DESIGN AND FABRICATION OF MOTORIZED SCISSOR JACK

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I. **ABSTRACT :** *A Scissor jack is mechanical equipment used to lift up heavy loads. The power screw mechanism included in a scissor jack is design to lower the amount of force needed to lift the heavy loads. The lifting section consists of arms. The turning of screw operates the arms in such a way that it lifts up very gently. Now the arm rotates very gently and force needed to lift the vehicle is divided into parts and user can lift very heavy objects with comparatively very less force. Also the weight of the load is not enough to push the scissor down, since it would require very large force. Thus it allows us to life heavy loads like cars by just using human strength, also the system is further improved by making it motorized so user does not need to operate it manually but just press a button for lifting and lowering it*

***Keywords*: -**Turning Screw, Crank, High Torque Motor, Supporting Arms And Frame.

I. INTRODUCTION

This paper deals with the design and fabrication of motorized screw jack which is used for lifting heavy automobiles, using the power from a dc motor. The project helps in reducing the effort as well as time taken to lift the load in comparison to the ordinary screw jack. It consists of a D.C motor, battery, worm gear arrangement and a screw jack arrangement. A screw jack's compressive force is obtained through the tension force applied by its lead screw. A square thread is most often used, as this thread is very strong and can resist the large loads imposed. These types are self-locking, which makes them more intrinsically safe than other jack technologies. This type of screw jack will be helpful for women and adolescents during the puncture to lift the vehicle when they have no means to serve. Electrical actuation is chosen here because the power obtained through this is comparatively high. The direction of the rotation of the motor is obtained by the pulse modulation from the control relay. Thus it is considered to be the most efficient and easy method to actuate. A scissor lift (jack) or mechanism is a device used to extend or position a plate formed by mechanical means. The term "scissor" is used since the folding supports are in criss cross "X" pattern. The extension or displacement motion is achieved by applying force to one of the supports and thus the elongation of the crossed pattern occurs. The force applied to extend the scissor mechanism may be hydraulic, pneumatic or mechanical means. Our objective is to actuate through electric mean.

MOTORIZED SCREW JACK

A. SCISSOR JACK: -

The scissor jack is used to lift the vehicle where the action is carried it out by mechanical, hydraulic or pneumatic means. Such a jack is a standard accessory with many cars. It consists of a diamond shaped frame having a nut on one side and a sleeve on the other. A screw is supported in the nut and the sleeve. Rotating the screw the nut moves towards or away from the sleeve depending upon the direction of the rotation, so that the vehicle supported on the jack is lifted or moved down. The jack is so designed that there is always sufficient friction in the screw to hold the jack from moving down under load. But we are using the motor to rotate the screw for lifting the vehicle.

B. SCREW JACK MECHANISM: -

We have used ON/OFF switch in this project; the ON/OFF switch keys are interface with control circuit with battery. And we are connecting the DC motor with the mechanical model for the up and down movement. When we switch ON, it will send a high pulse to control circuit then the control circuit activates the corresponding relay to rotate the DC motor in forward direction, so that the jack

will move up. When we switch OFF, it will also send a low pulse to the control circuits its activating relay to rotate the DC motor in reverse direction so the jack will move down. Using this we can lift the load using power jack without human effort.

II. LITERATURE REVIEW

Leonardo da Vinci (early 1400's): who first demonstrated the use of a screw jack for lifting loads. Leonardo's design used a threaded worm gear, supported on bearings, that rotated by the turning of a worm shaft to drive a lifting screw to move the load – instantly recognizable as the principle we use today.

John Wilkinson, el.at (early 1800's): The most notable inventor in mechanical engineering from undoubtedly the mechanical genius recognized the need for precision had become as important in industry as the provision of power.

Whitworth's(early 1850's) tools had become internationally famous for their precision and quality and dominated the market and inspired young engineers began to put Whitworth's machine tools to new uses.

Frank Henry Sleeper (early 1880's) : In Coaticook, a small town near Quebec, a 24-year-old inventor designed a lifting jack. Like da Vinci‟s jack, it was a technological innovation because it was based on the principle of the ball bearing for supporting a load and transferred rotary motion, through gearing and a screw, into linear motion for moving the load

Josiah Barrett (early 1883's) in Pittsburgh, an enterprising Mississippi river boat captain named had an idea for a ratchet jack that would pull barges together to form a „tow‟. The idea was based on the familiar lever and fulcrum principle and he needed someone to manufacture it.

Arthur Osmore Norton(early 1886's) : spotted the potential for Sleeper's design and hired the young man and purchased the patent. The „Norton‟ jack was born. Over the coming years the famous „Norton‟ jacks were manufactured at plants in Boston, Coaticook and Moline, Illinois.

III. METHODOLOGY

SCISSOR JACKS: -

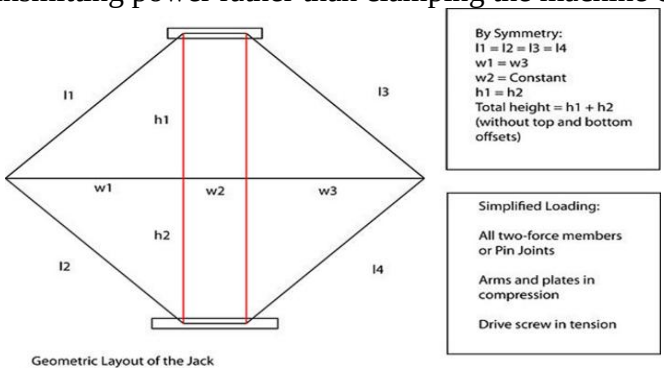
Scissors jacks are mechanical and have been in use at least since the 1930s. A scissor jack is a device constructed with a cross-hatch mechanism, much like a scissor, to lift up a vehicle for repair or storage. It typically works in just a vertical manner. The jack opens and folds closed, applying pressure to the bottom supports along the crossed pattern to move the lift. When closed, they have a diamond shape.

Scissor jacks are simple mechanisms used to drive large loads short distances. The power screw design of a common scissor jack reduces the amount of force required by the user to drive the mechanism. Most scissor jacks are similar in design, consisting of four main members driven by a power screw.

A scissor jack is operated simply by turning a small crank that is inserted into one end of the scissor jack. This crank is usually "Z" shaped. The end fits into a ring hole mounted on the end of the screw, which is the object of force on the scissor jack. When this crank is turned, the screw turns, and this raises the jack. The screw acts like a gear mechanism. It has teeth (the screw thread), which turn and move the two arms, producing work. Just by turning this screw thread, the scissor jack can lift a vehicle that is several thousand pounds.

DESIGN: -

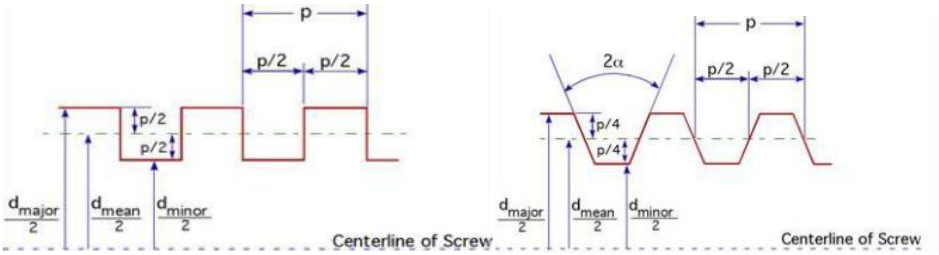
A power screw is a mechanical device used for converting rotary motion into linear motion and transmitting power. A power screw is also called translation screw. It uses helical translatory motion of the screw thread in transmitting power rather than clamping the machine components.



Geometric Layout of the Jack

FORMS OF THREADS: -

There are two popular types of threads used for power screws viz. square and I.S.O metric trapezoidal.



IV. EXPERIMENTAL WORK: -

A screw is a mechanism that converts rotational motion to linear motion, and a torque (rotational force) to a linear force. It is one of the six classical simple machines. Other mechanisms that use the same principle, also called screws, don't necessarily have a shaft or threads.

TYPES OF SCREW JACK: -

There are a few variations of screw jack available depending on the specific application. These variations can be achieved with either a machine screw jack or ball screw jack and are largely chosen based upon the system architecture in which they are to be fitted.

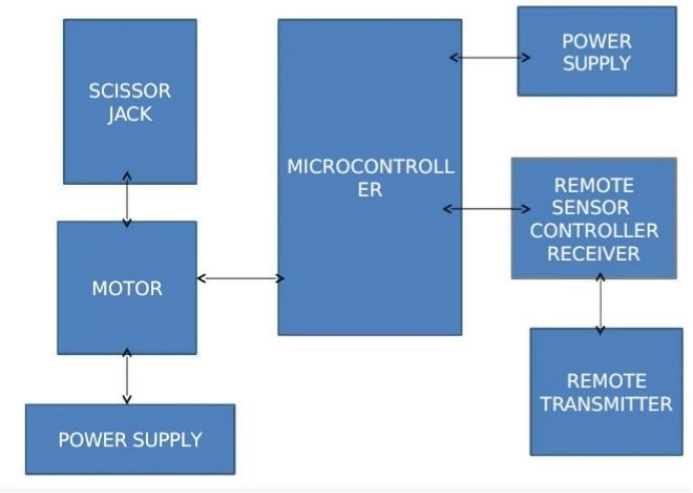
- Translating Screw Jack
- Translating Keyed Screw Jack
- Rotating Screw Jack
- Translating Screw Jack System
- Rotating Screw Jack System

PARTS OF MOTORISED SCREW JACK

- .DC motor

- Power screw
- Spur gear
- Adapter
- Remote control.

BLOCK DIAGRAM: -



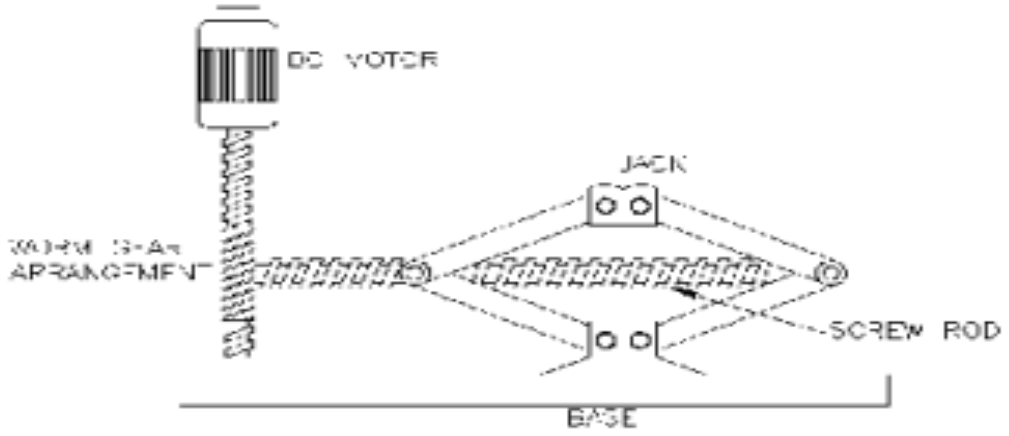
V. CONSTRUCTION: -

DESIGN AND CONSTRUCTION

A scissor lift (jack) or mechanism is device used to extend or position a plate form by mechanical means. The term "scissor" comes as from the mechanical utilized which is configured with linked, folding supports in a criss cross "x" pattern. The extension or displacement motion is achieved applying of force to one of the support resulting and an elongation of the crossing pattern, the force applied to extend the scissor mechanism may be hydraulic, pneumatic or mechanical (via a lead screw or rack and pinion system).

Details of Mechanism

When high pulse is given to the motor, the motor rotates in clockwise direction and when low pulse is given it rotates in anticlockwise direction. Thus the worm gear rotates and enables the lead screw to rotate in both directions shown in fig.



VI. DESIGN CALCULATION: -

A. Design of screw jack: -

To find out the power of the motor that can lift load of 30 kg

We know that,

Major Screw diameter (do) =12 mm

Pitch of screw (p) = 3 mm
Mean diameter, d = do - p/2……..(1)
= 12-3/2
d = 10.5 mm
tan∞ = p/ π d…….(2)
tan∞ = 3/π x10.5
tan∞ = 0.091
Assuming co efficient of friction, tan θ = 0.1
Load to be raised = 30 kg
W = 300 N
P = Effort required to raise the load
P = W x tan (∞+θ)…….(3)
= W x (tan ∞+ tan θ)/ (1-tan∞ x tan θ)……(4)
= 300 x (0.091+0.1)/ (1-0.091 x 0.1)
=300 x (0.191/0.99)
P = 57.82 N

B. Torque required operating the screw: -

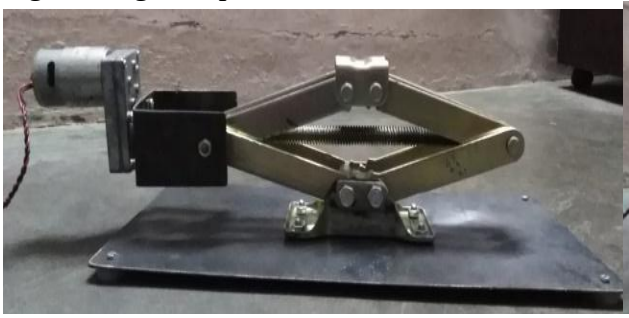
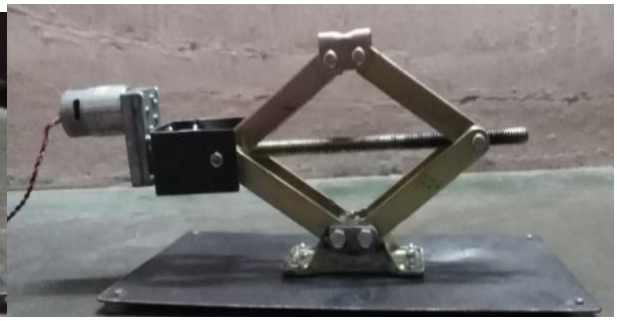
T=P x d/2……(5)
T =57.82 x10.5/2
T = 303.58x10-3 Nm
Since the screw moves in the nut at a speed of 65mm/min of speed of revolutions is minute is,
N = speed in mm/min/pitch in mm……(6)
N = 65/3(pitch)
N =21.6 (22 rpm)

C. Power of the motors required

p = T x ω…….(7)
Where ω is = 2 x π x N/6
p = T x ω
p = 303.58 x10-3 x 2 x π x 22/60
p = 0.699 watt.

VII. RESULT

As per the design calculations motorized screw jack is fabricated and as shown in Figures. Compare with ordinary jack, it possess self-locking property, No radial thrust acts since square thread is used, higher range of speed control is obtained.

CONCLUSION

Such a jack should desirably 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 4,000-5,000-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 thE motorized screw jack will prove to be beneficial in lifting and lowering of loads

FUTURE SCOPE

As a development the web part of the arms can be replaced by stiffening ribs to reduce the overall weight. the top and base plates can be made foldable to make the unit more compact. Permanently mounted jacks on the vehicle can be developed so that tire change can be completely automated.

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