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Research Paper

Design and Fabrication of Multi Nut Removing Tool

Engineering

KEYWORDS : Motor, Gears, Tools, Nuts

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ABSTRACT

The main concept of the proposed system is nut fitting & removing without human help for driving. The heart of the project and implementation is motor. The components used here for efficient function of individual blocks are Motor, Nut fitting arrangement (spanner) and spur gear arrangement.The main objective of the model is to remove the nuts of a wheel at once and not one at a time. The principle of the model is the usage of spur gear to transmit relative motion to other gears. In the model, the primary spur gear is connected to the motor shaftwhich has rotational motion due to the motor. The driver gear is the primary gear and the driven gears are the secondary gears. The primary gear is placed on the centre of the model. The secondary gears are in mesh with the primary gear. The secondary gears are placed at calculated distance at the base plate to make prefect meshing and for the perfect spacing of the tool. A primary gear is attached to the drive axle. A plurality of secondary axles extends through the cover. Each of the secondary axles has a first end positioned within the housing and a second end extending outwardly away from the cover. Each of a plurality of secondary gears is attached to one of the first ends. The secondary gears are each in communication with the primary gear. Each of a plurality of couplers is attached to one of the secondary axles. The project and implementation has to give the positive & negative potential to the motor. If we push the corresponding switch for forward rotation, it helps to fix the nut, or else if we push the corresponding switch for reverse rotation, the given polarity will be changed oppositely and it helps to remove the nut. The motor can be operated according to the operator's requirement. The electric power can be given by the battery. The operator should lift the model and place at the appropriate place to tighten or remove the nut.

1. INTRODUCTION

Vehicle is an important machine in human daily life. Nowadays, each family has at least one car to make the transportation easy and faster. For a car, the tool set-up for each vehicle is a T-nut wrench and car jacker which is hard to use for a women or teen to open their car's nut. One of the problems of a vehicle is tire problem. If the vehicle tires have some problem then the user must remove the tires and fix the problem. And for a car user, it's difficult to remove tire's nut especially for women users. The obstacles are time waste and force needed. In Malaysia automotive market there is no tool that is easy to use to remove the nuts. The time to open a car's tire nut is too long and has waste the car user's time with utilization of high force that is hard for women users. To resist the time waste and high force needed a tool have been designed to remove four tire nuts in one time with force used decrement.

CAR is not a symbol of luxurious anymore. It is a need for every family. People need car due to several reasons. Some of them are, to get to a destination, to travel conveniently, to do daily job and to move things to a greater distance. The problem occurs the most during car operation is the problem with tyre puncture . The flat tyre needed to be replaced with spare tyre. Therefore, drivers need to know basic knowledge of tyre replacement procedure if such problem occurs. In order to change the flat tyre, one requires minimal skills. Virtually every car has a tyre replacement tools such as the L-shaped nut remover and jack supplied by the manufacturer.

The tool used to remove the wheel nuts should be designed for ergonomic, easy to handle and requires small space for storage. The tool is also function as wheel nuts tightener. Nonetheless, it is difficult for women and the elderly drivers due to high required torque to remove the wheel nuts. In addition, if the nuts are successfully removed, the problem to retighten the nuts will follow. If the required torque is not applied in tightening the nuts, the nuts will lose, and this will jeopardize the driver's safety. Impact wrench used to remove wheel nuts is also consuming time in automotive maintenance industry. For these reasons, to avoid time wasting and a lot of energy used to change the tyre, a special tool is designed and fabricated to allow driver or mechanic to remove four wheel nuts at once with little energy consumption.

COMPONENTS REQUIRED

i. SHAFT:

Drive shaft, a shaft for transferring torque is used to transfer the torque from the motor to the primary gears which is in mesh with the secondary gears which remove the nuts using the re-

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moving tools. A hollow shaft is used to transfer the motion from the secondary gears to the removing tool.

ii. GEARS:

A gear or cogwheel is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part in order to transmit torque, in most cases with teeth on the one gear being of identical shape, and often also with that shape on the other gear. Two or more gears working in tandem are called a transmission and can produce a mechanical advantage through a gear ratio and thus may be considered a simple machine. Geared devices can change the speed, torque, and direction of a power source. The most common situation is for a gear to mesh with another gear; however, a gear can also mesh with a non-rotating toothed part, called a rack, thereby producing translation instead of rotation.

There are 2 types of gears used :

- PRIMARY GEARS (DRIVER GEAR)
- SECONDARY GEARS (DRIVEN GEAR)

iii. MOTOR:

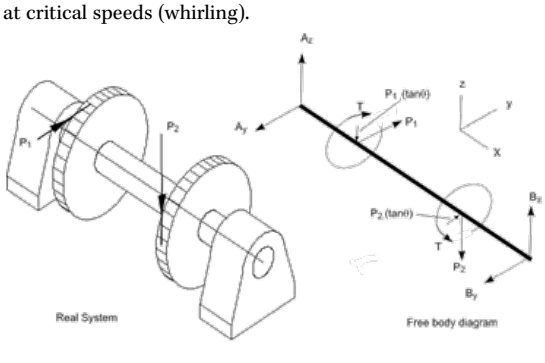
A DC motor relies on the fact that like magnet poles repel and unlike magnetic poles attract each other. A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. By switching the current on or off in a coil its magnet field can be switched on or off or by switching the direction of the current in the coil the direction of the generated magnetic field can be switched 180°. A simple DC motor typically has a stationary set of magnets in the stator and an armature with a series of two or more windings of wire wrapped in insulated stack slots around iron pole pieces (called stack teeth) with the ends of the wires terminating on a commutator. The armature includes the mounting bearings that keep it in the center of the motor and the power shaft of the motor and the commutator connections. The winding in the armature continues to loop all the way around the armature and uses either single or parallel conductors (wires), and can circle several times around the stack teeth. The total amount of current sent to the coil, the coil's size and what it's wrapped around dictate the strength of the electromagnetic field created. The sequence of turning a particular coil on or off dictates what direction the effective electromagnetic fields are pointed. By turning on and off coils in sequence a rotating magnetic field can be created. These rotating magnetic fields interact with the magnetic fields of the magnets (permanent or electromagnets) in the stationary part of the motor (stator) to create a force on the armature which causes it to rotate. In some DC motor designs the stator fields use electromagnets to create their magnetic fields which allow greater control over the motor. At high power levels, DC motors are almost always cooled using forced air.

iv. BASE PLATE:

Base plate is used to hold the gears and to withstand the forces the gears and the shaft extensions to hold the tool. It increases the weight and stability of the removing tool. It is a plate made of cast iron.

SHAFT

A shaft is a rotating or stationary component which is normally circular in section. A shaft is normally designed to transfer torque from a driving device to a driven device. If the shaft is rotating, it is generally transferring power and if the shaft is operating without rotary motion it is simply transmitting torque and is probably resisting the transfer of torque. Mechanical components directly mounted on shafts include gears, couplings, pulleys, cams, sprockets, links and flywheels. A shaft is normally supported on bearings. The torque is normally transmitted to the mounted components using pins, splines, keys, clamping bushes, press fits, bonded joints and sometimes welded connections are used. These components can transfer torque to/from the shaft and they also affect the strength of the shaft an must therefore be considered in the design of the shaft. Shafts are subject to combined loading including torque (shear loading), bending (tensile & compressive loading), direct shear loading, tensile loading and compressive loading. The design of a shaft must include consideration of the combined effect of all these forms of loading. The design of shafts must include an assessment of increased torque when starting up, inertial loads, fatigue loading and unstable loading when the shaft is rotating at critical speeds (whirling).



It is important that a shaft should not only have the strength to transmit the specified torque and load without the risk of failure but also that shaft deflections due to bending and torque are within acceptable limits. The limiting of the angular /radial deflection is required by the need to reduce vibration and ensure reliable operation of the related components including gears, splines bearings etc. The design procedure for a shaft should therefore include an appraisal of the resulting deflections when the shaft is loaded.

SELECTION OF SHAFT

Hollow shafting has become a preferred choice in more recent years due to the design advantages hollow shafting offers, increased availability, and more innovative methods of attaching impellers to the shaft without the use of key- ways (see- impellers; split hubs). When comparing a solid shaft with a hollow shaft of equal section modulus, both will transmit the torque with equal stress levels, but the hollow shaft will be stiffer, or rather will deflect less under the same overhung moment. This translates to longer allowable shaft lengths at a given stress level, and less weight at a given shaft length. Less weight means less thrust transmitted to the drive bearings, and a longer expected bearing life. Less weight and higher stiffness also helps avoid critical speed, frequently a limiting factor in mixer design.

REMOVING TOOL

A nut removing tool specially constructed to prevent its coming loose having a means of providing extra friction between itself and the screw. A thin supplementary nut screwed down upon a regular nut to prevent its loosening.

MOTOR

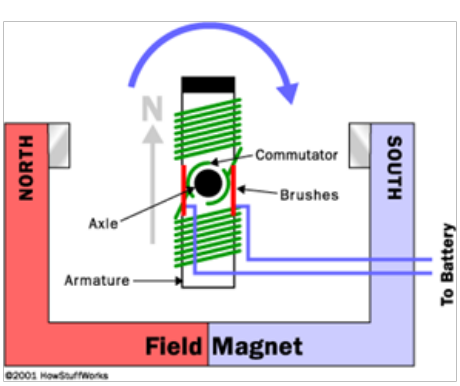
Electric motors are everywhere! In your house, almost every mechanical movement that you see around you is caused by an AC (alternating current) or DC (direct current) electric motor.

A simple motor has six parts:

- Armature or rotor
- Commutator
- Brushes
- Axle
- Field magnet
- DC power supplyof some sort

An electric motor is all about magnets and magnetism: A motor uses **magnets** to create motion. If you have ever played with magnets you know about the fundamental law of all magnets: Opposites attract and likes repel. So if you have two bar magnets with their ends marked "north" and "south," then the north end of one magnet will attract the south end of the other. On the other hand, the north end of one magnet will repel the north end of the other (and similarly, south will repel south). Inside an electric motor, these attracting and repelling forces create

rotational motion.



The **armature** takes the place of the nail in an electric motor. The armature is an electromagnet made by coiling thin wire around two or more poles of a metal core.

The armature has an **axle**, and the commutator is attached to the axle. In the diagram to the right, you can see three different views of the same armature: front, side and end-on. In the end-on view, the winding is eliminated to make the commutator more obvious. You can see that the commutator is simply a pair of plates attached to the axle. These plates provide the two connections for the coil of the electromagnet.The "flipping the electric field" part of an electric motor is accomplished by two parts: the **commutator** and the **brushes**.The commutator and brushes work together to let current flow to the electromagnet, and also to flip the direction that the electrons are flowing at just the right moment. The contacts of the commutator are attached to the axle of the electromagnet, so they spin with the magnet. The brushes are just two pieces of springy metal or carbon that make contact with the contacts of the commutator.General-purpose motors with highly standardized dimensions and characteristics provide convenient mechanical power for industrial use. The largest of electric motors are used for ship propulsion, pipeline compression and pumped-storage applications with ratings reaching 100 megawatts. Electric motors may be classified by electric power source type, internal construction, application, type of motion output, and so on.

SELECTION OF MOTOR

DC motors provide excellent speed control for acceleration and deceleration with effective and simple torque control. The fact that the power supply of a DC motor connects directly to the field of the motor allows for precise voltage control, which is necessary with speed and torque control applications. DC motors perform better than AC motors on most traction equipment. They are also used for mobile equipment like golf carts, quarry and mining equipment. DC motors are conveniently portable and well suited to special applications, such as industrial tools and machinery that is not easily run from remote power sources.

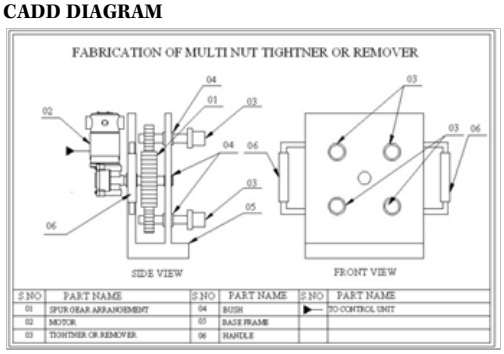
POWER CALCULATIONS

The minimum torque required to remove the nuts from a wheel tire is approximately 140 N/m.

Torque transmitted on a single tool = 45 Nm
Torque transmitted to the gear = 45 x 4 = 180 Nm
Power of the motor =
=2x100x180÷60
Power of the motor =471 KW
The motor produces power of 471 KW and hence a torque of 180 Nm is transmitted to the gear. The pinions are made to rotate at a torque of 45 Nm.

The required torque to remove a wheel nut is about 40 Nm and hence the all the tools can easily remove the nut at a single use.

CADD DIAGRAM



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The CADD model draft is shown above. The side view of the model is being drafted using the CADD modelling.

REAL TIME IMAGE
FRONT VIEW:

In the front view, the gear arrangement and the tool arrangement can be viewed.

BACK VIEW:

In the back view, the motor arrangement can be seen. The motor is connected to the shaft which is connected to the primary gear.

CONCLUSION

The multi nut remover is used to remove multiple nuts in a single use. These are commonly used to remove the wheel nuts and hence the mechanical effort required for removing the wheel is very less. The Multi nut remover can be used in automobile units and manufacturing units. The weight of the model can be reduced by using a light weight material base plate. The wheel nuts can be easily removed using the multi nut remover.

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