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Design and Fabrication of Automatic Scissor Jack

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ABSTRACT: The lead screw is used to convert rotary motion into translation motion. The screw jack is a device used for lifting the load with the application of small force. The mechanical advantage of screw jack is the ratio of the load applied to the effort applied. The screw jack is operated by turning a lead screw of jack. The effort required to operate the screw is eliminated by using 12 V DC Motor. The motor operates by 12V DC power supply which is drawn from the vehicle battery itself. The rotary motion transfer from the motor to lead screw through worm gear drive. The driver gear (pinion) located on the motor shaft and the driven gear located on the lead screw causes to transfer rotary motion.

KEYWORDS: Light moving vehicles, Integrated automated jack, Scissor Jack, Chassis.

I. INTRODUCTION

The manual work required more effort. The project helps in reducing human efforts as well as to reduce the time required for operation as compared to ordinary screw jack available in the market. It consists of D C Motor, Lead screw, Battery, Gear drive and Screw jack. 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.

For repairing and maintenance of an automobile, there is needed to lift the vehicle. According to that various jacks have been developed. They are categorized as; Standard jack, Pneumatic jack, Hydraulic jack. The standard jack operated on the lead screw for lifting. The purpose of the project is to minimize the human efforts required for operating the jack. The motorized screw jack has been developed to fulfill the need of small garage with the minimum skill set as well as for those persons who isn't able to do such works.

OBJECTIVE :

- To design a power scissor jack which is safe and reliable to raise and lower the load easily.
- Use of double start square thread in power screw.
- Pins in bearings.
- To fabricate the prototype of a scissor jack.
- To achieve mass production
- To reduce the production cost and time.

II. MATERIAL AND CONSTRUCTION

A. Lead Screw

The lead screw used as a linkage in a machine to turning motion into linear motion. The size and shape (i.e. short, tall, fat & thin) of lead screw depends on the load under they work and space in which they need to fit. Due to sliding

contact of the lead screw, a large amount of heat is generated. To overcome such problem and to increase efficiency it should be work under ambient condition or lubricant must be applied.

B. DC Motor

It is a machine which converts electrical energy into mechanical energy. It works on the principle of electromagnetic induction i.e. when current carrying conductor placed in a magnetic field it experiences a magnetic force whose direction is given by Fleming right-hand rule. The main advantage of DC motor is that its direction of rotation can be changed by changing the polarity of the power supply.



C. Control Switch

This is the switch used to operate the DC motor by which the entire operation of the jack is to be controlled. The commonly used switch is Toggle Switch. This switch is manually actuated by a mechanical lever. These switches are designed in such a way that it can operate multiple sets of electrical contacts.

D. Control Cables

These cables are used to provide electrical connection to a various part of the system with the battery.

E. Base and frame

It is a rigid construction on which all the parts are assembled.



Motorized scissor jack



•DESIGN and FABRICATION

the jack has a capacity of 1 ton and the load acting on the jack is of ¼ of a total load of the vehicle. The weight of the vehical is 2 tons therefore load acting on one wheel is 500 kg.

$$\text{Load (W)} = 500\text{Kg} = 5000 \text{ N}$$

$$\text{Major Screw Diameter (do)} = 15\text{mm}$$

$$\text{Pitch of Screw (p)} = 4 \text{ mm}$$

$$\begin{aligned} \text{Mean diameter (dm)} &= do - \frac{p}{2} \\ &= 15 - \frac{4}{2} \\ &= 13\text{mm} \end{aligned}$$

$$\text{Lead (l)} = \text{pitch (p)} = 4 \text{ mm} \dots (\text{since screw is single star})$$

Let,

$$\text{Lead angle } (\alpha)$$

$$\tan \alpha = \frac{l}{\pi dm}$$

$$\tan \alpha = \frac{4}{\pi 13}$$

$$\tan \alpha = 0.097$$

Assume coefficient of friction (μ) = 0.1

Load to be raise = 500Kg = 5000 N

P = Effort required to raise the load

$$P = W * \tan(\alpha + \theta)$$

$$P = W \left(\frac{\tan \alpha + \tan \theta}{1 - \tan \alpha * \tan \theta} \right)$$

$$P = 5000 \left(\frac{0.097 + 0.1}{1 - 0.097 * 0.1} \right)$$

$$P = 994.6$$

Torque required for operating the screw,

$$T = P * \left(\frac{dm}{2} \right) = 994.6 * \left(\frac{13}{2} \right)$$

$$T = 6464.9 \text{ Nmm} = 6.464 \text{ Nm}$$

Power required to drive the motor

$$P = T * \omega$$

$$P = 6.464 \left(\frac{2\pi N}{60} \right) (\text{since } N = 60 \text{ rpm})$$

$$P = 40.61 \text{ W}$$



Since the speed of revolution is 60 rpm then the feed per min is

$$N = \frac{x}{pitch}$$

Where x= feed per min.

$$60 = \frac{x}{4}$$

$$X = 240 \text{ mm/min}$$

The efficiency of screw calculated by using torque equation

$$\begin{aligned} \varepsilon &= \frac{\tan \alpha}{\tan(\alpha \pm \theta)} \\ &= \frac{0.097}{0.198} \\ \varepsilon &= 49.58\% \end{aligned}$$

└ ADVANTAGES

Checking and cleaning are easy, because the main parts are screwed.

- Handling is easy
- The loaded light vehicles can be easily lifted.
- No Manual power required.
- Easy to Repair.
- Replacement of parts are easy

└ DISADVANTAGES

- Cost of the equipment is high when compared to ordinary hand jack.
- Care must be taken for the handling the equipment such as proper wiring connection, battery charging checkup, etc.

III. CONCLUSION

In this project a prototype of power scissor jack which can be operated by a power gun has been designed and fabricated. The jack has been designed to a pay load of 4.5kN. The salient features of the present fabrication are elimination of human effort to operate the jack, through a simple electrical device which can be actuated by a 12 V battery and provision of a light source to facilitate convenient operation during night time. All the elements of the jack are fabricated in the machine shop. The assembly of the component can be achieved in 100 minutes. Another feature of the unit is provision of two trunions on both the sides of the jack to ensure jerk free operation. The elements which are useful are readily available commercially for each and early replacement of failed components if required. Screw 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 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.

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