Design and Fabrication of Unified Wheel Opener

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ABSTRACT

Unified wheel opener is an extraordinary tool used in automobiles to open and close all the nuts of a wheel with a lesser amount of force. Our main objective is to develop a solitary tool with numerous mechanisms, this tool could be utilized during dismantling and assembling of wheels in automobiles. This will also be utilized in automobile workshops, garages, and service stations. Main principle of this equipment is amplifying the torque by arrangement of gears. In the present study, calculation of forces required to open all the nuts together has been done by the use of simulation software and then arrangement has been planned to manufacture by the use of spur gears in which when we apply a force approximately 200N with hands of normal person then we get output at all the four spanners in which nuts of the wheel are gripped which we want to open. Apart from this special attention has been given for the selection of different parts and to the types of gears.

KEYWORDS: - Gears, Casing, Base Plate, ACP Sheet, Nuts and Bolts.

1.0 INTRODUCTION

1.1 Unified wheel opener

Mechanical engineering deals with manufacturing of wide range of products to help the society by making the life easier. It could be a service also instead of manufacturing a physical object which ultimately serves the society. This category come under the system in which labor, facilities and procedure s are required. The service delivered by an automobile engineer for repairing automobile in garage would be a characteristic example of mechanical Engineering. Computer software is also an engineering product which is used for treating some automatic or latest automobiles faults. It is also an invention of engineering and skills. In the consequential, product used to deliver any kind of service is designed with the help of engineering skills and knowledge. For manufacturing complex product, procedure can be further sub-divided into sub-assemblies or component etc. Design, planning and layout is a multidisciplinary activity, it requires the service of allied engineering branches also. It is always assumed that our work should be relaxed and quick. But fast and easy working needs some technical skills. In everyday life there are countless problems which requires a time to do the particular work. A simple work that all people would do in replacing a wheel of a vehicle in critical situations when they face issues with tyre on the way to their routine work It is a fact that a vast effort is compulsory to open a solitary nut of a car wheel and it will develop a tiresome task to open the wheel in emergency state and extreme atmospheric situations. Solution to the above discussed problem is provided by designing Adjustable Unified Wheel Opener, it is an exceptional tool designed for opening a wheel with a great ease. It is designed to open all nuts of car wheel together with less effort. It can open and close all the nuts of wheel with the identical tool effortlessly. This equipment is specialized with its simple design, ease to use and portable in nature.

1.2 COMPONENTS REQUIRED

One of the key design results that significantly increase the performance and reliability in any machinery is material selection. Our primary step was to demeanor a market investigation to have an idea of the accessibility of the material. After working through market survey, we have designated the required material for each part used in the unified wheel opener. Grounded on market survey we have selected following material namely:

Table 1.1 Parts and Material

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

2.0 DESIGN OF UNIFIED WHEEL OPENER

2.1 DESIGN REQUIREMENTS

While designing the UNIFIED WHEEL OPENER, following concerns were taken into account:

- The device should be fitting for local manufacturing competency.
- The supplements should employ low-cost materials and mechanized methods.
- It should be available and realistic for low-income groups, and should achieve their basic requirement for mechanical power.
- It should be simple to manufacture, maintain and repair.

2.2 DESIGN GEOMETRY

The design geometry describes us about the primary design parameters and considerations taken while creating the unified wheel opener. Its performances are a reference sketch for making the complete design.

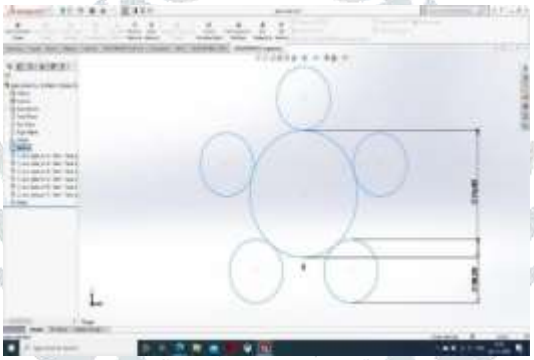

Figure 2.2 DESIGN GEOMETRY

Design of care and pinion

Crankshaft radius = 0.63 inch Radius of pinion shaft =

0.58 inch PCD = 139.7 mm

CC distance between gear = 57 mm

Torque required to open one nut = 120 Newton meter Torque required to

open 5 minute = 600 Newton meter Material used for making gear and

pinion = 080 m

40 also named as AISI 1045 Pressure angle = 20

degree module = 2.25

face width = 30 mm

Design of casing

Table 2.1: Design of upper and lower casing

Parameters	Upper casing	Lower casing
Length	8 inches	8 inches
Width	8 inches	8 inches
Thickness	0.25	0.25
Material	AISI 1020	ISI 1020 fillet to mm
	Sylhet to mm 4 holes in corner for nut	4 holes in corner for nuts, 5 in centre with distance = 57mm

Handle

Gear to handle distance = 14 inch Diameter = 1.50 inch

Material = AISI 1045

Screw and nut

Hexagonal washer screw 1 Machine screw hexagonal

nut 1 Material = AISI 1045

Bearing

Fore pinion

Bore = 0.75 outer diameter is 1 thickness = 0.15 Material = AISI 304

For Gear

Bore = 1.375 outer diameter = 1.625 thickness = 0.15

Material = AISI 304

Socket

Inner diameter = 23 mm

Outer diameter = 28 mm material used is similar to Chrome stainless steel

2.3 3D MODELING

In 3D computer graphics, 3D modelling (or modelling) is the method of developing a mathematical representation of any 3D surface of an object through particular software. The invention is called a 3D model. It can be showed as a 2D image through a practise called 3D rendering or recycled in a computer recreation of physical phenomena. The model can create physically also by using 3D printing devices.

Models may be formed automatically or manually. The manual modelling process of making geometric data for 3D computer graphics is analogous to plastic arts such as moulding 3D models, signify a physical body using a assembly of points in 3D space, related by various geometric units such as lines, triangles, curved surfaces, etc. being a pool of data (points and other information), 3D models can be formed by hand, scanned or algorithmically (procedural modelling). The 3D modelling software that is utilised to make our model is SOLID WORKS 2013.

3.0 ANALYSIS OF UNIFIED WHEEL OPENER

3.1 Analysis of casing

Analysis of casing is approved out in the SOLIDWORKS software 2013 version to recognise the loads substituting on the plate and stresses created in the plate. Extreme stress is created at the red coloured area and least stress is created at the blue coloured area. Other colours specify the condensed stress from red –blue area. The value of FOS (factor of safety) is taken at the extreme stress condition

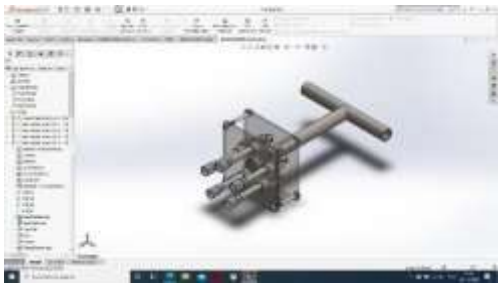

Figure 3.1 Analysis of casing

Figure 3.1 Analysis of handle

4.0 WORKING PRINCIPLE

4.1 Construction

Unified wheel opener comprises of one small input gear and four bigger output gears. The handle is revolved by the operator is coupled to the smaller central gear which is fixed on a bearing. The sockets through which the wheel nuts are receiving opening, are connected to the four bigger gears by utilising extension rods. Slots are prepared on the plate in such a technique that the unified wheel opener can be regulating for opening tires which are having diverse centre to centre distances. A subsidiary plate is kept overhead the gears to force the linear motion of the gears. The base plate and the supporting plates are connected by nuts and bolts. Spacing between the plate and the gear is given by means of washers.

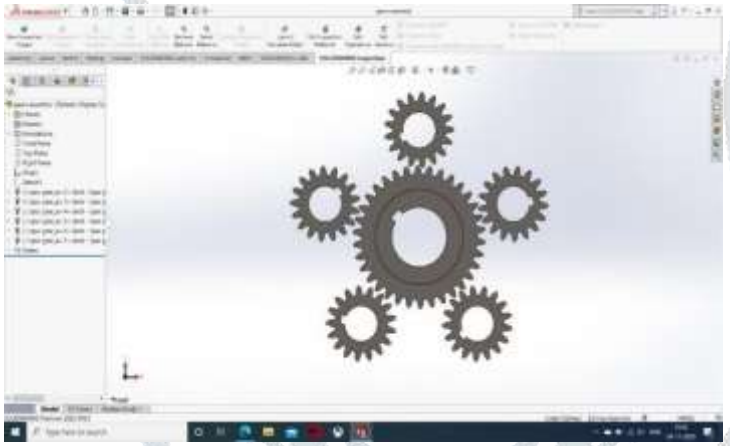

Figure 4.1 Working of unified wheel opener

4.2 Working

Five spur gears are organized in such a manner that, by applying force of 200 N with both the hands on the handle. Gears will be rotated and in conclusion necessary torque will be applied on the spanners to open the four- wheel nuts at one time. In the present work, we focused on the application domain that is actually the most of the passenger four wheelers. The foremost objective of the current study is to develop a broad mechanism in one assembly, which can be utilised in automobiles. unified wheel opener is operated by an operator by applying force with both the hands, which the help of which central gear rotates in a similar direction. By this motion the four output gears which are in net with the central gear rotates in opposite way to the first. Five bearings are linked at the centres of five gears to communicate free rotational motion and to provide the particular position to the gears. In conclusion the force is transferred to the sockets at the end of the linked rods, hence, the four nuts can be opened at once.

5.0 CALCULATIONS

Minimum Torque required to open a single wheel nut (approx. 94 Nm) For Four-wheel nuts

minimum Torque required (94 x 4 = 376 Nm)

As per the data available about strength Generated by human body, average torque that can be generated (200N)

On an average center to center distance between wheel nuts (2.255 inch) Diameter of larger

gear = 3.2 inches, Diameter of smaller gear = 1.6 inch Distance between center of small gear

and the handle: 12 inches

5.1 Design Calculations

The distance between the center of the smaller gear to the handle is assumed as 12 inches = 0.30m. With above

dimensions of gears the gear ratio becomes 1.88:1

Average force applied by human =200N

Torque necessary to open one-wheel nut = 176.72Nm (with effect of gear ratio). The above applied force will not be divided into four large gears so similar force will be experienced by all larger gears.

Therefore, the minimum force becomes = T/r = 176.72/0.04 (radius of smaller gear) = 4348.42N Maximum force thus

becomes = T/r = 376/0.04 = 9251.96N

Thus, minimum torque from center of gear to the handle = 94.1187/1.88 = 50.09Nm

Maximum torque becomes = 201.83/1.88 = 106.38Nm Minimum distance =

50.09/200 = 0.25m

Maximum distance = 106.38/200 = 0.53m

6.0 FUTURE SCOPE

The project is virtuously mechanical and has been invented. All the processes have been completed manually. A motor has to be linked to its drive so that this project will be valuable. A motor used reduces human effort in loosening and tightening the nuts of the wheel. Thus, the project can be proved a useful tool in assembling and dismantling the wheels of vehicles.

7.0 RESULTS AND DISCUSSIONS:

A. Practical applications

After the careful review of feasibility (i.e., operational, economic and technical) adjustable unified wheel opener is designed. It is applied in physical world problems. It works efficaciously and finally the goal is achieved according to the desire.

B. Comparative cost estimation

During the current situation, for tightening and loosening the nuts in the car, a generally used tool is four- way wrench brace spanner (costs about Rs.700). It has four spanners on each end: 18mm, 20mm, 21mm, and 22mm for fixing nuts, but it has a common problem that only one nut can be opened at one time. Thus, it is a time-consuming process. But with the invention of unified wheel opener tool all four nuts in a car wheel can be instantaneously removed and fixed. The whole cost involved for the construction of this new toll is approx. Rs.4000. Costs has been evaluated on the basis of parts that was being purchased and including machining costs and the parameters that are elaborated in the manufacturing of the project.

8.0 COST ESTIMATION:

Table: 3 Estimated cost of parts

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/-

CONCLUSION

- The production of Adjustable Unified Wheel Opener is magnificently done and the machine can be completed with an approximate cost of Rs 4000.
- This project is practically applied in a four-wheeler vehicle.
- it is found that the outcomes are positive.
- It has been found that adjustable wheel opener is a perfect tool for dismantling and assembling a wheel in a four-wheeler.
- The project is economically feasible.
- Thus, the project is functional as expected.

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