

# Design and Development of Multinut Remover in Automobile Industry

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## Abstract

In Automobile industry, Adjustable Unified wheel opener is a special purpose tool made to open/close all the nuts of a wheel in single operation with less effort. Although various methods are used for opening nuts, they require a lot of effort to open a single nut and also time consuming because you should open/close single nut separately. The main objective of work is to develop a single tool with use to open multiple nuts in single operation with simple mechanisms, which is widely use during assembling and dismantling of wheels in automobiles. It can be successfully used as a standard tool irrespective of the model of the vehicle. Also it can be used in assembly line of automobiles, garages, workshops and service stations.

**Keywords: Ball bearing, Box Spanner socket, Helical Gear, Pinion, Shaft**

## I. INTRODUCTION

In a day-to-day life there are many problems where there are needs 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.

## II. WORKING PRINCIPLE

Generally, spur gears are used for transmitting power between non parallel intersecting shafts. So spur gear arrangement is used for actuating the four socket spanners at a time. Twelve driven gears and one pinion gear are used. The cam and follower mechanism is used for making the project adjustable. For this purpose radial cam is used because the follower moves in the direction perpendicular to the cam axis. And spherical face follower is used because the side thrust and wear is considerably low.

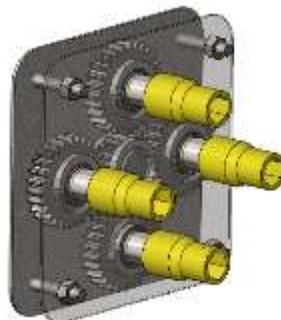


Fig. 1: Cad Design of Model

The pinion gear is meshing with four auxiliary gears which are in turn connected to a gear whose axle containing the socket spanners at its end. The auxiliary gear connected to a hollow shaft (main shaft) which is acting as a guide for follower. The other end of the follower is connected to a bevel gear. A lock nut arrangement is provided for connecting the main shaft to follower at any desired position. When the pinion is rotated the auxiliary gears are also rotated which in turn gives a rotary motion to the socket spanner. This helps to tighten or loosen the bolts. The adjustment for removing the bolts which are having different pitch circle diameter is achieved by rotating the cam.

### III. COMPONENT

Name of the component are

Table – 1  
Name of components

SR.NO.	COMPONENT NAME	QUANTITY
1	Pinion gears	2
2	Shafts	5
3	Helical gears(60mm)	4
4	Box Spanner Socket	4
5	Side Plate	2
6	Hand Lever	1
7	Bearing	10

### IV. FUNCTION OF COMPONENT USED

#### A. Gears



Fig. 2: Gear

Gear Cutting machine with a rotating wheel of a gear or cog teeth, or cogs, to be broadcast on the size of the other gear being a gear to mesh with another toothed part of torque, the teeth of the same size in most cases, and is often also. Two or sequence (train) work in many cases, a more or gear train is called Gears, a transmission; such a mechanical advantage through a gear ratio of the gear system of income and thus may be considered a simple machine. Some devices can change the speed, torque, direction and a power source. The most common scenario is a gear and a gear mesh; however, one can also mesh with the gear portion of a linear toothed, rack, instead of allowing the production version is called rotation.

#### B. Shaft



Fig. 3: Shaft

Drive shaft, a shaft for transferring torque is used to transfer the torque from the manually to the primary gears which is in mesh with the secondary gears which remove the nuts using the removing tools. A hollow shaft is used to transfer the motion from the secondary gears to the removing tool.

### C. Box Spanner Socket



Fig. 4: Box Spanner Socket

The second type socket wrench is a box design is very similar. The head of the socket wrench that is completely the same as the nut / bolt head cover and the sense of the handle is not fixed. The socket is a hexagonal shape or size estimate which itself is either a square. This estimate, which fits into the appropriate size of the cavity or on the handle, can be used to apply force. If you want to see a picture or description of a lot better about this type of content, and everything will be clear.

### D. Base Plates



Fig. 5: Base Plates

In order to keep the forces and means of the gear base plate is used to withstand the gears and the shaft extension. To remove the weight and increases the stability of the device. This is a plate made of cast iron.

### E. Ball Bearing



Fig. 6: Bearing

A ball bearing rolling-element bearing a type races. The purpose of balls to maintain the separation between the rotational friction and support radial loads and to reduce the axial. In most applications, a race is stationary and the other rotating assembly (eg.hub or shaft) is attached. Causes the ball to rotate the bearing races as well as a change. Because the balls are rolling, it is much less than the coefficient of sliding friction against each other if the two flat surface.

## V. WORKING PRINCIPLE

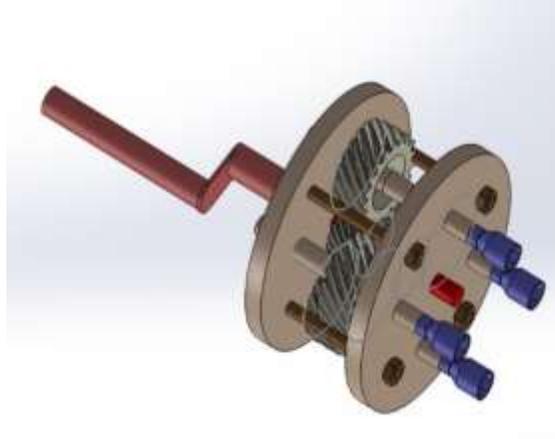


Fig. 7: 3D Model

This device is so simple. Hand operated or manual means as input power to the gear pinion. This will transfer the wings through a spur gear belt. Wing walking round a spur belt, it may be attached to a car wheel nut wrench are open around. This screw spindle revolution. As required, the car BCD (bolt circle diameter.) We also have to change the BCD are the same device. This wing is straight gear to work. BCD need to change a tire belt movement spur wheel gear to help achieve the wings. So we can continue to work with the opening of all four car wheel nut. By doing so, we can achieve higher productivity. [1]

## VI. DESIGN CRITERIA

### A. Find out PCD of wheel

Select the select the domain area for observation purpose which area name is Amar car, and that time we visited all department for observation purpose and finally we visited at assembly department and find out wheel which name is Maruti Wagon-R, which wheel has some specific dimension which is 100 PCD



Fig. 8: Find out PCD of wheel

### B. Find Out Torque for Opening a Nut

In Amar car we used digital torque meter for measuring particular torque acting for opening a nut from wheel base and finally we got a torque with the help of digital torque meter.



Fig. 9: Find Out Torque for Opening a Nut

### C. Drafting and Design Criteria via Calculation

- Firstly we find out some data from our machine design book and analytical calculation done with the help of design data book.
- Find out size of gear dimensions like as PCD, width, module and teeth. As same we calculated dimension of pinion, As well as of design of gear.
- Select the standard data and size of pinion such as number of teeth, pressure angle, addendum etc., and same procedure follow for the gear.

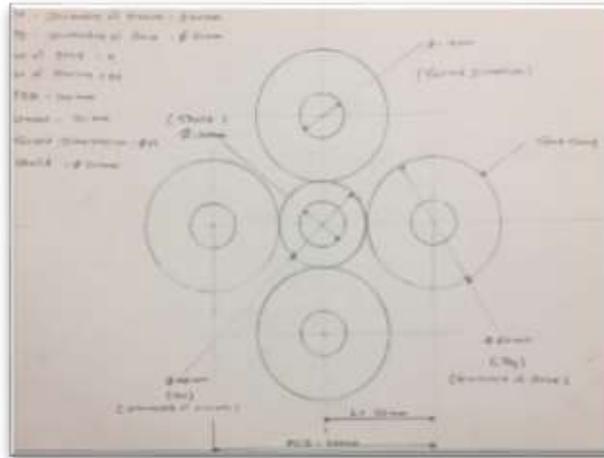


Fig. 10: Drawing of Removal Tool

### VII. STRESS ANALYSIS

Detail of von mises stress analysis:

Model = Maruti Alto

Engine = Maruti 800 cc

Torque (T) = 85 NM

Speed (N) = 2500 rpm

Power (P) = 35405.74 W = 35.40 kW

Torque (T) =  $F \times (d/2)$

Where, F-load,

d- Pitch circle diameter ( $z \times m = 56 * 2$  mm)

$F = T / (d/2)$

$F = 135240 / 90$

Load (F) = 1502.66 N

Using Lewis equation,

Tangential load,  $F = b \times y \times pc \times \sigma_b$

$pc = \pi \times m = 3.14 * 2.0$  mm

y= Lewis form factor=0.134mm

b = face width = 40 mm

### VIII. ADVANTAGES

- Simple in construction.
- Less weight.
- Less cost.
- It saves time as compared to other devices.
- It can operate easily.

### IX. APPLICATIONS

- Automobile workshops
- Automobile Manufacturing units
- Garage
- Junkyards

## X. CONCLUSION

Search time was reduced to remove lug nuts consumed. Some of the traditional methods of torque must be applied in a single lug nut off. In this search, the stiffness torque / remove all lug nuts is enough to form a lug / hard nut to remove the wheel. Use the same multi-nut remover is used to remove more than one nuts. This device can be operated manually and is external power. These are commonly used to remove the wheel nuts and remove the wheel mechanical effort required is very low so. Multi-vehicle unit and the nut remover can be used to produce units.

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