



# Multi Spindal Wheel Nut Tightening System: A Review

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**Abstract:** In recent years, the automotive sector has seen a growth in the number of vehicles on the road, resulting in an increase in tyre failures. Traditional methods of tyre replacement, which involve manually removing and tightening wheel nuts one at a time, are frequently time-consuming and physically difficult. To overcome this issue, a variety of inventive equipment have been developed to speed the wheel nut repair procedure. The development and use of multi-nut openers represents a significant leap in vehicle repair. These tools are designed to remove and tighten numerous wheel nuts at the same time, considerably reducing the amount of time and effort necessary for tyre replacement. The significance of these tools rests in their capacity to improve efficiency, safety, and lessen the strain on car owners and mechanics. This research paper will provide an overview of recent advances in multi-nut openers for automotive wheel repair. It will look at the design, manufacture, and functionality of these tools, with a focus on their ability to handle the issues of tyre replacement. The paper will also address the significance and usability of multi-nut openers in diverse automotive environments, including as garages, workshops, service stations, and assembly lines.

**Keywords-** Multi Nut Opener, Tightener, Fabrication, Automobiles, Wheel Nut Remover.

## 1.INTRODUCTION

This project aims to atomize the labour involved in tightening or loading nuts one at a time. This study focuses on reducing the amount of human work and time required to fix all four nuts of a four-wheeler tyre with a single stroke of the lever employing multiple operated spanners. To save time and energy when changing a tyre, a special tool is devised and manufactured to allow the driver or machine to remove four wheel nuts at once while using less energy. The design is based on basic features seen in the majority of cars on the market. This sort of tyre nut vehicle will analyse and show the nut removal processes, the type of tools required, the project calculation, and the material specification. A vehicle is a crucial piece of equipment in daily life. In order to facilitate easier and quicker commuting, most families these days own at least one car. A T-nut wrench and car jacker are the standard tools for every car, and they can be difficult for ladies or teenagers to use to unlock their car's nut. Tire issues are one kind of car trouble. The user must remove the tires and address any issues if the vehicle's tires are malfunctioning. Furthermore, removing a tire's nut can be challenging for drivers, particularly for women. Time loss and force requirements are the barriers. There isn't a simple-to-use tool available in Malaysia's automotive industry for removing nuts.

The process of unscrewing a car tire takes too long and requires strong power, which might be difficult for female drivers. A tool that can remove four tire nuts in a single session with decreasing effort usage has been developed to counteract time wastage and excessive force requirements. The CAR is no longer a representation of luxury. It is essential for all families. People require cars for a variety of reasons. Getting somewhere, traveling comfortably, doing daily tasks, and moving objects farther are a few of them. Tyre puncture is the most common issue that arises when driving an automobile. It was necessary to replace the flat tire with a spare. As a result, drivers must be familiar with the fundamentals of replacing tires in the event that an issue arises. It takes very little expertise to change a flat tire. Almost all cars come with a jack and an L-shaped nut extractor from the manufacturer, which are used to replace tires. This project's primary goal is to divide up the labor-intensive task of individually loading or tightening each nut. This study focused on reducing

the amount of time and human labor required to use numerous operated spanners to fix all four of the tire's nuts with a single lever stroke. Everyday living involves a great deal of wants and problems. A simple yet essential task that every person performs on a regular basis is unlocking a car wheel. It is a known fact that a car wheel requires a lot of effort to open a single nut, and in extremely cold or hot weather, opening the wheel becomes a laborious operation. When there is an emergency, it also causes issues. The Adjustable Unified Wheel Opener is a unique gadget that makes opening a wheel simple and is the answer to the previously described issue.

Its design allows it to simultaneously unlock all four car wheel nuts. The most coveted outcome is that the entire process requires a great deal of time and work. The tool's straightforward design makes it simple to use and transport with the car. One of the most fundamental items that a person can own is a car. Cars are no longer just a sign of wealth; they are increasingly considered necessities. One of the most important factors affecting an automobile's lifespan is maintenance. This involves having a basic understanding of how to change a car's tire. However, changing a punctured tire has never been an easy task. In the daily lives of a human, a vehicle is a crucial machine. In order to facilitate easier and quicker commuting, most families these days own at least one car. This project's primary goal is to reduce the amount of labor involved in individually tightening or unscrewing nuts. The goal of this project is to use several operated spanners to reduce the amount of human labor and time required to tighten and remove all four of the tire's nuts with a single lever stroke. The tool's straightforward design makes it simple to use and transport with the car. This apparatus operates based on the gear arrangement system. Without the use of an electric motor or other hydraulic or pneumatic equipment, this operation may have partially resolved the issues with removing four nuts and using force. A vehicle is a crucial piece of equipment in daily life. In order to facilitate easier and quicker commuting, most families these days own at least one car. All wheel nut removal tools were manufactured by a process of machining, welding, and fitting. Because of its design, changing a tire doesn't have to take as much time or energy because a driver or mechanic may release four wheel nuts at once with minimum effort.

## 2. Problem Statement

For wheel nut removal and tightening, the traditional approach of utilizing a standard L wrench and nut spanners is problematic, especially for older or frailer people or in instances where time is of the utmost, like medical emergencies or hectic schedules. A vehicle multi-wheel nut remover and tightener tool has been devised in response to these difficulties. With the help of this creative gadget, all four nuts may be removed quickly and easily, saving a great deal of time and labour. Because of its simplicity of use, it is accessible to people with different skills and needs, making it a useful tool for both routine use and emergency situations.

## 3. Methodology

Five electric nut runners are integrated into the power head assembly used in tire assembly in car manufacture to fasten wheel nuts to tires. The assembly is made up of two primary parts, the 350mm-diameter front plate and the rear plate, both of which are made of lightweight but sturdy aluminium. These plates provide enough room to arrange the nut runners in a way that guarantees exact alignment and stability while in use. This assembly is made to be as precise and efficient as possible, and it is built to last a long time in the harsh automotive environment.

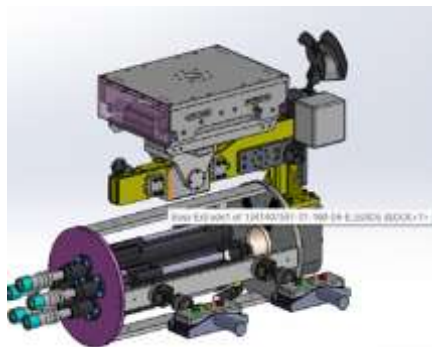


Fig: Five Spindal Wheel

With a pitch circle diameter (PCD) of 114.3 mm, the power head assembly's five electric nut runners are positioned thoughtfully on the front plate to guarantee precise engagement with wheel nuts. By maintaining a secure spacing of 673mm between the front and rear plates, weight distribution is optimized for balanced rotational movement. With the help of a tapered roller bearing, the rear plate is attached to a rotating shaft, allowing for precise and smooth rotation that adapts to the PCD of the tire. With its sturdy design, precise

engineering, and sophisticated rotational mechanisms for constant and accurate wheel nut tightening, this assembly offers a dependable and effective solution for automobile tire installation, improving the quality and safety of vehicles.

The power head assembly can be precisely adjusted and moved thanks to the Fixed Tool Suspension (FTS) assembly, which is an essential part of the tire assembly process. It is essential to the automated tire assembly system because of its durable construction and broad range of uses. consists of several essential parts, each of which plays a distinct role in permitting precise and effective tire assembly by permitting controlled movement and adjustment.

#### 4. Components

4.1 Down Tube: Stability and rigidity are provided by the down tube, which is the primary structural support for the FTS system. It guarantees that, while operating, the entire system stays firmly attached.

4.2 LM Block: As a linear motion guide, the LM block is fixed to the down tube. It makes it easier for the pneumatic cylinder to move along the vertical axis smoothly and precisely, which enables precision power head assembly adjustment.

4.3 Bellows (x2): Installed around the pneumatic cylinder are flexible devices that resemble accordions, called bellows. They ensure the cylinder operates smoothly and lasts a long time by shielding it from dust, debris, and other impurities.

4.4 Pneumatic Cylinder: One essential part that raises and lowers the power head assembly is the pneumatic cylinder. It transforms compressed air into linear motion, applying the requisite force to change the power head assembly's height as needed.

4.5 M5BD100-250Z-M9BL: SMC's pneumatic cylinder model was chosen in particular for its dependability and efficiency. It has enough range to allow the power head assembly to be raised or lowered, with a stroke length of 250 mm.

4.6 Single Knuckle Joint: Smooth and controlled movement along the vertical axis is made possible by the single knuckle joint that joins the pneumatic cylinder and LM block. It guarantees an efficient transfer of force from the cylinder to power head assembly.

4.7 LVDT (Linear Variable Differential Transformer):

Accurately tracking the location of the pneumatic cylinder is made possible by the LVDT, a precision measurement tool. It enables accurate control and adjustment by giving real-time feedback on the power head assembly's vertical displacement.

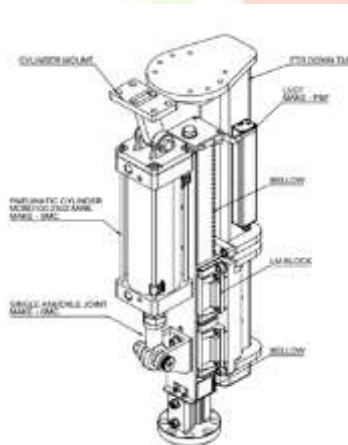


Fig: Pneumatic Cylinder

#### 5. Calculation

To determine the specifications of the pneumatic cylinder required to lift the 300 kg load of the power head assembly, calculations were performed to ascertain the force exerted and the necessary pressure:

The force required to lift the load was calculated using the formula: Force = mass  $\times$  acceleration due to gravity  
 $\text{Force} = 300 \text{ kg} \times 9.81 \text{ m/s}^2$   
 $\text{Force} \approx 2943 \text{ N}$ . The bore diameter of the pneumatic cylinder was calculated using the formula for force exerted by a pneumatic cylinder: Bore Diameter =  $\sqrt{(4 \times \text{Force} / \pi)}$   
 Bore Diameter  $\approx 61.17 \text{ mm}$ . The pressure required to exert that force was calculated using the formula: Pressure = Force / Area  
 $\text{Area} = \pi \times (\text{Bore Diameter})^2 / 4$   
 $\text{Area} \approx 2941.28 \text{ mm}^2$   
 Pressure  $\approx 1.001 \text{ MPa}$



Thus, a pneumatic cylinder with a bore diameter of approximately 61.17 mm and a pressure of approximately 1.001 MPa is needed to lift the 300 kg load with a 250 mm stroke.

## 6. Future Scope

It functions as a practical and easy way to replace tires, thus it is better to use this configuration for tire removal in all cars in order to cut down on the amount of time and labour needed to replace tires and handle emergency situations. Therefore, the multi-wheel nut remover and tightener for vehicles can be utilized in all auto shops and kept in every car for quick tire replacement, saving a great deal of time and effort for everyone.

## 7. Conclusion

Thus, the design of the car's nut remover and tightener for wheel was completed effectively. Practical implementation of this project in a four-wheeler yielded great results. The project maintains the necessary feasibility and is cost-effective. A wheel nut remover and tightener is an essential tool for both assembling and disassembling wheels in four-wheel drive vehicles. Several nuts can be removed with a single usage of the multi-nut remover. Because these are frequently used to loosen wheel nuts, relatively little mechanical effort is needed to remove the wheel. Both manufacturing and automotive units can employ the multi-nut remover. Using a light-weight base plate made of material will help the model weigh less. The multi nut remover makes it simple to remove the wheel nuts. Several nuts can be tightened at once with the multi-nut tightener. The effort needed to remove or tighten the wheel is minimal because they are mostly used to tighten and loosen wheel nuts. Both manufacturing and automotive units can employ the multi-nut tightener. Using a light-weight base plate made of material will help the model weigh less. To get rid of the lug nuts used, the search time was decreased.

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