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Battery Operated Mechanical Load Lifter

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Abstract:

Provided is a system, lifting column and method for the energy efficient lifting and lowering of a load, such as a vehicle. The system includes a lifting column having a frame with a movable carrier and a drive which acts on the carrier. The drive includes a power source for power supply to a motor, a pump in an ascent mode driven by the motor and in a decent mode driving the motor as a generator for energy-recovery, and motor control unit for control of the motor. The motor control unit is arranged such that the power supply of the motor is manipulated for speed control of the carrier in at least the ascent mode. A bolt remover is used to remove and tighten the bolt which rotates both in clockwise and counter clockwise direction, which has different gear transmission to increase torque.

I. INTRODUCTION:

Battery operated car jack is propelled by means of electric motor rather than manual power motorized jack is useful for those unable to propel a manually a car jack. The electric power car jack is already there in the market, but the jack used in it is a scissor jack.

We replaced the bottle neck screw jack instead of scissor jack to improve the lifting capacity. The jack has 2ton lifting capacity and modified such that, Geared DC motor used consumes less power from the battery and gives more output with help of gear setup arranged to equipment. Now-a-days many of the senior citizens, women, and who cannot afford more manual power to change the vehicle tire when it gets trouble. This jack is used for such people we had introduced this battery operated jack. Additionally a bolt remover is attached to it. So to remove the bolts of the tire which are fit tightly can be easily removed using the bolt remover and can be tightened easily.

II. CONSTRUCTION:

Battery operated mechanical load lifter consists of:

1. Frame
2. Power supply(Battery)
3. Geared DC motor
4. Gear setup
5. Bottle neck screw jack
6. Controller

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Frame:

The frame is made of cast iron, on which the whole setup is arranged. But as this Type is powered so folding is not possible. The frame is made up of 1 inch sq meter which is welded to build the desired structure. The length of the frame is 86cm and the width is 17.5cm.The distance between the motor and the gear setup is 12cm and the length between the gear setup and the jack is 8cm. The shaft which connects the motor and the gear box has the length of 7cm and the diameter of 1.5cm.The hook made of iron is connected to the screw jack of length 5cm and diameter of 1.5cm, and the hole of the provided to fit the hook on the jack has the internal diameter of 2.2cm and external diameter of 3cm. The height of the frame when the jack it is at bottom dead is 23cm and the height when it is at top dead is 38cm.

Battery:

An electric battery is a device consisting of two or more electrochemical cells that convert stored chemical energy into electrical energy. Each cell has a positive terminal, or cathode, and a negative terminal, or anode. The terminal marked positive is at a higher electrical potential energy than is the terminal marked negative. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Although the term battery technically means a device with multiple cells, single cells are also popularly called batteries.

DC Geared Motor:

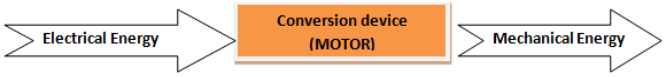
Almost every mechanical movement that we see around us is accomplished by an electric motor. Electric machines are a means of converting energy. Motors take electrical energy and produce mechanical energy. Electric motors are used to power hundreds of devices we use in everyday life. Motors come in various sizes. Huge motors that can take loads of 1000's of Horsepower are typically used in the industry. Some examples of large motor applications include elevators, electric trains, hoists, and heavy metal rolling mills. Examples of small motor applications include motors used in automobiles, robots, hand power tools and food blenders. Micro-machines are electric machines with parts the size of red blood cells, and find many applications in medicine. Electric motors are broadly classified into two different categories: DC (Direct Current) and AC (Alternating Current). Within these categories are numerous types, each offering unique abilities that suit them well for specific applications. In most cases, regardless of type, electric motors consist of a stator (stationary field) and a rotor (the rotating field or armature) and operate through the interaction of magnetic flux and electric current to produce rotational speed and torque. DC motors are distinguished by their ability to operate from direct current. There are different kinds of D.C. motors, but they all work on the same principles.

Electromechanical Energy Conversion

An electromechanical energy conversion device is essentially a medium of transfer between an input side and an output side. Three electrical machines (DC, induction and synchronous) are used extensively for electromechanical energy conversion. Electromechanical energy conversion occurs when there is a change in magnetic flux linking a coil, associated with mechanical motion.

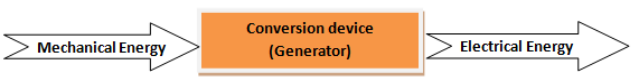
Electric Motor:

The input is electrical energy (from the supply source), and the output is mechanical energy (to the load



Electric Generator

The Input is mechanical energy (from the prime mover), and the output is electrical energy



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Construction:

DC motors consist of one set of coils, called armature winding, inside another set of coils or a set of permanent magnets, called the stator. Applying a voltage to the coils produces a torque in the armature, resulting in motion.

Stator:

The stator is the stationary outside part of a motor. The stator of a permanent magnet dc motor is composed of two or more permanent magnet pole pieces. The magnetic field can alternatively be created by an electromagnet. In this case, a DC coil (field winding) is wound around a magnetic material that forms part of the stator.

Rotor:

The rotor is the inner part which rotates. The rotor is composed of windings (called armature windings) which are connected to the external circuit through a mechanical commutator. Both stator and rotor are made of ferromagnetic materials. The two are separated by air-gap.

Winding:

A winding is made up of series or parallel connection of coils. Armature winding - The winding through which the voltage is applied or induced, Field winding - The winding through which a current is passed to produce flux (for the electromagnet) Windings are usually made of copper.

Gear Setup:

A gear or cogwheel is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a transmission.

A gear can mesh with a linear toothed part, called a rack, thereby producing translation instead of rotation. The gears in a transmission are analogous to the wheels in a crossed belt pulley system. An advantage of gears is that the teeth of a gear prevent slippage. When two gears mesh, if one gear is bigger than the other, a mechanical advantage is produced, with the rotational speeds, and the torques, of the two gears differing in proportion to their diameters. In transmissions with multiple gear ratios such as bicycles, motorcycles, and cars the term "gear" as in "first gear" refers to a gear ratio rather than an actual physical gear. The term describes similar devices, even when the gear ratio is continuous rather than discrete, or when the device does not actually contain gears, as in a continuously variable transmission.

Compound Gear Ratio:

In mechanical engineering, a gear ratio is a direct measure of the ratio of the rotational speeds of two or more interlocking gears. When a gear train has multiple stages, the gear ratio for the overall gearing system is the product of the individual stages and known as compound gear ratio. A compound gear ratio of 1:10 is proposed in this paper, there are 4 spur gears we used hear with different gear teeth.

Gear box:

The shaft is connected with a spur gear with 50 teeth which is connected to another spur gear of 10 teeth which reduces the speed 5 times and increases the torque up to 5 times. The 1:5 gear setups is as shown in figure. The shaft from this gear is connected with another gear of 10 teeth and it is connected to the 50 teeth of other spur gear as shown in figure. Which produce the gear ratio 1:5 These two 1:5 gear setups combine and form a compound gear ratio of 1:10 ratio. Which interns reduces 10 times and increases the torque up to 10 times. The compound gear we used is shown in figure.

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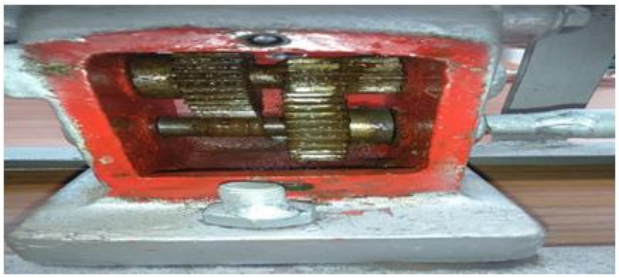

Fig 1: Compound Gear

Screw Jack:

A screw jack is a portable device consisting of a screw mechanism used to raise or lower the load. The principle on which the jack works is similar to that of an inclined plane.Main components of screw jack are trapezoidal lifting screw, worm screw, worm gear, and gear housing. Worm screw is rotated manually or by motor. Worm gear is rotated by worm screw. The lifting screw moves through the rotating worm gear. The linear motion speed of lifting screw depends on thread size and rotation ratio of the worm gear.

Controller:

Controller is used to control the lifting and lowering of the jack by using toggle switches. A toggle switch is a class of electrical switches that are manually actuated by a mechanical lever, handle, or rocking mechanism. Toggle switches are available in many different styles and sizes, and are used in numerous applications. Many are designed to provide the simultaneous actuation of multiple sets of electrical contacts, or the control of large amounts of electric current or mains voltages. The word "toggle" is a reference to a kind of mechanism or joint consisting of two arms, which are almost in line with each other, connected with an elbow-like pivot. However, the phrase "toggle switch" is applied to a switch with a short handle and a positive snap-action, whether it actually contains a toggle mechanism or not. Similarly, a switch where a definitive click is heard, is called a "positive on-off switch" the most common use of this type of switch is a typical light switch or electrical outlet switch. Multiple toggle switches may be mechanically interlocked to prevent forbidden combinations. This toggle switch is connected and extended and connected to a three pin sort. So that it can it can transmit the power from battery to D.C motor in both clock and counter clock wise directions.

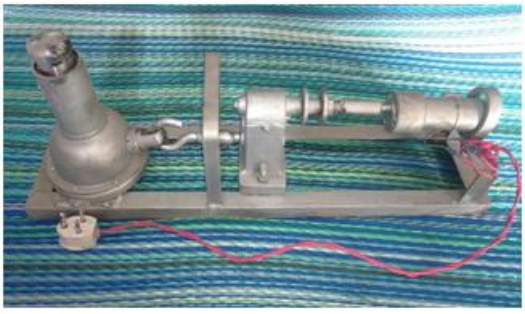

Fig2: Prototype of proposed Load Lifter

Advantages:

•Have a very high efficiency

•Could be used in application which require precise and repeatable movement

•Could be easily preloaded to eliminate backlash

•Smooth movement over full travel range

•Can be used a smaller size for same load

•Has a longer life for thread

•Easy maintenance

Self-locking feature

III. CONCLUSION:

This paper resulted into a successful prototype of a Battery Operated Mechanical Load Lifter. This minimized expense is pretty affordable for many people and it can be even cheaper when taken for mass production. This study can be counted as a good initiative for comfort and betterment of the senior citizen, women, and for some other people in an easy way.