International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 4, Issue 4, April 2015)

Recent Technologies in Automobiles: Need of Motorised Screw Jack: A Review

Pawar R. R.[1], Shinde M. S.[2], Shinde A. B.[3], Garde M. B.[4], Prof. Bhane A.B.[5].

[1,2,3,4]*UG Student, Savitribai Phule Pune University, SND COE & RC, Yeola, Dist-Nashik, Maharashtra, India*
[5]*Assistant Professor, Savitribai Phule Pune University, SND COE & RC, Yeola, Dist-Nashik, Maharashtra, India*

***Abstract*— The purpose of this paper is to design a screw jack which is easy for operating, safe and able to lift and lowering the car without spending much effort. Available car jacks are typically manually operated and therefore require more physical effort on the part of the user. Such jacks creates difficulties for the elderly, handicapped, and women's. Disadvantageous in bad weather conditions. And this is a waste of time and even will endanger if jacking and changing the tire is in hurry. So, for that reason electrical-powered jacks not only remove the task of lifting an Automobile via manually operated jacks, but also decrease the time needed to repair the automobile. This is a review of one type of automation project.**

***Keywords* – D.C motor, Gear & pinion, Lifting Arm, On/Off switch, Power screw, Speed reduction.**

I. INTRODUCTION

A Screw jack is a device which is used to raise part of a vehicle in order to facilitate vehicle maintenances or breakdown repairs. In normal Jack system a mechanical jack is used for lifting the vehicles. The most common form is a car jack, garage jack, floor jack which lifts vehicles so that maintenance can be performed. Car jacks generally used to increase mechanical advantage while lifting the vehicle. In general the weight of the vehicle is near about the 1 tons. A specified jack can hold up to 1000 kilograms, but tests taken by Consumer Affairs has revealed that is fails to work after lifting 250 kilograms and may physically break when it has a weight close to its 1000 kilograms capacity. Tests have proven that the jack has the tendency to buckle under the weight it is promoted to withstand. For this reason, we have to developed the system which can used with toggle jack is automatic in operation. That means with the help of the electric motor. For this motor we have to use the vehicle battery is as source. In this, vehicle battery should be a 12V DC motor with some torque which is required to overcome the thread friction and to raise the load.

II. NEED OF INVENTION

In the world, the fact is that 'necessity is the mother of invention' and the necessary condition is that, large effort is required for the manual operation of jacks, so for that reason, it is the need of invention. In the repair and maintenance of automobiles, it is often necessary to raise an automobile to change a tyre or access the bottom of the automobile. According to that, various car jacks have been developed for lifting an automobile from a ground surface. In that case, they are categorised as; Standard jack, pneumatic jack, farm jack, hydraulic jack. Normally the standard jack uses the power screw for lifting. These standard jack has limited degree of freedom with corresponding link members. In Hydraulic jack, incompressible fluid is used instead of screw for lifting. Which is achieved by increasing the fluid pressure in cylinder to uplift the load. Available jacks are typically large, heavy and also difficult to store, transport, carry or move into underside of an automobile. Doing work in a bent or occupying position for a period of time is not ergonomic to human body, i.e. It is not completely desirable in ergonomics point of view. It may give back problem while continuous working with same. Engineering is preferred for making things simpler or improving and effective, for that Car jacks must be easy to use for pregnant women. The general purpose of the project is to minimize the human effort while operating the jack.

III. LITERATURE REVIEW

Screw type mechanical jacks were very commonly referred in jeeps and trucks at World War II vintage. For ex., the World War II jeeps (Ford GPW and Willys MB) were introduced with the Jack, Screw type, Capacity 1 1/2 ton, Ordnance part number 41-J-66. In that days, the 41-J-66 jack was carried in the jeep's tool box. Screw type jack's preferred continued for small capacity use due to minimum cost of production for raise or lower the load. It had negligible maintenance.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 4, Issue 4, April 2015)

The concept of using a screw as a machine was first demonstrated by Archimedes in 200BC with his device used for pumping water. There is also evidence that screws were preferred in the Ancient Roman world. But, In the late 1400s, the Leonardo da Vinci, who first displayed the method of use of a screw jack for lifting the loads. Its design used a threaded worm gear, supported on bearings, which is rotated by the turning of a worm shaft to drive a lifting screw to move the load instantly recognisable as the principle used today.

Thomas J. Prather (2009): In this, there was a introduction about vehicle lift system. A drive assembly was mechanically coupled to the piston. The drive assembly was operated in first direction to raise an upper end of the piston with respect to the housing. The drive assembly was operated in a second direction to lower the upper end of the piston with respect to the housing. The drive assembly was coupled to the power supply port which is removable to supply electrical power to the drive assembly.

Farhad Razzaghi (2007): In this, electrically powered jack shown for normally raising and lowering of automobile from ground surface. The mechanism may be used in joining with a typical portable car jack, during which the mechanism constitute a power drill, a rod, and a numerous jack adapters.

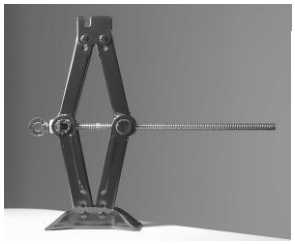
Manoj Patil (2014): In this general article, screw jack is to developed to overcome the human effort. It is actually difficult job to operate for pregnant women and old person. Changing the tyre is not a pleasant experience. Especially women can't apply more force to operate. For that, electric operated car jack is introduced

Lokhande Tarachand (2012): This paper referred to Optimise the efficiency of square threaded mechanical screw jack by varying different helix angle.

IV. Principle Of Working

Standard Jack:

Standard jack is a mechanical device which is used to lifting device. Standard jack employs a screw thread for lifting heavy equipment. The most common used in cars as car jack, floor jack or garage jack which lifts vehicles for purpose of vehicle maintenance. Standard Mechanical jacks are usually rated for a maximum lifting capacity (for ex., 1.5 tons or 3.0 tons). For maximum load hydraulic or pneumatic power is used to lift the Vehicle.



Pneumatic jack:

A pneumatic jack is a part of hydraulic jack that is actuated by compressed air - for example, air from a compressor - instead of human work. It saves the effort which exclude the need of the user to actuate the hydraulic mechanism, with potentially increasing speed. In certain circumstances, these jacks are also capable to be operated by normal hydraulic actuation mechanism, by that keeping possession ability, even when source of compressed air is not available.

Farm jack:

The farm jack is also known as a Hi-Lift Jack. It is composed of a steel beam with a chain or series of equally spaced holes continuous with its length and a mechanism with hand operated which is moved from one end of the beam to the other through the use of a pair of climbing pins. The farm jacks are categorised as 1.2m , 1.5m and 1.8m.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 4, Issue 4, April 2015)

Hydraulic jack:

Incompressible Fluid is uses in hydraulic jack that is forced into a cylinder by a pump plunger. Oil is used which is self lubricating and stable. At the time, when the plunger goes into the reservoir, it get return with oil by means of a suction check valve into the pump chamber. When the plunger goes toward the reservoir, it presses the oil into the cylinder by means of discharge check valve. Due to action of suction valve ball, the valve is open by to and fro motion of plunger which is fitted inside the chamber and same action also done when is moved out but in that condition discharge valve ball is fitted out of the chamber. At this stage the suction ball inside the chamber is pressurized by external work which help to increase pressure in the cylinder.

V. DESIGN CONCEPT

Torque Requirement to Raise the Load

The screw is considered as an inclined plane with inclination α.When the load is get raised, following forces act at a point on it's inclined plane.

Load, W: It always acts in vertically downward direction. *Normal reaction, N:* It acts transversely perpendicular to the normal inclined plane.

Frictional force, μN: Frictional force acts opposite to the motion. Since the load travel in the direction of inclined plane , frictional force acts toward the downward direction along the inclined plane.

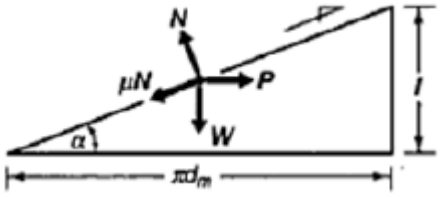


Fig. 5.1

Effort, P: The effort P acts in a direction perpendicular to the load W. It always move towards right to reduce the friction and raise the load on that direction.

For an equilibrium of horizontal forces.

$$P = \mu N \cos\alpha + N \sin\alpha \quad (a)$$

For an equilibrium of vertical forces,

$$W = N \cos\alpha - \mu N \sin\alpha \quad (b)$$

Dividing expression (a) by (b),

$$P = \frac{w(\mu\cos\alpha+\sin\alpha)}{(\cos\alpha-\mu\sin\alpha)} \quad (c)$$

The coefficient of friction μ is expressed as,

$$\mu = \tan\theta \quad (d)$$

Where θ is the friction angle.

Substituting μ = tan θ in Eq. (c),

$$P = \frac{w(\tan\theta+\tan\alpha)}{(1-\tan\theta\tan\alpha)}$$

Or $P = W \tan(\theta + \alpha)$ (e)

The torque"T" required to raise the load is given by,

$$T=\frac{pd_m}{2}$$

$$T=\frac{wd_m}{2}\tan(\theta+\alpha) \quad (f)$$

Torque Requirement for Lowering the Load

When the load is being lowered, the following forces act at a point on the inclined plane.

Load, W: It always acts in vertically downward direction.

Normal reaction, N: It acts transversely perpendicular to the normal inclined plane.

Frictional force, μN: Frictional force acts opposite to the motion. Since the load travel in the direction of inclined plane , frictional force acts toward the upward direction along the inclined plane.

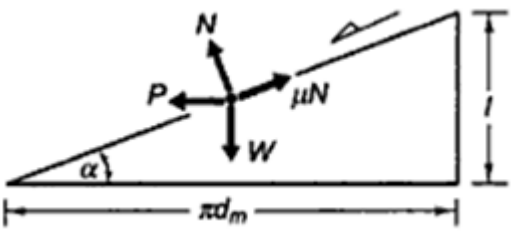


Fig. 5.2

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 4, Issue 4, April 2015)

Effort, P: The effort P acts in a direction perpendicular to the load W. It always move towards left to reduce the friction and lower the load on that direction. For an equilibrium of horizontal forces,

$$P = \mu N \cos \alpha - N \sin \alpha \quad (a)$$

For an equilibrium of vertical forces,

$$W = N \cos \alpha + \mu N \sin \alpha \quad (b)$$

Dividing expression (a) by (b),

$$P = \frac{w(\mu cos\alpha + sin\alpha)}{(cos\alpha - \mu sin\alpha)}$$

Dividing the numerator and denominator of the right hand side by cos α,

$$P = \frac{w(\mu - \tan\alpha)}{(1 + \mu \tan\alpha)} \quad (c)$$

The coefficient of friction μ is expressed as,

$$\mu = \tan\theta \quad (d)$$

Substituting $\mu = \tan\theta$ in Eq. (c),

$$P = \frac{w(tan\theta - tan\alpha)}{(1 + tan\theta tan\alpha)}$$

or $P = W \tan(\theta - \alpha)$ (e)

The torque „T" required to raise the load is given by,

$$T = \frac{pd_m}{2} \quad (f)$$

VI. Comparison With Manual Jack

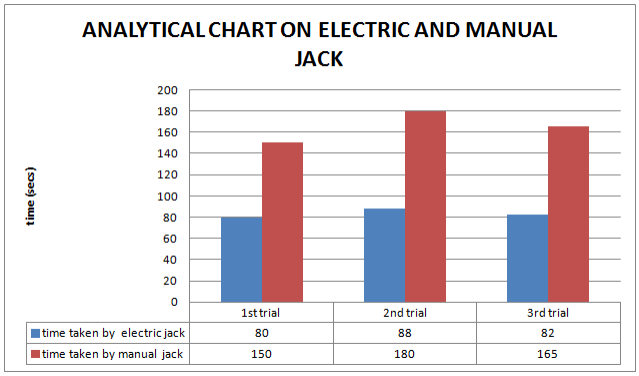


Fig.: Comparison between manually operated jack and Motorised screw jack.

VII. Conclusion

This jack is highly desirable jack to become available in vehicles that can be operated by the electric D.C. Motor and the electric supply is given to motor from vehicle battery. Such a jack is should be compact. Hence it can easily store in an automobile. That whole design is control by a switch so that jacking can be done from a position of safety. It should be easily movable and other support surface is not required. Thus, the design has been developed considering all the above requirements. This is the beneficial in lifting and lowering of loads.

REFERENCES

[1] Bansal, R.K.(2012)," Strength of materials" Revised Edition, LAXMI PUBLICATION(P) LTD.

[2] Khurmi, R.S. and Gupta, J.K. (2005), "A Textbook of Machine Design", Eurasia Publishing House (P.V.T) Ltd.14th Edition.

[3] Thomas J. Prather, US. "Vehicle lift system" United States Patent Issued on January 6, 2009, Patent Number: US 7472889 B1.

[4] Farhad Razzaghi, US. "Apparatus and method for an electric jack" United States Patent Issued on November 8, 2007, Patent Number: US 2007/0256526 A1.

[5] Manoj Patil, Gaurav Udgirkar, Rajesh Patil and Nilesh, "Automated Car Jack", International Journal of Current Engineering and Technology (Vol.4, No.4, Aug 2014) E-ISSN 2277 – 4106, P-ISSN 2347 – 5161.

[6] Lokhande Tarachand G., Chatpalliwar Ashwin S. And Bhoyar Amar A., "Optimizing Efficiency of Square Threaded Mechanical Screw Jack by Varying Helix Angle", International Journal of Modern Engineering Research (IJMER)(Vol.2, Issue.1, Jan-Feb 2012 pp-504-508) ISSN: 2249-6645