become available that can be operated alternatively from inside the vehicle or from a location of safety off the road on which the vehicle is located. Such a jack should be light enough and be compact enough so that it can be stored in an automobile trunk, can be lifted up and carried by most adults to its position of use, and yet be capable of lifting a wheel of a 4000-5000 pound vehicle off the ground. Further, it should be stable and easily controllable by a switch so that jacking can be done from a position of safety. It should be easily movable either to a position underneath the axle of the vehicle or some other reinforced support surface designed to be engaged by a jack. Thus, the product has been developed considering all the above requirements. This particular design of motorized automated object lifting jack will prove to be beneficial in lifting and lowering of heavy loads.

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