DESIGN & FABRICATION OF MULTI-NUT OPENING MACHINE

[1]**Atharva U. Dahitule**, [2]**Hruthik V. Deokar**, [3]**Aniket V. Jokare**, [4]**Hritik R. Ohol**

[1,2,3,4] B.E Student
Department of Mechanical Engineering,
P.E.S's Modern College of Engineering, Pune, India

Abstract: The main goal of the work is to develop a single tool that can be used for assembly and disassembly of car wheels. As the number of cars on the road has increased, car problems due to tyre failure have increased. The traditional way to change a car tyre is to use a wrench to loosen the locking nuts one by one. However, this can sometimes be very tedious and time-consuming. However, planetary gear tools have been developed to remove nuts and save time. In our project, we focused on minimizing the human effort of tightening all the nuts on a given PCD wheel at once. The puller is ergonomically designed for ease of maintenance, storage, handling and the ability to remove all nuts simultaneously using a torque gun which is deliver power for tightening & loosening the nuts.

Keywords: - T- wrench, PBT, Multi-Nut, PCD, Torque Gun

1. INTRODUCTION

Vehicles are important machines in people's daily lives. Today, every family has at least one car to make travel easier and faster. For cars, each vehicle's tool kit is a T-wrench and a car jack, which are difficult for women or teenagers to use to open a car's nuts. One of the problems with cars is tyre problems. If there is a problem with the vehicle's tyres, the user must remove the tyres and fix the problem. And for car users, especially female users, it is difficult to remove nuts from tyres .In the automotive market of India and many other countries, there is no tool to easily remove the nut. The time to open the nut of the car tyre is too long, wasting a lot of time for the car user, which is a great obstacle to female users in particular. To avoid wasting time and the need for a lot of effort, a tool has been developed that can loosen four tyre nuts in one go with less applied force. Tyre punctures are the most common problem when driving a car. The flat wheel had to be replaced with a spare.

Therefore, drivers must have basic knowledge of the procedure for replacing tyres when such problems occur. Changing a tyre requires minimal skill. Almost all vehicles have tyre changing tools such as L-shaped nut pullers and jacks provided by the manufacturer. So here we can use our Multi Nut Opener, it is a special tool designed for opening a wheel with ease. It is so designed that it can open all the four nuts of a car wheel in one time. This information has collected from books and market survey. This project is to atomize the labor work in tightening or loading the nuts one by one. This project aims to minimize the manpower and time required to secure all four 4-wheel tyre nuts with single stroke of lever by using multiple operated spanners. There are many problems in everyday life that require a lot of effort and time to complete this full-scale work.

The aim of this project is to reduce the number of workers and time wasted by using a multi-function wrench to tighten all four nuts of all four wheels in a single travel stroke. This has been achieved with improvements such as the planetary gear mechanism, which reduces the time and effort of specified tasks such as unscrewing or tightening the wheel nuts. In order not to waste too much time and energy on changing tyres, a special tool has been designed and developed that allows the driver or the machine to remove all four nuts from the wheel in a time that consumes less energy. In this type of tyre nuts car, the nut removal steps, type tools needed, basic gear theory, spur gear terminology, standard gear calculation, standard spur gear tooth, the project calculation, and material specification will be shown.

2. LITERATURE REVIEW:-

1. The references taken are M. Mukhtar, M.H.P Hilmie Hussaine, 2014, Design Improvement and Computer Assisted Fabrication on the Impact Wrench for a Car Wheel Nuts Puller in Automotive Industry, Australian Journal of Basic and Applied Science, Vol.1, Issue 3, ISSN: 2320-401X, pp. 381-384.

2. IJSRD - International Journal for Scientific Research & Development| Vol. 3, Issue 02, 2015 | ISSN (online): 2321-0613 Design & Fabrication of Four-Wheeler Opening Spanner had a published a paper for adjustable one.

3. In the paper of B. Sivakumar a gear or "gear wheel" is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part in order to transmit power. Two or more gears working in tandem are called a transmission and produce mechanical advantages through a gear ratio and thus may be considered a simple machine. Gears are mostly used in the mechanical field for power transmission, this project report on stress analysis of spur gears. Spur gear made of cast iron which is use for high strength.

4. Azizul Rahman B Abd Aziz, 2008, Improvement and Optimization of Wheel Nut Remover with 114 PCD". University of Malaysia, Pahang. These references helped us to develop our model for 100 PCD.

3. NEED OF THE STUDY:-

The main goal of this work is to reduce the time and problem of setting tool again and again spent on each nut using L wrench and jack. Replace and remove with your car's multi lug nut. If a flat tyre is used for tyre replacement, each tyre must be removed individually and strictly using human tools. But with the multi-wheel nut opener and remover, it's possible to remove all four nuts from the wheel at the same time, instead of removing the nuts one by one. Therefore, loosening and tightening the multi-wheel nut of the car will reduce the time consumption compared to the energy used in the conventional process. Considering all the benefits of this tool, we recommend using it on all cars. The device, which is easy to use and wear, can be used by everyone, young and old.

Theoretical framework:-

1. Frame :-
The frame is usually made of MS as it is strong enough to withstand all types of loads in working condition. All other parts are fitted on to the frame. Frame is helping the supporting of the various light load support. Frame shows the good aesthetic loop. Every machine should have required the good frame design. Frame material should have high strength because frame balancing of another machine load.

2. Shaft :-
The shaft is defined as a mechanical component which is used for transmitting power from one place to another. The power is delivered by some tangential force to the shaft and the resultant torque set up within the shaft a set up within the shaft permits the power to various machines linked up to the shaft. The material commonly used for an ordinary shaft is MS. The materials used for ordinary shafts are carbon steel of grades 40C8, 45C8, 50C4 and 50C12.

3. Fasteners :-
The nut is a type of a fastener with a threaded hole. Nuts are almost always used with mating bolts to hold two or more parts together. The two partners are held together by a combination of thread friction, slightly stretching the bolt and tightening the area intended to hold it together.

4. Pedestal Bearing :-
A pillow block is a pedestal used to provide support for a rotating shaft with the help of compatible bearings & various accessories. Housing material for a pillow block is typically made of cast iron or cast steel. A pillow block usually refers to a housing with an included anti-friction bearing.

5. Spur Gear :-
Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially. Viewing the gear at 90 degrees from the shaft length (side on) the tooth faces are straight and aligned parallel to the axis of rotation. Spur gear can be classified into two pressure angles, 20° being the current industry standard and 14½° being the former (often found in older equipment). Spur gear teeth are manufactured as either involute profile or cycloidal profile. Looking down the length of the shaft, a tooth's cross section is usually not triangular.

6. Socket :-
A socket is a cylindrical type female hexagonal fit which is fitted over the common male hexagonal head of the nut.

7. Push Connector :-
It is used to connect nylon pipe here pneumatic pipe of PU material will go inside it and thread size is ¼ British standard pitch. Pneumatic push-to-connect fitting bodies are made of a strong thermoplastic (PBT) and have stainless steel tube gripping claws

4. CAD DRAWING & ANALYSIS

Procedure:-
- The entire model has been designed with the help of designing software solid works.
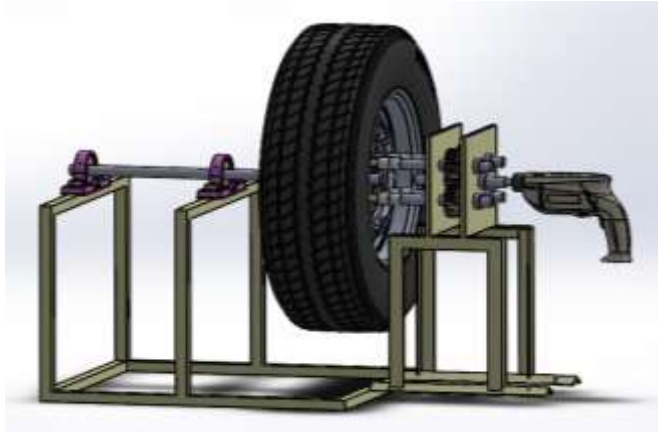- With the help of colour feature the colours are given to the entire model.
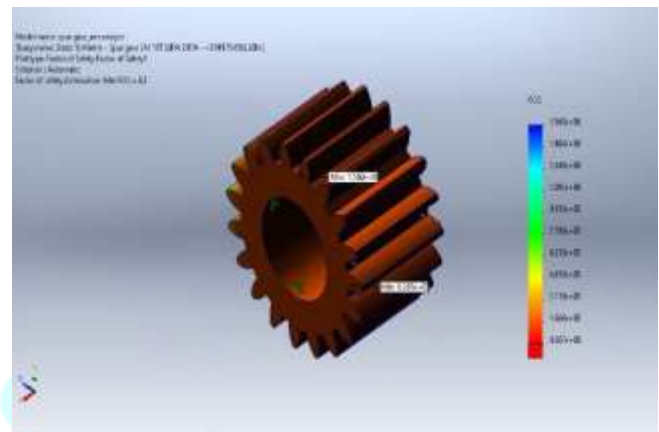

Figure: - isometric front view

Figure: - spur gear factor of safety

5. CALCULATIONS

EN 10083 C45 steel carbon steel

C45 steel sheet Physio-chemical testing items for products of the plant include tensile test, hardness test, impact test, flattening test, and chemical composition analysis, etc. C20, C45 steel pipes are manufactured by cold drawn process.

Table:- Mechanical Properties of EN C45 steel

Grade	Condition	Yield Strength R°(Mpa)	Tensile Strength Rm (Mpa)	Elon-gation A5(%)	Hardness HRC	Quenching Temperature (°C)	Benda-ability	Nominal Thickness,t 1.95mm≤t≤10.0mm	
								Rolled	Annealed
C45	Rolled Annealed Water-quenched Oil quenched	460 330	750 540 2270 1980	18 30	58 55	820 860	Min.reco-mmended Bending radius (≤90°)	2.0 ×t	1.0×t

1. Material

Material = C 45 (mild steel)
Take factor of safety 2

$\sigma_t = \sigma_b = 540/fos = 270$ N/mm
$\sigma_s = 0.5\ \sigma_t = 0.5 \times 270$
$\qquad = 135$ N/mm^2

2. Torque and speed of first gear

This will be same as motor

We will calculate spur gear terminology.

Now, if you will buy gear in market, you can buy it telling diametrical pitch Dp & no of teeth to shopkeeper, with same Dp the teeth will match with each other no matter the size of gear.

For small gear teeth
Module = m = D÷T
T = Force × radius
F = 864 N
F =   88.03 Kg

3. Calculation for force generated by big gear for tightening nut

For big gear teeth

Now, T_1= 17282 N-mm is divided into four gears = 4320.5 N-mm

T_2 = 6480.75 N-mm
N_2= 66.66 rpm
T = Force × radius
F =   22 Kg

Final force at nut opening socket F = 50.79 Kg

6. RESULT AND CONCLUSION

Thus, the design and fabrication of vehicle all wheel's nut remover and tightner is successfully done. This project is practically implemented in a four-wheeler and it found that the results are positive. The project is economical, and it sustains all the required feasibilities vehicles all wheel's nut remover and tightener is a perfect tool for assembling and dismantling a wheel in a four-wheeler. The project' Multi-nut Opener' is advantageous for all common workers as well as people working at several service stations & garages, because of this anyone can loosen or tighten the nuts of the wheel at time.
 Also, the main advantage is that the nuts of the wheel of the vehicle are tightened at accurate torque and considering the given factor of safety. The project can easily be handled from one place to another.

7. APPLICATION :-

1. Automobile Workshops.
2. Manufacturing Unit.
3. Racing Car Units

8. FUTURE SCOPE:-

1. To design a nut opener for multiple PCD wheels.
2. Use of suitable manufacturing process to reduce the weight of the Assembly.

9. REFERENCES

[1] A. R. Abd Aziz "Improvement and Optimization of Tyre Nut Removal with 114 PCD" Universiti Malaysia Pahang, Thesis Degree 2008Stability Control of Vehicle Emergency Braking with Tyre Blowout by Qingzhang Chen, Youhua Liu & Xuezhi Li.

[2] M. F. Abd Rahim "Design, Development and Fabrication of Tyre Lug Wrench". Universiti Technical Malaysia Melaka (UTeM), Thesis Degree, 2007Analysis of Emergency Braking Performance with Particular Consideration of Temperature Effects on Brakes by Silvia FariaIombriller .

[3] R. Abdul Rahman, C. A. Che Ismail and M. Y. Abdullah "Mechanisms". UniversitiTeknologi Malaysia Publisher, 2003.

[4] V. Sarkar "Mechanics of Machines". Tata McGraw-Hill, 2004Fabrication of Auto- Braking System for Pre-Crash Safety Using Sensor by EungSoo Kim.

[5] Abd Azizul Rahman (MBA), University of Malaysia Pahang, Improvement & Optimization of Tyre Nut removal, Malaysia,2008, 199-202(2012).

[6] Bhandari, V. B., "Design of Machine Elements," Tata McGraw Hill