Savitribai Phule Pune University, Pune.

A Project Report on

"DESIGN AND FABRICATION OF MULTIPLE SPINDLE DRILLING ATTACHMENT."

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C E R T I F I C A T E

This is to certify that,

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Has successfully completed the Project entitled **"Design And Fabrication Of Multi spindle Drilling Attachment** under my supervision, in the partial fulfilment of Bachelor of Engineering-Mechanical Engineering of Savitribai Phule Pune University

Date:
Place:

Prof. P.V JATTI **(Project Guide)**

(External Examinar)

Institute Seal

Dr. P. S. Kachare. **(HOD)**

Dr. T. K. Nagaraj. **(Principal)**

ACKNOWLEDGEMENT

It's my great pleasure to present Project report entitled "**DESIGN AND FABRICATION OF MULTIPLE SPINDLE DRILLING ATTACHMENT** "

This Project is an outcome of various efforts by us in collating and identifying the sources of information and knowledge.

I use this occasion to thank my guide with whose guidance this effort would not have borne fruits. I find no words to express my gratitude to **Prof. P. V. Jatti** who not only advised and guided me during the report writing but also answered all my queries concerning collection of data, proper structuring of the report, and its improvement. I would also thankful of my friends which gave me a proper guide line about my subject.

I am virtually indebted to the Head of the Department **Dr. P.S Kachare** from Bhivarabai Sawant Institute of Technology and Research who have bestowed all their blessings in the form of guidance which was the leading light to complete this seminar report. I would also like to thank our principal, **Dr. T.K Nagaraj** who provided me valuable support in completion of seminar by providing me different facilities in college and by giving permission for working out of college.

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ABSTRACT

Manufacturing productivity is critical to the success of the Indian manufacturing industry. Drilling machines are usually used for drilling holes, but they may also do additional activities like as tapping, spot facing, reaming, countersinking, and counter boring, to mention a few. While the multiple spindle drilling attachment conducts fundamental drilling operations, there are some particular duties that are more correctly and readily accomplished. This connection is primarily based on a planetary gear system configuration. Drilling Attachment with Multiple Spindles The primary role is to do many drilling operations at the same time. It offers several advantages, including increased output, decreased operating time, lower labor costs, increased productivity, and many more. Reduce the number of operations cycles as well. If general-purpose machines are used for production, this is not feasible. The design and manufacturing process of the multiple spindle drilling attachment will improve the drilling machine's performance and productivity. In order to optimize the component's cycle time, this article focuses on improving the design and manufacturing process of the multiple spindle drilling attachment.

Keywords: Planetary gear system, Manufacturing, Multi-spindle Drilling Attachment, Gear.

CONTENTS

Introduction

The aforementioned issue, where a traditional drilling machine is utilized to execute three operations at once, maybe perfectly solved with the Multi-spindle drilling attachment. This attachment allows for the simultaneous completion of several operations, such as drilling, reaming, countersinking, and spot-facing. The MT-2 taper arbor fits directly into the drilling machine sleeve, making it simple to place the multi-spindle drilling attachment on the drilling machine. If additional stability is needed, a support sleeve may be fastened to the top casing plate. Three spindles that hold three drill chucks are operated concurrently in the multi-spindle drilling attachment. To accomplish the required operation, the drill chucks can be fitted with twist drills, reamers, countersink drills, or spot-facing cutters.

A drilling machine, also known as a drill press, is a machine tool used for drilling holes in various materials, such as metal, wood, plastic, and more. Here's how a drilling machine typically works:
Setup: The first step is to set up the drilling machine. This involves securing the workpiece to the drill press table or workbench, and adjusting the height and alignment of the drill bit to ensure it lines up with the desired drilling location on the workpiece.

Selecting the Drill Bit: Choose the appropriate drill bit for the material you are drilling. Different materials require different types of drill bits, such as twist drills for metal, brad point bits for wood, or spade bits for large holes.
Adjusting Speed and Depth: Most drill presses allow you to adjust the speed of the drill bit rotation and the depth to control the drilling process. Slower speeds are typically used for harder materials, while faster speeds are suitable for softer materials.

Power On: Turn on the drilling machine and adjust the speed to the desired setting. Some drill presses have variable speed controls, while others have a selection of preset speeds.

Drilling: Position the workpiece under the drill bit and bring the drill bit down by lowering the quill (the spindle that holds the drill bit) using the feed handle or a lever. Apply a consistent, even pressure to the workpiece to ensure a clean and accurate hole. The drill bit will rotate and cut into the material.
Withdraw the Drill Bit: Once the hole is drilled to the desired depth, release the pressure on the feed handle or lever, and then raise the quill to withdraw the drill bit from the hole. Be sure to turn off the drill press when not in use.
Workpiece Removal: After completing the drilling operation, remove the workpiece from the machine.

It's essential to follow safety precautions when using a drilling machine, such as wearing safety glasses, securing the workpiece properly, and using appropriate cutting fluids or lubricants when drilling metal to reduce friction and heat.

Keep in mind that there are various types of drilling machines, including benchtop drill presses, floor-standing drill presses, and portable hand-held drills, each with its own features and capabilities. The specific operation and controls may vary depending on the type and model of the drilling machine you are using.

Innovation in drilling machines has led to the development of multifunctional machines that can perform various tasks in addition to drilling holes. These multi-tool drilling machines are designed to increase efficiency, save space, and improve versatility. Here are some innovations in multitool functions for drilling machines:

Combination Drilling and Milling Machines: Some machines can switch between drilling and milling operations. This versatility is valuable for applications where precision holes and complex shapes need to be created in the same workpiece.

Tapping and Reaming: Multi-tool drilling machines can also perform tapping and reaming operations. Tapping is the process of creating threads in a hole, while reaming is used to achieve a precise diameter and smooth finish in drilled holes.

Rotary Tool Attachments: Some machines come with attachments that allow them to function as rotary tools. This enables tasks like grinding, polishing, and sanding in addition to drilling.

Routing and Engraving: In some CNC (Computer Numerical Control) drilling machines, routing and engraving capabilities are integrated. This is especially useful in the woodworking and sign making industries.
Automatic Tool Changers: Advanced drilling machines may incorporate automatic tool changers. These systems can switch between different tools, such as drills, end mills, or other cutting tools, without manual intervention. This feature is common in CNC machining centers.

Laser Cutting and Marking: Some multi-tool machines can incorporate laser cutting or marking capabilities alongside drilling. This is particularly useful in applications where precision and noncontact processes are required.
3D Printing Attachments: In some innovative machines, 3D printing heads can be attached, allowing them to perform both traditional drilling and 3D printing. This is especially valuable in rapid prototyping and additive manufacturing.

High-Speed Spindles: Multi-tool drilling machines may feature high-speed spindles that can accommodate a variety of tooling, including small diameter drills, engraving bits, and even small end mills. Digital Control and Automation: Many modern multi-tool drilling machines are equipped with advanced digital controls and automation features. This allows for precise control of tool movements, tool changes, and the execution of complex machining tasks with ease.

Adaptive Machining and Tool Path Optimization: Some machines have the ability to adapt toolpaths and machining strategies based on real-time feedback, reducing waste and improving efficiency. Quick-Change Tooling Systems: Quick-change tooling systems make it easier to swap out different tools, reducing setup times and increasing productivity.

These innovations are driven by advancements in technology, including CNC control systems, automation, and the integration of various machining capabilities into a single machine. Multi-tool drilling machines are particularly valuable in manufacturing, prototyping, and fabrication environments where flexibility and efficiency are crucial. They allow users to perform a wide range of operations with a single piece of equipment, reducing the need for multiple machines and tool changes.

Advantages:

1. The machine is compact in size.
2. Less wear and tear because of less number of moving components.
3. The machine requires less space.
4. Increase in productivity.
5. Accuracy of dill hole is maintained.

Limitations:

1. It is difficult to operate.
2. They require a specialist to repair if you don't know about small parts.

PROBLEM STATEMENT:

In many manufacturing and fabrication processes, the need for high-precision, high-efficiency drilling operations is paramount. Existing drilling methods and attachments often fall short in terms of speed, precision, and adaptability to various materials. To address these issues, there is a pressing need to design and fabricate an advanced modern multiple-spindle drilling attachment

Objectives

1. To design a drill and gear calculate the required power, forces, and other parts.
2. To analyse stresses on the drill.
3. To develop the model select suitable materials and components.
4. Testing the working of the drill and fixing their problems

Literature Review

1. Dae-ji Kim, Jaewon Kim, Booyeong lee, Min-Seok Shin, Joo-Young Oh, Jung-Woo Cho, and Changheon song **Prediction Model of Drilling Performance for Percussive Rock Drilling Tool** this study focused on predicting the drilling performance of a death hammer. a numerical analysis model of the death hammer was established and validated through comparison with the results of an in situ drilling test. -the results of this work are summarized as follows: simulations considering the effect of rock strength were used to quantify the energy efficiency according to the rock strength, impact energy required for crushing, and performance of the hammer. the developed model was applied to an actual death drilling system. -e model predicted a drilling speed of 5.4 mm/s, and the measured speed was 5.7 mm/s. similar results validated the proposed model. the model allows the performance of the drill bit and death hammer (i.e., the key components of the drilling system) to be predicted by considering the sensitivity of the major design factors and the effect of the rock mass. the validity of the proposed prediction model for the drilling performance was experimentally verified. the results of this study suggest that the performance of drilling equipment can be predicted by considering the sensitivity of major design factors for the drilling tool and the effect of the rock type.
2. F. Forestier, V. Gagnol, P. Ray, and H. Paris **Modeling Of Self-Vibratory Drilling Head-Spindle System For Predictions Of Bearings Lifespan** this paper, a comprehensive approach to developing a hybrid model of the dynamic behaviour of the spindle self-vibratory drilling head—tool system has been proposed. this approach has resulted in a numerical model enriched with physical data. the various components of the system are modeled using a specific beam element, taking into account the gyroscopic effects, centrifugal forces, and shear deformation. the receptance coupling method is used to identify the dynamic behaviour of the interface. the complete system is vibration then obtained by assembling the beam model of each component using spring-damper elements. finally, the assembled model is validated by comparisons between numerical and experimental. the model is used to predict the influence of a high-speed vibratory drilling operation on the bearing lifespan.

The predictions of bearing lifespan are used to give rules of uses of the high-speed vibratory drilling head.

3. Prof.M.B. Bankar ,Prof. P.B. Kadam , Prof. M.R. Todkar **Improvement In Design & Manufacturing Process Of Multiple Spindle Drilling Attachment** drilling is nothing but the use of a rotating multi-point drill to cut a round hole into a workpiece. in a lot of manufacturing processes, one of the most indispensable machining tools is the multiple spindle drilling machine. the drilling machine is commonly called a drill press and is responsible for drilling various sizes of holes in any surface area and to precise depths. aside from the fact the drilling machine is used primarily in drilling holes, there are a few other functions that the multiple spindle drilling machine is capable of performing. these functions include tapping, spot facing, reaming, countersinking, and counterboring to name a few. there are four major categories of drilling machines which include the upright sensitive drilling machine, upright drilling machine, radial drilling machine, and special purpose drilling machine. although these multiple spindle drilling attachments perform basic drilling operations, there are some specific functions that are performed more accurately and conveniently by each of these types.
4. Chukwumuanya, Emmanuel O, Obuka, Nnaemeka Sylvester P, Onyechi, Pius C*., And Okpala Charles Eoretical **Design And Analysis Of A Semiautomatic Multiple-Spindle Drilling Head (Msdh) For Mass Production Processes In Developing Countries** A multiple-spindle drilling head (msdh) for use in automobile manufacturing industries in developing countries where the purchase and use of computer numerical control drills are still found difficult has been designed and reported in this paper. this initiative was taken to help in mass production of brake drums locally and, more importantly too, to assist in solving the problem of peugeot 504 brake drums accumulation at the drilling points of our local automobile manufacturing industries. the machine is designed as an attachment (accessory) to a main drill from which it derives the power for its operations. there are forces by which the msdh operates. these are forces that cause rotation of the kinematics elements of the msdh, and the ones that cause the translation motion (in the opposite vertical directions) of the msdh as a rigid body. combined effects of these forces results in

driving of multiple drills through a given work piece (peugeot 504 break drum) made of grey cast iron material. the analyses made in this paper will hopefully provoke the interests of, and also encourage our local designers and students in the design and development of mechanical elements such as gears and their systems that will assist in solving the problems of our local manufacturing industries.

5. J. Panju, M. Meshreki, M. H. Attia **Design Of A Retrofittable Spindle Attachment For High Frequency Vibration Assisted Drilling** A retrofittable hf-vad spindle attachment for hsk 100a tool holder comprising a piezoelectric actuator system was designed and fabricated. a controlled amplified sinusoidal signal was fed into the actuator enclosed in the rotating toolholder through the slip ring. as a result, an hf-vad system was developed in which simultaneous rotatory and vibratory motion on the drill bit are superimposed. the system has a capability of providing high frequency (up to 2,500 hz) and low amplitude (up to 5 µm) vibrational motion to the tool excluding resonance condition. at the resonance frequency of 900 hz, the amplitude goes up to 100 µm. this high frequency vibrational motion is superimposed to the high speed rotational motion (up to 10,000 rpm) of the tool. experiments on the system revealed a shift in amplitude response of the system under no load and spring loaded conditions. the frequency, at which maximum amplitude response is obtained, shifts from 800 hz (in no load condition) to 1,500 hz (in spring loaded condition). the hf-vad experiments conducted on al60601 using this attachment showed remarkable improvement in cutting forces. finer chips with break-off serrations were formed during hf-vad as opposed to difficult-to-remove thick spiral chips in conventional drilling test.
6. Shinde Nikhil , Vishwakarma Prem , Sanjay Kumar , Godse Rahul, P.A. Patil **Design & Development Of Twin Drill Head Machine And Drilling Depth Control** The twin-spindle drilling attachment is mounted on the drilling machine spindle sleeve, for extra stability an support sleeve may be mounted. the cutting tools as per the job requirements are mounted in the respective three drill chucks of the drilling attachment.

7. M. Madhavi* , B. Karthik Anand **Optimization And Analysis Of Multi Tool Arbor** After completing the major project on `milt' tool arbor" we am much happy and would like to thank our professor. guides and the lectures of the concerned department who have guided us. while making project we have been able to learn a lot and understand the various aspects of - multi tool arbor" we can use our knowledge, which we get during our study.

Methodology

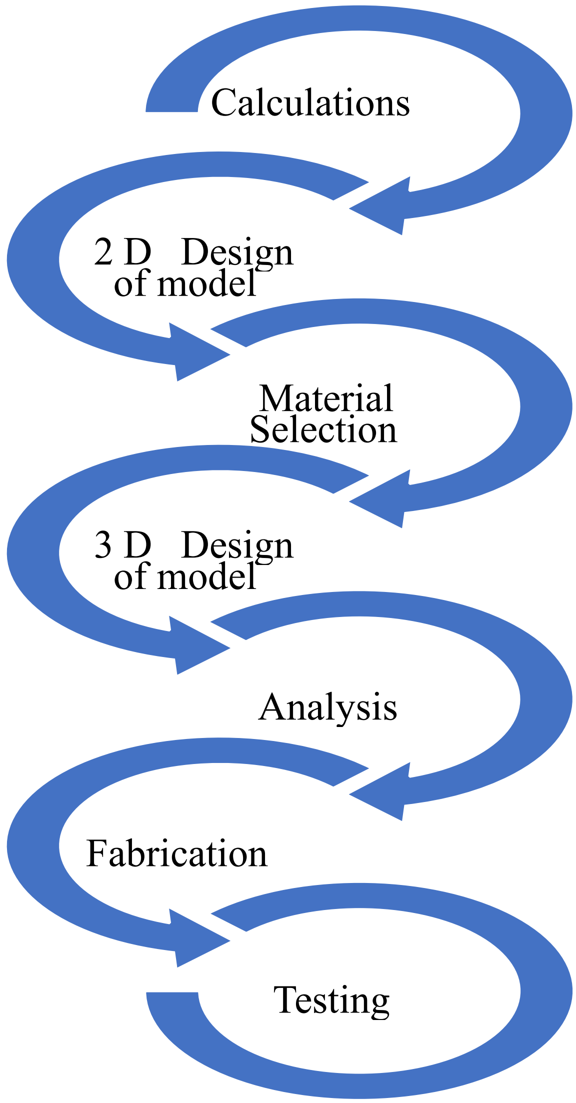

Figure no 1- Methodology Chart

Design 2-D And 3-D

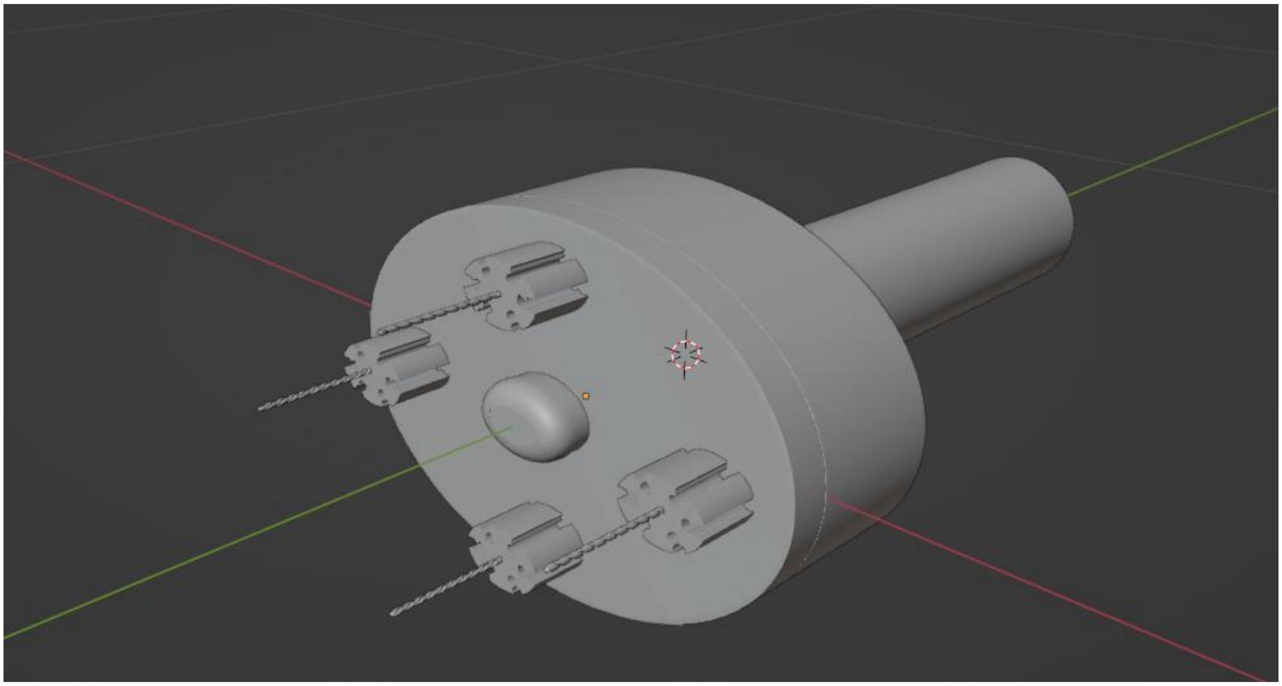

Figure no 2- 3D design

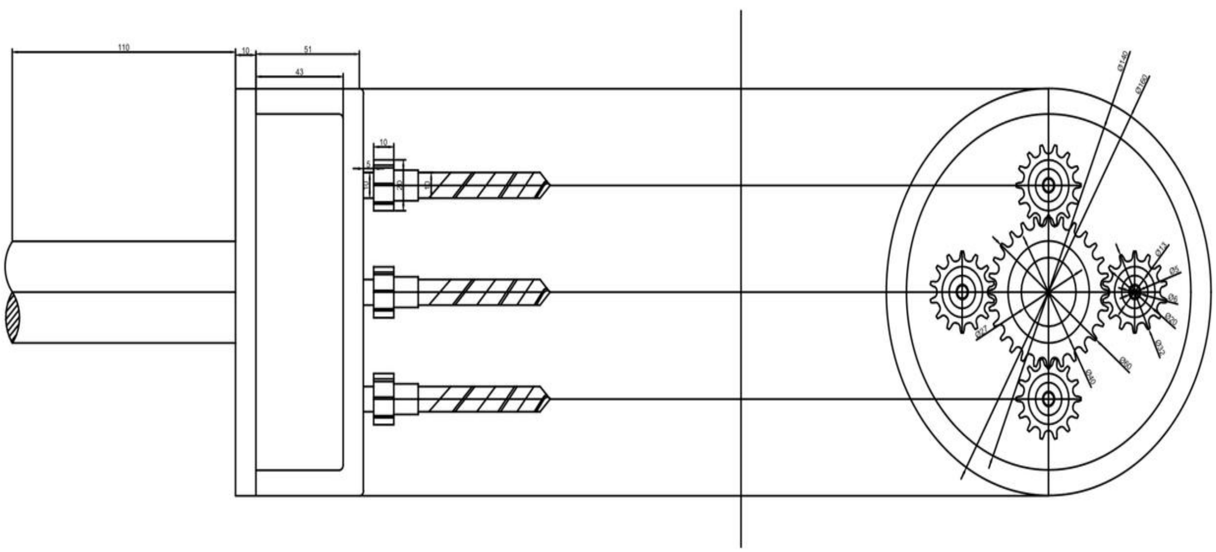

Figure no 3- 2D design

Specifications & Calculations

Specifications of Lathe Machine:

LIGHT DUTY LATHE MACHINE :

1. Motor RPM: 1440 RPM
2. Power : 1 HP
3. Power transmission : 0.75 KW

Spindle RPM – VARIABLE 230-830 RPM.

Spur Gear
Design power = 1000 W
Speed of gear,
Z1=44
Z2=22
N1=900 rpm
N2=1800 rpm
Gear ratio, i = 1:2
Pressure angle, $\phi = 20^o$
• Tooth Profile = 20^0 Full Depth
Material for gear, AISI 1010 Steel having
Bending Strength σb= 140 MPa
Design on the basis of bending strength:
Modified Lewis form factor,
Y=0.330
Diameter of gear, D1 =m*Z = 44m, mm
Diameter of gear, D2 =m*Z = 22m, mm
Solving for D1
Tangential tooth load on gear, Ft = $\frac{Pd}{Vp}$
Pitch line velocity Vp = $\frac{\pi DN}{60000} = \frac{\pi * 44 * 900}{60000}$ m/s
Bending strength of gear, Fb=$\sigma b.Cv.b.Y.m$
Assuming velocity factor, Cv =$\frac{3}{3+vp}$
Face width, b=8.5 m <b < 12.5m
taking b=10m
Using relation, Ft=Fb

$$\frac{Pd}{Vp} = \sigma b.Cv.b.Y.m$$

$\frac{1000}{\frac{\pi*44m*900}{60000}}$ = 140 * $\frac{3}{3+\frac{\pi*44m*900}{60000}}$ * 10m*0.330*m

After solving, we get
m = 1.2 mm
Standard module, m = 1.75mm
Diameter of gear, D1 = 76 mm
Pitch line velocity, Vp = 2.07m/s
Tooth load, Ft = 483.09 N
Face width, b = 15mm
Bending strength, Fb = 615.08 N
As Fb> Ft (Design safe)

Solving for D2
Tangential tooth load on gear, Ft = $\frac{Pd}{Vp}$
Pitch line velocity Vp = $\frac{\pi DN}{60000}$ = $\frac{\pi*22*1800}{60000}$ m/s = 2.07 m/s
Bending strength of gear, Fb=$\sigma b.Cv.b.Y.m$
Assuming velocity factor, Cv = $\frac{3}{3+vp}$
Face width, b=8.5 m <b < 12.5m
taking b=10m
Using relation, Ft=Fb

$$\frac{Pd}{Vp} = \sigma b.Cv.b.Y.m$$

$\frac{1000}{\frac{\pi*22m*1800}{60000}}$ = 140 * $\frac{3}{3+\frac{\pi*22m*1800}{60000}}$ * 10m*0.330*m

After solving, we get
m = 1.248 mm
Standard module, m = 1.75mm
Diameter of gear, D2 = 38mm
Pitch line velocity, Vp = 2.07m/s
Tooth load, Ft = 483.09 N
Face width, b = 15mm
Bending strength, Fb = 615.08 N
As Fb> Ft (Design safe)

Used Component

Spur Gear

Figure no 4 – Spur gear

PINOIN:

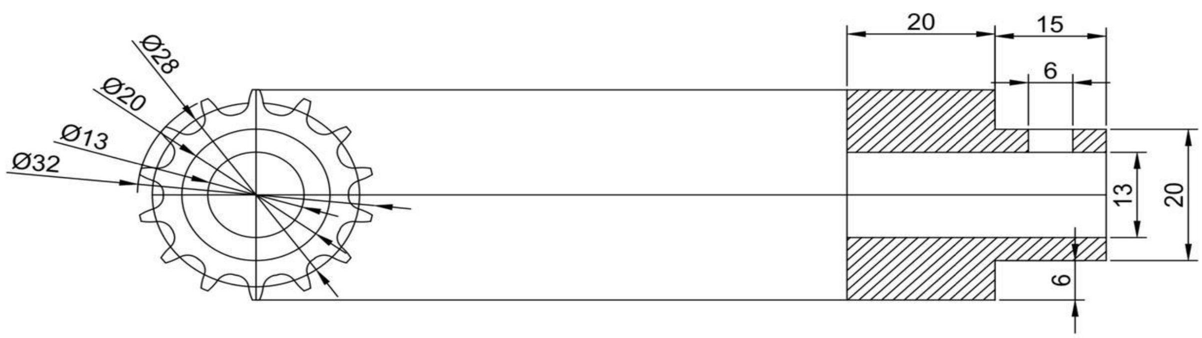

Figure no 5- Pinion Gear 2D

SUN GEAR :

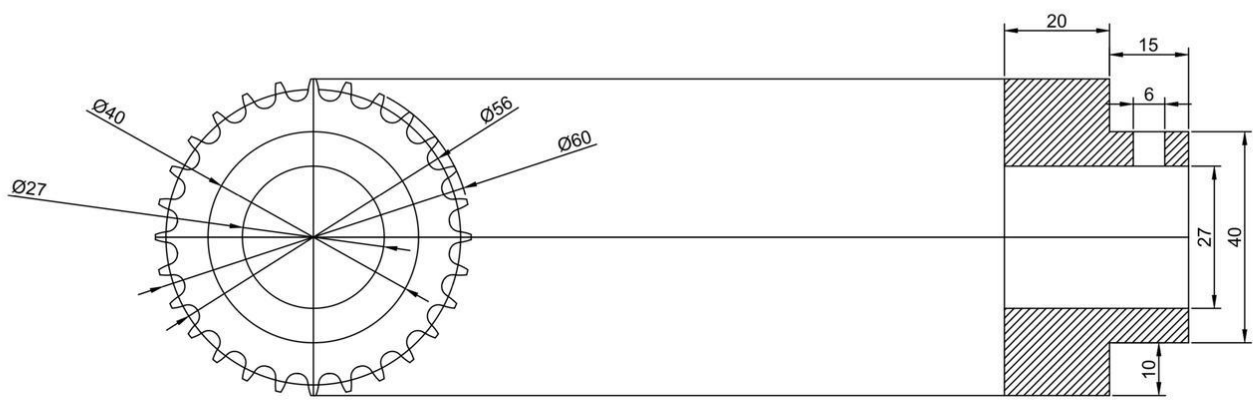

Figure no 6- Sun Gear 2D

Spur gears are an essential component in various mechanical systems, and they play a crucial role in transmitting motion and power between rotating shafts. Here are some reasons why spur gears are important:

Power Transmission, Speed Reduction, and Increase, Direction Change, Simple and Reliable Design, High

Efficiency,Wide Range of Sizes and Applications

Casing

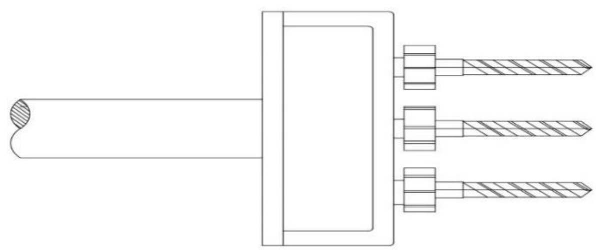

Figure no 7- Casing

Gear casings, also known as gear housings or gearboxes, are essential components in many mechanical systems where gears are used. They serve several important functions that are vital for the proper functioning and longevity of gear assemblies. Here are the key reasons why gear casings are important:
Enclosure and Protection, Noise Reduction, Lubricant Retention, Containment of Lubricant, Thermal Management

Shaft:

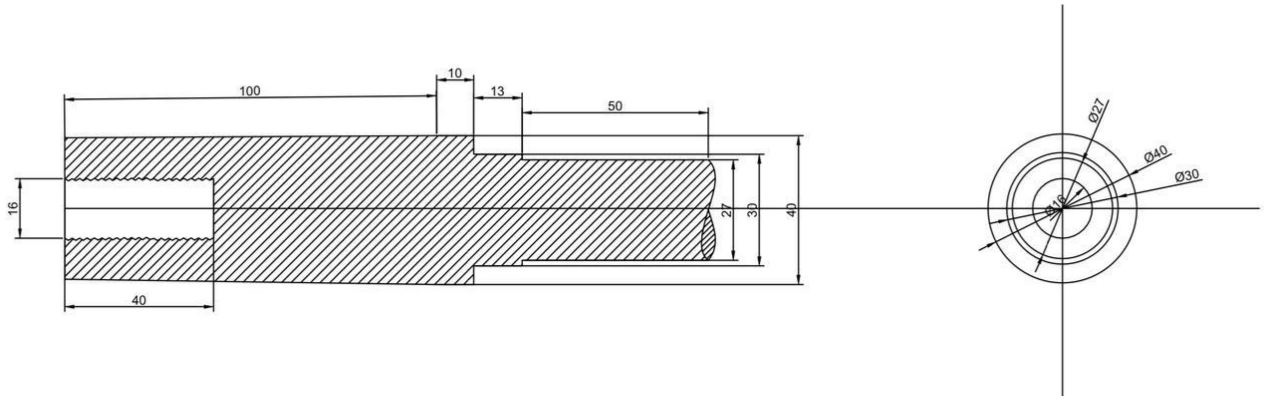

Figure no 8- Shaft

Shafts are important mechanical components that play a crucial role in various engineering and industrial applications. They are cylindrical rods or rotating members that transmit power, torque, and motion between different machine elements. Here's why shafts are important in the world of engineering and machineru:
Power transmission,Rotational Stability , support for bearing, length adjustment.

Bearing:

Figure no 9 - Bearing

Bearings are critically important mechanical components used in various industries and applications. They serve a fundamental role in reducing friction and facilitating the smooth and reliable movement of rotating and linear parts in machinery. Here's why bearings are important: function reduction, load support, motion control, rotation stability

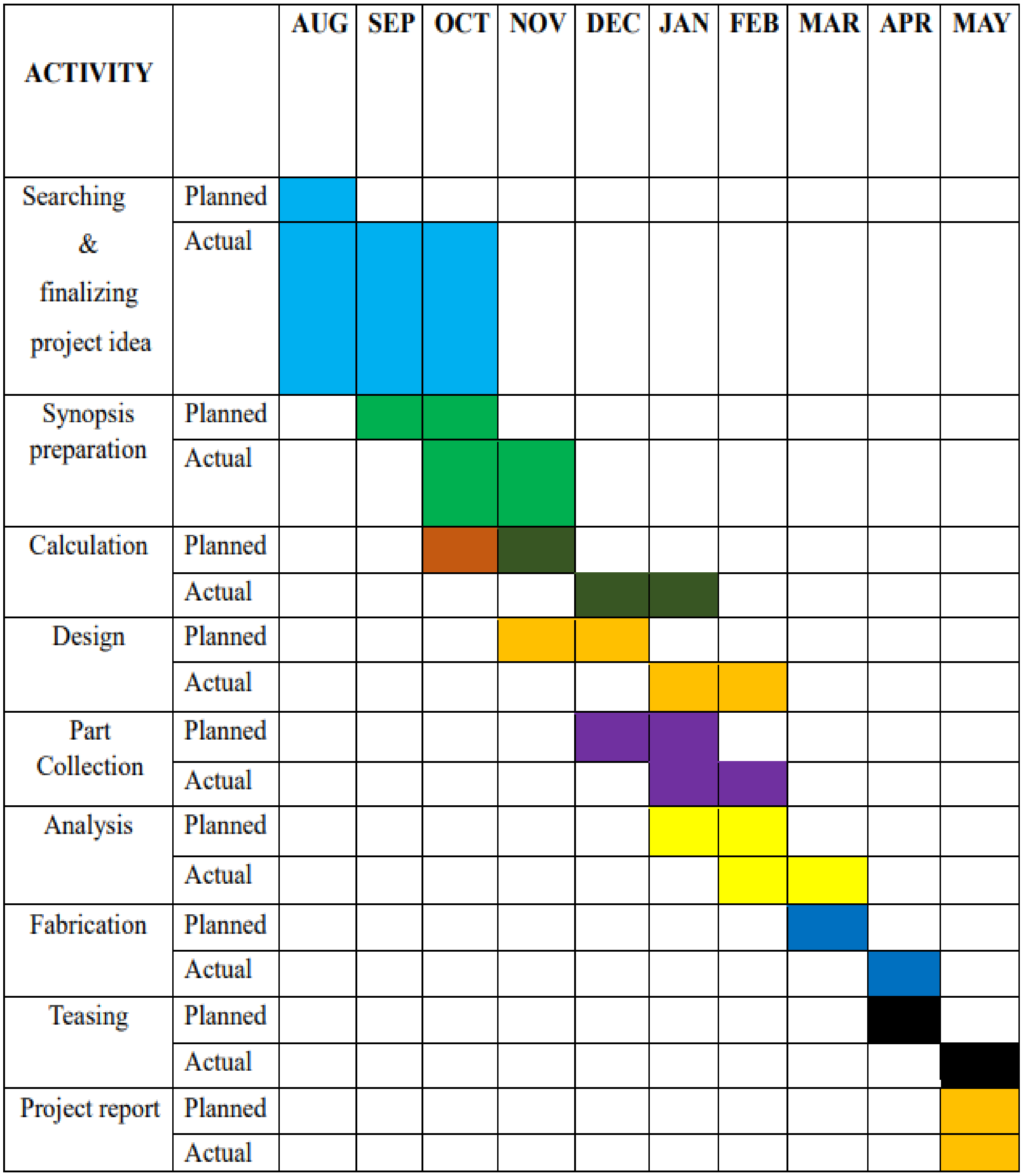

Figure no 10- Activity Chart

MANUFACTURING PROCESS

PROCESS SHEET:

Following operations were while fabricate the project

Cutting: -Cutting is the separation or opening of a physical object, into two or more portions, through the application of an acutely directed force.

Implements commonly used for cutting are the knife and saw, or in medicine and science the scalpel and microtome. However, any sufficiently sharp object is capable of cutting if it has a hardness sufficiently larger than the object being cut, and if it is applied with sufficient force. Even liquids can be used to cut things when applied with sufficient force (see water jet cutter).

The material as our required size. The machine used for this operation is power chop saw. A power chop saw, also known as a drop saw, is a power tool used to make a quick, accurate crosscut in a work piece at a selected angle. Common uses include framing operations and the cutting of moulding. Most chop saws are relatively small and portable, with common blade sizes ranging from eight to twelve inches.

Figure no 11 - Cutting

The chop saw makes cuts by pulling a spinning circular saw blade down onto a work piece in a short, controlled motion. The work piece is typically held against a fence, which provides a precise cutting angle between the plane of the blade and the plane of the longest work piece edge. In standard position, this angle is fixed at 90°. A primary distinguishing feature of the mitre saw is the mitre index that allows the angle of the blade to be changed relative to the fence. While most mitre saws enable precise one-degree incremental changes to the mitre index, many also provide "stops" that allow the miter index to be quickly set to common angles (such as 15°, 22.5°, 30°, and 45°). The time required for this operation is 50 minutes.

Welding: -Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by using high heat to melt the parts together and allowing them to cool causing fusion. Welding is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal.

In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material (the weld pool) that cools to form a joint that, based on weld configuration (butt, full penetration, fillet, etc.), can be stronger than the base material (parent metal). Pressure may also be used in conjunction with heat, or by itself, to produce a weld. Welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized.

Square pipes of different lengths to make frame. The machine used for this operation is electric arc welding. Electrical arc welding is the procedure used to join two metal parts, taking advantage of the heat developed by the electric arc that forms between an electrode (metal filler) and the material to be welded. The welding arc may be powered by an alternating current generator machine (welder). This welding machine is basically a single-phase static transformer Suitable for melting RUTILE (sliding) acid electrodes. Alkaline electrodes may also be melted by alternating current if the secondary open-circuit voltage is greater than 70 V.

Figure no 12 - Welding

The welding current is continuously regulated (magnetic dispersion) by turning the hand wheel on the outside of the machine, which makes it possible to select the current value, indicated on a special graded scale, with the utmost precision. To prevent the service capacities from being exceeded, all of our machines are fitted with an automatic overload protection which cuts of the power supply (intermittent use) in the event of an overload. The operator must then wait for a few minutes before returning to work. This welding machine must be used only for the purpose described in this manual. Read the entire contents of this manual before installing, using or servicing the equipment, paying special attention to the chapter on safety precautions. Contact your distributor if you do not fully understand these instructions. The time required for this operation is 120 minutes.

Drilling: -

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool, often multi-point. The bit is pressed against the work-piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work-piece, cutting off chips (swarf) from the hole as it is drilled.

In rock drilling, the hole is usually not made through a circular cutting motion, though the bit is usually rotated. Instead, the hole is usually made by hammering a drill bit into the hole with quickly repeated short movements. The hammering action can be performed from outside the hole (top-hammer drill) or within the hole (down-the-hole drill, DTH). Drills used for horizontal drilling are called drifter drills.

In rare cases, specially-shaped bits are used to cut holes of non-circular cross-section; a square cross-section is possible.

Figure no 13 – Drilling Machine

Drilled holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical feed marks.

Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion and crack propagation at the stressed surface. A finish operation may be done to avoid these detrimental conditions.

For fluted drill bits, any chips are removed via the flutes. Chips may form long spirals or small flakes, depending on the material, and process parameters. The type of chips formed can be an indicator of the machinability of the material, with long chips suggesting good material machinability.

Figure no 14 - Drill

Finishing: -

Finishing is a broad range of industrial processes that alter the surface of a manufactured item to achieve a certain property. Finishing processes may be employed to: improve appearance, adhesion or wettability, solder ability, corrosion resistance, tarnish resistance, chemical resistance, wear resistance, hardness, modify electrical conductivity, remove burrs and other surface flaws, and control the surface friction. In limited cases some of these techniques can be used to restore original dimensions to salvage or repair an item.

An unfinished surface is often called mill finish.

The edges with grinder using grinding wheel. The machine used for this operation is hand grinder. An angle grinder, also known as a side grinder or disc grinder, is a handheld power tool used for cutting, grinding and polishing. Angle grinders can be powered by an electric motor, petrol engine or compressed air.

The motor drives a geared head at a right-angle on which is mounted an abrasive disc or a thinner cut-off disc, either of which can be replaced when worn. Angle grinders typically have an adjustable guard and a side-handle for two-handed operation. Certain angle grinders, depending on their speed range, can be use*d* as sanders, employing a sanding disc with a backing pad or disc. The backing system is typically made of hard plastic, phenolic resin, or medium-hard rubber depending on the amount of flexibility desired. The time required for this operation is 20 minutes.

Figure no 15 - Finishing

Polishing: -

Polishing is the process of creating a smooth and shiny surface by rubbing it or using a chemical action, leaving a surface with a significant specular reflection (still limited by the index of refraction of the material according to the Fresnel equations.) In some materials (such as metals, glasses, black or transparent stones), polishing is also able to reduce diffuse reflection to minimal values. When an unpolished surface is magnified thousands of times, it usually looks like mountains and valleys. By repeated abrasion, those "mountains" are worn down until they are flat or just small "hills." The process of polishing with abrasives starts with coarse ones and graduates to fine ones.

The welded joints with hand grinder using grinding wheel. The machine used for this operation is hand grinder. With refinement, grinding becomes polishing, either in preparing metal surfaces for subsequent buffing or in the actual preparation of a surface finish, such as a No. 4 polish in which the grit lines are clearly visible. Generally speaking, those operations which serve mainly to remove metal rapidly are considered as grinding, while those in which the emphasis is centred on attaining smoothness are classified as polishing. Grinding employs the coarser grits as a rule while most polishing operations are conducted with grits of 80 and finer. If polishing is required, start with as fine a grit as possible to reduce finishing steps. There is a wide range of grinding and polishing tools on the market and advice is available from ASSDA members to assist in particular applications. Polishing operations are conducted with the abrasive mounted either on made-up shaped wheels or belts which provide a resilient backing. The base material may be in either a smooth rolled or a previously ground condition. If the former, the starting grit size may be selected in a range of 80 to 100. If the latter, the initial grit should be one of sufficient coarseness to remove or smooth out any residual cutting lines or other surface imperfections left over from grinding. In either case, the treatment with the initial grit should be continued until a good, clean, uniform, blemish-free surface texture is obtained. The initial grit size to use on a pre-ground surface may be set at about 20 numbers finer than the last grit used in grinding, and changed, if necessary, after inspection. Upon completion of the initial stage of polishing, wheels or belts are changed to provide finer grits. Polishing speeds are generally somewhat higher than those used in grinding. A typical speed for wheel operation is 2500 meters per minute. The time required for this operation is 20 minutes.

Figure no 16 - Polishing

SAFETY PRECAUTIONS

The following points should be considered for the safe operation of machine

And to avoid accidents: -

- All the parts of the machine should be checked to be in perfect alignment.
- All the nuts and bolts should be perfectly tightened.
- The operating switch should be located at convenient distance from the operator so as to control the machine easily.
- The inspection and maintenance of the machine should be done from time to time.
- All the nuts and bolts should be perfectly tightened.
- The operating switch should be located at convenient distance from the operator so as to control the machine easily.
- The inspection and maintenance of the machine should be done from time to time.

ASSEMBLY

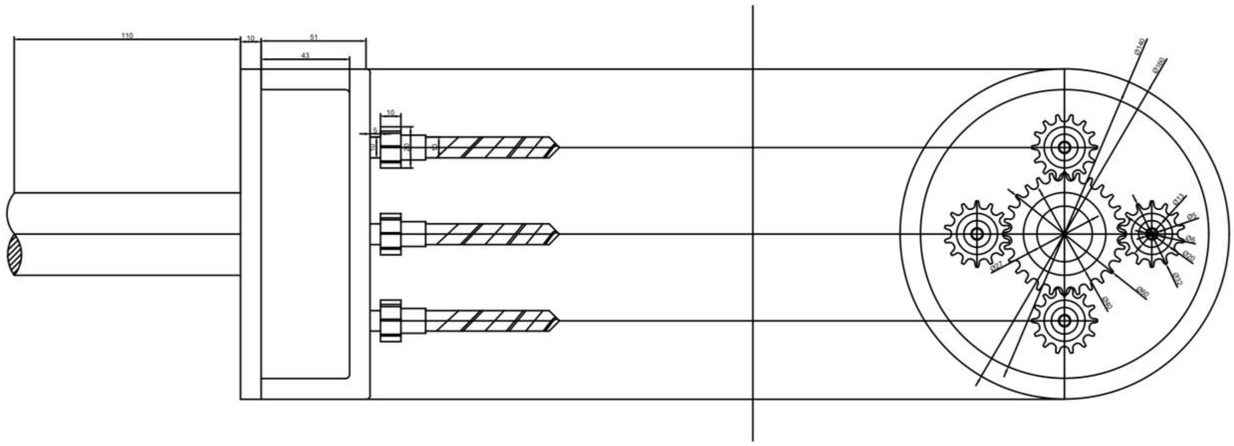

Figure no 17 - Assembly

Figure no 18 - Assembly

Bill of Material

Sr. No	Material	Quantity	Cost per Unit Rs.	Total cost in Rs.
1	Material cost (casing,shaft)		4000	4000
2	Mechanism with Gear and labor cost	Gear - 05	4000	4000
3	Nut and Bolts	1	500	500
4	Bearing	1	500	500
			Total	**10,000**

Figure no 19 - Billing Chart

FUTURE SCOPE:-

Future work may focus on further refining the design to accommodate more complex drilling patterns and integrating automation features to further streamline the drilling process.

Results:-

The "Design and Fabrication of Multiple Spindle Drilling Attachment" project successfully achieved its primary goal of creating a functional and efficient drilling attachment capable of performing simultaneous drilling operations. This project not only enhances productivity but also ensures consistency and precision in drilling tasks. The following key conclusions can be drawn from the project

Conclusion:-

The multiple spindle drilling attachment represents a significant advancement in drilling technology. Its ability to enhance productivity, precision, and cost-effectiveness makes it a valuable addition to any manufacturing setup.

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ii. F. Forestier, V. Gagnol, P. Ray, And H. Paris **Modeling Of Self-Vibratory Drilling Head-Spindle System For Predictions Of Bearings Lifespan** Hindawi publishing corporation advances in acoustics and vibration volume 2011, article id 606087, 10 pages doi:10.1155/2011/606087

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vi. Shinde Nikhil , Vishwakarma Prem , Sanjay Kumar , Godse Rahul, P.A. Patil **Design & Development Of Twin Drill Head Machine And Drilling Depth Control** (An iso 3297: 2007 certified organization) vol. 4, issue 5, may 2015

vii. M. Madhavi* , B. Karthik Anand **Optimization And Analysis Of Multi Tool Arbor** © 2019 Ijsrset | volume 6 | issue 1 | print issn: 2395-1990 | online issn : 2394-4099 themed section

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DESIGN AND FABRICATION OF MULTIPLE SPINDLE DRILLING ATTACHMENT

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Abstract: Manufacturing productivity is critical to the success of the Indian manufacturing industry. Drilling machines are usually used for drilling holes, but they may also do additional activities like as tapping, spot facing, reaming, countersinking, and counter boring, to mention a few. While the multiple spindle drilling attachment conducts fundamental drilling operations, there are some particular duties that are more correctly and readily accomplished. This connection is primarily based on a planetary gear system configuration. Drilling Attachment with Multiple Spindles The primary role is to do many drilling operations at the same time. It offers several advantages, including increased output, decreased operating time, lower labor costs, increased productivity, and many more. Reduce the number of operations cycles as well. If general-purpose machines are used for production, this is not feasible. The design and manufacturing process of the multiple spindle drilling attachment will improve the drilling machine's performance and productivity. In order to optimize the component's cycle time, this article focuses on improving the design and manufacturing process of the multiple spindle drilling attachment.

Keywords: Planetary gear system, Manufacturing, Multi-spindle Drilling Attachment, Gear.

I. INTRODUCTION

The aforementioned issue, where a traditional drilling machine is utilized to execute three operations at once, maybe perfectly solved with the Multi- spindle drilling attachment. This attachment allows for the simultaneous completion of several operations, such as drilling, reaming, countersinking, and spot-facing. The MT-2 taper arbor fits directly into the drilling machine sleeve, making it simple to place the multi-spindle drilling attachment on the drilling machine. If additional stability is needed, a support sleeve may be fastened to the top casing plate. Three spindles that hold three drill chucks are operated concurrently in the multi-spindle drilling attachment. To accomplish the required operation, the drill chucks can be fitted with twist drills, reamers, countersink drills, or spot-facing cutters.

A drilling machine, also known as a drill press, is a machine tool used for drilling holes in various materials, such as metal, wood, plastic, and more. Here's how a drilling machine typically works:
Setup: The first step is to set up the drilling machine. This involves securing the workpiece to the drill press table or workbench, and adjusting the height and alignment of the drill bit to ensure it lines up with the desired drilling location on the workpiece. Selecting the Drill Bit: Choose the appropriate drill bit for the material you are drilling. Different materials require different types of drill bits, such as twist drills for metal, brad point bits for wood, or spade bits for large holes. Adjusting Speed and Depth: Most drill presses allow you to adjust the speed of the drill bit rotation and the depth to control the drilling process. Slower speeds are typically used for harder materials, while faster speeds are suitable for softer materials.

Power On: Turn on the drilling machine and adjust the speed to the desired setting. Some drill presses have variable speed controls, while others have a selection of preset speeds.

Drilling: Position the workpiece under the drill bit and bring the drill bit down by lowering the quill (the spindle that holds the drill bit) using the feed handle or a lever. Apply a consistent, even pressure to the workpiece to ensure a clean and accurate hole. The drill bit will rotate and cut into the material.

Withdraw the Drill Bit: Once the hole is drilled to the desired depth, release the pressure on the feed handle or lever, and then raise the quill to withdraw the drill bit from the hole. Be sure to turn off the drill press when not in use. Workpiece Removal: After completing the drilling operation, remove the workpiece from the machine. It's essential to follow safety precautions when using a drilling machine, such as wearing safety glasses, securing the workpiece properly, and using appropriate cutting fluids or lubricants when drilling metal to reduce friction and heat. Keep in mind that there are various types of drilling machines, including benchtop drill presses, floor-standing drill presses, and portable hand-held drills, each with its own features and capabilities. The specific operation and controls may vary depending on the type and model of the drilling machine you are using. Innovation in drilling machines has led to the development of multifunctional machines that can perform various tasks in addition to drilling holes. These multi-tool drilling machines are designed to increase efficiency, save space, and improve versatility. Here are some innovations in multitool functions for drilling machines:

Combination Drilling and Milling Machines: Some machines can switch between drilling and milling operations. This versatility is valuable for applications where precision holes and complex shapes need to be created in the same workpiece. Tapping and Reaming: Multi-tool drilling machines can also perform tapping and reaming operations. Tapping is the process of creating threads in a hole, while reaming is used to achieve a precise diameter and smooth finish in drilled holes. Rotary Tool Attachments: Some machines come with attachments that allow them to function as rotary tools. This enables tasks like grinding, polishing, and sanding in addition to drilling.

II. LITERATURE SURVEY

Dae-ji Kim, Jaewon Kim, Booyeong lee, Min-Seok Shin, Joo-Young Oh, Jung- Woo Cho, and Changheon song **Prediction Model of Drilling Performance forPercussive Rock Drilling Tool** this study focused on predicting the drilling performance of a death hammer. a numerical analysis model of the death hammerwas established and validated through comparison with the results of an in situ drilling test. -the results of this work are summarized as follows: simulations considering the effect of rock strength were used to quantify the energy efficiencyaccording to the rock strength, impact energy required for crushing, and performance of the hammer. the developed model was applied to an actual deathdrilling system. -e model predicted a drilling speed of 5.4 mm/s, and themeasuredspeed was 5.7 mm/s. similar results validated the proposed model. themodel allows the performance of the drill bit and death hammer (i.e., the key components of the drilling system) to be predicted by considering the sensitivityof the major design factors and the effect of the rock mass. the validity of the proposed prediction model for the drilling performance was experimentally verified. the results of this study suggest that the performance of drilling equipment can be predicted by considering the sensitivity of major design factorsfor the drilling tool and the effect of the rock type.

F. Forestier, V. Gagnol, P. Ray, and H. Paris **Modeling Of Self-Vibratory Drilling Head-Spindle System For Predictions Of Bearings Lifespan** this paper, a comprehensive approach to developing a hybrid model of the dynamic behaviour of the spindle self-vibratory drilling head—tool system has been proposed. this approach has resulted in a numerical model enriched with physicaldata. the various components of the system are modeled using a specific beam element, taking into account the gyroscopic effects, centrifugal forces, and sheardeformation. the receptance coupling method is used to identify the dynamic behaviour of the interface. the complete system is vibration then obtained by assembling the beam model of each component using spring-damper elements.

Prof.M.B. Bankar ,Prof. P.B. Kadam , Prof. M.R. Todkar **Improvement In Design & Manufacturing Process Of Multiple Spindle Drilling Attachment** drilling is nothing but the use of a rotating multi-point drill to cut a round hole into a workpiece. in a lot of manufacturing processes, one of the most indispensable machining tools is the multiple spindle drilling machine. thedrilling machine is commonly called a drill press and is responsible for drilling various sizes of holes in any surface area and to precise depths. aside from the fact the drilling machine is used primarily in drilling holes, there are a few otherfunctions that the multiple spindle drilling machine is capable of performing. these functions include tapping, spot facing, reaming, countersinking, and counterboring to name a few. there are four major categories of drilling machineswhich include the upright sensitive drilling machine, upright drilling machine, radial drilling machine, and special purpose drilling machine. although these multiple spindle drilling attachments perform basic drilling operations, there aresome specific functions that are performed more accurately and conveniently byeach of these types.

J. Panju, M. Meshreki, M. H. Attia **Design Of A Retrofittable Spindle Attachment For High Frequency Vibration Assisted Drilling** A retrofittable hf-vad spindle attachment for hsk 100a tool holder comprising a piezoelectric actuator system was designed and fabricated. a controlled amplified sinusoidal signal was fed into the actuator enclosed in the rotating toolholder through the slip ring. as a result, an hf-vad system was developed in which simultaneous rotatory and vibratory motion on the drill bit are superimposed. the system has acapability of providing high frequency (up to 2,500 hz) and low amplitude (up to5 µm) vibrational motion to the tool excluding resonance condition. at the resonance frequency of 900 hz, the amplitude goes up to 100 µm. this high frequency vibrational motion is superimposed to the high speed rotational motion(up to 10,000 rpm) of the tool. experiments on the system revealed a shift in amplitude response of the system under no load and spring loaded conditions. the frequency, at which maximum amplitude response is obtained, shifts from 800 hz (in no load condition) to 1,500 hz (in spring loaded condition). the hf-vadexperiments conducted on al60601 using this attachment showed remarkable improvement in cutting forces. finer chips with break-off serrations were formedduring hf-vad as opposed to difficult-to-remove thick spiral chips in conventionaldrilling test.

Shinde Nikhil , Vishwakarma Prem , Sanjay Kumar , Godse Rahul, P.A. Patil **Design & Development Of Twin Drill Head Machine And Drilling Depth Control** The twin-spindle drilling attachment is mounted on the drilling machine spindle sleeve, for extra stability an support sleeve may be mounted. the cuttingtools as per the job requirements are mounted in the respective three drill chucksof the drilling attachment.

M. Madhavi* , B. Karthik Anand **Optimization And Analysis Of Multi Tool Arbor** After completing the major project on `milt' tool arbor" we am much happy and would like to thank our professor. guides and the lectures of the concerned department who have guided us. while making project we have been able to learn a lot and understand the various aspects of - multi tool arbor" we can use our knowledge, which we get during our study.

III. METHODOLOGY

3.1 Methodology Chart

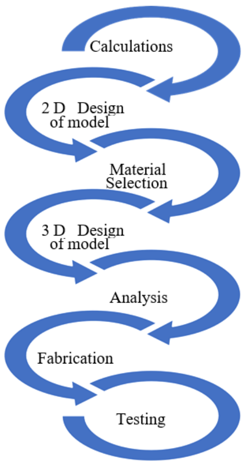

Fig.1 Methodology Chart

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3.2 Assembly

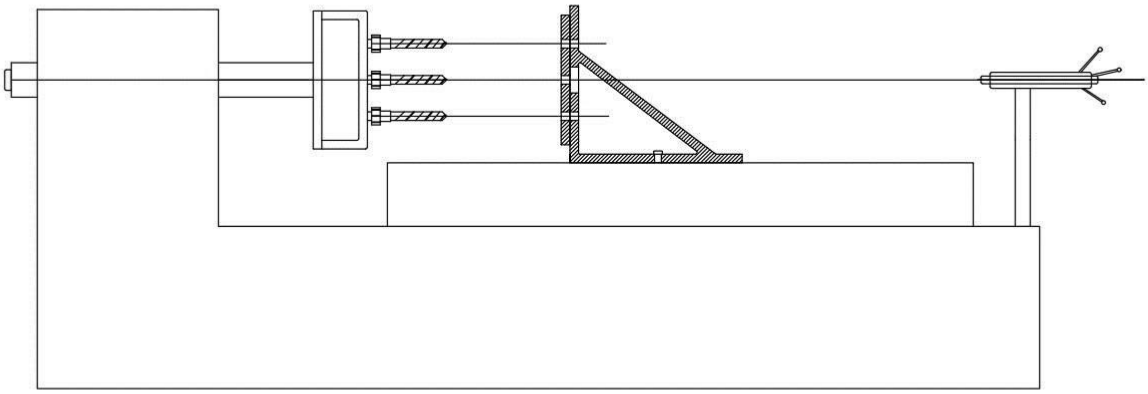

Fig 2- Assembly

3.3 2D & 3D Design

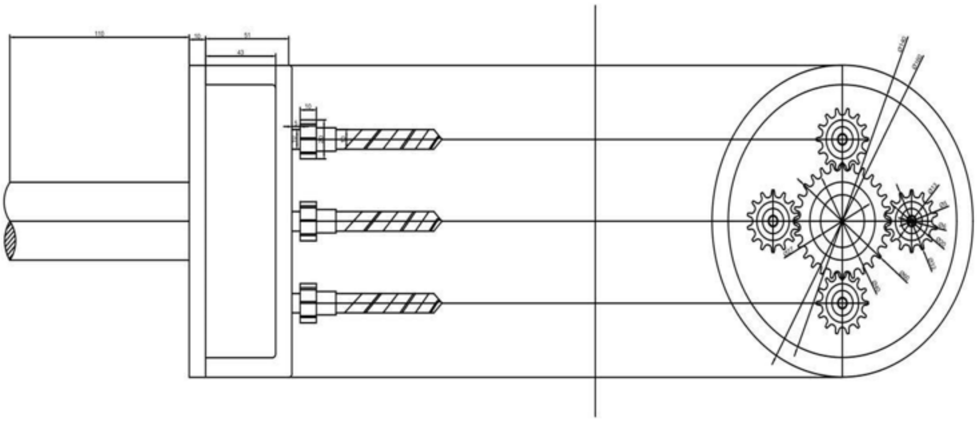

Fig. 2D Design

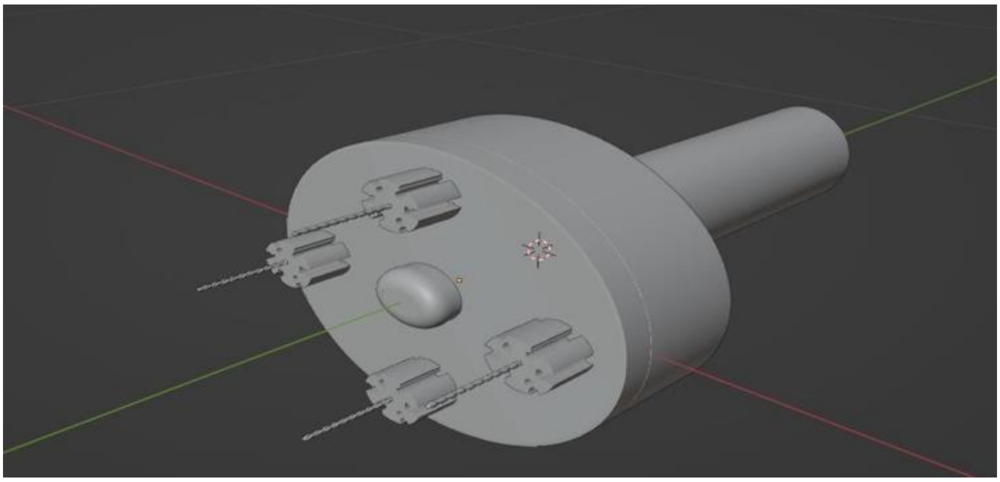

Fig. 3D Design

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IV. SPECIFICATIONS & CALCULATIONS

4.1 Specifications of Lathe Machine:

Light Duty Lathe Machine

- Motor RPM: 1440 RPM
- Power : 1 HP
- Power transmission : 0.75 KW

Spindle RPM-VARIABLE 230-830 RPM

1. To calculate Drill RPM:We have,

For pinion gear , D1: 32mm No of teeth: 14

For sun gear , D2 : 60mm No of teeth : 28 Speed = 830 RPM.

WE KNOW,

$$\text{DRIVEN GEAR RPM} = \frac{\text{DRIVER GEAR RPM X DRIVER GEAR TEETH}}{\text{DRIVEN GEAR TEETH}}$$

…(Spur gear RPM Transmission Formula.)

$$= \frac{830 \text{ X } 28}{14}$$

$$= 1660 \text{ RPM.}$$

SPUR GEAR CALCULATION

Design power = 1000 W
Speed of gear,
Z1=44
Z2=22
N1=900 rpm
N2=1800 rpm Gear ratio, i = 1:2
Pressure angle, $\phi = 20^{\circ}$

Tooth Profile = 20^{0} Full Depth
Material for gear, AISI 1010 Steel havingBending Strength σb= 140 MPa
Design on the basis of bending strength:
Modified Lewis form factor,
Y=0.330
Diameter of gear, D1 =m*Z = 44m, mm
Diameter of gear, D2 =m*Z = 22m, mm Solving for D1

Tangential tooth load on gear, Ft = $\frac{Pd}{Vp}$

Pitch line velocity Vp = $\frac{\pi DN}{60000} = \frac{\pi * 44 * 900}{60000}$ m/s

Bending strength of gear, Fb=$\sigma b. Cv. b. Y. m$

Assuming velocity factor, Cv = $\frac{3}{3+vp}$

Face width, b=8.5 m <b < 12.5m
Taking b=10m
Using relation, Ft=Fb

$$\frac{Pd}{Vp} = \sigma b. Cv. b. Y.\text{m}$$

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After solving, we get
m = 1.2 mm
Standard module, m = 1.75mm
Diameter of gear, D1 = 76 mm
Pitch line velocity, Vp = 2.07m/s
Tooth load, Ft = 483.09 N
Face width, b = 15mm
Bending strength, Fb = 615.08 N
As Fb> Ft (Design safe)

Solving for D2
Tangential tooth load on gear, Ft = $\frac{Pd}{Vp}$
Pitch line velocity Vp = $\frac{\pi DN}{60000} = \frac{\pi * 22 * 1800}{60000}$ m/s = 2.07 m/s
Bending strength of gear, Fb=$\sigma b.Cv.b.Y.m$
Assuming velocity factor, Cv = $\frac{3}{3+vp}$
Face width, b=8.5 m <b < 12.5m
taking b=10m
Using relation, Ft=Fb

$$\frac{Pd}{Vp} = \sigma b.Cv.b.Y.m$$

V. CONCLUSION

In conclusion, the multiple spindle drilling attachment represents a significant advancement in drilling technology. Its ability to enhance productivity, precision, and cost-effectiveness makes it a valuable addition to any manufacturing setup. Future work may focus on further refining the design to accommodate more complex drilling patterns and integrating automation features to further streamline the drilling process.

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