INTERNATIONAL JOURNAL OF ADVANCE RESEARCH AND DEVELOPMENT

(Volume3, Issue4)

Available online at: www.ijarnd.com

Fabrication of automatic screw 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.

Keyword: *Screw Jack, DC Motor, Lead screw, Battery, Gear drive.*

1. 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. The screw jacks used in garages are generally manually operated and that required large human effort and skilled labor.

Our project based on when the tyre gets puncher people get up from their seat to jack the car. For new comers, it is very difficult to jack the car. It required more human effort and it is a very time-consuming process. Some people don't know how to jack the car and they drive the car with that puncher tyre. So it directly affects the tyre as well as engine life.

2. LITERATURE REVIEW

A screw jack is a portable device that consisting of a lead screw mechanism used to raise or lower the load [4]. They used to convert rotary motion into linear motion [6]. The problem of tyre puncher is common in nowadays [1]. Now a day the technology increases and manual effort get decreases. The screw jack mostly available in the market is of the manual type which required more effort [2]. Weight after some limit can't be lift by a human for which some devices, tools and equipments are used. These lead to fatigue to human [3]. To remove these problems, saving time reduce effort. We fabricate this jack [1]. They can be short, tall, fat or thin depending on the amount of load and space available [4]. The hi-tech jacks are available in the market but due to high cost, these can't be owned by everyone [1]. In screw jack the square thread most commonly used because these threads are very strong and able to resist the large load. It also has self-locking properties [5]. The mechanical advantage of screw jack is the ratio of the load applied to the effort required/applied [6]. Electrical actuation method is used for operating machine because it is easy to change the direction of rotation of the motor by changing pluses [5]. For operating screw jack large force is required and during operation large amount of heat is generated to overcome this problem lubricant must be applied [2]. For the operation of screw jack, some

consideration to be under taken i.e. maintain low speed, keep the mating surfaces lubricated, keep the matting surface clean, keep heat away [3]. The assumption should be taken that the ground clearance should be of 200mm and the jack supports the load of ¼ of car weight i.e. 300 to 1000 kg for safety it should be taken as 400 kg [1].

3. OBJECTIVE

The main objectives of this project are

- To Increase in fuel economy.
- To minimize human effort
- To reduce time
- Minimization of lifting and tilting/twisting forces.
- To reduce fatigue

4. 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 Flaming 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.

4. DESIGN and FABRICATION

Let 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.
Therefore load acting on one wheel is from 300 to 500 kg, for safety consideration the load assumes to be 400 Kg.

Load (W) = 400 Kg = 4000 N

Major Screw Diameter (do) = 12 mm

Pitch of Screw (p) = 3 mm

Mean diameter (dm) = $do - \left(\frac{p}{2}\right)$

$$= 12 - \left(\frac{3}{2}\right)$$

$$= 10.5\ mm$$

Lead (l) = pitch (p) = 3 mm ….(since screw is single star)

Let,

Lead angle (α)

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

$$\tan\alpha = \frac{3}{\pi * 10.5}$$

$$tan\alpha = 0.091$$

Assume coefficient of friction $(\mu) = 0.1$
Load to be raise = 400 Kg = 4000 N

P = Effort required to raise the load

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

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

$$P = 4000 * \left(\frac{0.091 + 0.1}{1 - (0.091 * 0.1)}\right)$$

$$P = 771.01\ N$$

Torque required for operating the screw,

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

$$T = 771.01 * \left(\frac{10.5}{2}\right)$$

$$T = 4047.83\ Nmm$$

$$T = 4.047\ Nm$$

Power required to drive the motor

$$P = T * \omega$$

$$P = 4.047 * \left(\frac{2\pi N}{60}\right)$$

$$P = 4.047 * \left(2\pi * \frac{60}{60}\right)$$….(since N=60 rpm)

$$P = 25.433\ W$$

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

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

Where x= feed per min.

$$60 = \frac{x}{3}$$

$$x = 180\frac{mm}{min}$$

The efficiency of screw calculated by using torque equation

$$\varepsilon = \frac{tan\alpha}{\tan(\alpha+\theta)}$$

$$\varepsilon = \frac{0.091}{0.192}$$

$$\varepsilon = 47.36\ \%$$

Fig 1: Screw Jack

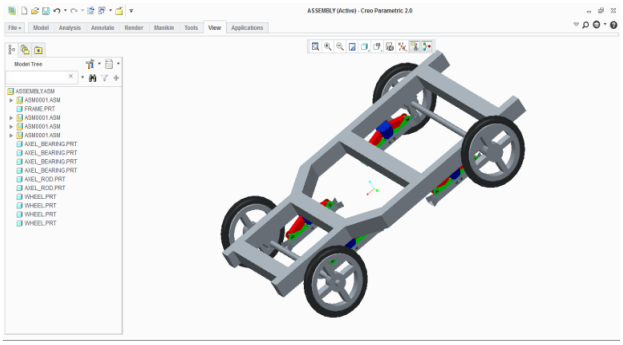

Fig 2: CAD Model

5. CONCLUSIONS

The screw jack is the best device lift the heavy load. It is necessary that the jack is portable, easy to use, operate by any unskilled worker. It is desirable that it should be stable and can be operated by switch quickly from inside the vehicle by safety point of view.

Our project helps to cover all the above parameter.

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