MANTECH Publications

Journal of Product Design, Quality Engineering & Technology
Volume 6, Issue 1, January-April 2021

Automated Motorised Jack Design and Fabrication

Jai Kishor[1], Narendra Kumar[2], Deepak Tyagi[3]
Students
Department of Mechanical Engineering
Axis Institute of Technology, Kanpur
Corresponding Author's Email id: *dktyagi567@gmail.com[3]*

Abstract

With the advancement of technology, the amount of effort required to perform any type of labour has been steadily reducing. By implementing superior designs, the work necessary to get the target output can be reduced effectively and inexpensively. Power screws are used to convert rotary motion into translatory motion. A screw jack is an example of a power screw in which a small force applied in a horizontal plane is used to raise or lower a large load. The principle on which it works is similar to that of an inclined plane. The ratio of the load applied to the effort applied is the mechanical advantage of a screw jack. A lead screw is used to operate the screw jack.

The jack's height is modified by turning a lead screw, which can be done either manually or electrically. The jack (manually operated) that is still supplied as standard equipment with most new cars is familiar to most people. In the repair and maintenance of automobiles, it is frequently essential to raise the vehicle in order to change a tyre or gain access to the vehicle's undesirables. As a result, a number of car jacks have been invented to lift a vehicle from the ground. As a result, the screw jack is powered by electricity and driven by a D.C. motor to reduce human effort.

Keywords: *Lead screw, screw jack, DC Motor*

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INTRODUCTION

The fact is that necessity is the mother of invention in the world, and the necessary condition is that manual jack operation requires a lot of work, so there is a need for invention. In the repair and maintenance of automobiles, it is frequently required to lift the vehicle in order to change a tyre or gain access to the undercarriage.

Various car jacks have been designed to lift an automobile from a ground surface, according to this. They are classified as standard jack, pneumatic jack, farm jack, and hydraulic jack in this situation. Normally, the power screw is used to lift the conventional jack. The project's overall goal is to reduce the amount of human work required to operate the jack.

The motorised screw jack was created to meet the needs of small and medium-sized car garages, which are often run by manpower with little specialised labour.

In most of the garages the vehicles are lifted by using screw jack. This needs high man power and skilled labor. In order to avoid all such disadvantages, the motorized jack has been designed in such a way that it can be used to lift the vehicle very smoothly without any impact force. The operation is made simple so that even unskilled labour can use it with ease. The D.C motor is coupled with the screw jack. The screw jack shafts rotation depends upon the rotation of D.C motor.

Our research survey in this regard revealed that in several automobile garages, revealed the facts that mostly some difficult methods were adopted in lifting the vehicles for reconditioning, repair and maintenance. This fabricated model has mainly concentrated on this difficulty, and hence a suitable device has been designed, such that the vehicle and heavy objects can be lifted from floor land without the application of impact force.

This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains to be an essential part of the system although with changing demands on physical input, the degree of mechanization is increased.

While screw jacks are designed purposely for raising and lowering loads, they are not ideal for side loads, although some can withstand side loads depending on the diameter and size of the lifting screw. Shock loads also be avoided or minimized. Some screw jacks are built with anti-

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backlash. The anti-backlash device moderates the axial in the lifting the screw assembly to regulated medium.

A large amount of heat is generated in the screw jack and long lifts can cause serious overheating. To retain the efficiency of the screw jack, it must be used in ambient temperatures, otherwise lubricants must be applied. There is oil lubricants intended to enhance the equipment's capabilities.

Apart from proper maintenance, to optimize the capability and usefulness of a screw jack it is imperative to employ it according to its design and manufacturers instruction. Ensure that you follow the speed, load capacity, temperature recommendation and other relevant factors for application.

WORKING PRINCIPLE

The lead-acid battery is used to drive the d.c motor. The d.c motor shaft is connected to the spur gear. If power is given to the D.c motor, it will run so that the spur gear also runs to slow down the speed of the D.C motor. The screw jack moves the screw upward, so that the vehicle lifts from ground.

The vehicle is lifted by using the lifting platform at the top of the screw jack. The motor draws power supply from the battery. The lifting and uplifting is done by changing the battery supply to the motor.

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

- **Load (W):** It always acts in vertically downward direction.
- **Normal reaction (N):** It acts perpendicular (normal) to the inclined plane.
- **Frictional force (μN):** It acts opposite to the motion. When the load is moving the inclined plane, frictional force acts along the inclined plane in downward direction and when the load is moving down the inclined plane, frictional force acts along the inclined plane in upward direction.

The motorised screw jack was created to meet the needs of small and medium-sized car garages, which are often run by manpower with little specialised labour.

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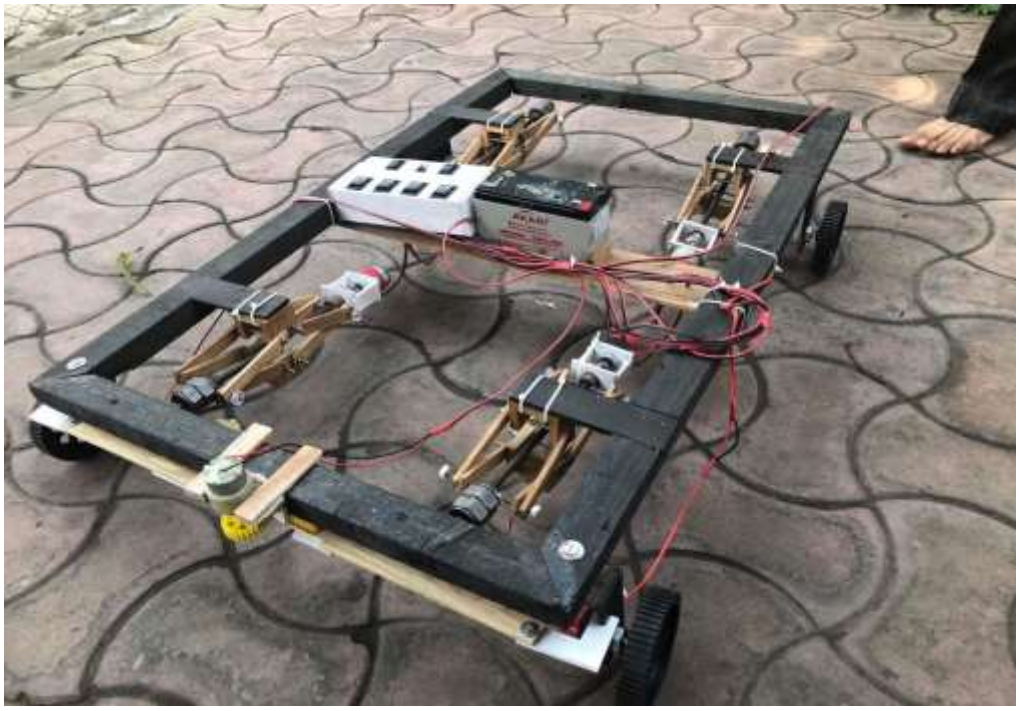
ACTUAL PROJECT PHOTO





CALCULATIONS

Observed data

Load W = 20 kg

Nominal diameter of screw, d = 13.7 mm

Coefficient of friction, μ = 0.15

Core diameter of screw, dc = 11 mm

Mean diameter of screw, dm = 12.7 mm

Pitch of screw thread, p = 2 mm

Helix angle of screw, α = 2.680

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Tangential force required at the circumference of the screw to raise the load μ = tan ø = 0.15

p = W × tan α + tan ø = 40.2 N

tan α.tan ø Torque required to operate the screw = p × d + μrm 2 = 40.2 × (12.7/2) + (0.15 × 200 × 18)

= 825.27 N mm

= 0.8257 Nm

= 8.5 Kg cm

Efficiency of the screw = T0/T1

= [200×(12.7/2)]/[0.15×200×18+200×(12.7/2)]=27%

For lowering load (P) = W tan (α + ø) = W × tan α + tan ø

= 19.826 N

1-tan α.tan ø

Torque = p × d + μrm W= 0.662 N

Shear stress due to torque T1, τ = 16T1/ π(dc)3 = 825.27 N/mm2 = 3.15 N/mm2

Compressive stress due to axial load (σc) = W/A = 2.10 N/mm

Shear stress due to torque (σc max) = 0.5 [σc + σc2 + 4τ2 = 4.5 N/mm2 < 50 N/mm2

Maximum shear stress = 3.32 N/mm2 < 40 N/mm2

So, design is safe

Motor Specification

Motor is of 12 v D.C

Motor power = 300 W = 0.4 HP

Motor rpm = 300 rpm

Motor torque = 1 N.m

APPLICATIONS

1) It is useful in auto-garages.
2) In emergency conditions like tyre flat out.
3) This motorized screw jack is used for lifting the vehicles.
4) Thus it can be useful for the following types of vehicles in future;
5) To raise the load, e.g. screw-jack,
6) To obtain accurate motion in machining operations, e.g. lead-screw of lathe,
7) To clamp a work piece, e.g. vice
8) To load a specimen, e.g. universal testing machine.
9) In other applications, the nut is kept stationary and the screw moves in axial direction. Screw-jack and machine vice are the examples of this category

CONCLUSION

- Screw jack are the ideal product to push, pull, lift, lower and position loads of anything from a couple of kilograms to hundred of tones.

- The need has long existed for an improved portable jack for automotive vehicles.

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- The primary thing is that it should be capable of lifting a wheel of a 4,000-5,000 pound vehicle of the ground.

- Further it should be stable and easily controllable by a switch so that jacking can be done from a position of safety.

FUTURE SCOPE

- The developed automatic car jack can only withstand below 1000kg of load.

- The developed automatic car jack must be operated on a flat surface.

- The developed automatic car jack is only a prototype and not readily functioning as commercial product

- The design is based on current scissor jack in the market

- The developed automatic car jack is only for normal person

- The developed automatic car jack can only work by using the internal car power (12V)

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