International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

Design and Fabrication of Remote Controlled Hydraulic Jack

Pradeepa V[1], Puneeth Kumar[2], Shiva Kumar K[3], Nagaraja Naik C[4], Raju Jadar[5]

[1234]Student, Department of Mechanical Engineering BITM Ballari
[5]Associate Professor, Department of Mechanical Engineering BITM Ballari

---

Abstract - With the growing stages in generation, the efforts required in reaching the favored output can be correctly and economically be reduced with the aid of the implementation of better designs. Power screws are used to convert rotary motion into translator motion. A hydraulic jack is an instance of a power screw in which a small pressure carried out in a horizontal plane is used to raising and lowering the load. The mechanical gain of a hydraulic jack is the ratio of the load implemented to the effort applied. The hydraulic jack is operated through manually or robotically with the help of fluids present in the cylinder. The peak of the jack is adjusted via plunger inside the cylinder and this adjustment may be done either manually or with the aid of integrating an electric motor. This research paper analyzes the change of the present motor hydraulic jack by way of incorporating an electric powered circuit for the faraway with the intention to make load lifting less difficult. on this modified layout, the crank wheel is rotated by way of connecting motor through regularly occurring coupling, plugged to the auto 12 V battery source to generate energy for the high mover (motor), which transmits its rotating speed to the crank wheel to be rotated with required speed discount and extended torque to pressure the crank wheel. The significance and motive of this work is to alter the prevailing car jack on the way to make the operation less difficult, more secure and greater dependable with a purpose to reduce health risks specially lower back ache issues related to doing paintings in a bent or squatting function for an extended period of time. The changed vehicle jack is simple to apply by ladies or whoever had problem with the vehicle tyres alongside the road. The designed faraway controlled hydraulic jack may also store time and requires less human power to operate.

***Key Words*: lead screw, screw jack, DC motor, remote control.**

1. INTRODUCTION

Cars are lifted for diverse purposes like for drawback inspection or restore, substitute of tyres and many others. Till date, the software of manually operated devices additionally called lifting gears such as block and tackles, hoists, rotating screws, gantries, wedges and so on. [5]
The exercise of lifting and reducing is as vintage because the life of guy and continuous improvement of effective and appropriate medium for lifting and reducing heavy device has evolved via this era. These observe is centered at the layout of remote controlled hydraulic jack for lifting up of cars for simple protection and servicing. The utility of a jack in car is generally for growing up motors in order that automobile mechanics/technicians may have greater paintings space or clean get admission to carry out numerous tasks beneath the car. Jacks are normally relevant to motors however are also used in several mechanical programs along with industrial machineries.

[13]There are two fundamental sorts of jacks namely, hydraulic jack and mechanical jack. In a regular hydraulic jack which normally consist of a cylinder and piston mechanism, the upward or downward movement of the piston rod is especially used to raise or lower the weight, while, Mechanical jacks can either be hand operated or energy driven. Vehicle jacks commonly use mechanical benefit to simplify the act of rising up an automobile and this in turn offsets the staff and guy electricity that would have been exhausted within the process. More powerful jacks use hydraulic power to provide greater lift over extra distances. Mechanical jacks are commonly rated for maximum lifting capacity. Hydraulic jacks are usually used for shop work, as opposed to as an emergency jack to be kept inside the trunk of a car.

[9] The hydraulic jack uses an incompressible fluid that is pressured right into a cylinder by using a pump plunger (this relies upon on the stress generated by using the pump), and oil is commonly used because of its lubricating consequences on the shifting elements. When the plunger is pushed backward, it draws oil out of the oil sump thru a suction take a look at valve into the pump chamber. Whilst the plunger is moved ahead, it pushes the oil through a discharge check valve into the cylinder. The suction valve ball is within the chamber and opens with every draw of the plunger. The release valve is placed out of doors the chamber and opens when the oil is pushed into the cylinder. At this factor the suction valve in the chamber remains closed and oil strain builds up within the cylinder. Hydraulic jacks may be categorized into 3 categories depending on their layout and ability and this consists of bottle jacks, scissor jacks and ground jacks respectively. Lifting device is generally require in automobile and bike workshops, and one of the essential lifting device utilized in a standard automotive and motorcycle workshop is the bottle jack. This kind of jack is widely recognized for its versatility, and it isn't always only applicable in rising up vehicles to the desired peak, but can similarly play an important position in pushing vehicles round. An average bottle jack is compact in length, however

are designed and constructed for max overall performance and efficiency. In recent times, the hydraulic jack design is replaced by means of a bottle Jack which takes the shape of a bottle, having a cylindrical frame and neck from which the hydraulic ram emerges.

Those jacks use a hydraulic mechanism and its concepts to offer a whole lot of lift. They're designed in a wide variety of sizes which could nevertheless healthy into car trunks, and are extra ideal for large car consisting of vehicles or sport utility automobiles (SUVs). Scissor jack is one the maximum commonplace form of jack that is like minded with a huge variety of motors. It is simple to lift and frequently observed within the spare tire compartment of latest automobiles. Scissor jacks function through turning a big screw, which reasons the 2 sides to "scissor" together and lift the auto to the preferred peak. Scissor jack uses an arm to permit the auto proprietor to raise the automobile. The lug nuts should be loosened if the automobile is jacked or raised up while converting tyres. The scissor jack is designed to turn the screw with the arm in a clockwise motion to raise the platform that the auto rests on or the notch that suits right into a difficult point on the car's undercarriage. They normally light weight and compact, so that they make first-rate additions to emergency kits. However, ground jacks are often used in garages with jack stands. They are included with wheels for clean movement, when you consider that they tend to be lots heavier and unwieldy. Those jacks are workhorses, specially known for his or her durability and reliability, and are particularly high priced than scissor or bottle jacks. Ground jacks will likely not be wished except in cases wherein maintenance is executed frequently. Comparably, while a compact scissor jack is exceptional for cars and convenient to tote around, system barely beefier, which includes the hydraulic ground jack is probably important for automobile that is on the bigger aspect however bottle jack has a large 3-ton potential and a peak variety of eleven to 20-one inches, making it ideal for vehicles, SUVs, and other big, heavy-duty automobiles.

1.1 Types of hydraulic jacks

1.1.1 Bottle hydraulic jack: [14]

In a bottle jack the piston is vertical and directly helps a bearing pad that connects the gadgets being lifted. With an unmarried action piston the elevate is fairly less than twice the collapsed peak of the jack, making it suitable handiest for the cars with an exceptionally high clearance. For lifting systems including homes the hydraulic interconnection of multiple vertical jacks through the valves enables the even distribution of forces whilst permitting near manipulate of elevate.

Fig-1 Bottle hydraulic jack

1.1.2 Hydraulic floor jack

In a floor jack a horizontal piston pushes on the short end of the bell crank, with the long arm providing vertical motion to the lifting pad, kept horizontal with horizontal linkage. Floor jacks usually include castors and wheels, allowing compensation for arc taken by the lifting pad. This profile provides low profile when collapsed, for easy operating underneath the vehicle while allowing considerable extension.

Fig-2 Hydraulic floor jack

1.1.3 Strand hydraulic jack

A strand jack used to lift very heavy loads for construction and engineering purposes. Strand jacks were invented in Europe in the 1970s in the development of post tensioning systems and are now used in all around the world to erect bridges, offshore structures, refineries, power stations, major buildings and other structures where the use of conventional cranes is either impractical or too expensive.

Fig-3 Strand hydraulic jack

1.1.4 Toe hydraulic jack

Hydraulic toe jacks are a specialized jack for lifting or jacking masses with low clearance heights. Toe jacks as the decision implies characteristic a low foot or toe casting this is lifted by means of way of an internal hydraulic jack. They're in particular beneficial for lifting and positioning of heavy device or loads. They can also be used for lifting forklifts or low clearance equipment. Provided in pretty various capacities our toe jacks are immoderate excellent, durable, are from professional corporation proven manufacturers.

Fig-4 Toe hydraulic jack

2. LITERATURE REVIEW

- **Asonye g.U., Nnamani C. E., alaka, C. A.** [1]**:** Studied "design and fabrication of a far flung managed machine for a hydraulic jack" in this paper authors have executed an green automatic lifting system turned into designed the usage of the Khurmi and Gupta dating to decide the specified torque with recognized parameters consisting of strength rating and rotating velocity of the motor. A green computerized lifting gadget was fabricated with moderate steel for elements needing metals and a hydraulic jack serving because the lifting device. Fabrication techniques of marking out, cutting, welding and assembling were employed. This challenge paintings turned into tested and it worked correctly. Sizes of hundreds lifted were determined by using the specifications from their producer.

- **Balkeshwar Singh, Anil Kumar Mishra :** Studied "Analysis and Fabrication of Remote Control Lifting Jack" on this paper authors[2] have carried out an Screw Jacks are the appropriate product to push, pull, raise, decrease and position loads of anything from more than one kilograms to masses of tonnes. The need has lengthy existed for an advanced transportable jack for automobile automobiles. It is enormously suitable that a jack grow to be to be had that can be operated as a substitute from in the car or from a vicinity of protection off the road on which the car is placed. one of these jack have to desirably be mild enough and be compact sufficient in order that it could be saved in an vehicle trunk, may be lifted up and carried with the aid of maximum adults to its function of use, and but be capable of lifting a wheel of a four-five ton car off the floor. In addition, it ought to be strong and effortlessly controllable by means of a transfer so that jacking may be accomplished from a role of protection. It must be effortlessly movable either to a function beneath the axle of the automobile or a few other strengthened support surfaces designed to be engaged by means of a jack. For this reason, the product has been evolved considering all of the above requirements. This particular design of the motorized screw jack will prove to be useful in lifting and lowering of hundreds.

- **Deepa A., Naveen Krishna Baru and Sagarnath G.:** Studied "Design, development and testing of novel remote controlled electrically operated hydraulic jack" in this paper authors [7] have finished A reachable and compact model of a far off controlled electrically operated hydraulic jack turned into designed, advanced and fabricated (figure-6) to serve the humans thereby reducing the bodily burden of the usage of car jacks manually. It is also feasible that the wiper motor may be changed through stepper motor to have extra torque and much less area consumption ensuing in reduction of weight and value, additionally the range of operation may be expanded. Accordingly, this model is a limelight of its kind with constrained variety of hyperlinks and as a substitute simple mechanism that could serve mankind with the aid of making the existence simpler.

3. **C.S Agu and J.E Igwe:**[8] Studied "Design and Construction of a Remote Control Car Jack" in this paper authors recommending For efficient function of the jack the researcher therefore made the following pointers: use green code for better and quicker reaction time; use greater green mechanism for jack manipulate and lifting of heavy hundreds. greater researches ought to be made

to make the mission relevant for heavy responsibility automobiles; also to comprise it into the car automobile device (e.g. cigarette lighter sockets or clipped to the 12 volts battery); to boom lifting travel range from as low as 15 cm to as high as 40 cm and to make it extra transportable and person friendly.

4. METHODOLOGY

The power source was used from 12V battery in each of the cars the remote controlled hydraulic jack was tested on. Electric cables with high corrosion resistance were used as extension wires from the cathode (-) and anode (+) of the battery and for connecting between electric motor and micro-controllers. Prime mover of 12V, 40 watt, 2650 rpm electric motor was incorporated into the system to generate the torque transmitted to a pair of meshed spur gear. The gear system (driver and driven gear) was introduced for the purpose of transmitting rotary motion of the prime mover to the crank link. Crank mechanism was installed in between the gear and the hydraulic cylinder to convert the rotary motion of the gear to linear motion required for the raising and lowering the jack plunger. Electronic Control Unit was also added to the design to serve as control medium between the user and the device through a remote or switch controlled operation. The main function of the hydraulic system is to drive the bottle jack, a principle based on Pascal's law.

5. WORKING PRINCIPLE

The motor connection cables are connected to the car battery terminal or external battery which provides power for the jack operation immediately after the power button is switched on. The jack consists of an electric circuit, electric motor, switch, control unit, and the jacking assembly. When switch is turned on, current flows to the control unit to power unit. Mean while majority of the current flows to the motor to start the rotation of its shaft, the driving gear is connected to a larger driven gear for torque amplification. This rotation causes the slider crank mechanism on the driven gear to rock the lever on the push rod to and fro thus pumping the fluid in the jack cylinder and by Pascal principle of pressure transmission, thus the piston begins to raise any load in its path. The control unit has the following functions:

1) Checks the current flowing to the motor.
2) Checks the condition of the motor during operation by measuring the working condition of the motor.

4.1 GEAR SYSTEM

To maintain the revolution speed of the motor, a spur gear system with the following specification was adopted. [11]

For the driving gear;

No of teeth (N) = 08
Pitch diameter (d_p) = 9 mm

Gear module (m) = $\frac{d_p}{N} = \frac{9}{8}$ = 1.125 mm

For the driven gear

No of teeth (N) = 56

Pitch diameter (d_p) = 63 mm

Gear module (m) = $\frac{d_p}{N} = \frac{63}{56}$ = 1.125 mm

Circular pitch (p) = $\frac{\pi d_p}{N} = \pi m$ = 3.142*1.125
= 3.534 mm

4.2 MOTOR SPECIFICATION

Power	=	40 Watts
Voltage	=	12 Volt
Output Speed	=	60 RPM
Speed in rotor	=	2800 RPM
Type	=	Permanent Magnet Type

4.3 REQUIRED TORQUE

By the term torque, it is meant the turning or twisting moment of a force about an axis. It is measured by the product of the force and the radius at which this force acts.

For an armature of a motor, to rotate about its centre, a tangential force is necessary. This force is developed within the motor itself.

$$T = \frac{p*60}{2\pi n_p} = \frac{40*60}{2*\pi*2800} = 0.1364 \text{ N-m}$$

The torque given by the above equation is the developed torque in the machine. But the output torque is less than the developed torque due to friction and wind age losses.

4.4 DESIGN OF BEARING

Outer Diameter of Bearing (D) = 47 mm
Thickness of Bearing (B) = 14 mm
Inner Diameter of the Bearing (d) = 25 mm
Corner radii on shaft and housing (r_1) = 1 (From design data book)
Maximum Speed = 14,000 rpm (From design data book)
Mean Diameter (d_m) = (D + d) / 2

= (47 + 25) / 2

d_m = 36 mm

Spring index (C) = (D /d)

= 12/2

C = 6

Stress factor

$$K_s = \frac{4C-1}{4C-4} + \frac{0.65}{C} = \frac{4*6-1}{4*6-4} + \frac{0.65}{6} = 1.128$$

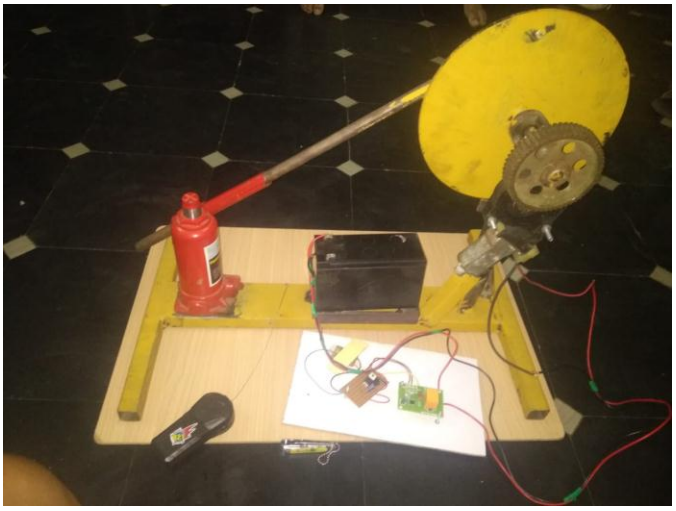

Fig-5 Remote controlled Hydraulic jack

4.5 REMOTE CONTROL UNIT

The below figure illustrates the DC motor-actuator control circuit incorporated in the jack assembly design. [3]

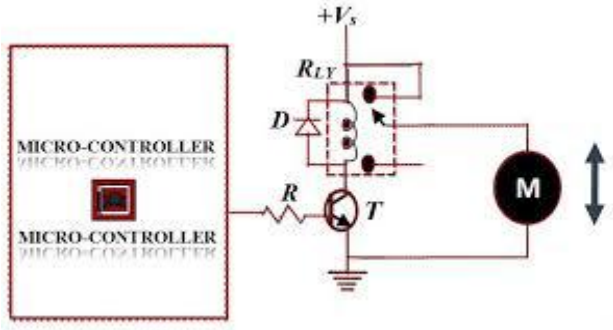

Fig-6 Remote control unit

Incorporated with the motor-actuator control circuit is a transistor-relay switch that transmits power to the DC motor to enable movement of the car jack. In other words, operation of the hydraulic jack is aided by a DC motor actuator via an infra-red transmitter which transmits a modulated infra-red beam to the receiver. The receiver amplifies and modulates the signal to suite the coded language of the microcontroller for upward and downward movement of the hydraulic jack.

5. CONCLUSION

An efficient work for "Remote controlled hydraulic jack" was designed using the standard data handbooks by "Khurmi & Gupta" relationship to determine the required torque, stress concentration factor and all other parameters. The remote controlled hydraulic jack was fabricated with mild steel for needed parts, fabrication process like marking, cutting, welding and assembling were done. This project work was tested and it worked appropriately, with limited number of links and simple mechanism. This particular design of Remote controlled hydraulic jack will prove to be beneficial in lifting of loads.

REFERENCES

[1] Asonye g.U., Nnamani C. E., alaka, C. A.: Studied "design and fabrication of a remote controlled system for a hydraulic jack"

[2] Balkeshwar Singh, Anil Kumar Mishra : Studied "Analysis and Fabrication of Remote Control Lifting Jack"

[3] J. J. Coulton, "Lifting in Early Greek Architecture". The Journal of Hellenic Studies, 94: 1-19, 2004.

[4] A. Parr, Hydraulics and Pneumatics: A Technician's and Engineer's Guide. 1st Edition. Oxford Press, London; 2003. R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

[5] S. Zhigiang, "Variations of Hydraulic Jack", Auto Universal press, Shangai publication no. US8348237, 2013.

[6] C. Jackson, "Radial and thrust bearing practices", Monsanto Press, United States; 2009

[7] Deepa A., Naveen Krishna Baru and Sagarnath G.: Studied "Design, development and testing of novel remote controlled electrically operated hydraulic jack"

[8] C.S Agu and J.E Igwe: Studied "Design and Construction of a Remote Control Car Jack"

[9] S. B. Elliot, "Air-Over-Hydraulic Jacks", Compressed air operations manual, McGrawHill Professional, pp. 56–58, 2006.

[10] M. Fauzi, Performance Evaluation of Car Jack, Kuala Lumpur University Press, Malaysia; 2011.

[11] K. Sainath, Mohd Jibran Baig and Mohd Sulahuddin. 2014. Design of mechanical hyadraulic jack. IOSR Journal of Engineering. pp. 2278 – 8719.

[12] Tian Hongyu, Zhang Ziyi. 2011. Design and simulation based on pro/e for a hydraulic lift platform in scissors type. Procedia Engineering – 16. pp. 772 – 781.

[13] Ghosal. A. 2010. The Freudenstein equation: Design of four-link mechanisms. Resonance. 15: 699–710.

[14] K. L. Kumar. 2008. Engineering Fluid Mechanics - 8th Edition. S. Chand Limited.