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### TOGGLE SCREW JACK

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#### ABSTRACT

Now a days side road emergency like tire puncher, is a problem commonly observed in cars. Conventional car jacks uses mechanical advantage to allow a human to lift a vehicle by manual force. This paper studies the modification of the current toggle jack by incorporating an electric DC motor in the screw in order to make load lifting easier for emergency use with using power of car battery (12 Volts). The purpose of this work is to modify the existing car jack in order to make the operation easier, safer and more reliable in order to save individual internal energy and to reduce health risks especially back ache problems associated with doing work in a bent or squatting position for a long period of time. Fabrication work are using with drilling, grinding, and welding machine. Implementation of design will solve problem associated with ergonomics Car battery D.C Motor, propeller shaft, jack, screw.

#### INTRODUCTION

Toggle jack is used to jack the car during side road emergency i.e. tire puncher. A mechanical jack is a device used to lift heavy equipment, all or part of a vehicle into the air in order to facilitate vehicle maintenances or breakdown repairs . Changing a flat tire is not a very pleasant experience. Nowadays, a variety of car jacks have been developed for lifting an automobile from a ground surface. Available car jacks, however, are typically manually operated and therefore require substantial laborious physical effort on the part of the user. Such jacks present difficulties for the elderly and handicapped. It further requires the operator to remain in prolonged bent or squatting position to operate the jack. Doing work in a bent or squatting position for a period of time is not ergonomic to human body. It will give back ache problem in due of time. A toggle jack is operated by turning a lead screw. In this case of a jack, a small force applied in the horizontal plane is used to raise or lower large load A jackscrew's compressive force is obtained through the tension force applied by its lead screw.

In which propeller shaft is used to transmit the power from motor to toggle screw jack Propeller shaft is bent with helps of universal joints. An Acme thread is most often used, as this thread is very strong and can resist the large loads imposed on most jackscrews while not being weakened by wear over many rotations. An inherent advantage is that, if the tapered sides of the screw wear, the mating nut automatically comes into closer engagement, instead of allowing backlash to develop.

#### MATERIALS AND METHODS

##### Working Of Electrically Operated Jack

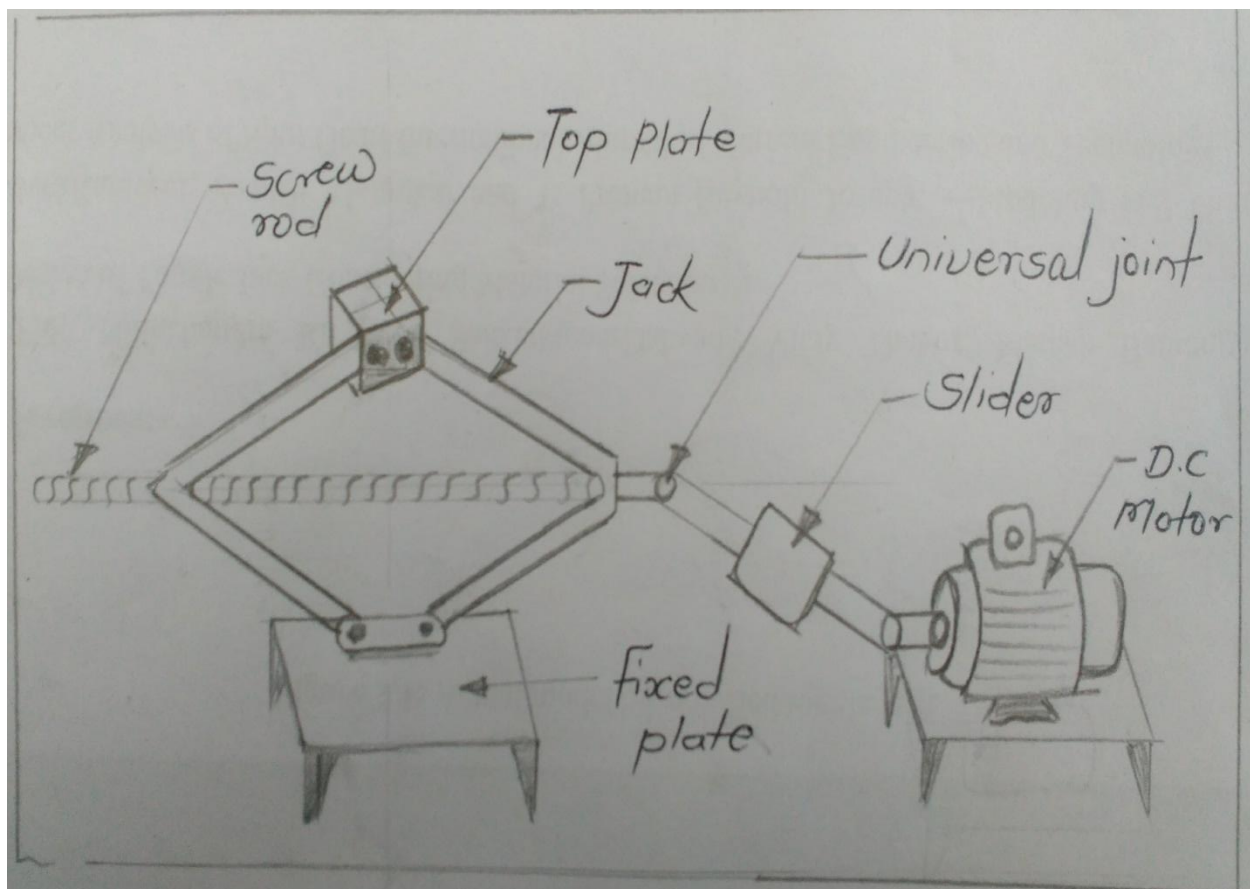
Under working condition the jack will lift a vehicle chassis in contact with the top plate when the power screw is rotated through its connecting propeller shaft with the universal joints when electrical power applied to the wiper motor when plugged to the 12V battery in car. Motor transmits its rotating speed to the propeller shaft with the universal joints connected to the power screw to be rotated with required speed reduction and increased torque to drive the power screw. The power screw rotates within the threaded bore of side member in the clockwise direction that will cause the links to be drawn along the threaded portion towards each other during load-raising process and vice versa. Initially the jack will first be placed below the chassis to be lifted such that at least a small clearance space will exist between the top plate and the vehicle chassis to be raised. Then after power screw will be turned so that the top plate makes contact with the car chassis and the clearance space is eliminated. As contact is made, load of car will be increasingly shifted to the top plate and cause forces to be developed in and transmitted through links and side member. The force transmitted through the side member will be transferred on threads of screw. A switching circuit connected to the motor is used to regulate the lifting and lowering process.

##### Design and development of jack

Figure 1.1 shows modified toggle jack. The main components of required for development of this jack are:

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- a) Original toggle jack with alteration and replacement of Power Screw and Side members.
- b) Power screw.
- c) Propeller shaft and universal joints
- d) DC wiper motor.
- e) Bracket and holder to carry motor.



*Figure 1.1: Automatic toggle jack.*

### Material selection

Jacks are usually made of materials that are very strong and are suitable for withstanding heavy loads. The two main materials used for making good quality jacks are Steel and Aluminium. When selecting the material suitable for the construction of the Scissor jack one has to consider the properties that will enable it to function with no expected failure and at the same time the weight of machining the product. Therefore the main areas that can be classified in this case are the strength of the material, weight, ease and cost of manufacturing. Aluminium is around one-third the density of steel at 2.72 mg/m cubed compared to steel's 7.85 mg/m cubed. The light weight and low melting point of aluminium makes it easier and more efficient to machine than steel.



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Aluminium's fatigue performance is half that of steel, which is an advantage steel has over aluminium in car jack life durability.

### RESULTS AND DISCUSSION

We have brought the toggle jack from junk yard which needs little alteration, Parts like power screw and side member are newly designed and replaced. Design of screw and side member are as follows:

#### Assumptions

1. 1.The ground clearance of the vehicle is assumed to be 165 mm.
2. When the screw jack carries the maximum load, i.e. when the wheel of the vehicle leaves the ground, the screw jack is assumed to have moved in the vertical axis (linearly) by a distance of 50mm.
3. 3.The screw jack supports a quarter of the total vehicle mass, which is approximately 300 kg, i.e. 3000 N of force of car of weight 1200 kg i.e. 12000 N. For safety design weight is taken as 500 kg i.e. 5000 N.

#### Derived

- a. Max load on jack depending on condition of road.

I. On horizontal road surface.

II. On slop.

It is observed that max load acts on jack when vehicle is on horizontal surface.

### CONCLUSION

The existing jack was modified by making small alteration and making use of an electric motor to drive power screw, connecting Propeller shaft with universal joints mounted on the motor shaft. The automobile 12V battery source operates prime mover (motor), to facilitate load lifting easier. The power screw is rotated through its gear when electrical power flows through it. The advantages of this jack is it will save time, be faster and easier to operate and requires less human energy and additional work to operate. There by effectively curb the problems associated with Ergonomics - which is a fundamental concept of design process. Considering all available car jacks in the market, this prototype can be improved by a few modifications on the features and design. The objectives are to design a car jack that is safe, reliable and able to raise and lower the level, to develop a car jack that is powered by internal car power and automated with buttons system. Based on the testing and results from the analysis, it is considered safe to use Jack car work under certain specifications. Furthermore the torque supplied on the system is more than enough to lift a car weight around 1200 kg. There are certain weak point that can be improved based on propeller shaft, motor and design.

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