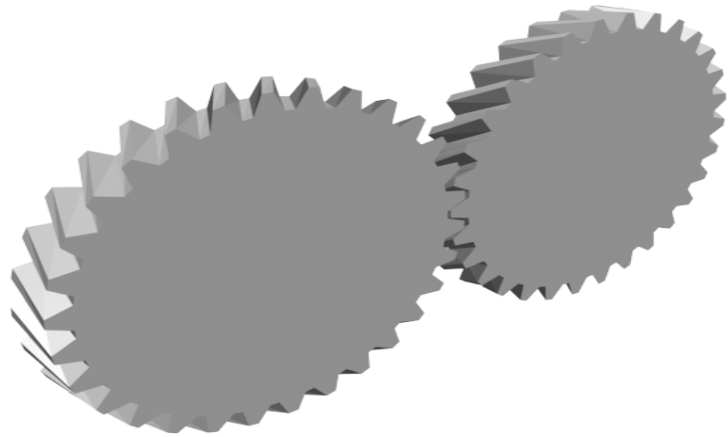


FABRICATION OF QUICK LIFTING SCREW JACK USING SPUR GEAR ARRANGEMENT



DONE BY

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Motivation for the research

With the increasing levels of technology, the efforts being put to produce any kind of work has been continuously decreasing. The efforts 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 by integrating an electric motor. In this project, an electric motor will be integrated with the screw jack and the electricity needed for the operation will be taken from the battery of the vehicle and thereby the mechanical advantage will be increased.

| S.NO | PUBLISHER NAME | JOURNAL NAME | YEAR | ABSTRACT |
|------|-----------------------|---|------|---|
| 1. | M V Babu Tanneru, Taj | Quick Lifiting Screw Jack Using Spur Gear Arrangement | 2017 | <p>With the increasing levels of technology, the efforts being put to produce any kind of work has been continuously decreasing. The efforts 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 by integrating an electric motor. In this project, an electric motor will be integrated with the screw jack and the electricity needed for the operation will be taken from the battery of the vehicle and thereby the mechanical advantage will be increased.</p> |

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| 2. | Modestus Okwu | Modified Screw Jack for Lifting Operation in Industrial Setting | 2017 | <p>With the increasing level of technology, researchers all over the world are working continuously to improve and implement better and robust design of materials at workplace for productivity, efficiency and effectiveness. Detailed design procedure of a quick lifting screw jack is presented in this paper. The design is fundamentally a modification of the conventional scissor jack. The problems associated with the conventional jacks are the ergonomic snags experienced by operators due to prolonged bending or squatting positions during operation. These problems of waist pain and backaches are as a result of continuous turning of the wrench or crank shaft in an uncomfortable position for a long period. These led to the design and modification of quick lifting screw jack with gear arrangements that are safe, reliable and capable of raising or lowering heavy load with little effort. The results showed that the introduction of the crank and gear mechanism would help reduce difficulty in operation, reduce time, increase efficiency and effectively control the difficulties concomitant with Ergonomics - which is an ultimate sensitivity in design process</p> |
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| 3. | Benjamin Ezurike1 , Modestus Okwu | Modified Screw Jack for Lifting Operation in Industrial Setting | 2017 | <p>With the increasing level of technology, researchers all over the world are working continuously to improve and implement better and robust design of materials at workplace for productivity, efficiency and effectiveness. Detailed design procedure of a quick lifting screw jack is presented in this paper. The design is fundamentally a modification of the conventional scissor jack. The problems associated with the conventional jacks are the ergonomic snags experienced by operators due to prolonged bending or squatting positions during operation. These problems of waist pain and backaches are as a result of continuous turning of the wrench or crank shaft in an uncomfortable position for a long period. These led to the design and modification of quick lifting screw jack with gear arrangements that are safe, reliable and capable of raising or lowering heavy load with little effort. The results showed that the introduction of the crank and gear mechanism would help reduce difficulty in operation, reduce time, increase efficiency and effectively control the difficulties concomitant with Ergonomics - which is an ultimate sensitivity in design process.</p> |
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| 4. | Ivan Sunit Rout , Dipti Ranjan Patra , Sidhartha Sankar Padhi | Design and Fabrication of motorized automated Object lifting jack | 2014 | <p>With the increasing levels of technology, the efforts are being put to produce any kind of work that has been continuously decreasing. The efforts 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 reciprocating motion. An object lifting 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. In this fabricated model, an electric motor will be integrated with the object lifting jack and the electricity needed for the operation will be taken from the d.c battery and thereby the mechanical advantage will be increased.</p> |
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Methodology

1. Literature reviews
2. Analysis
3. Requirements specification
4. Manufacture
5. Implementation
6. Testing and Investigation
7. Maintenance
8. Conclusion

Problem Definition

- The problem statement of quick lifting screw jack using spur gear arrangements is too costly and in some models of jack screws, the lifting screw does not move up and down. It only rotates around its axis. A lifting nut (also known as travelling nut) moves along the screw. The lifting nut of jack screw is made of bronze to decrease friction.
- Battery is easily drained

WORKING PRINCIPLE

- It is required to design a screw jack for supporting the machine parts during their repair and maintenance. It should be a general purpose jack with a load carrying capacity of 50KN and a maximum lifting height of 0.3m. The jack is to be operated by means of a D.C motor.
- Step II Selection of Materials, The frame of the screw jack has complex shape. It is subjected to compressive stress. Grey cast iron is selected as the material for the frame.
- Cast iron is cheap and it can be given any complex shape without involving costly machining operations.
- Cast iron has higher compressive strength compared with steel. Therefore, it is technically and economically advantageous to use cast iron for the frame.
- The screw is subjected to torsional moment, compressive force and bending moment. From strength consideration, EN8 is selected as material for screw.
- There is a relative motion between the screw and the nut, which results in friction. The friction causes wear at the contacting surfaces.
- When the same material is used for these two components, the surfaces of both components get worn out, requiring replacement. This is undesirable.
- The size and shape of the screw make it costly compared with the nut. The material used for the nut is stainless steel.

MAJOR COMPONENTS

1. DC MOTOR
2. BATTERY
3. TWO WAY SWITCH
4. FRAME
5. SHAFT
6. SPUR GEAR
7. SCREW JACK
8. BEARING
9. METAL STRIP

DC MOTOR

➤ An electric motor is a machine which converts electrical energy into mechanical energy. Its action is based on the principle that when a current carrying conductor is placed on a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule. When a motor is in operation, it develops torque. This torque can produce mechanical rotation. D.C motors are also like generators classified into shunt wound or series wound or compound wound motors.

Specification of a DC motor Speed : $N = 30 \text{ RPM}$

Voltage : $V = 12 \text{ Volt}$

Loading Current : $I = 300 \text{ MA}$ No Load Current : $I = 60 \text{ Ma}$

Power : $P = V \times I = 12 \times 0.3 = 3.6 \text{ WATT}$

$P = 0.0048 \text{ HP}$

Motor Efficiency : $E = 36\%$



BATTERY

- In order to provide supply to the controller unit battery is used. Lead acid battery is used in this project. The lead-acid battery is a rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to volume ratio, their ability to supply high surge currents means that the cells maintain a relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors

Specifications

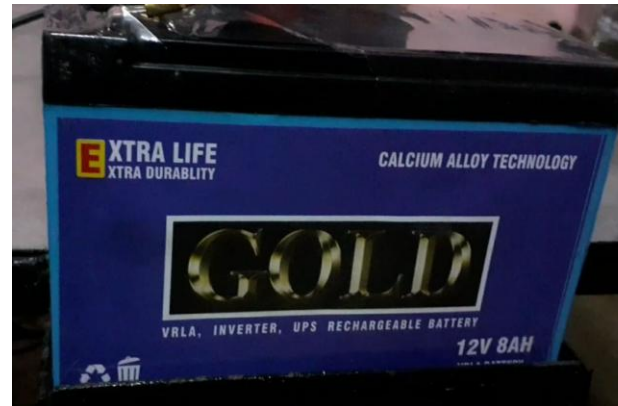
Power: 12V 8AH

Size: 150*65*102mm

Weight: 2.300kgs(plus)

Material: lead acid

Capacity: 8Ah



SPUR GEAR

- Spur gears or straight-cut gears are the simplest type of gear. A gear having involute teeth either straight or helically cut on a cylindrical surface. Two such gears are used to transmit power between parallel shafts. They consist of a cylinder or disk with teeth projecting radially. Though the teeth are not straight-sided (but usually of special form to achieve a constant drive ratio, mainly involute but less commonly cycloidal), the edge of each tooth is straight and aligned parallel to the axis of rotation. These gears mesh together correctly only if fitted to parallel shafts. No axial thrust is created by the tooth loads. Spur gears are excellent at moderate speeds but tend to be noisy at high speeds.



SPECIFICATION

Design of gears:

No of teeth in drive gear (z_1) = 20

No of teeth in driven gear (z_2) = 60

Speed (N_1) = 60 Rpm

Speed Ratio,

$$i = \frac{N_1}{N_2} = \frac{Z_2}{Z_1} = \frac{60}{20} = 3$$

$N_2 = 20$ Rpm

$N_2 \approx 20$ Rpm

Gear ratio = $\frac{\text{Driven gear teeth}}{\text{Drive gear teeth}}$

Gear ratio = $\frac{60}{20} = 3:1$

TWO WAY SWITCH

Type: reverse and forward condition.

Power supply: AC or DC.



FRAME

Material: Mild steel



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SHAFT

Shaft diameter: 12mm

Material: mild steel

Length: 26 inch



DESIGN OF BALL BEARING

- This is a type of rolling element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support and radial and axial loads. It achieves this by using atleast two races to contain the balls and transmit the loads through the balls.

SPECIFICATION

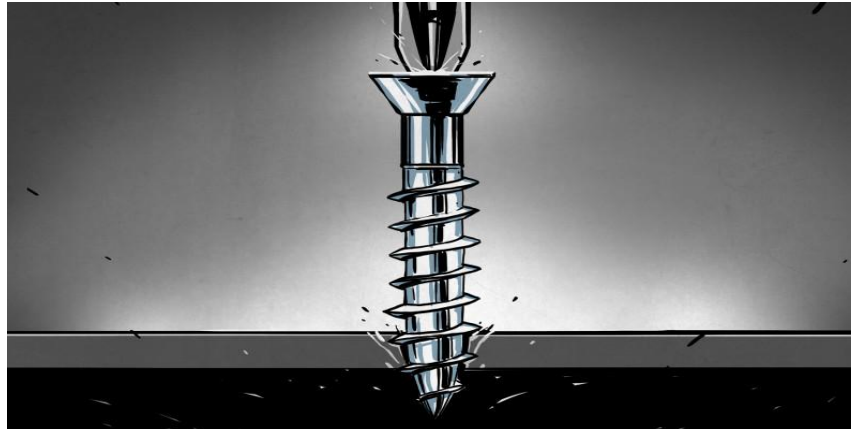
INNER DIA :12mm

OUTER DIA : 37mm



SCREW JACK

- Screw jack is used in applications where linear motion is required. Lifting of any load, pushing or pulling of mechanical equipment, adjusting of tight clearances of mechanical parts can be done by screw jacks.



METAL STRIP

Specifications

Material: Mild Steel Strip

Length: 50cm

Width: 5cm

Thickness : 4mm



Specifications

Length: 60cm

Width: 5cm



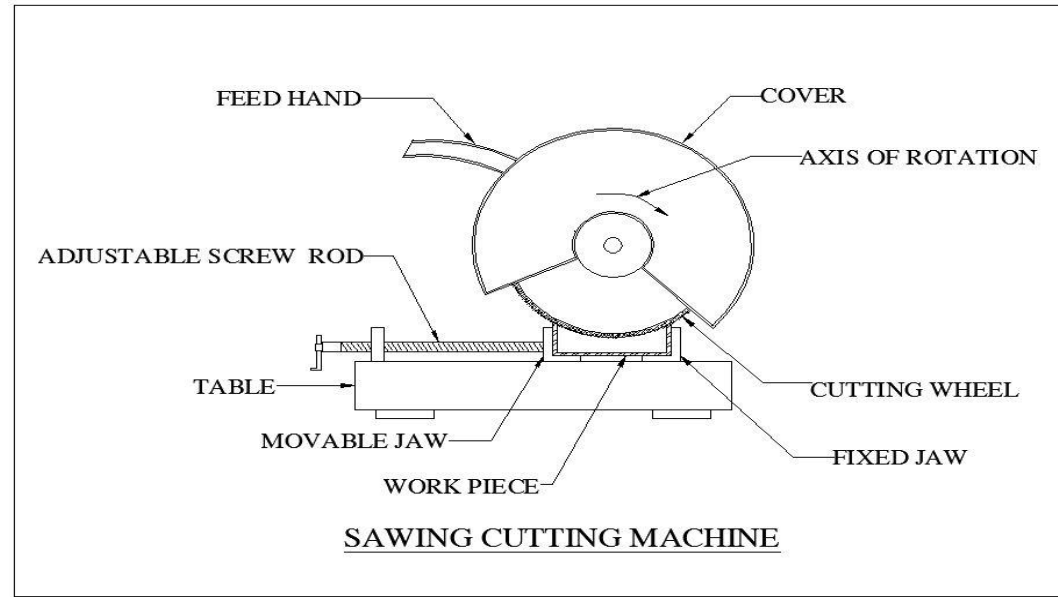
metalmantauk.com

MANUFACTURING PROCESS

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

SAWING:

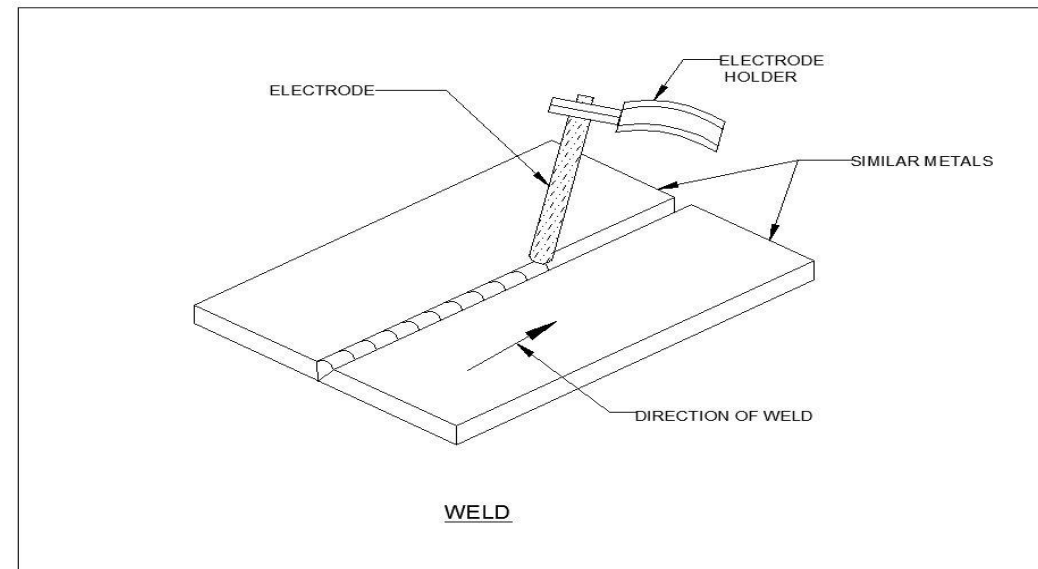
Cold saws are saws that make use of a circular saw blade to cut through various types of metal, including sheet metal. The name of the saw has to do with the action that takes place during the cutting process, which manages to keep both the metal and the blade from becoming too hot. A cold saw is powered with electricity and is usually a stationary type of saw machine rather than a portable type of saw.



The circular saw blades used with a cold saw are often constructed of high speed steel. Steel blades of this type are resistant to wear even under daily usage. The end result is that it is possible to complete a number of cutting projects before there is a need to replace the blade. High speed steel blades are especially useful when the saws are used for cutting through thicker sections of metal.

WELDING:

Welding is a process for joining similar metals. Welding joins metals by melting and fusing **1**, the base metals being joined and **2**, the filler metal applied. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based metals such as steel and stainless steel. Weld joints are usually stronger than or as strong as the base metals being joined.



Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

OPERATION:

- Several welding processes are based on heating with an electric arc, only a few are considered here, starting with the oldest, simple arc welding, also known as shielded metal arc welding (SMAW) or stick welding.
- In this process an electrical machine (which may be DC or AC, but nowadays is usually AC) supplies current to an electrode holder which carries an electrode which is normally coated with a mixture of chemicals or flux. An earth cable connects the work piece to the welding machine to provide a return path for the current. The weld is initiated by tapping ('striking') the tip of the electrode against the work piece which initiates an electric arc. The high temperature generated (about 6000°C) almost instantly produces a molten pool and the end of the electrode continuously melts into this pool and forms the joint.
- The operator needs to control the gap between the electrode tip and the work piece while moving the electrode along the joint.

DRILLING:

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (sward) from the hole as it is drill

Advantage

- Handling is simple
- No Manual power
- Easy to Repair.
- Replacement of parts are simple

Application

- This using on four wheelers

Photographic view:



MATERIAL USED

| S.No | DESCIRPTION | QTY | MATERIAL |
|------|----------------|----------------------|-----------------|
| 1. | D C MOTOR | 1 | ELECTRICAL |
| 2. | FRAME | AS PER REQUIRMENT | MILD STEEL |
| 3.. | SHAFT | AS PER REQUIRMENT | MILD STEEL |
| 4. | METAL STRIP | AS PER REQUIRMENT | MILD STEEL |
| 5.. | BEARING | 4 | STAINLESS STEEL |
| 6. | BATTERY | 1 | ELECTRICAL |
| 7. | SCREW JACK | 1 | MILD STEEL |
| 8. | TWO WAY SWITCH | 1 | ELECTRICAL |
| 9. | SPUR GEAR | 1 | MILD STEEL |

COST ESTIMATION

| S.No | DESCIRPTION | RATE |
|------|----------------|------|
| 1. | D C MOTOR | 1200 |
| 2. | FRAME | 1000 |
| 3.. | SHAFT | 300 |
| 4. | METAL STRIP | 200 |
| 5.. | BEARING | 400 |
| 6. | BATTERY | 1000 |
| 7. | SCREW JACK | 200 |
| 8. | TWO WAY SWITCH | 100 |
| 9. | SPUR GEAR | 600 |
| 10. | TOTAL | 5000 |

Conclusion

- Screw Jacks are the ideal product to push, pull, lift, lower and position loads of anything from a couple of kg to hundreds of tones.
- The need has long existed for an improved portable jack for automotive vehicles. It is highly desirable that a jack become available that can be operated alternatively from inside the vehicle or from a location of safety off the road on which the vehicle is located.
- Such a jack should desirably be light enough and be compact enough so that it can be stored in an automobile trunk, can be lifted up and carried by most adults to its position of use, and yet be capable of lifting a wheel of a 400-500 kg vehicle off the ground. Further, it should be stable and easily controllable by a switch so that jacking can be done from a position of safety.
- It should be easily movable either to a position underneath the axle of the vehicle or some other reinforced support surface designed to be engaged by a jack. Thus, the product has been developed considering all the above requirements. This particular design of the motorized screw jack will prove to be beneficial in lifting and lowering of loads.

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THANK YOU