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DESIGN AND FABRICATION OF UNIFIED WHEEL OPENER

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ABSTRACT

Today life of man is simple and comfortable, as various resources are available for each and every process that a person has to perform in his day-to-day life. These resources and equipments help us to complete the work in efficient and less time consuming manner. Today, a four wheeler is available for more than 70% people. While fixing or opening a wheel of a car it takes more time and human effort to remove each nut separately and finally the wheel. For this problem the ***unified wheel opener*** *is the ultimate solution.*

Unified wheel opener *is an extraordinary instrument made to open/close the nuts of a wheel in one time with less effort. Though different techniques are utilized for opening nuts, they require a considerable measure of push to open a solitary nut.*

With the help of Unified Wheel opener we made arrangement to open/close all the nuts by amplifying the torque. Five spur gears are arranged in such a way that, by applying 200 N of force with both the hands on the handle (which any normal person can do), gears will be rotated and finally required torque will be applied on the spanners to open the four wheel nuts at a time. In this work, we concentrated on the application domain i.e., to open the wheels of BAJA vehicle. The main objective of this work is to develop a complete mechanism in one assembly, which can be used in automobiles.

Unified wheel opener *is operated by an operator by applying force by using both hands, due to which the central gear rotates in the same direction as the handle. By this motion the four output gears which are in mesh with the main gear rotates in opposite direction to the first. Five bearings are attached to the casing and are connected to the gears by means of small shafts to transmit free rotational motion and to give the exact position to the gears. Four socket heads are connected to the output gears. By this finally the force is transmitted to the sockets at the end of the connected rods, and thus the four nuts can be opened at once.*

Keywords: Gears, Casing, Base Plate, Acp Sheet Nuts And Bolts.

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I.INTRODUCTION

1.1 UNIFIED WHEEL OPENER

Engineering in general, and Mechanical engineering in particular, deals with a wide spectrum of products, ranging from large and complex systems comprising of numerous elements down to a single component. The service offered by an automobile maintenance and repair garage would be a typical example from mechanical Engineering. Even computer software could be treated as an engineering product. It is also created using engineering knowledge and skills. In the following, the term product when used alone denotes the object to be designed and made with the help of engineering knowledge and skills, irrespective of whether it is a large system, a simple machine, a component or a service. A complex product can be sub divided into sub-assemblies or sub system, component etc. Frequently the planning, layout and design of a complex multi element product is an interdisciplinary effort, requiring the expertise and skills not only of several engineering specialization but even non engineering ones. It is always preferable that our work should be easy and fast. But easy and fast working requires some technical skills to work efficiency and properly. In a day-to-day life there are many problems where there is a need of lot of effort and time to do that specific work. A little but important work that all people would do often is opening a wheel of a vehicle. It is a fact that a huge effort is required to open a single nut of a car wheel and it will become a tedious task to open the wheel in extreme atmospheric conditions. It also creates problem when there is an emergency situation. Here is the solution to the problem mentioned above by Adjustable Unified Wheel 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. And the most desired achievement is that, the total effort and time needed in the process is very less. It can open and also refit the wheel with the same tool easily. Tool is simple in design, easy to use and easily portable along with the vehicle.

1.2 COMPONENTS REQUIRED

One of the key design decisions that greatly increase the reliability and performance in any machinery is material selection. Our initial step was to conduct a market survey to have an idea of the availability of the material. After going through market survey we have selected the required material for each part used in the **UNIFIED WHEEL OPENER**. . Based on market survey we have chosen following material namely:

S.NO	PARTS	MATERIAL
1	Bearing	Stainless Steel
2	Gears	Mild Steel
3	Sockets	Chrome Vanadium Steel
4	Casing	Mild Steel and ACP
5	Extension Bar	Chrome Vanadium Steel
6	Washer , Nut and Bolts	Aluminium and ASTM

TABLE 1.1 PARTS AND MATERIAL

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II.DESIGN OF UNIFIED WHEEL OPENER

2.1 DESIGN REQUIREMENTS

[1] While designing the UNIFIED WHEEL OPENER, following considerations were taken into account:

[2] The device should be appropriate for local manufacturing competence.

[3] The attachment should employ low-cost materials and mechanized methods.

[4] It should be accessible and reasonable for low income groups, and should accomplish their basic need for mechanical power.

[5] It should be simple to manufacture, maneuver, maintain and repair.

2.2 DESIGN GEOMETRY

The design geometry explains us about the initial design parameters and considerations taken while making the unified wheel opener. It acts as a reference sketch for making the complete design.

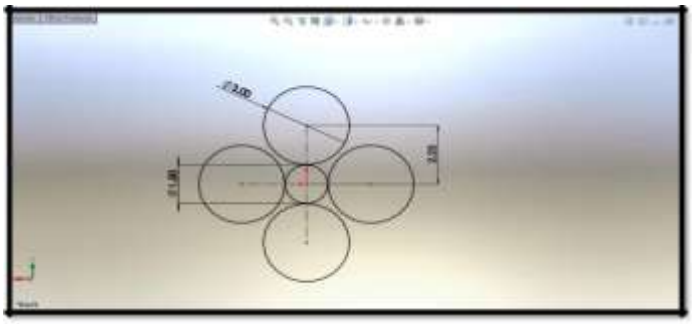

Figure 2.2 DESIGN GEOMETR

2.3 3D MODELING

In 3D computer graphics, 3D modeling (or modeling) is the process of developing a mathematical representation of any three-dimensional surface of an object via specialized software. The product is called a 3D model. It can be displayed as a two-dimensional image through a process called 3D rendering or used in a computer simulation of physical phenomena. The model can also be physically created using 3D printing devices.

Models may be created automatically or manually. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting 3D models represent a physical body using a collection of points in 3D space, connected by various geometric entities such as triangles, lines, curved surfaces, etc. being a collection of data (points and other information), 3D models can be created by hand, algorithmically (procedural modeling), or scanned. The 3D modeling software that is used to make our model is SOLIDWORKS 2013.

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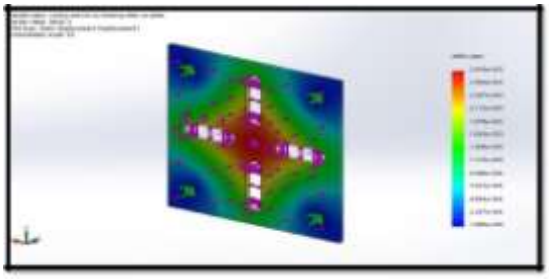
III. ANALYSIS OF UNIFIED WHEEL OPENER

3.1 ANALYSIS OF CASING

Analysis of casing is carried out in the SOLIDWORKS software 2013 version to know about the loads acting on the plate and stresses produced in the plate. Maximum stress is produced at the red colored area and minimum stress is produced at the blue colored area. Other colors indicate the reduced stress from red to blue. The value of FOS i.e., factor of safety is taken at the maximum stress condition.



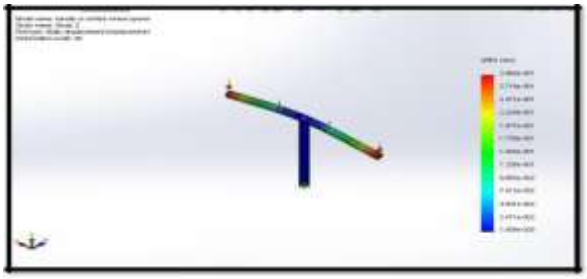


Figure 3.1 ANALYSIS OF CASING

Figure 3.1 ANALYSIS OF HANDLE

IV.WORKING PRINCIPLE

4.1 CONSTRUCTION

UNIFIED WHEEL OPENER consists of one small input gear and four bigger output gears. The handle which is rotated by the operator is connected to the smaller central gear which is mounted on a bearing. The sockets by which the wheel nuts are getting opened are connected to the four bigger gears by using extension rods. Slots are made on the plate in such a way that the UNIFIED WHEEL OPENER can be adjustable for opening tires which are having different centre to centre distances. A supporting plate is kept above the gears to constrain the linear motion of the gears. The base plate and the supporting plates are connected by bolts and nuts. Spacing between the gear and plate is given by using washers.

WORKING

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Figure 4.1 WORKING OF UNIFIED WHEEL OPENER

Five spur gears are arranged in such a way that, by applying 200 N of force with both the hands on the handle (which any normal person can do), gears will be rotated and finally required torque will be applied on the spanners to open the four wheel nuts at a time. In this work, we concentrated on the application domain i.e., most of the passenger four wheelers. The main objective of this work is to develop a complete mechanism in one assembly, which can be used in automobiles. UNIFIED WHEEL OPENER is operated by an operator by applying force by using both the hands, due to which the central gear rotates in the same direction as the handle and by this motion the four output gears which are in mesh with the main gear rotates in opposite direction to the first. Five bearings are attached at the centers of five gears to transmit free rotational motion and to give the exact position to the gears. By this finally the force is transmitted to the sockets at the end of the connected rods, and thus the four nuts can be opened at once.

4.2 MATERIALS USED

EXTENSION BARS SOCKETS AND HANDLE

CHROME VANADIUM STEEL is used for extension bars, sockets and handle.

EXTENSION BARS **SOCKET HEAD** **HANDLE**

BEARING AND WASHER: Bearing is of STAINLESS STEEL (SS) material and the washers are of ALUMINIUM.

BEARING

WASHER

GEARS, NUTS AND BOLTS

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Gears are manufactured by using MILD STEEL material.Nuts and bolts are made up of ASTM material.

GEARS

NUTS AND BOLTS

SUPPORTING PLATES

Base plate is made up of MILD STEEL material and the supporting plate is made up of ACP sheet.

BASE PLATE

ACP SHEET

4.2 MACHINES USED IN MANUFACTURING

1 MILLING MACHINE
2 RADIAL DRILLING MACHINE
3 HAND CUTTER
4 HAND GRINDER
5 WELDING MACHINE

TOOLS USED IN MANUFACTURING

1 CUTTER
2 DRILL BITS
3 WELDING ELECTRODES
4 ROUND, FLAT AND HALF ROUND FILES

SEQUENCE OF OPERATIONS

1 MARKING AND CUTTING THE SUPPORTING PLATE
2 GEAR MILLING
3 DRILLING
4 GRINDING
5 WELDING

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V.CALCULATIONS

According to the calculations done on wheel nuts by scientist

Torque required for opening a single wheel nut

: 94.187 Nm (min)

: 201.83 Nm (max)

By this we can say that,

Torque required for opening four wheel nuts

: 376.75 Nm (min)

Average human can apply with both the hands

Centre to centre distance of wheel nuts

Larger gear diameter

Smaller gear diameter

: 807.32 Nm (max)

:200 N (of force)

: 2.25inch=0.05715m

: 3.2inch=0.08128m

: 1.7 inch=0.04318m

Perpendicular distance from smaller gear centre to The holding portion of handle Gear ratio

: 12inch=0.25m

: 1.88:1

5.1 DESIGN CALCULATIONS:

By taking the diameters of the diameters of the gears the gear ratio is

= 0.08128/0.04318m

= 1.88:1

Min force applied by a normal human = 200N

Torque required for opening one wheel nut is 176.72Nm. The torque given by operator will not be divided for the four output gears so each gear will get 176.72Nm torque from the operator.

Min required force (F) = T/r

= 176.72/0.04064

= 4348.42N

Max required force (F) = T/r

= 376/0.04064

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= 9251.96N

Perpendicular distance from centre of gear to the holding portion of the handle is given by:

Minimum torque = 94.187/1.88

Maximum torque = 201.83/1.88

= 50.09Nm = 106.38Nm

Perpendicular distance(r) = T/F

Minimum distance

= 50.09/200Maximum distance = 106.38/200

= 0.25m = 0.53m

According to the calculations the Perpendicular distance from centre of gear to the holding portion of the handle is taken as: 12inch= 0.30m.

VI. FUTURE SCOPE

The project has been fabricated which is purely mechanical. All the operations are done manually. To further extend our project as a useful tool, a motor has to be attached to its drive. Such that by providing a motor, it reduces all the human effort in tightening and loosening the wheel's nut. Thus the project can be made an indispensable tool in assembling and dismantling wheels in cars.

MOTORIZED MULTI WHEEL NUT OPENER

VII. RESULTS AND DISCUSSIONS:

A. Practical Implementation

After checking the feasibility conditions, (i.e. economic feasibility, operational feasibility and technical feasibility) adjustable unified wheel opener is designed and it is implemented in real world problems. It worked successfully and finally the output is obtained as such as what is desired.

B. Comparative cost estimation

Now-a-days for loosening and tightening nuts in the car, a commonly used tool is four way car wheel nut wrench brace spanner which costs about Rs.700. It has four different size box spanners (17mm, 19mm, 21mm, 23mm) for removing different nuts, but it suffers with the disadvantage that only one nut can be removed at a time. And so it is a time consuming process. But with U.W.O tool all four nuts in a car wheel can be simultaneously removed. The total cost involved for the fabrication of U.W.O is around Rs.4000. Costs have been estimated based on the cost of the materials that are being purchased, machining costs and other parameters that are involved in the fabrication of the project.

COST ESTIMATION

S .No	Parts	Estimated cost
1	Bearing	50/-
2	Gears	2100/-
3	Extension Bar	360/-
4	Sockets	200/-
5	Casing	200/-
6	Nut and bolt	150/-

Table:7 COST ESTIMATION

VIII. CONCLUSION

Finally the machine i.e, **UNIFIED WHEEL OPENER** which is a special tool for opening all the four wheel nuts at once can be made with an approximate cost of Rs 4000.

Thus the fabrication of Adjustable Unified Wheel Opener is successfully done. This project is practically implemented in a four wheeler and it is found that the results are positive. The project is working as what it is expected. Thus the project is economical, and it sustains all the required feasibilities. It has been found that adjustable wheel opener is a perfect tool for assembling and dismantling a wheel in a four wheeler.

REFERENCES

[1.] **A. R. Abd Aziz** "Improvement and Optimization of Tire Nut Removal with 114 PCD".
[2.] University Malaysia Pahang, Thesis Degree, 2008.
[3.] **M. F. Abdul Rahim** "Design, Development and Fabrication of Tyre Lug Wrench". Universiti
[4.] Teknikal Malaysia Melaka (UTeM), Thesis Degree, 2007.
[5.] **R. Abdul Rahman, C. A. Che Ismail and M. Y. Abdullah** "Mechanik Mesin".
[6.] University Teknologi Malaysia Publisher, 2003.
[7.] **V. Sarkar** "Mechanics of Machines". **Tata McGraw-Hill**, 2004.
[8.] **E. Oberg, F. D. Jones, H. L. Horton and H. H. Ryffel** (2008) "Machinery's Handbook 28th
[9.] Edition". Industrial Press, 2008.
[10.] Abdullah, M.A, Shaharuzaman, M.A, Jenal, R., Boejang, H., Mat Idera, I.H. and Mohd Razi,
[11.] **M.Z.,** Development of Conceptual Vehicle All-Wheel-Nuts Remover, Proceeding for the 2nd
[12.] International Conference on Design and Concurrent Engineering (iDECON2012), Malacca,