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"Design and Fabrication of Automated Motorised Jack"

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Abstract

With the increasing levels of technology, the efforts being put to produce any kind of work has been continuously decreasing. The effort required in achieving the desired output can be effectively and economically be decreased by the implementation of better designs. 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 mechanical advantage of a screw jack is the ratio of the load applied to the effort applied. The screw jack is operated by turning a lead screw. The height of the jack is adjusted by turning a lead screw and this adjustment can be done either manually or electrically. Most people are familiar with the jack (manually operated) that is still included as standard equipment with most new cars. In the repair and maintenance of automobiles, it is often necessary to raise an automobile to change a tire or access the undesirable of the automobile. Accordingly, a variety of car jacks have been developed for lifting an automobile from a ground surface. Thus to overcome the manual effort of human being the screw jack is operated on the electricity by means of D.C. motor.

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

INTRODUCTION

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 tire 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 categorized as; Standard jack, pneumatic jack, farm jack, hydraulic jack. Normally the standard jack uses the power screw for lifting. The general purpose of the project is to minimize the human effort while operating the jack.

The motorized screw jack has been developed to cater to the needs of small and medium automobile garages, which are normally man powered with minimum skilled labor.

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-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

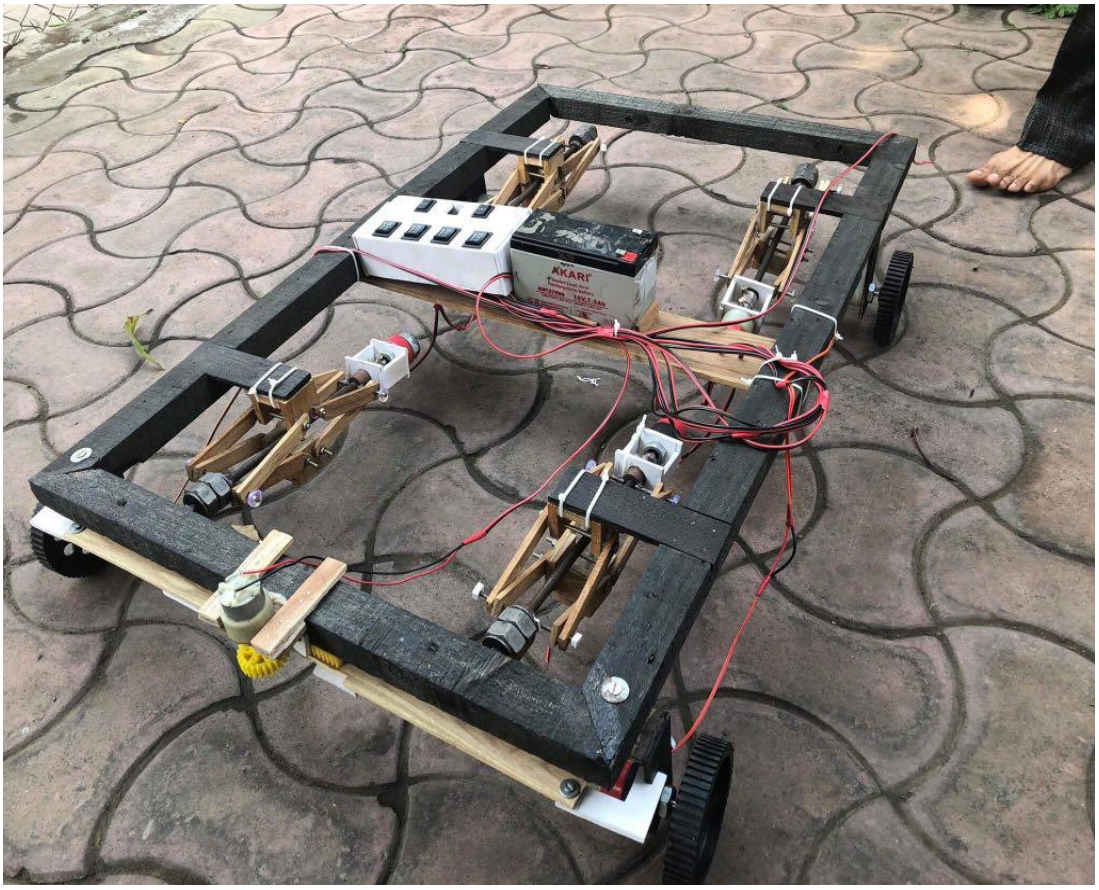
The lead-acid battery is used to drive the d.c motor. The d.c motor shaft is connected to the spur gear. If power is given to the D.c motor, it will run so that the spur gear also runs to slow down the speed of the D.C motor. The screw jack moves the screw upward, so that the vehicle lifts from ground.

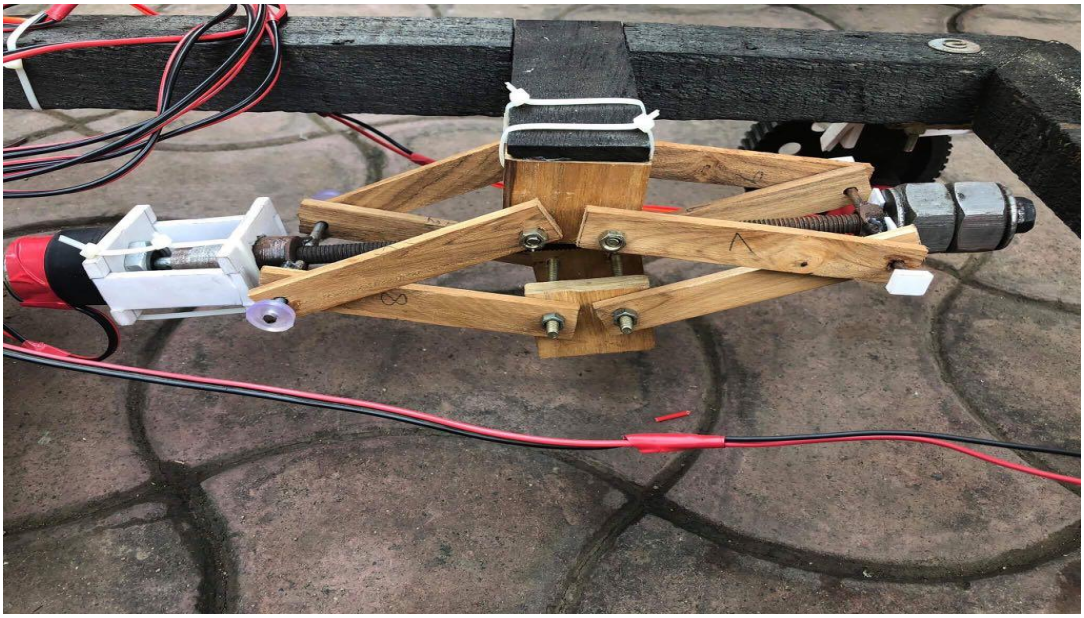
The vehicle is lifted by using the lifting platform at the top of the screw jack. The motor draws power supply from the battery. The lifting and uplifting is done by changing the battery supply to the motor.

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.

ACTUAL PROJECT PHOTO





CALULATIONS

Observed data

Nominal diameter of screw, d = 13.7 mm

Core diameter of screw, dc = 11 mm

Pitch of screw thread, p = 2 mm

Load W = 20 kg

Coefficient of friction, μ = 0.15

Mean diameter of screw, dm = 12.7 mm

Helix angle of screw, α = 2.680

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.
- 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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