A PROJECT REPORT

ON

“Design and Fabrication of all wheel Nut Runner for 100mm PCD”

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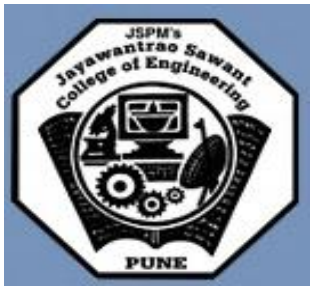

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C E R T I F I C A T E

This is to certify that ***Mr. Kolate Akshay, Mr. Chaudhary Suresh, Mr. Maske Mayur, Mr. Gaikwad Subodh,*** has successfully completed the project stage-I entitled ***"Design and Fabrication of all wheel Nut Runner for 100mm PCD"*** under my supervision, in the partial fulfillment of Bachelor of Mechanical Engineering of Savitribai Phule Pune University.

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ABSTRACT

This project aim is to design and fabrication of four wheel nut removing tool for tightening and removing of four nuts in one stroke. With the increment of number of car on the road, the number of cars problem due to tyre failure has increased. Often, the car is provided with tyre wheel nuts remover and jack for instance spare tyre replacement. Nevertheless, due to difficulty in applying torque to remove nut and to save a time. We develop tool having a gear planetary mechanism. In our project we are tried to focus on the minimization of human effort for fixing all for nuts of 100mm PCD wheel in one time. The main objective of work is to develop a single tool, which can be made use during assembling and disassembling of wheels in automobiles. It can be successfully used as standard tool irrespective of the model of the vehicle. Also it can be used garages, workshops and service stations. The remover is designed to be ergonomic to be used, easy maintenance, easy storage, easy to handled and able to remove all nuts at once.

INDEX

List of figure

ACKNOWLEDGEMENT

It is our proud privilege and duty to acknowledge the kind of help and guidance received from several people in preparation of this report. It would not have been possible to prepare this report in this form without their valuable help, co-operation and guidance.

First and foremost, we wish to record our sincere gratitude to **Management of this college** and to our beloved Principal, **Dr. M. G. Jadhav**, Jayawantrao Sawant College of Engineering, Hadapsar for his constant support and encouragement in preparation of this report and for making available library and laboratory facilities needed to prepare this report. Our sincere thanks to **Dr. P. A. Patil**, Head, Department of Mechanical Engineering, JSCOE, for his valuable suggestions and guidance throughout the period of this report.

We express our sincere gratitude to our guide, **Prof. Mallikarjun B. Patil**, Department of Mechanical Engineering, JSCOE, Hadapsar for guiding us in investigations for this Project and in carrying out experimental work. Our numerous discussions were extremely helpful. We hold his in esteem for guidance, encouragement and inspiration received from him. The Project on "**Design and Fabrication of all Wheel Nut Runner for 100mm PCD**" was very helpful to us in giving the necessary background information and inspiration in choosing this topic for the Project. Our sincere thanks to **Prof. Shivaji Maknikar** Project Coordinator for having supported the work related to this Project. His contributions and technical support in preparing this report are greatly acknowledged.

Last but not the least, we wish to thank **our parents** for financing our studies in this college as well as for constantly encouraging me to learn engineering. Their personal sacrifice in providing this opportunity to learn engineering is gratefully acknowledged.

Place: Hadapsar, Pune

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1. INTRODUCTION

Today's world is of fast and rapid process. Everybody wants to save time and effort by inventing some newer technique or mechanism and implanting them in the daily life. Car is not a symbol of luxurious anymore. It is need for every family. People need car due several reasons. Some of them are, to get to a destination, to travel conveniently, to do daily job and to move things to a greater distance. The problem occurs the most during car operation is problem with tyre failure. To overcome the above problem, we design vehicle all wheel nut removing tool. The main objective of this project is to atomize the labor work in tightening or loading the nuts one by one. This project focuses on the minimization of human effort and time consumed for fixing all four nuts of the four wheeler tire with a single stroke of lever by using multiple operated spanners. This is achieved by developing a planetary gear mechanism as such occurs which reduced the time and effort for the above mentioned task that is losing or tighten the nut of the car wheel.

If we consider a four wheeler removing and replacing the car wheel is a very frequent job performed by the worker. Normally each of the four nuts is removed individually by simultaneously applying the spanner. But with the help of the mechanism developed we can loosen or tight all four nut at a time and at the single stroke. To avoid time wasting and a lot of energy used to change the tyre, a special tool is designed and fabricated to allow driver or machine to remove four nuts of wheel at once with less energy consumption. The design is based on standard PCD of 100mm for most of cars available. For this project, the 100 PCD cars has been the guide. This chapter will give all the information on 100 PCD and all part that will be used in this project. In this chapter, type of tire 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 analyzed and shown. This information has been collected from books, journals, company's websites, and market survey.

In India there are many of cars with nut such as 3 nuts, 4 nuts, 5 nuts and 6 nuts. We have chosen 100mm PCD having 4 nuts, many of the cars in India with that pitch size. For the tester, we have chosen Maruti Suzuki swift dezire where there are 4 bolts with 100 PCD. Figure shows the sample of Maruti Suzuki swift dezire Wheel.

Fig.1.1 Swift dezire tyre

For removing or changing the car tire, some steps must to be done. The steps must be followed by the procedure to keep the changing process inline. All the steps and the procedure have been studied and listed out.

There are some steps for removing tire nuts and change the car tyre. Below are the methods of change the car tire.

1. Tools selection (locate tyre spare, jack and tire nut removal)

2. Lug the nuts (loose up the nuts before jack the car up)

3. Jack the car (locate the jacking point to body car to lift the car)

4. Remove the tire (removes the nuts and changes the tyre)

5. Get new tire (get the new tire and replace the old tyre)

6. Jack the car (let the car down off jack and tighten the nuts)

Instead of using above method for wheel removal we can used multi nut removing tool. A special tool is designed and fabricated to allow driver to remove four nuts of wheel at once with less energy consumption.

It works on the principle wheel is a very frequent job performed by the worker. Normally each of the four nuts is losing or tightens individually by simultaneously applying the spanner. Either with the help of mechanism developed that one can loosen or tight all four nuts at a time and at the single stroke of the hand operated or motor operated lever. This is done by adjusting the five gears between two side plates operated only by lever or input pinion shaft.

1.1 PROBLEM STATEMENT

To design and fabricate the Four Wheel vehicle nut runner having the PCD of 100mm. the process of changing a vehicle wheel will typically time consuming so to overcome this problem we design a tool. The cars with PCD 100mm are major in quantity, so we design wheel nut remover for wheel vehicles tool for these vehicles. Also we are using the lighter material for making this tool light. Use less expensive materials and lower the production cost.

1.2 OBJECTIVE

The objective is to design and fabricate the wheel nut runner for 100mm PCD with the following properties,

1. To make the wheel nut removal tool lighter.
2. To use less expensive materials.
3. To reduce the production cost.
4. To apply the less human effort.

1.3 SCOPE

1. To design and fabricate the complete assembly of the multiple operated spanner to be fitted to all vehicle wheels having 100mm PCD.
2. Make a kit of fabricated tool, so it can carry along vehicle and used at any instant easily.
3. By replacing the motor with different gear arrangements in such manners that it can be operated manually by hand lever with less power requirement. The weight of the model can be reduced by using a light weight material of base plate.

1.4 METHODLOGY

1. Finding the most common Pitch Circle Diameter for wheels and for that pitch circle find the current running cars name.
2. The design calculation for vehicle all wheel nut removing tool with chosen pitch circle diameter.
3. Designing the vehicle all wheel nut removing tool for the above chosen pitch circle diameter.
4. Material selection on basis of design and calculation.
5. Analysis vehicle all wheel nut removing tool on design software's.
6. Fabrication of vehicle all wheel nut removing tool.
7. Testing of vehicle nut removing tool.
8. Results, discussion and conclusion.
9. Validation by actual performance of the tool
10. Report writing

2. LITERATURE REVIEW

[1] Ahmad Farudzi Bin Azib

Changing a large truck wheel is more difficult than changing out a car wheel due to the size and weight of the wheel. For changing the wheel require loosening and remove the lug nut. Therefore, to loosen the lug nut with lug wrench or wheel wrench requires more than manpower and takes a long time. Hence necessity hydraulic extension lug wrench for reduce the problems encountered for the loosening lug nut in commonly with lug wrench. Usually force and torque require for loosening and tightening the nut and screw. For lug nut many wrench can doing the loosening and tightening using man power to produce the force or power tool be related fluid power. Fluid power as air and fluid or electrical energy to produce torque energy. Lug wrench or a socket wrench used to turn lug nuts on automobile wheels. For lug wrench or wheel wrench heavy vehicle different light vehicle as strength, material and size socket. Furthermore the lug nut for heavy vehicle extremely built tough because "torque value" (torque is the twisting force applied to a threaded component such a bolt or nut) for lug nut around 450Nm to 600Nm. Generally, human power cannot produce against the torque value lug nut heavy vehicle. Excluding lug wrench connection with long hollow pipe and more than one human power.

These process harm or weary to human and taken a time. Rotary wrench designed with its own internal gear. Purpose of this tool is to do the work loosen the nuts by turning the crank tool. The gear is easy to failure and using human power. A spindle rotate given the force and external gear produce more torque to rotating the socket wrench or nut. The spurs gear built in rotary wrench own ratio for more force and torque. Furthermore the rotary wrench own debility because require man power to rotate spindle. The pneumatic torque wrench is sometimes confused with a standard impact wrench, because it looks similar, but is actually a totally different tool. A pneumatic torque wrench is driven by continuous gearing, and not by the Hammers of an impacting wrench. This is why a pneumatic torque wrench has very little vibration, and excellent repeatability and accuracy. Torque capabilities of pneumatic torque wrenches range from 118Nm, up to a maximum of 47,600Nm.Using pneumatic torque wrench is a limited power in the workshop alone in doing work to loosen and tighten the nut. Air compression for this operation is on 10 Bar and built in jack hammer. Require two stage air compression for operation

because air compression for pneumatic require high air pressure The pneumatic torque wrench cannot use for breakdown case because require air compressed as power source.

Procedures

Computer-aided engineering (CAE) is the broad usage of computer software to aid in engineering tasks. In general, there are three phases in any computer-aided engineering task:

1. Pre-processing – defining the model and environmental factors to be applied to it. (typically a finite element model, and thin sheet methods are also used)
2. Analysis solver (usually performed on high powered computers)
3. Post-processing of results (using visualization tools)

CAE areas covered include

4. Stress analysis on components and assemblies using FEA (Finite Element Analysis);
5. Thermal and fluid flow analysis Computational fluid dynamics (CFD);
6. Multi body dynamics (MBD) & Kinematics;
7. Analysis tools for process simulation for operations such as casting, molding, and die press forming.
8. Optimization of the product or process.
9. Safety analysis of postulate

Journal paper preferred was IJAST (International Journal of Applied Science and Technology).

Fig 2.1 Extension of Hydraulic Wheel Wrench [1]

[2] Nitesh L. Gomase, Pankaj R. Chawhan

This project aims to design and fabrication of four wheeler multiple-opening spanner for tightening and removing of the four nuts in a single stroke of a hand operated lever. Nowadays everybody wants to save time and effort by inventing some newer technique or mechanism and implement them in the daily life. We have developed a gear planetary mechanism to reduce the time and effort for the above mentioned task. In our project we have tried to focus on the minimization of human effort and time consumed for fixing all four nuts of the ø100mm PCD tire with a single stroke of lever. If we consider a four wheeler removing and replacing the car wheel is a very frequent job performed by the worker. Normally each of the four nuts is removed or tightened individually by simultaneously applying the spanner/lever. But with the help of the mechanism developed we can loosen or tight all four nut at a time and at the single stroke of the motor operated lever. The multi nut remover is used to remove multiple nuts in a single use. These are commonly used to remove the wheel nuts and hence the mechanical effort required for removing the wheel is very less.

Working principle

Works on the principle wheel is a very frequent job performed by the worker. Normally each of the four nuts is losing/tighten individually by simultaneously applying the spanner/lever. Either with the help of mechanism developed that one can loosen or tight all four nuts at a time and at the single stroke of the hand operated or motor operated lever. This is done by adjusting the five gears between two side plates operated only by lever or input pinion shaft.

1) “ON” the MOTOR regulator switch.

2) It consist of 4 spur gears , 4 shafts for spur gears , 4 box spanner, 1 lever on which the pinion gear are fixed i.e. input pinion , 2 side plates .

3) Considering out these attempts to reduce time and effort why should small operation like losing and tightening of nuts of a car wheel ignored. The subject of the project solved be and above inconveniences.

4) This is achieved by developing a mechanism as such ours which reduced the time and effort for the above mentioned task that is losing or tighten the nut of the car wheel.

5) If we consider a four wheeler removing and replacing the car the mechanism developed one can loosen or tight all four nut at a time and at the single stroke of the hand operated lever.

Journal paper preferred was (IJSRD) International Journal for Scientific Research & Development.

Fig.2.2 Fabricated Model [2]

[3] Vaibhav Chowki, Sarvesh Mhatre

Adjustable Multi nut wheel opener is a special purpose tool made to open or close all the nuts of a wheel in one time with less effort. Although various methods are used for opening nuts, they require a lot of effort to open a single nut. The main objective of work is to develop a single tool with multiple mechanisms.

The main concept of the proposed system is nut fitting & removing without human help for driving. The heart of the project and implementation is motor. The components used here for efficient function of individual blocks are Motor, Nut fitting arrangement (spanner) and spur gear arrangement. The main objective of the model is to remove the nuts of a wheel at once and not one at a time. The principle of the model is the usage of bevel gear to transmit relative motion to other gears. Generally bevel gears are used for transmitting power between non parallel intersecting shafts. So bevel 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. The pinion gear is meshing with four auxiliary gears which are in turning 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. The followers are in contact with cam when the cam is rotated the follower will move linearly. After reaching a desired position the follower is locked with the hollow shaft to make them to rotate as a single shaft. Then the cam is brought back into its initial position to prevent the cam from severe wear while the follower is rotating.

Journal paper preferred was (IJSRP) International Journal of Scientific and Research Publications.

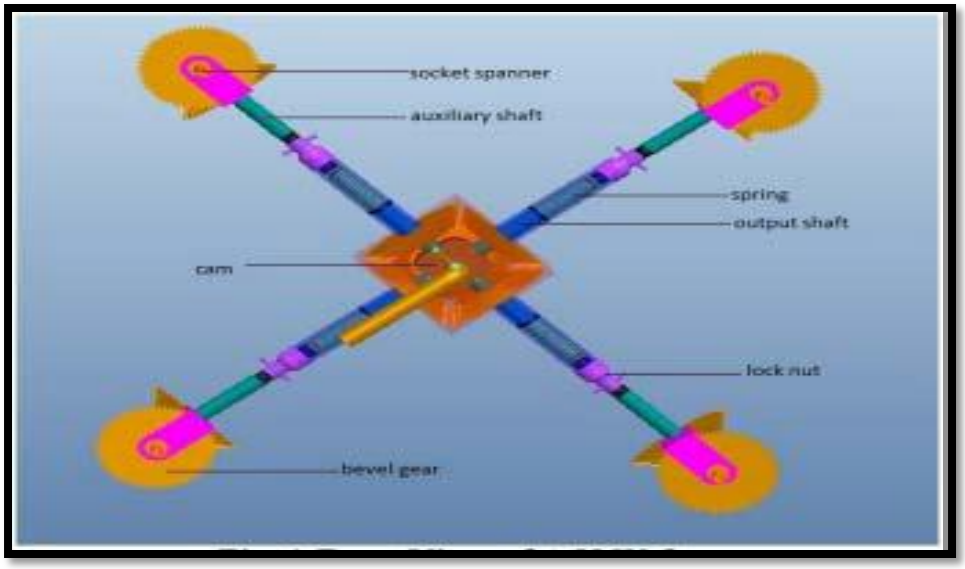


Fig.2.3 Adjustable nut removing [3]

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.

[4] C.Veeranjaneyulu, U. Hari Babu

The main aim of this paper is to focus on the mechanical design and analysis on assembly of gears in gear box when they transmit power at different speeds 2500 rpm, 5000 rpm and 7500 rpm. Analysis is also conducted by varying the materials for gears, Cast Iron, Cast Steels and Aluminum Alloy. Presently used materials for gears and gear shafts are Cast Iron, Cast steel. In this paper to replace the materials with Aluminum material for reducing weight of the product.

A differential is a device, usually but not necessarily employing gears, capable of transmitting torque and rotation through three shafts, almost always used in one of two ways: in one way, it receives one input and provides two outputs this is found in most automobiles and in the other way, it combines two inputs to create an output that is the sum, difference, or average, of the inputs. In automobiles and other wheeled vehicles, the differential allows each of the driving road wheels to rotate at different speeds, while for most vehicles supplying equal torque to each of them. A vehicle's wheels rotate at different speeds, mainly when turning corners. The differential is designed to drive a pair of wheels with equal torque while allowing them to rotate at different speeds. In vehicles without a differential, such as karts, both driving wheels are forced to rotate at the same speed, usually on a common axle driven by a simple chain drive mechanism. When cornering, the inner wheel needs to travel a shorter distance than the outer wheel, so with no differential, the result is the inner wheel spinning and/or the outer wheel dragging, and this results in difficult and unpredictable handling, damage to tires and roads, and strain on (or possible failure of the entire drive train).

Journal paper preferred was (IJAERS) International Journal of Advanced Engineering Research and Studies.

[5] N. Frederiksen

A multiple lug nut removal tool includes an air gun that includes a cylindrical housing having a front end. A cover is mounted over the front end. A drive axle is mounted within the housing. A primary gear is attached to the drive axle. A plurality of secondary axles extends through the cover. Each of the secondary axles has a first end positioned within the housing and a second end extending outwardly a Way from the cover. Each of a plurality of secondary gears is attached to one of the first ends. The secondary gears are each in communication with the primary gear. Each of a plurality of couplers is attached to one of the secondary axles. Each of a plurality of sockets may be attached to one of the second aryl axles by the couplers so that the sockets are rotated when the primary gear is rotated. To this end, the present invention generally comprises an air gun that includes a cylindrical housing having a frontend. A cover is mounted over the front end. A drive axle is mounted within the housing and is rotated When air flows through the air gun. A primary gear is attached to the drive axle and is positioned within the housing adjacent to the cover. A plurality of secondary axles extends through and is rotatable coupled to the cover. Each of the secondary axles has a first end positioned within the housing and a second end extending outwardly a Way from the cover. Each of a plurality of secondary gears is attached to one of the first ends of the secondary axles. The secondary gears are each in communication with the primary gear so that each of the secondary gears rotates when the primary gear is rotated. Each of a plurality of couplers is attached to one of the

Secondary axles and is adapted for releasable engaging a socket to an associated one of the secondary axles. Each of a plurality of sockets may be attached to one of the second axles so that the sockets are rotated when the primary gear is rotated.

3. WORK SIMULATION

3.1 Design calculation

3.1.1 Basic principles and Theory

The basic fundamentals of law of gearing have to be followed in designing the spur gears. The Fundamental law of gearing states that, "For a pair of gear to transmit constant angular velocity ratio, the tooth profiles of these mating gears must be designed in such a way that the common normal (line n-n) or the line of action passes through a fixed point, or also known as the pitch point, on the line of centers."

3.1.2. Design Parameters

PCD (Pitch Circle Diameter) = 100mm

Common nut sizes = M19

Torque required, T = 100Nm (4 nuts).

Average force by human, F = 500N.

Length of handle, LH = 500 mm.

Gear material = EN8 (Mild steel)

Module, m = 2.5 mm.

Pressure angle = 20˚

Dp+Dg=100mm

$$\frac{N1}{N2}=\frac{T2}{T1}=\frac{Dg}{Dp}$$

$$m=\frac{D}{T}$$

3.1.3 Dimensions of pinion and gear

Gear ratio G = 1.5

T1 (pinion) = 16 teeth,

T2 (gear) = 24 teeth.

Pitch circle diameter of pinion, DP=40mm

Pitch circle diameter of gear, Dg=60mm

Young's modulus, E = 2×103 N/mm2.

Module, m = D/Z=2.5

Addendum, Aw = 2×m = 5 mm.

Dedendum, Ad = 1.25×m= 2.5 mm.

Face Width b= 25mm

Minimum no. of teeth to avoid interference

$$\mathbf{T1} > \frac{2a_w \frac{1}{T1} P_d}{\sqrt{1+\frac{1}{T2}\left(\frac{1}{T2}+2\right)\sin\theta^2 - 1}}$$

3.1.4 Base plate Dimensions

1. Base plate is made of mild steel having 200mm diameter and thickness of 10mm.
2. Four holes of 15mm diameter is made on plate at 45 degrees' angular pattern.

3.1.5 Bearing

1. Bearing number 6202 is used for mounting of shaft.
2. 6202 bearing having bore diameter 15mm and outside diameter 35mm.

3.1.6 Dimensions of spanner holder

1. Spanner holder made of a steel material
2. Spanner holder is 70mm long and 12mm square head for spanner fitting

3.2 Software design

This project uses modern approach for modeling and simulation. We used software NX9 to make model. NX9 software used to achieve the study objectives. The results obtained from the simulation are compared with the calculated data collectively. In addition, all solid body constructed using NX9 pre-requisite before the simulation is made & finally the project is built.

3.2.1 Modeling

1. Design the gear in NX9 from given calculation of gear
2. Meshing of gear and pinion
3. Select the proper bearing from catalogue
4. Design of the base plate
5. Design of spanner holder
6. Design of the spline key rod

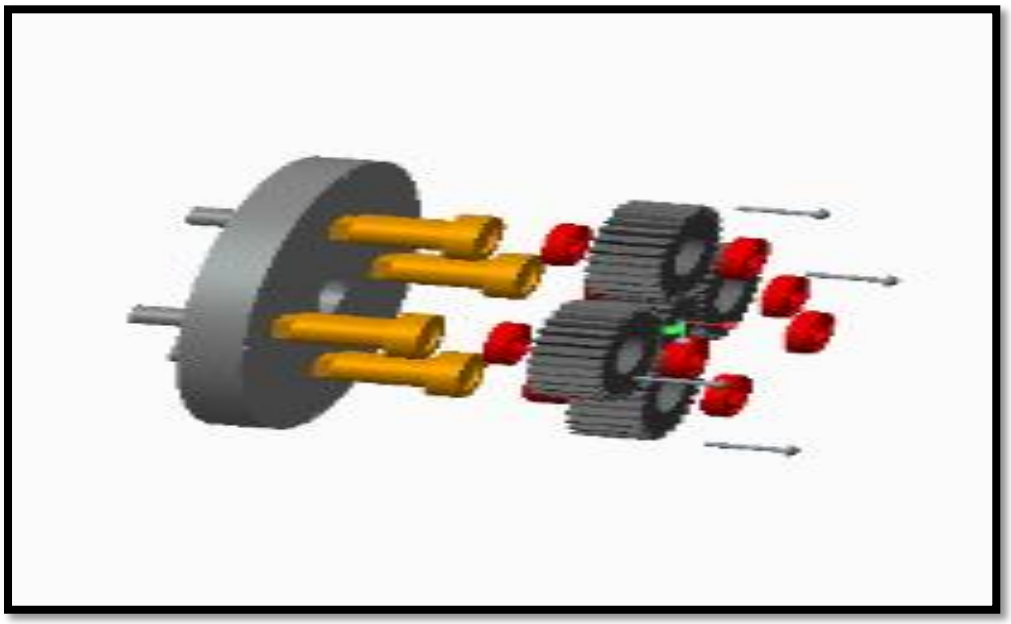


Fig 3.2.1 Detailed view of equipment

3.2.2 Assembly

The assembly we have done is top up assembly as shown in fig.

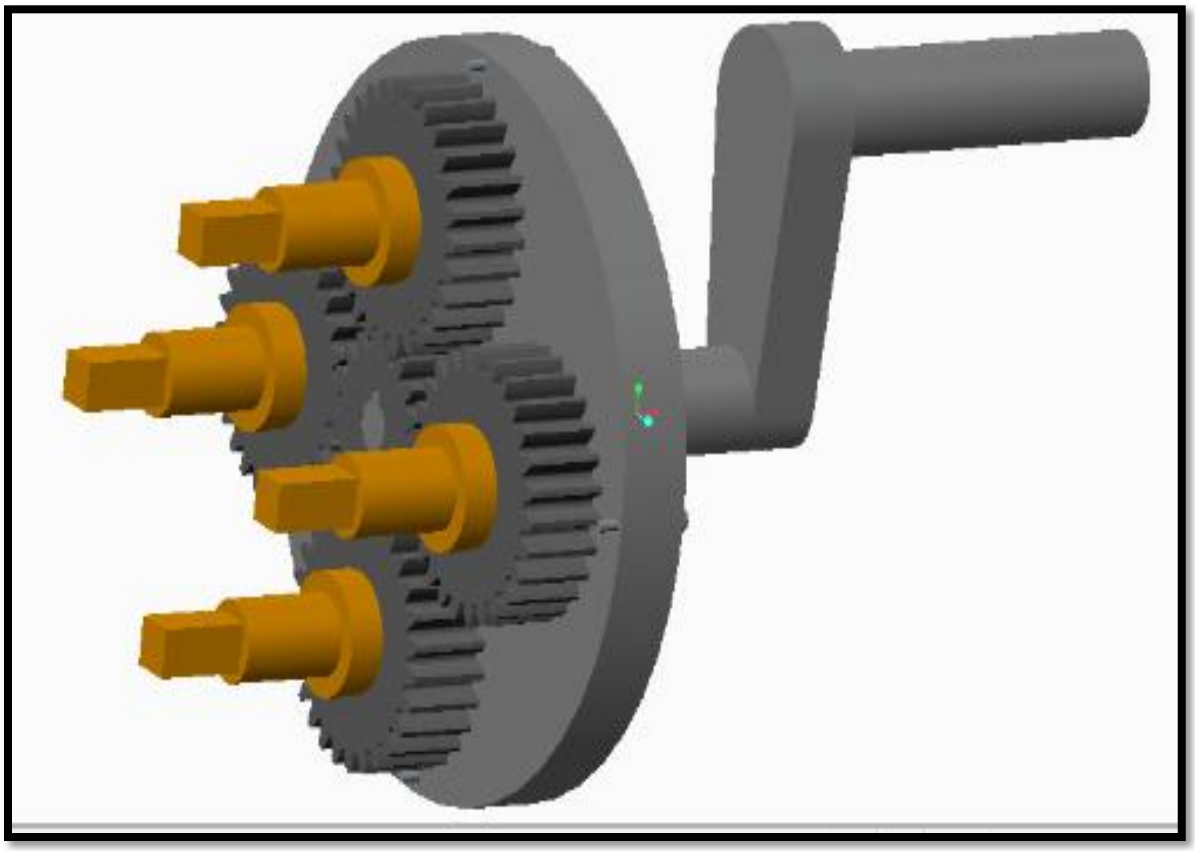


Fig .3.2.2 assembled view of equipment

3.2.3 Different parts of assembly

1. Gear
2. Spanner holder
3. Base plate
4. Central shaft with spline key way
5. Bearing

1. Gear model

Model of gear is done on NX9 software. NX9 software used to achieve the study objectives. Part model and Draft view as shown in figure below.

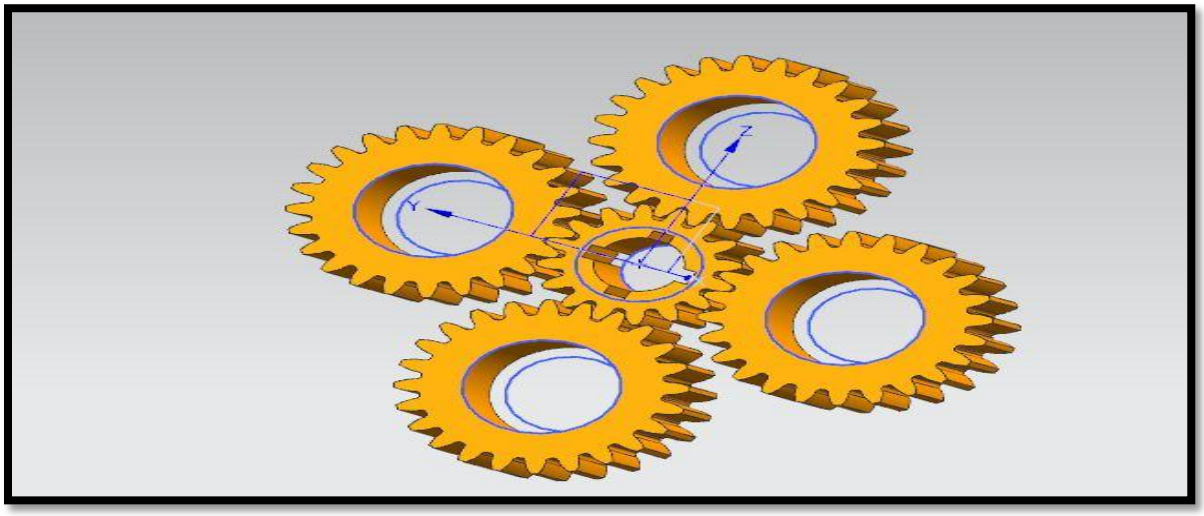


Fig.3.2.3 Model of gear assembly

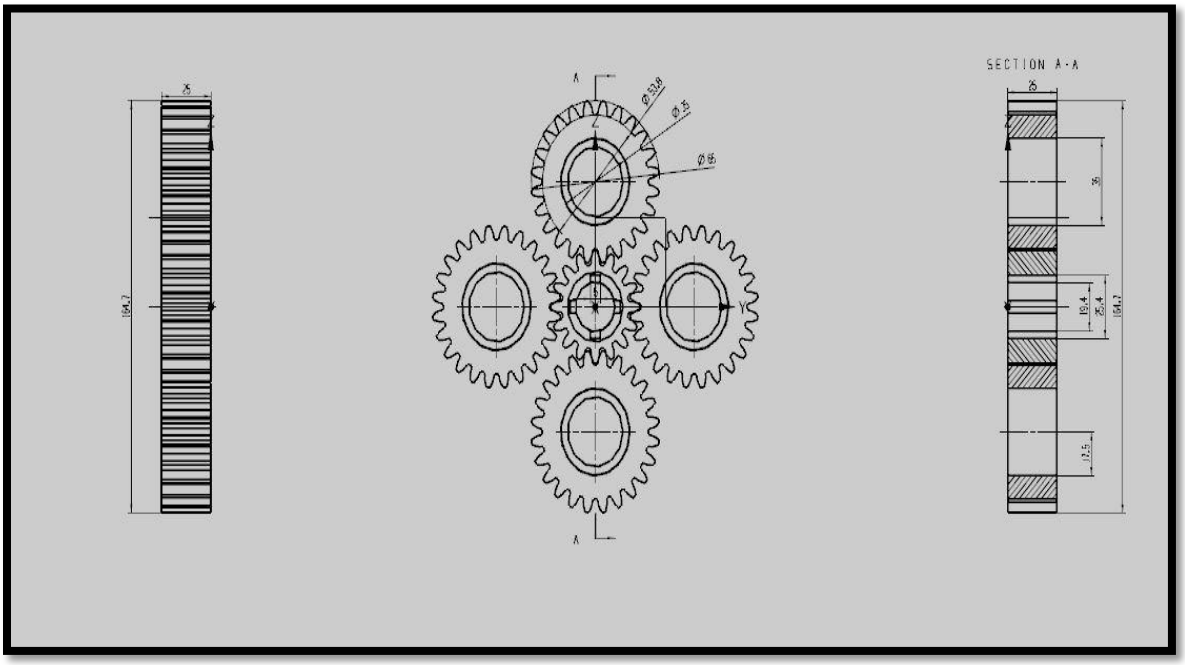


Fig.3.2.4 Section view of gear

2. Spanner holder

Model of spanner holder is done on NX9 software. NX9 software used to achieve the study objectives. Part model and Draft view as shown in figure below.

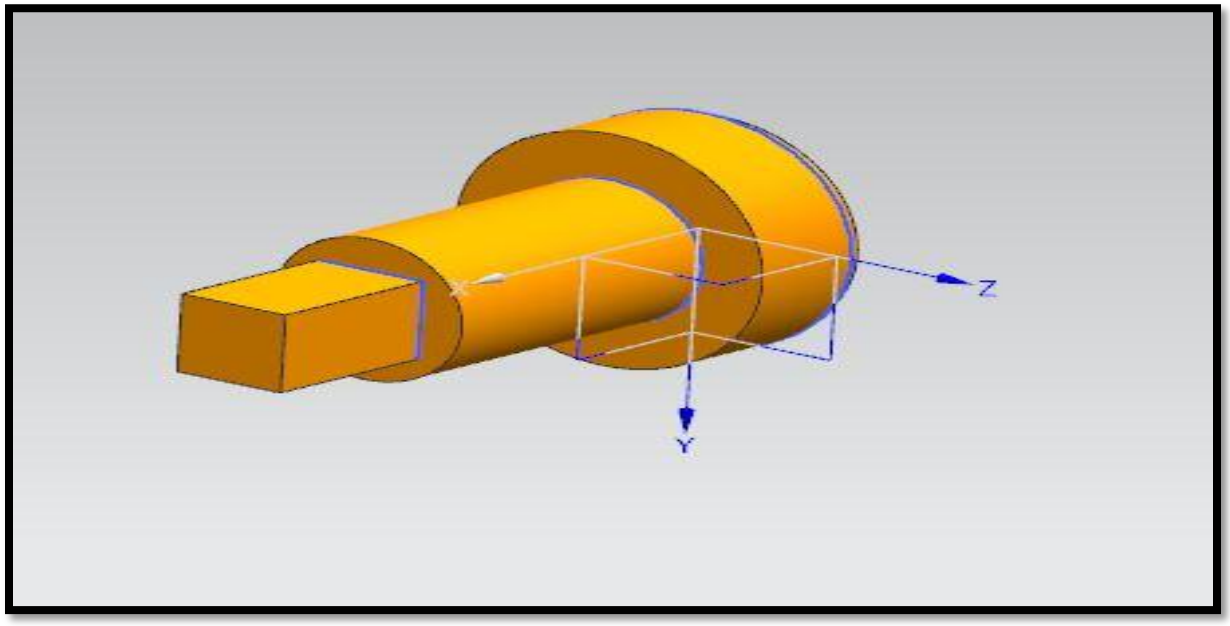


Fig.3.2.5 model of spanner holder

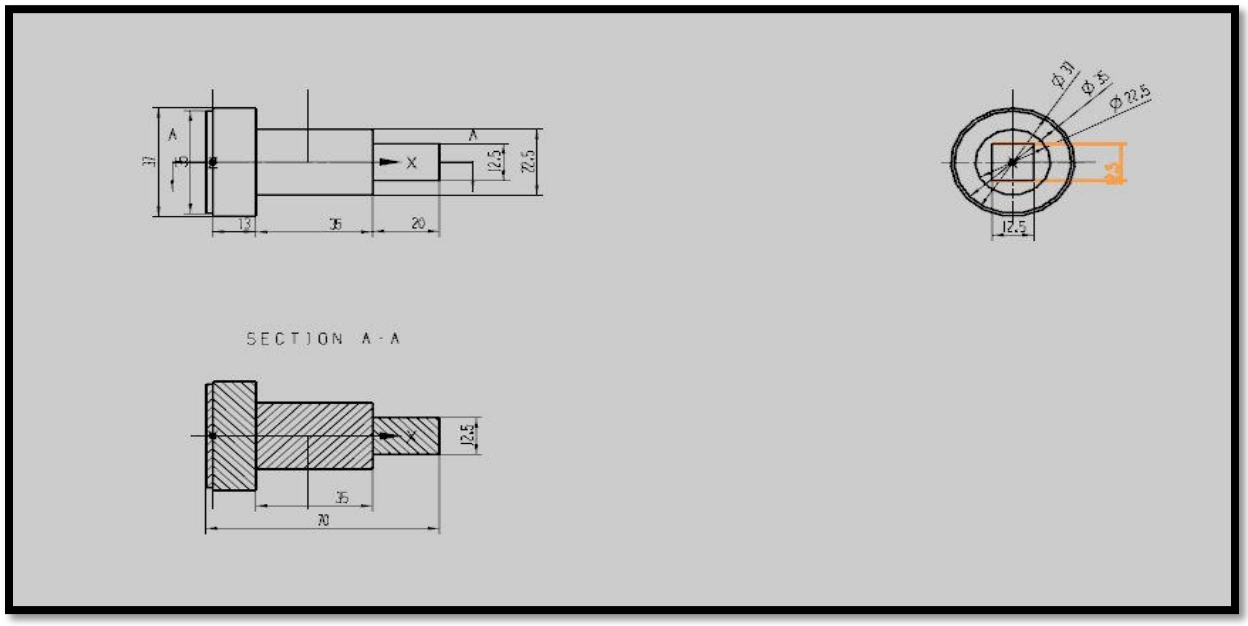


Fig.3.2.6 Section view of spanner holder

3. Base plate

Model of bas plate is done on NX9 software. NX9 is used to achieve the study objectives. Part model and Draft view as shown in fig below.

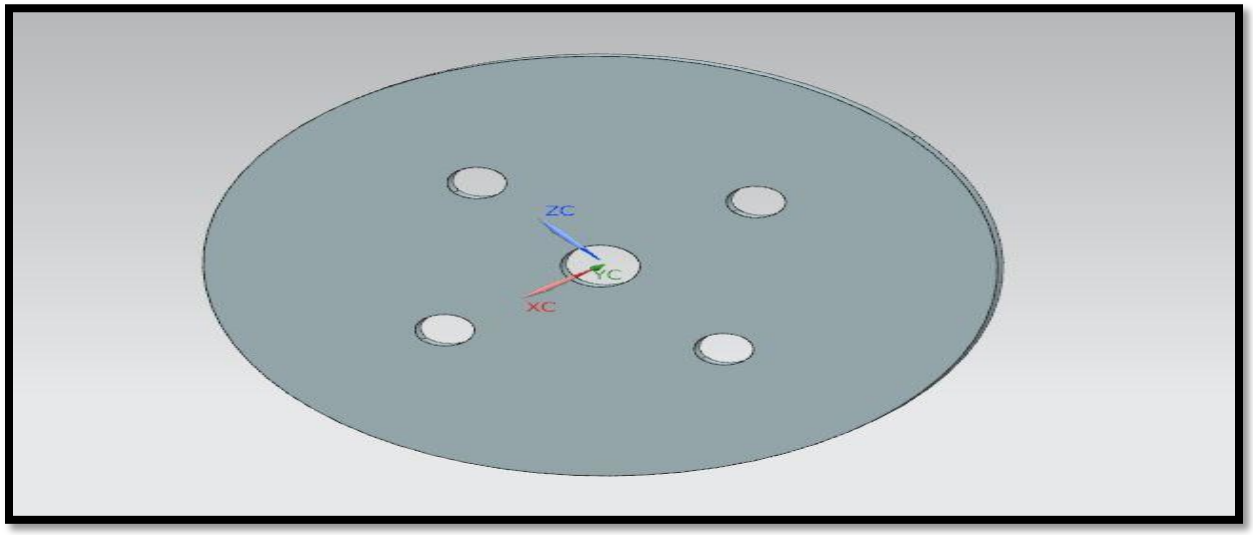


Fig.3.2.7 Model of base plate

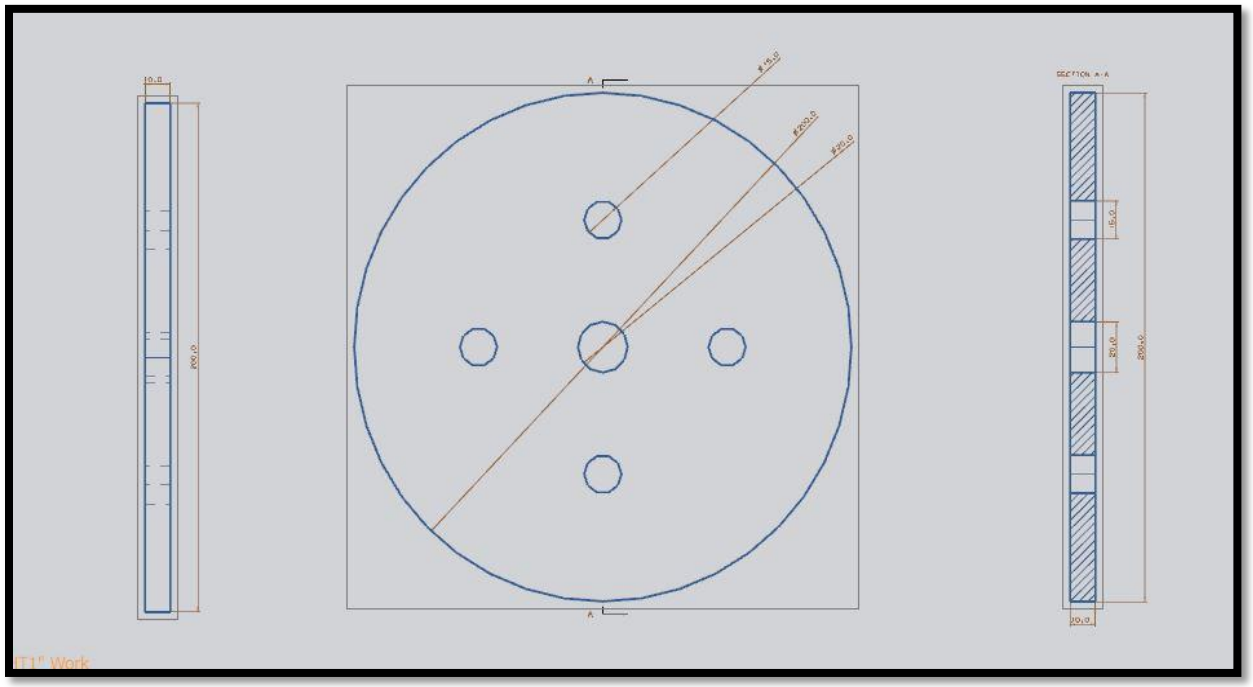


Fig.3.2.8 Section view of base plate

4. Central shaft with spline key way

Model of Central shaft with spline key way is done on NX9 software. NX9 software used to achieve the study objectives. Draft view as shown in figure below.

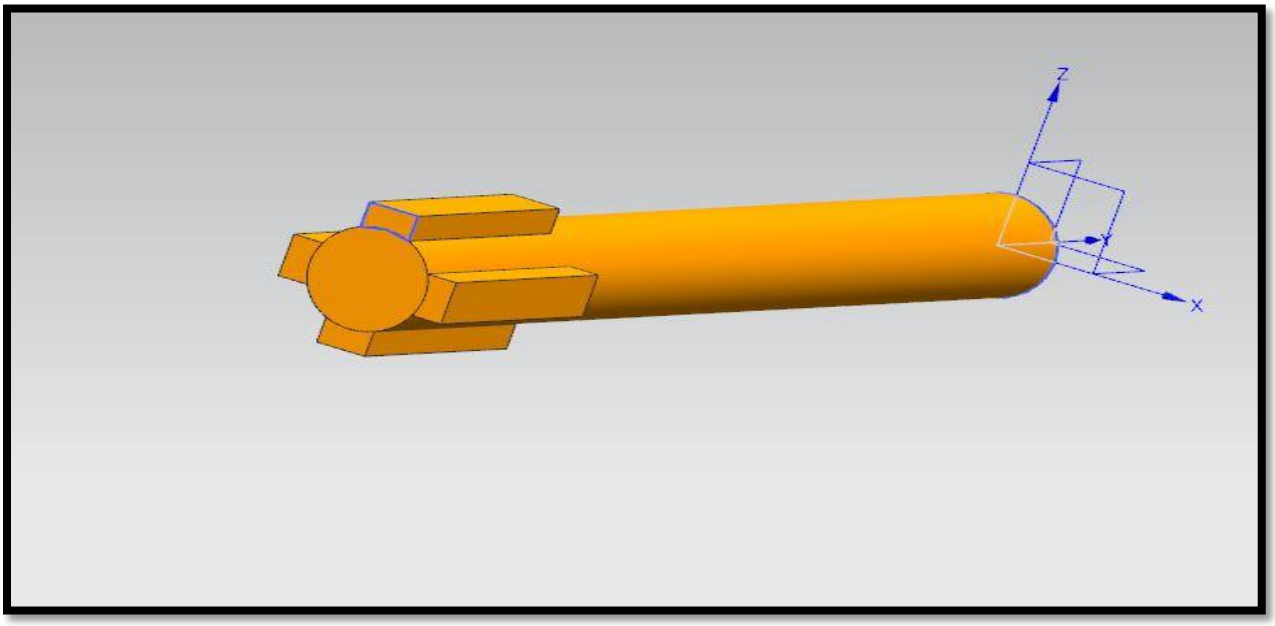


Fig.3.2.9 model of shaft with spline key

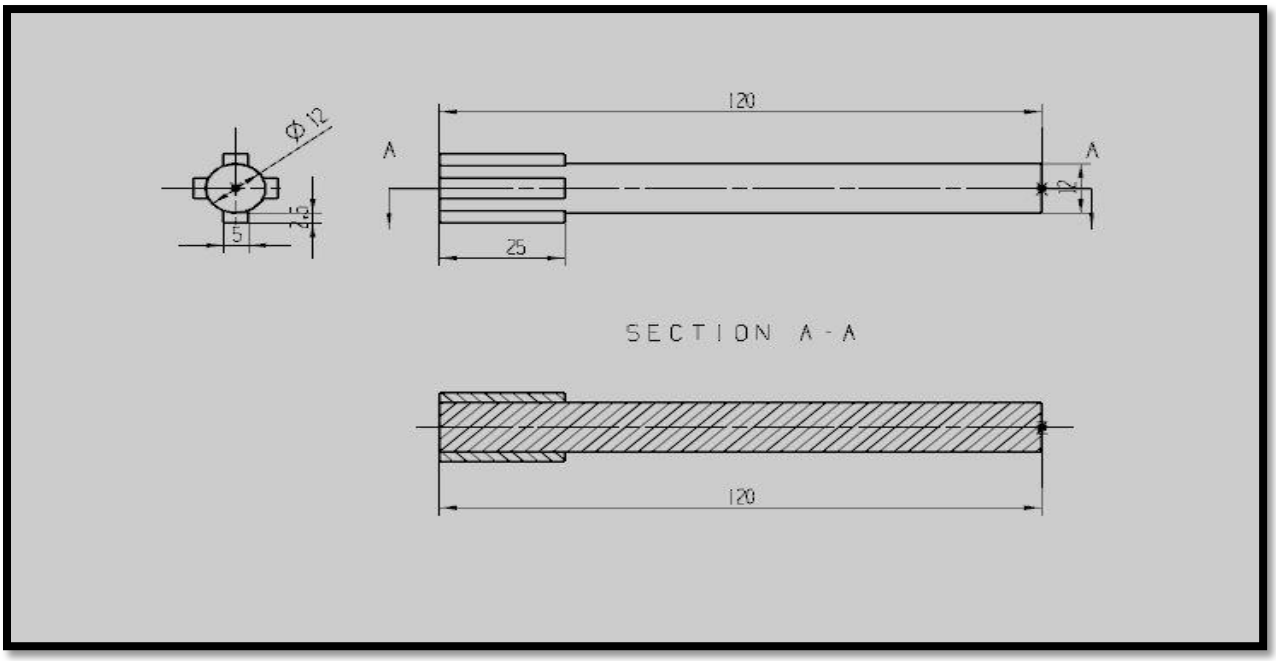


Fig.3.2.10 Section view of shaft with spline key

5. Bearing

Model of bearing is done on NX9 software. NX9 software used to achieve the study objectives. Draft view as shown in figure below.

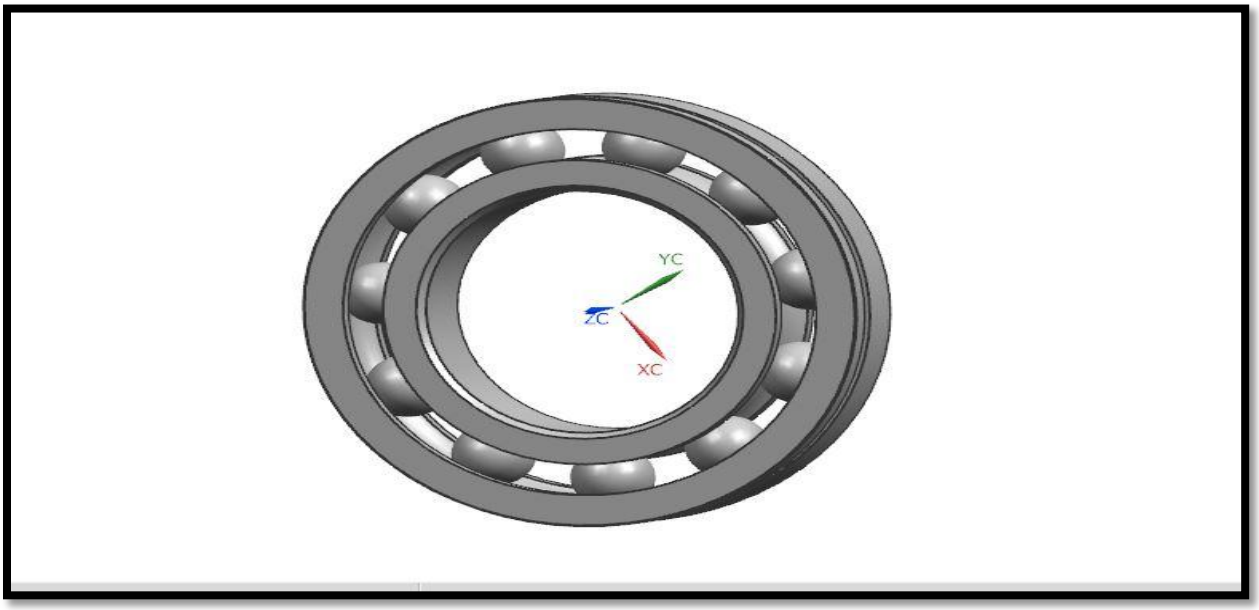


Fig.3.2.11 Model of 6202 bearing

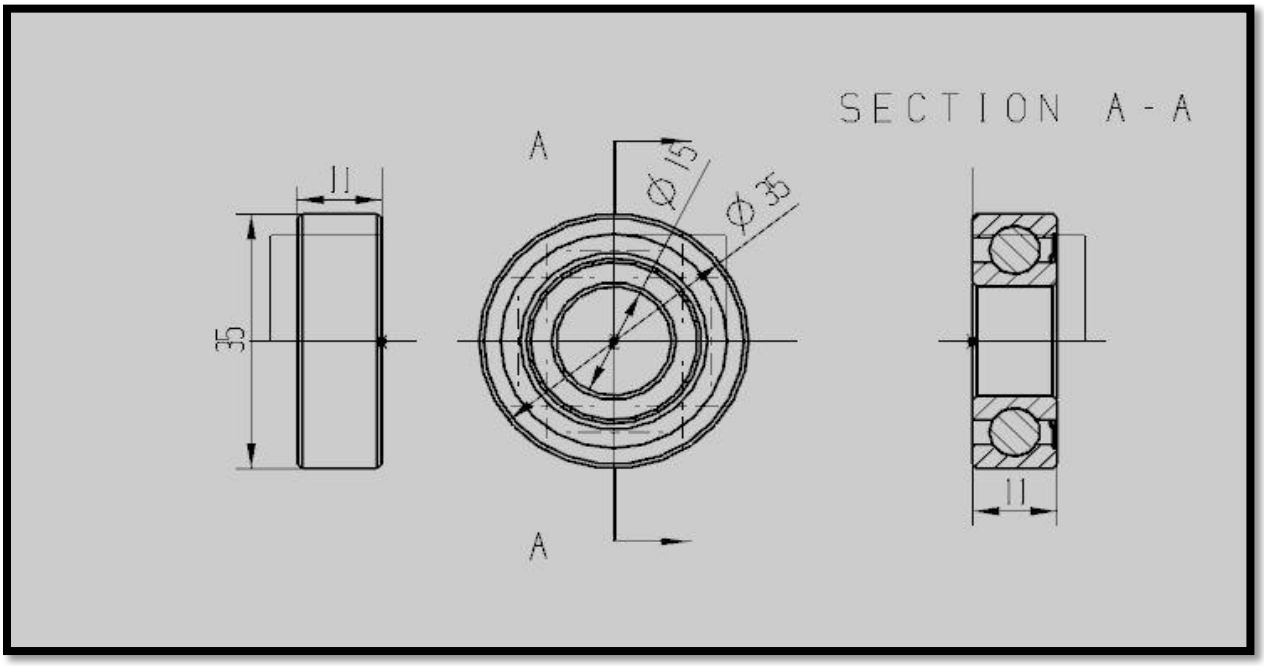
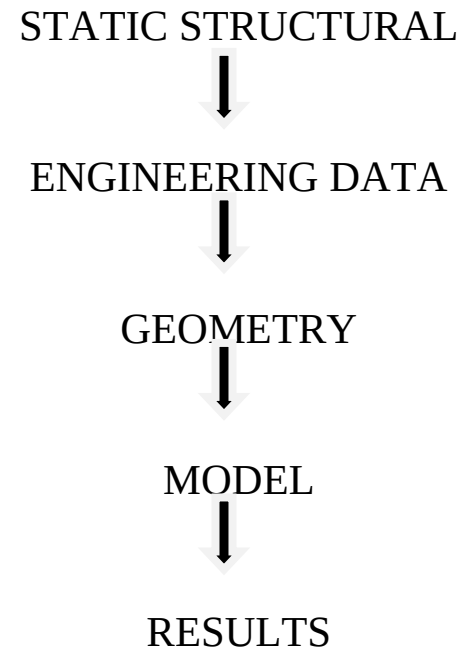


Fig.3.2.12 Section view of 6202 bearing

3.2.4 Analysis of gears and spanner holder

In these we use the ANSYS WORKBENCH 16. We analyze the gear in static structural. To estimate the force exerted on the body and acting projects will be built. ANSYS WORKBENCH 16software used to achieve the study objectives. Steps for analysis as given below



1) **ENGINEERING DATA:** In these we add the material and its properties (i.e. E N8).
2) **GEOMETRY:** we import the geometry which is in the form of IGES or STP files.
3) **MODEL:** It is very important procedure in ansys because whatever we do in this result depends on it. We first give the connection of gear (i.e. contacts of gear).after these we mesh the component and applying load
4) **GEOMETRY:** we import the geometry which is in the form of IGES or STP files.
5) **RESULTS:** In these we get the final results of component which we analyze.

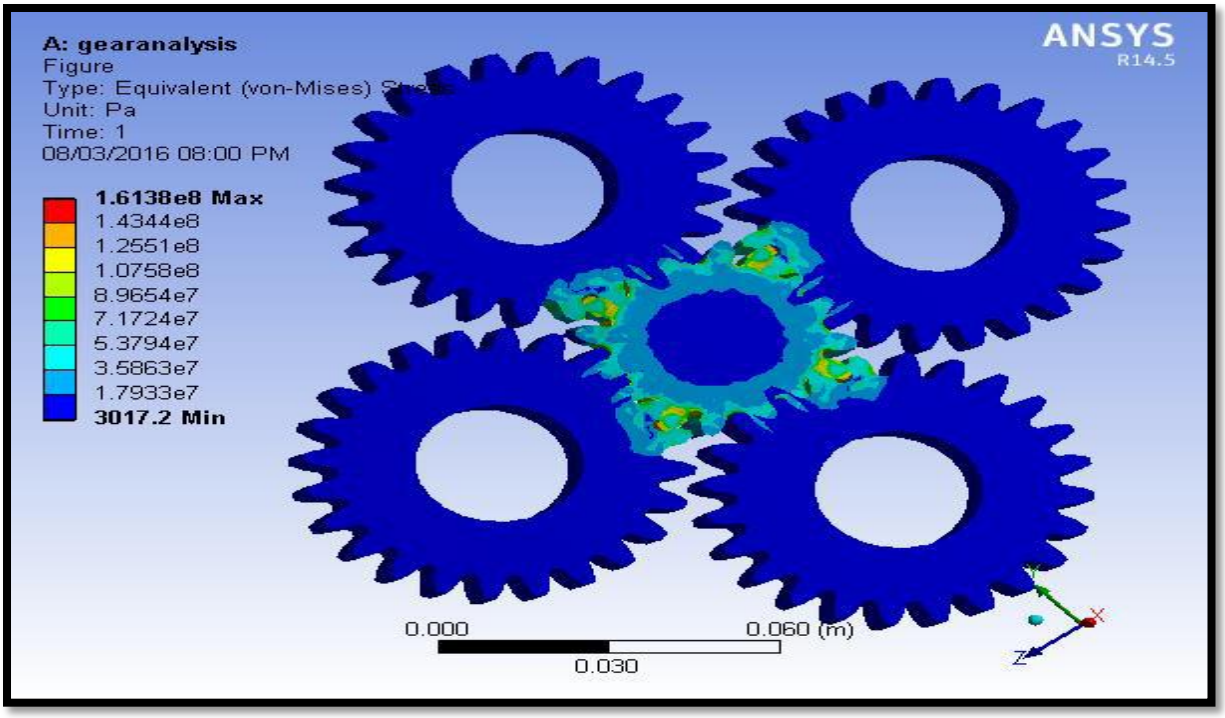


Fig .3.2.13 Analysis of gear

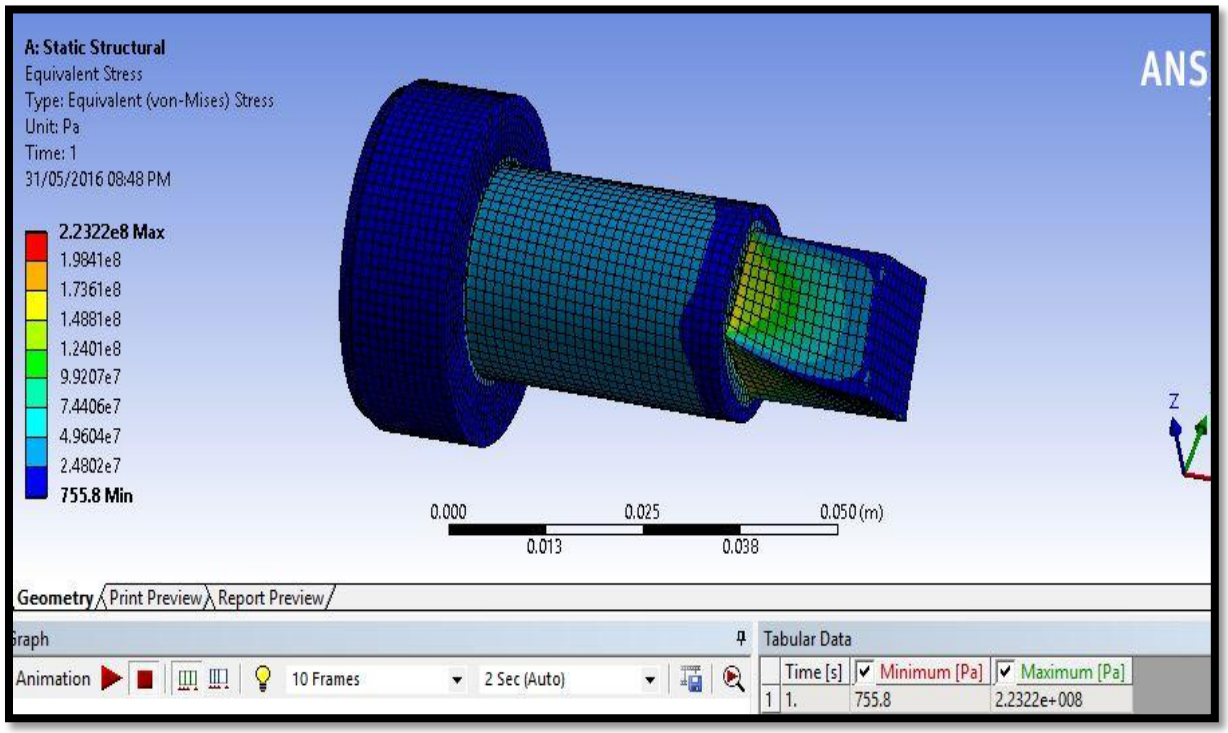


Fig.3.2.14 Analysis of spanner holder

3.3 Manufacturing

Assembly as shown in fig. it consists of four gear and central pinion for input. Pinion is a driving member. These gears are mounted on base plate by using nut and bolt arrangement. The tool are made of medium carbon steel. A spanner holder is directly welded on the driven gears. Grease is used to reduce wear, tear and heat of friction from mating gears. Once the tool is assembled, a layer of paint is applied to finish the surface and protect from corrosion.

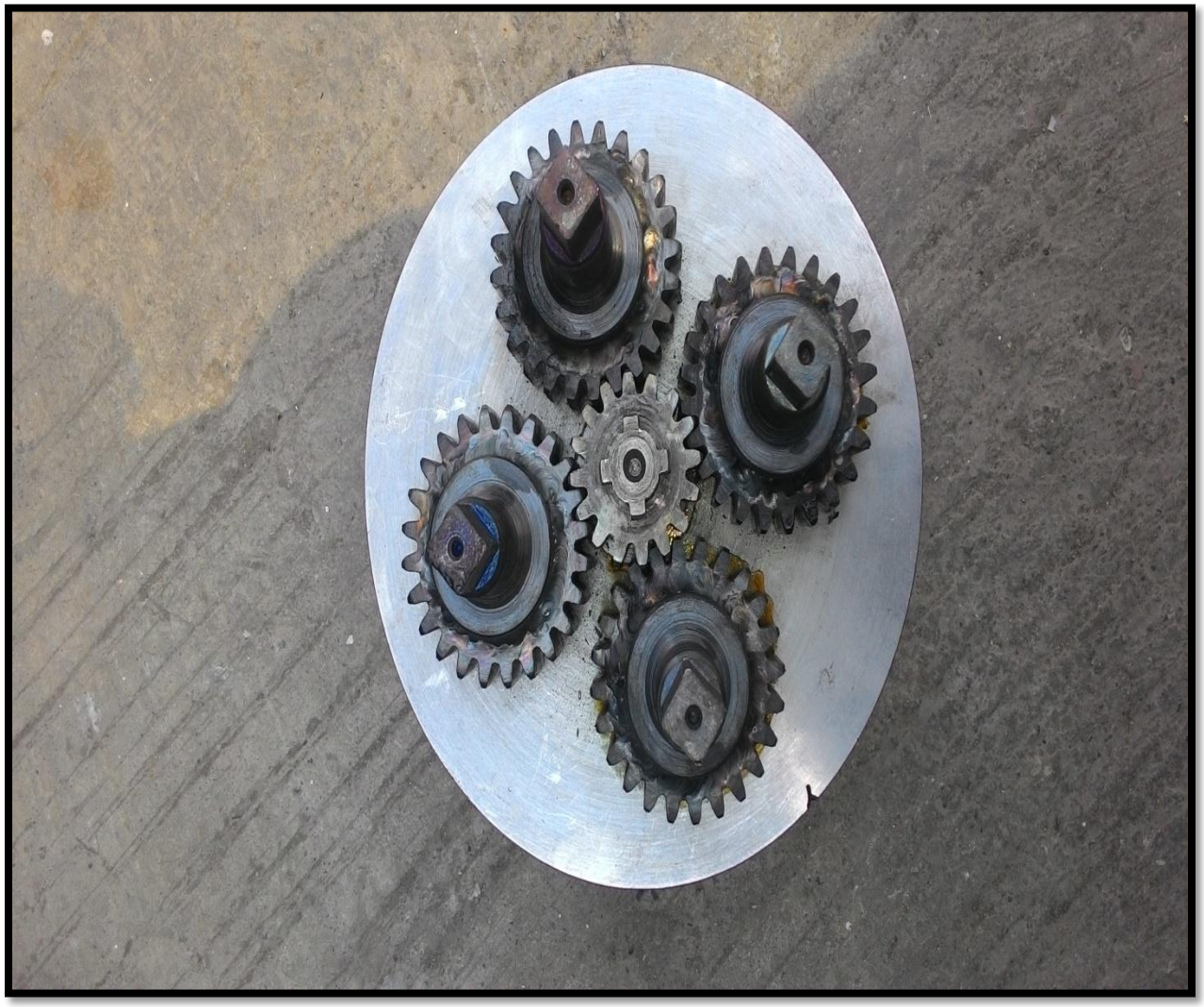


Fig 3.3.1 fabricated view of equipment

3.3.1 Component of assembly

1. gear
2. Base plate
3. Spanner holder
4. Central shaft with spline key way

1. Gear

A gear is a rotating machine part having cut teeth, which mesh with another toothed part in order to transmit torque. Gear is used extensively for transmission of power. They find application in automobile, gear boxes, oil engine, machine tools, industrial machinery, agricultural machinery, geared motors etc.

Methods of manufacturing gear-

1. milling processes
2. gear planning processes
3. gear hobbing
4. gear shapers
5. bevel gear generating

Gear shaping process

Here spur gear is used to transmit torque and these gear are manufactured by shaping method. In gear shaping tooth is cut one by one. Fig shows shaping machine and gear manufactured by shaping machine. Material used for gear manufacturing is EN8 and time required to manufacture gears are one an half hour for each gear. In gear shapers the cutters reciprocate rapidly. The teeth are cut by the reciprocating motion of the cutter, the cutter can either 'rack type cutter' or a rotary pinion type cutter.

Rack type cutter process

The rack cutter generating process is also called as gear shaping process. In this method the generating cutter has the form of basic rack for gear to be generated. the cutting action is similar to shaping machine. The cutter reciprocators rapidly and remove metal only during the cutting stroke.

Fig.3.3.2 shaping machine

Fig.3.3.3 fabricated gears

2. Base plate

Base plate is used to hold the gears and to withstand the forces the gears and the shaft extensions to hold the tool. It increases the weight and stability of the removing tool. Material used for base plate is mild steel.

Fig.3.3.4 Base plate

3. Spanner Holder

It is mounted on gear and fitted by using welding process as shown in fig. These are rotating along gear on which spanner for different nut size can be hold easily. It is main part of the tool. Material used is mild steel. Manufacturing is done on lathe machine.

Fig.3.3.5 Spanner holder

Lathe machine process

The lathe is a machine tool used principally for shaping articles of metal, wood, or other material. All lathes, except the vertical turret type, have one thing in common for all usual machining operations; the work piece is held and rotated around a horizontal axis while being formed to size and shape by a cutting tool. The cutter bit is held either by hand or by a mechanical holder, and then applied to the work piece. Principal capabilities of the lathe are forming straight, tapered, or irregularly outlined cylinders, facing or radial turning cylindrical sections, cutting screw threads, and boring or enlarging internal diameters. The typical lathe provides a variety of rotating speeds and suitable manual and automatic controls for moving the cutting tool.

Types of Lathe machine-

Lathes can be conveniently classified as engine lathes, turret lathes, and special purpose lathes. All engine lathes and most turret and special purpose lathes have horizontal spindles and, for that reason, are sometimes referred to as horizontal lathes. The smaller lathes in all classes may be classified as bench lathes or floor or pedestal lathes, the reference in this case being to the means of support.

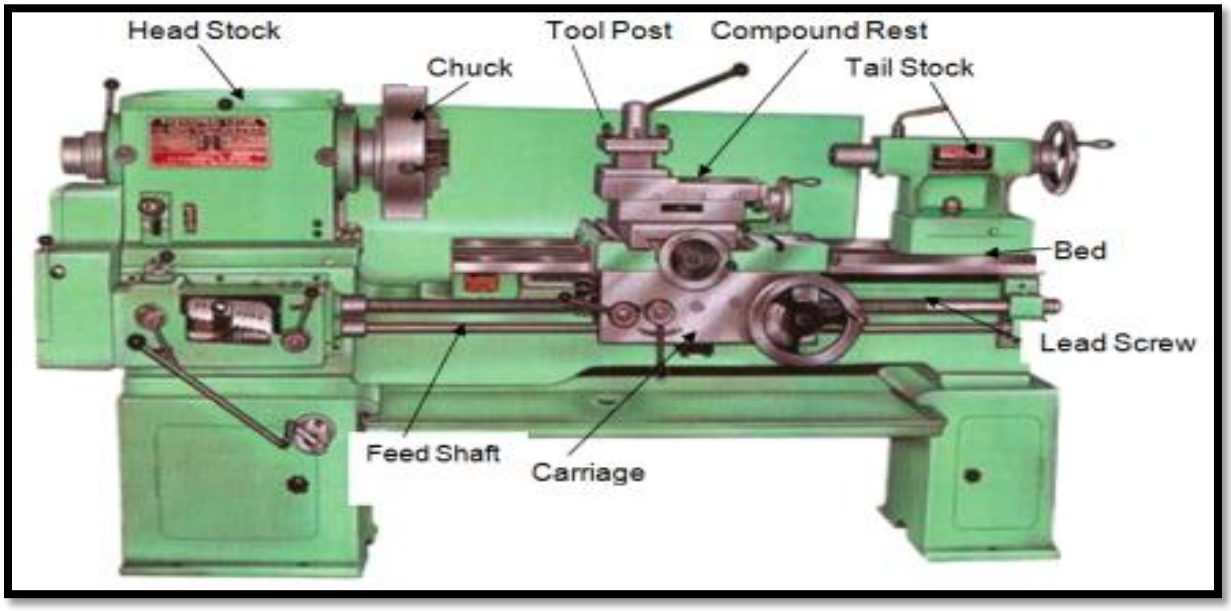


Fig.3.3.6 Lathe Machine

4. Central shaft with spline key way

Rack milling machine

It acts as driving member for tool. Shaft having external spline key ways at one end and lever arm at another end for giving input rotation. It is manufactured on Rack Milling machine. Milling is the process of machining flat, curved, or Milling machines are basically classified as vertical or irregular surfaces by feeding the work piece against a rotating horizontal. These machines are also classified as knee-type, cutter containing a number of cutting edges. Most machine consists basically of a motor driven spindle, which milling machines have self-contained electric drive motors, mounts and revolves the milling cutter, and a reciprocating coolant systems, variable spindle speeds, and power-operated adjustable worktable, which mounts and feeds the work piece.

Types of milling machine

1. Universal Horizontal Milling Machine
2. Ram-Type Milling Machine
3. Universal Ram-Type Milling Machine
4. Swivel Cutter Head Ram-Type Milling Machine

Fig.3.3.7 Rack milling machine

Spline milling

Splines are often used instead of keys to transmit power from a shaft to a hub or from a hub to a shaft. Splines are In effect a series of parallel keys formed integrally with the shaft. Mating with corresponding grooves in the hub or fitting. They are particularly useful where the hub must slide axially on the shaft, either under load or freely. Typical applications for splines are found in geared transmissions, machine tool drives. And in automatic mechanisms. Splined shafts and fittings are generally cut by bobbing and broaching on special machines. The operation may be accomplished on the milling machine in a manner similar to that described for cutting keyways. Standard spline shafts and splint fittings have 4, 6, 10, or 16 splines, and their dimensions depend upon the class of tit for the desired application: a permanent fit, a sliding fit when not under load, and a sliding fit under load.

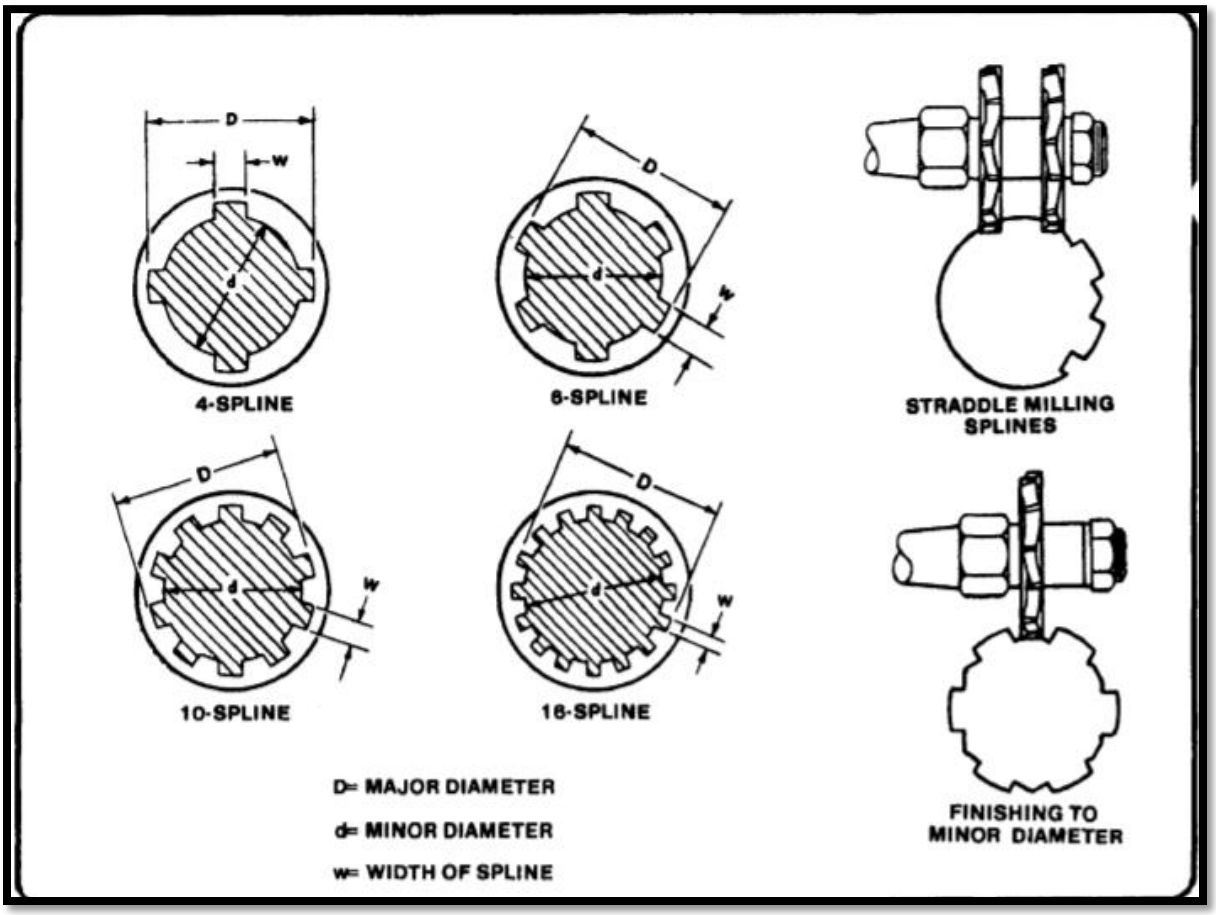


Fig.3.3.8 milling of spline shaft

Fig.3.3.9 Central spline shaft

Fig.3.3.10 Central input shaft with lever

3.3.2 Wire cutting operation on EDM

1. Wire EDM is variation of EDM and is commonly known as wire cut EDM or wire cutting.
2. In WEDM, a thin metallic wire is fed on to the work piece. This is submerging in a tank of electric flied such as demonized water.
3. WEDM can put plates as thick as 300 mm & is used for making punches, tool & dies form hard metals that are difficult to machine by other methods.
4. The wire, which is contently fed form a spool, is held between upper & lower diamonds guides.
5. As many as 50 hrs. of machining can be performed with one reel of wire, which is then discarded.
6. The guides usually CNC controlled and mover in X-Y plane.
7. Generally flexibility due to independent movement of upper guide helps in programming the wire-cut EDM, for cutting very intricate and delicate shapes.

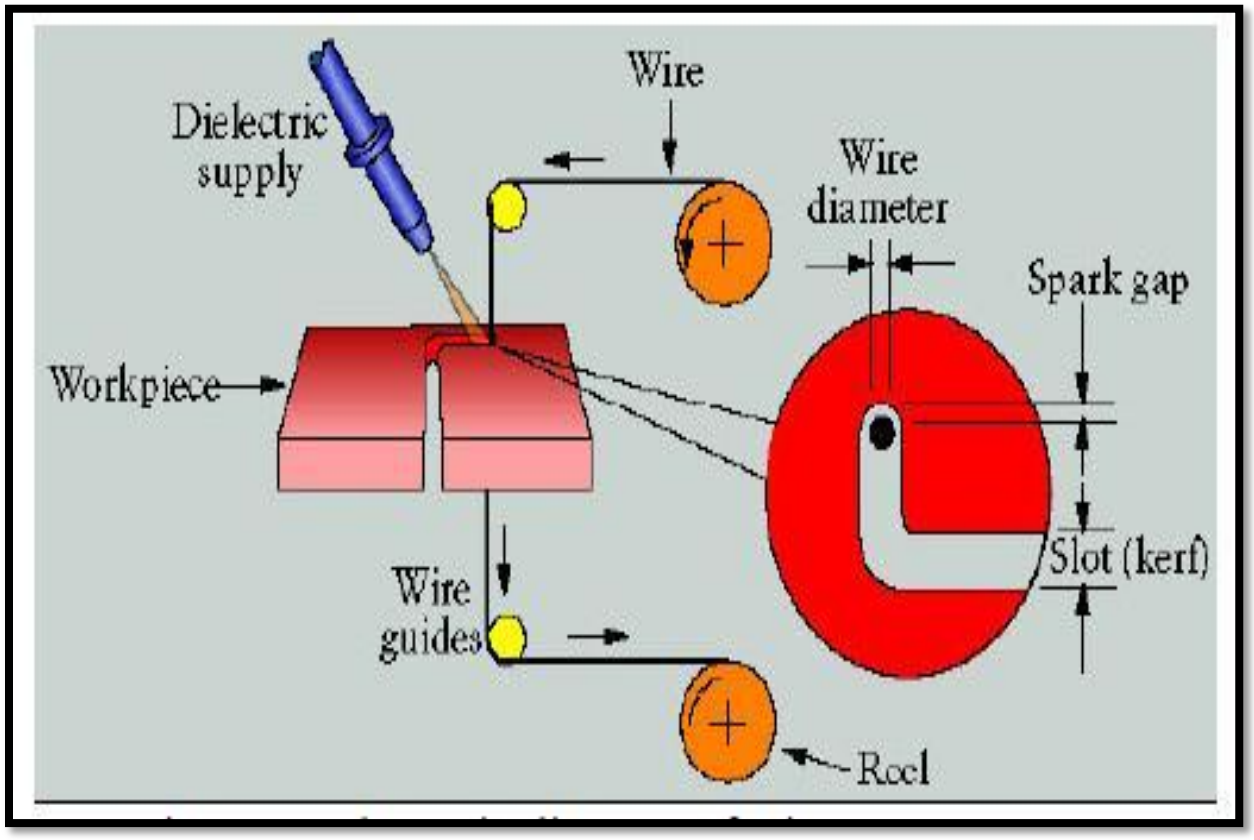


Fig.3.3.11 EDM process

8. A thin single-stand metal wire (usually brass) is fed through the work piece submerged in a tank of dielectric fluid (typically demonized water).
9. Used to cut plates as thick as 300mm and to make punches, tools and dies for hard metals that are difficult to machine to others methods.
10. Uses water as its dielectrics fluid, its resistivity and other electric properties are controlled with filters and deionizer units.
11. The water flushes the cut derbies away from cutting zone.
12. Flushing is an important factor in determining the maximum feed rate for a given material thicknesses.
13. Commonly used when low residual stresses are desired, because it does not required high cutting forces for material removal.

Fig.3.3.12 Wire cutting EDM machine

Central pinion having internal spline as shown in fig. manufacturing of spline done on EDM machine. Material used for pinion is EN8.four spline is used for the pinion.

Fig.3.3.13 fabricated Pinion with internal spline

3.3.3 Welding process

Welding is a fabrication or sculptural process that joints materials, usually metals or thermoplastic, by causing fusion, which is distinct from lower temperature metal joining process techniques such as brazing and soldering. in addition to melting the base metal, a filler material is often added to the joint to form a pool of molten material that cools to form joint that cools to form a joint that can be as strong, or even stronger then the base material. Pressure may also be used in conjunction with heat, or by itself, to produced weld.

Types of welding process-

1. Shielded metal arc welding(SMAW)
2. Gas tungsten arc welding (GTAW)
3. Flux cored arc welding (FCAM)
4. Submerged arc welding (SAW)
5. Electro slag welding (ESW)
6. Gas metal arc welding (GMAW) or CO2 welding

CO2 welding process

Commonly term as MIG (metal inert gas) welding uses a wire feeding gun that feed wire at an adjustable speed and flows an argon base shielding gas or ,mix off argon and carbon dioxide (CO2) over the weld puddle to protect it from atmospheric contamination

Spanner holder is welded on gear by using CO2 welding process. In CO2 arc welding, the welding wire wound in coil is fed into the welding torch by the feeding motor automatically. The welding wire that is electrified through the contact tip becomes the electrode to strike an arc between itself and the base metal. The arc heat melts the wire and the base metal to join two pieces of base metal. In this case, in order that the weld metal will not be affected by oxygen and nitrogen in the atmosphere, CO2 gas is supplied from the nozzle of the welding torch to shield the weld pool. Its schematic is shown below.

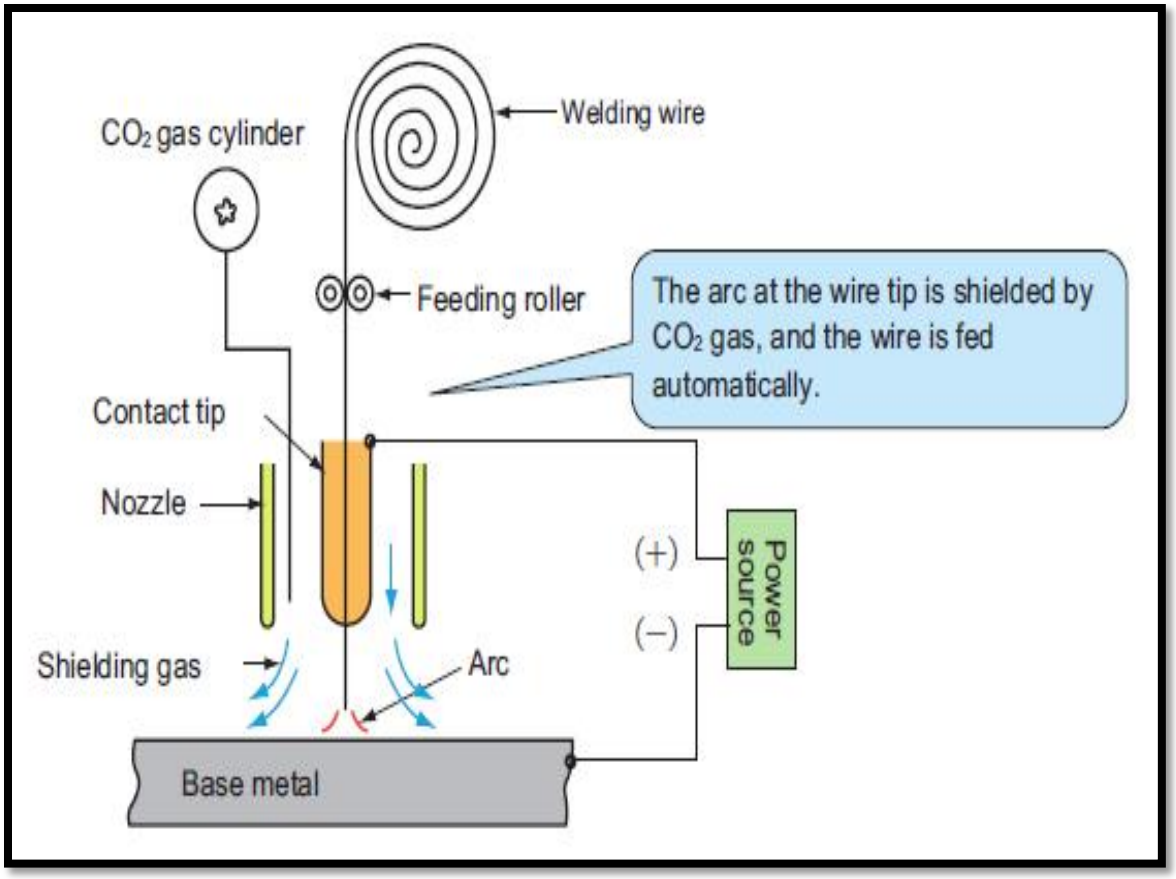


Fig.3.3.14 CO2 welding process

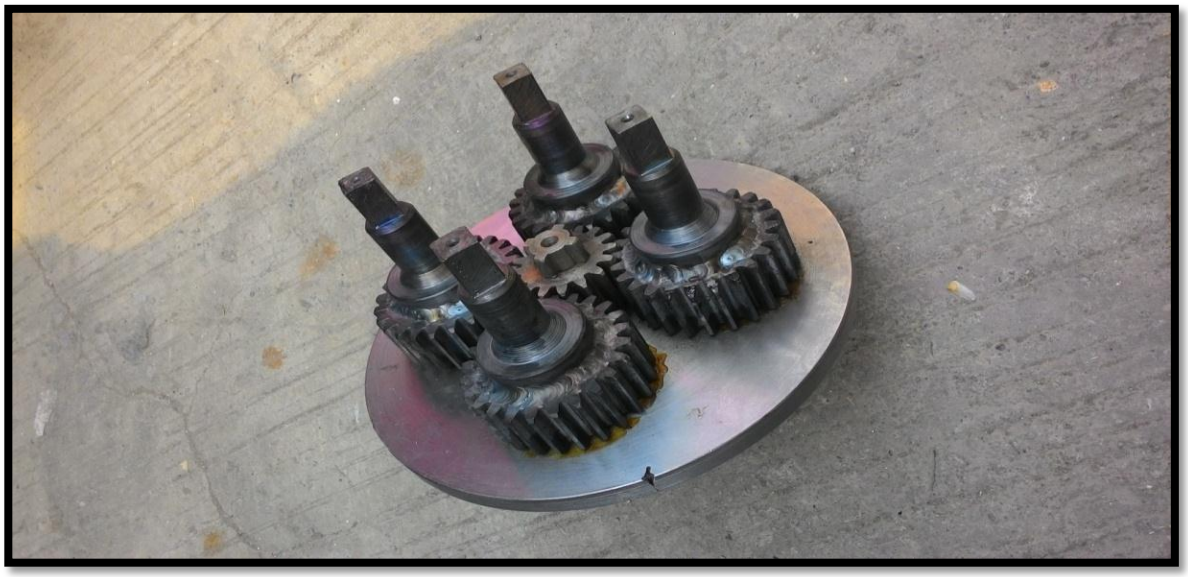
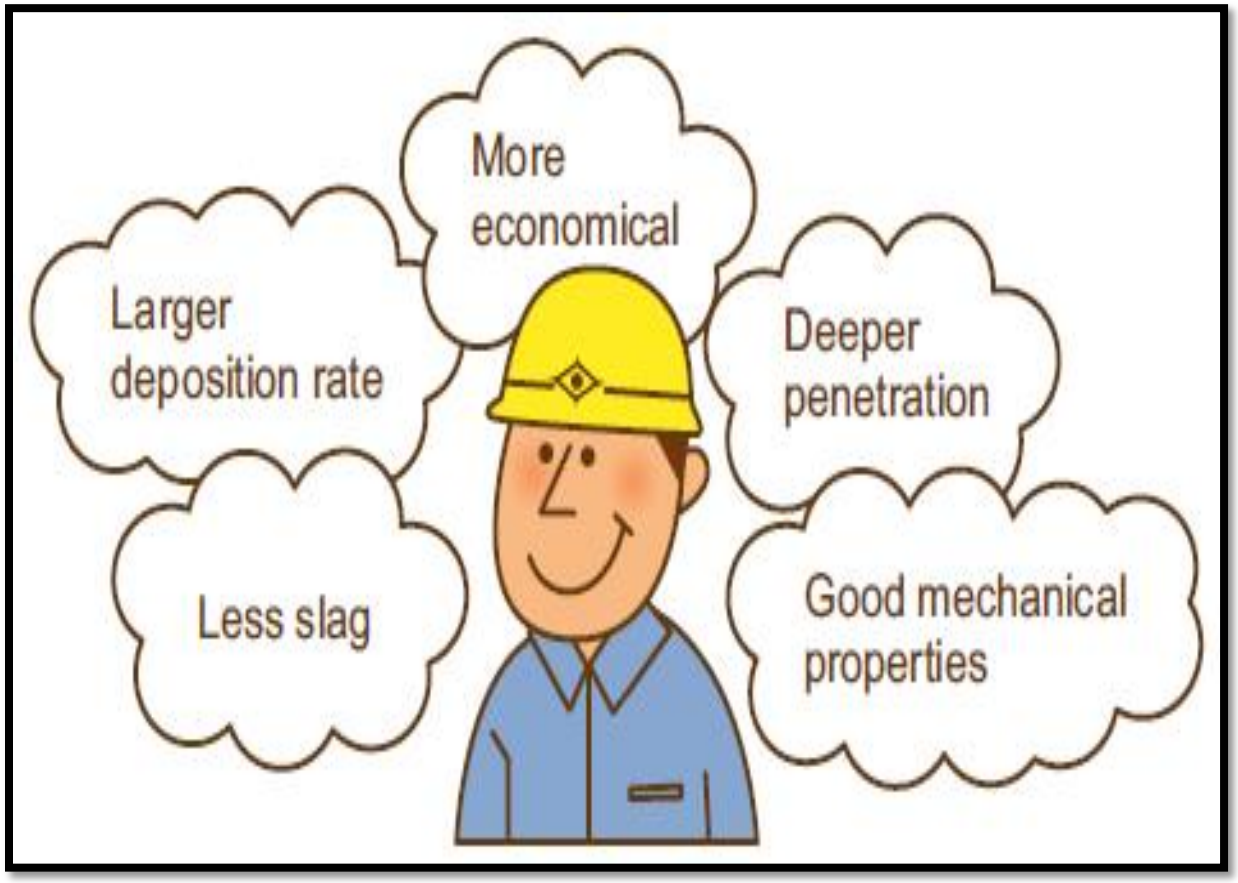


Fig.3.3.15 welding of spanner

Advantages of CO2 welding process



3.3.4 Lug nuts

A lug nut is the nut with one rounded or conical (tapered) end, used on steel and most aluminum wheels. A set of lug nuts are typically used to secure a wheel to threaded wheel stud and thereby to a vehicle.

Fig.3.3.16 Types of lug nuts

Wheel nut seat style

The contact area between the fastener and the wheel is referred to as the "seat." This is the surface area where the fastener actually contacts the wheel and where clamping pres- sure is applied when the fastener is tightened. It is absolutely vital that the seat style of the fastener matches the seat style of the wheel's fastener hole entry. The use of incorrect seat styles, even though thread pitch and thread diameter may be correct, can easily result in wheel damage during tightening, and fastener loosening during vehicle operation. If the fasteners loosen, the wheel will "wobble" as it moves in relation to the hub. Eventually, this movement, or play, will ruin the wheel's fasteners holes, resulting in either breaking the wheel or complete loss of the tire/wheel assembly.

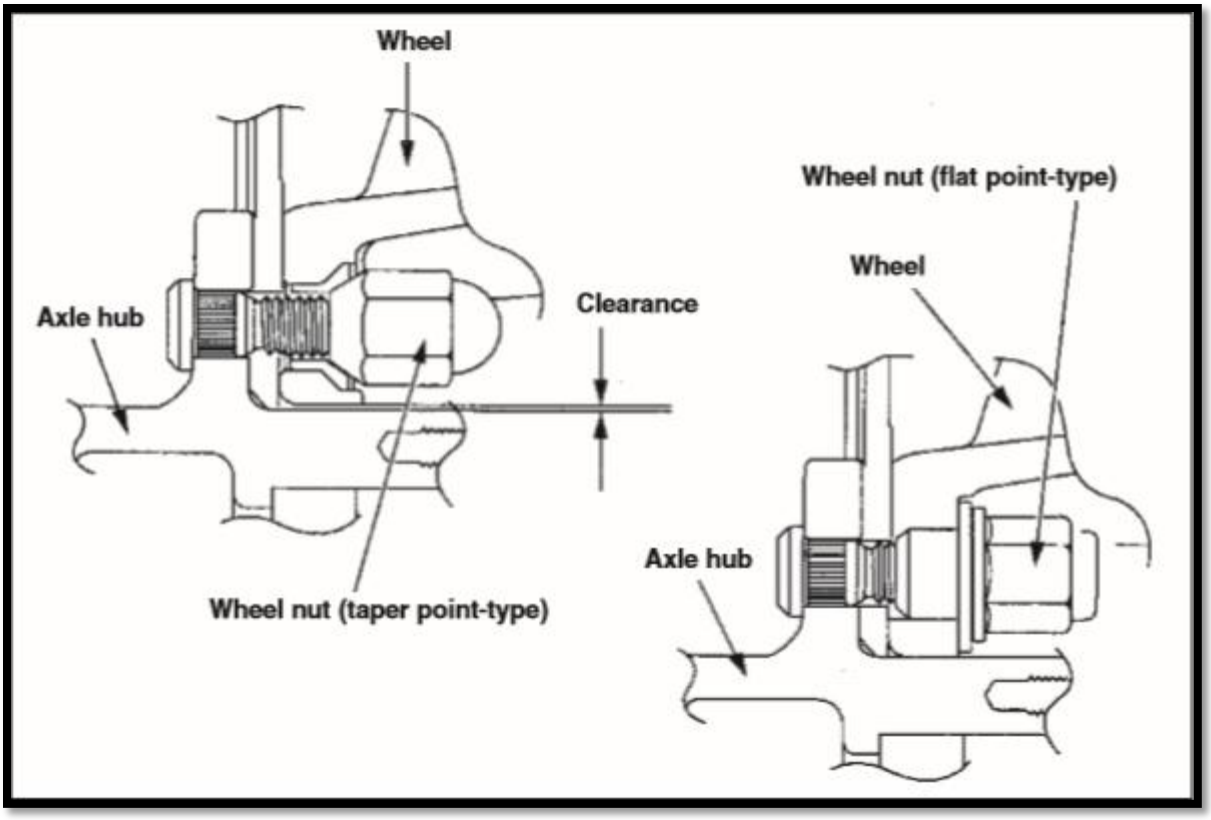


Fig.3.3.17 Wheel nut seat style

3.3.5 Cost Estimation

Multi nut removing tool all four nuts in a car wheel can be simultaneously removed. The total cost involved for the fabrication of Multi nut removing tool is around Rs.5980. 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. Approximate cost estimation has been done and it has been listed as a Table.

Sr. No.	**Description**	**Cost in Rupees**
1	Gears	3000
2	Spanner holder	740
3	Bearing	160
4	Base plate	350
5	Central shaft with spline key way	500
6	Nuts, bolts and spanner	430
7	Lever rod	200
8	Welding	350
9	Wire cutting on pinion	250
Total		5980

4. Experimental Validation

The tire nut removal has been designed with 100 pitch circle diameter PCD. This tool can open four nuts in one time and the force utilization has been reduced. We tested our tool on Honda city which having 100 PCD nut arrangement as shown in fig There are two major problems that can avoid the tire nut removal from marketing. The problems are the tire nut removal is too heavy where it's hard for a women user to use the tool. Then the materials for this tire nut removal are quite expensive and are not suitable for marketing. So we can use this tool to remove wheel easily. Testing of equipment is done in geetika motors, Hadapser

Fig.4.1 Fabricated nut tool arrangement

5. Conclusion and Future Scope

5.1 Conclusion

In this Project, the design and fabrication of multi nut removing tool is proposed. The static load analysis is performed. The fabrication of tool is completed by Shaping, welding and fitting processes. The tool is successfully manufactured and fully functional either tested manually using lever. From the results of analyses and experiments, the tool is possible to be improved and prototyped for mass production. For future development and improvement of the tool, light and strong material is expected to be available and applied.

5.2 Future Scope

1. Improvement in the system by making automatic operation with the help of pneumatic system which is clean and hazardous free.
2. To design and fabricate the complete assembly of the multiple operated spanner to be fitted to all vehicle wheels by adjusting pitch circle diameter by making pinion gear small or large as per wheel's pitch circle diameter.
3. By replacing the motor with different gear arrangements in such manners that it can be operated manually by hand lever with less power requirement. The weight of the model can be reduced by using a light weight material of base plate.
4. It is also suggested to operate it with different gear arrangements with less power required.

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ANNEXURE

1. Ratna gears Pvt. Ltd.

Address- 95 &108 Swami Vivekanand ind. Estate, Handewadi road, Hadapser ,411028

Tele No. – (020) 26970987

2. Amoka Traders

Address- Sai garden society, Malwadi road, Hadapsar, Pune-411028

Tele No.-(020) 26818799

3. Shree Engineers

Address- Opp. Green City, Satav Nagar, Handewadi Road, Hadapsar, Pune-411028

Mob. No.-9422559229/9970060017

4. Sparktech Engineers

Address- Sumukh, S.No.50/2, opp. B.S. Park, Wadgaon Sheri,Pune-411028

Mob. No.-9320661919

5. Inox Industries

Address- 95 &110 Swami Vivekanand ind. Estate, Handewadi road, Hadapser ,411028