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FABRICATION OF AN INNOVATIVE SCISSOR JACK

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ABSTRACT:
A Scissor Jack is a mechanical device used to easily lift a vehicle off the ground to gain access to sections underneath the vehicles or to change the wheel. The most important fact of a jack is that, it gives the user a mechanical advantage by changing the rotational force on power screw into linear motion, allowing user to lift a heavy car to the required height. It is called a scissor jack as the structure consists of diagonal metal components that expand and contract in the same way as a pair of scissors. In this work a power scissor jack to lift and support a load of 4.5KN for typical use in four wheelers has been designed and fabricated by selecting the most appropriate materials and cross sections. The dimensions of various components are standardized for easy assembly and replacement, if required. The overall cost of the jack is relatively less compared to commercially available screw jacks. The self-weight of the power jack is minimized for easy handling.

KEYWORDS
Screw jack, Scissor jack, Power gun, Light source.

INTRODUCTION :

Screw type mechanical jacks were very common for jeeps and trucks since World War II vintage. These jacks were activated by using the lug wrench as a handle for the ratchet action to the jack. Screw type jacks continued in use for small capacity requirements due to low cost of production to raise or lower the load. A control tab is marked up/down and its position determines the direction of movement and with no maintenance. The virtues of using a screw as a machine element was first demonstrated by Archimedes in 200BC with his device used for pumping water.

There is evidence of the use of screws in the Ancient Roman world but ,it was the great Leonardo da Vinci, in the late 1400s, who first demonstrated the use of a screw jack for lifting loads. Leonardo's design used a threaded worm gear, supported on bearings, rotated by the turning of a worm shaft to drive a lifting screw to move the load.

With the industrial revolution of the late 18th and 19th centuries, came the first use of screws in machine tools, via English inventors such as John Wilkinson and Henry Maudsley. The most notable inventor in mechanical engineering from the early 1800s was undoubtedly the mechanical genius Joseph Whitworth, who recognized the need for precision as important in industry.

Over the next 30 years the Duff Manufacturing Company became the largest manufacturer of lifting jacks in the world, developing many new types of jack for various applications including its own version of the ball bearing screw jack.

There was a clear potential for using this technology for other applications and only 10 years later, in 1940, the first worm gear screw jack, that is instantly recognizable today, was offered by Duff-Norton, for adjusting the heights of truck loading platforms and mill tables. With the ability to be used individually or linked mechanically and driven by either air or electric motors or even manually, the first model had a lifting capacity of 10 tons with a raise of 2inch or 4inch.

Various Developments in Lifting Devices are lever, screw threads, gear, hydraulics, wheels and axles.

2. DRAWBACKS OF EXISTING JACK

In the repair and maintenance of automobiles, it is often necessary to raise an automobile to change a tire or access the underside of the automobile. Accordingly, 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 and are especially disadvantageous under adverse weather conditions.

Furthermore, available jacks are typically large, heavy and also difficult to store, transport, carry or move into the proper position under an automobile. In addition, to the difficulties in assembling and setting up jacks, such jacks are generally not adapted to be readily disassembled and stored after automobile repairs have been completed. Car jacks must be easy to be used even by women or whoever had problem with the tire in the middle of nowhere.

In the light of such inherent disadvantages, commercial automobile repair and service stations are commonly equipped with large and hi-tech car lift, wherein such lifts are raised and lowered via electrically-powered systems. However, due to their size and high costs of purchasing and maintaining electrically-powered car lifts, such lifts are not available to the average car owner. Engineering is about

making things simpler or improving and effective. Such electrical-powered portable jacks not only remove the arduous task of lifting an automobile via manually-operated jacks, but further decrease the time needed to repair the automobile. Such a feature can be especially advantageous, when it is necessary to repair an automobile on the side of a roadway or under other hazardous conditions. There are also reports on car jacks which lead to a serious failures.

3. POWER SCISSOR JACK

Scissor jacks are mechanical devices and have been in use since 1930s. A scissor jack is a device constructed with a cross-hatch mechanism, much like a scissor, to lift up a vehicle for repair. It typically works in a vertical manner. The jack opens and folds closed, applying pressure to the bottom supports along the crossed pattern to move the lift. When closed, they have a diamond shape. Scissor jacks are simple mechanisms used to handle large loads over short distances. The power screw design of a common scissor jack reduces the amount of force required by the user to drive the mechanism. Most scissor jacks are similar in design, consisting of four main members driven by a power screw.

To overcome aforesaid draw backs, a power scissor jack which has a frame type design utilizing the power from the battery of the automobile has been developed and fabricated. The power screw of the jack will be driven by the power gun connected to the battery parallely and at the same time the developed jack can be safely used during night time with an attachment of low wattage LED bulbs. The jack is embedding 2 trunions to ensure smooth and uniform lifting and lowering of jack.

4. FABRICATION

The fabrication process started with identification of suitable materials for various parts.

(a) Top Arms and Bottom Arms

As per design calculations the cross section of arms is selected as Channel Section. The pictorial view of the arm is shown in Fig.1. The sequence of operations performed with respect to time is presented in Table.1

Fig.1 Arm of Scissor Jack

Table.1 Sequence of operations on top and bottom arms

S no.	Machine	Operation	Tools	Time taken (min)
1	Stores	Check the raw material	Try square, steel rule, and dot punch	20
2	Welding shop	Welding of a flat plate to the angular to obtain channel section.	Welding gun, Files and Emery paper	120
3	Grinding machine	Grinding the plate in vice	Grinding wheel	60
4	Radial Drilling machine	Drilling 10 mm holes at both the ends of the plate	Drill bit, dot punch , hammer and steel rule	40

(b) Power Screw

A double start square threaded screw is machined on a lathe as shown in Fig.2.

Table.2 shows the sequence of operations and time taken for each operation

Fig.2 Forming of power screw on lathe

Table.2 Sequence of operations and time taken for each operation

S no.	Machine	Operation	Tools	Time (min)
1	Stores	Check the raw material	Outer calipers, steel rule	5
2	Sawing machine	Cutting the length of the rod as per requirement	Hack saw	25
3	Lathe machine	Turning the diameter to 16 mm	Single point cutting tool	35
4	Lathe machine	Threading of square thread	Threading tool	60
5	Shop Floor	Inspection	Vernier calipers	5

(c) Trunions

A circular rod was drilled to form a through hole. Then the hole has been finished to form internal square thread corresponding to the external threads of the power as shown in the Fig.3. Table.3 gives various Sequence of operations along with the time taken

Fig.3 Trunions with internal threading

Table.3 Sequence of operations along with the time taken

S no.	Machine	Operation	Tools	Time (min)
1	Stores	Check the raw material	Inner calipers, steel rule	5
2	Sawing machine	Cutting the length of the rod as per requirement	Hack saw	25
3	Lathe machine	Turning the outer diameter to 24 mm	Single point cutting tool	35
4	Lathe machine	Boring the Trunions to 16mm diameter	Boring tool	15
5	Lathe machine	Threading of square thread	Internal Threading tool	60
6	Shop Floor	Inspection	Vernier calipers	5

(d)Top and Bottom Plates

The left out pieces of the channel sections of the arms have been used for the top plate and then holes were drilled to the plate for fasteners connecting top plate and the arms. The top plate is fabricated in order to act as a loading platform as shown on the Fig.4.The bottom plate was shaped by welding two L-angles so that the bottom arms fit into the bottom plate. The bottom plate is fabricated in order to obtain maximum stability to the Power Scissor Jack. The sequence of operations along with the time taken is shown in Table.4.

Fig.4 Top Plate and Bottom plate

Table.4 Sequence of operations on top and bottom plates

S no.	Machine	Operation	Tools	Time (min)
1	Stores	Check the raw material	Try square, steel rule, dot punch	15
2	Welding shop	Welding of a flat plate to the angular to obtain channel section.	Welding gun, Files and Emery paper	120
3	Grinding machine	Grinding the plate in vice	Grinding wheel	90
4	Radial Drilling machine	Drilling 10 mm holes at both the ends of the plate	Drill bit, dot punch , hammer and steel rule	60
5	Shop Floor	Inspection	Vernier calipers	10

(e) Power Gun

It has been fabricated to drive the power screw by providing a suitable slot in the head of the power screw. The power required to operate the gun is obtained from the battery by means of step up transformer.

(f) Light Source

A LED bulb is fitted to the base plate on both the sides to facilitate the repairs during the night time.

Fig.5 shows assembled view of fabricated jack and the operating circuit is presented in Fig.6

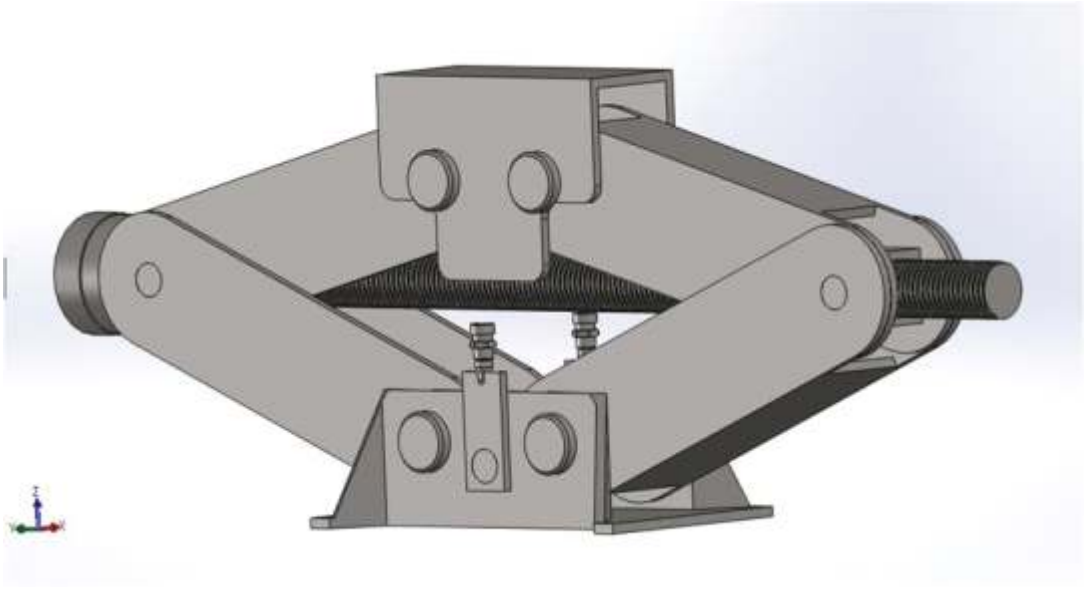

Fig.5 Assembly of Power Scissor Jack

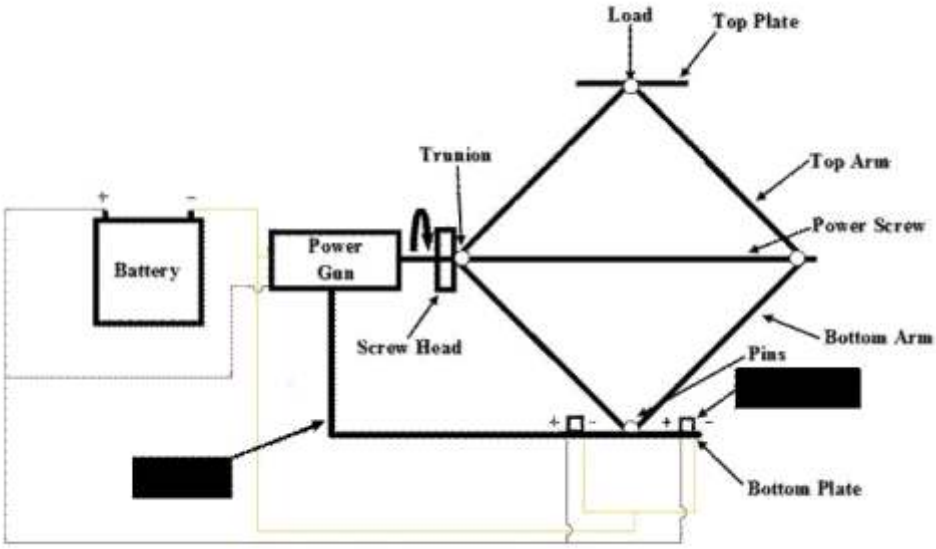

Fig.6 Operating Circuit of Scissor Jack

5. CONCLUSIONS

In this work a power scissor jack which can be operated by a power gun has been designed and fabricated. The jack has been designed to a pay load of 4.5kN. The salient features of the present fabrication are elimination of human effort to operate the jack, through a simple electrical device which can be actuated by a 12 V battery and provision of a light source to facilitate convenient operation during

night time. The assembly of the component can be achieved in 100 minutes. Another feature of the unit is provision of two trunions on both the sides of the jack to ensure jerk free operation. The elements which are useful are readily available commercially for easy replacement of failed components, if required.

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