Innovation on Adjustable Multi Spindle Drilling Attachment: Cost effective for MSMEs

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ABSTRACT

The drilling machine is a machine that is necessary in practically every industry. The manufacturing sector's growth is mostly determined by its productivity and quality. By lowering total machining time, merging operations, and so on, productivity can be increased. Multi drilling machines are required to boost productivity, precision, and quality. Using a particular purpose machine is the greatest technique to increase production rate (productivity) and quality.

This invention relates to an improved drilling machine with a low manufacturing cost, high accuracy, and interchangeability, one in which the parts are removable attached to allow for cleaning, repair, and oiling, and which is adapted to be quickly and easily removed from the attached drill machine, and is capable of drilling holes in various adjustable positions and has a greater range of adjustable and lateral movement of the drills with respect to each other. The present inventions aim to provide a new and improved multi-spindle drill, a multi-spindle drill with a novel gear in which the gears and related parts may be easily and quickly assembled and disassembled, and a novel uniformly arranged multi-spindle drill. As the design is completely cost effective for smaller firms, this would assist MSMEs in developing independent and constructive development.

Keywords: *Multi spindle drilling attachment; Design; Innovation; Cost effectiveness; Application in MSMEs.*

1.0 Introduction

Perhaps the most important procedure in industry is whole production. Almost every work piece or product has a hole in it. Holes can be made in a variety of processes, including casting, forging, punching, and drilling. Drilling is a very basic and practical approach to make holes. Drilling machines are used to drill holes. All drilling machines have spindles that rotate in a fixed relative direction parallel to their axis.

When the sleeve carrying the spindle with the cutting tools is moved in the forward direction, the cutting tools approach their position in the sleeve, which does not revolve but may slide in its bearings in an or is fed into the work, and when the sleeve is moved in the reverse direction, the cutting tools are withdrawn from the work. The drills are held by the spindle, while the rotating spindle and drill are carried by the non-revolving sleeve. Feeding pressure is given to the sleeve by hand or by power, causing the rotating drill to cut a few thousands of an inch into the work with each rotation.

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2.0 Problem Statement

Currently, industry development is at an all-time high. All sectors strive for optimum quality and precision in order to boost production rates. Industries strive to meet their objectives ahead of schedule while also meeting all of the needs of their consumers. In our project, we attempt to cover the main parameters of the production department, such as production rate, quality control, and accuracy, among others. Four holes, for example, are drilled to create a flange. If a universal drilling machine is used to make a hole, it will take longer to complete the procedure because each drill will take longer to complete. This will also increase the machine's setting time and idle time.

Other multi-spindle drilling attachment is available in the industry, but they have limits, such as only employing one attachment for one type of flange or for a specific diameter. If the dimensions are changed for a larger size flange to be drilled, the attachment becomes useless. The gearbox is intended for a specific one-dimension standard in this sort of attachment. Adjustable signifies that we must be able to interchange the size of the attachment's output in a flexible manner. This form of flexible attachment is found in the multi-spindle drilling machine's head. However, fulfilling this demand on a standard drilling machine is expensive, thus we created the adjustable multi-spindle drilling attachment.

3.0 Literature Review

[1] Tushar b. Malode, Prof. R.R. Gandhe (JULY 2016) The productivity and quality of the Indian manufacturing sector are critical to its growth. Productivity is determined by a variety of variables, one of which is the manufacturing efficiency with which the organization's operations/activities are carried out. By decreasing overall machining time, merging processes, and so on, productivity may be increased. It is critical to create the work at a faster rate in cases of mass production where the diversity of jobs is limited and the quantity to be produced is large. This is not conceivable if we use general-purpose machinery to complete the manufacture. Using a specific purpose machine is the greatest approach to increase production rate (productivity) and quality. By developing and constructing a multi-spindle head attachment, the usefulness and performance of an existing radial multi-spindle machine will be improved. This article is about the design and development of a multi-spindle head for component cycle time optimization.

[2] Bajirao H. Nangare Patil, Prof. P. R. Sawant (MAY 2013) The focus of this project will be on designing, modeling (AutoCAD), and creating a gearbox that will run a multi-spindle drilling machine for counter bore drilling operations of 5 mm, 6.8 mm, and 14.4 mm for a cylinder block. Different variables impacting gear performance and gear selection for power transmission (at high rotational speeds) from prime movers and driven units are investigated. To solve this challenge and optimize efficiency and profitability by boosting production rates without sacrificing quality by reducing time frames, labor costs, component rejections, and so on, Special Purpose Machines are developed, which play an important role in higher output and may be achieved by creating gearboxes that can run a large number of various types of drilling tools at the same time.

[3] Mr. Tushar T. Bhaisare, Prof. M.V. Kavade (APRIL 2017) Drilling activities are carried out in most industries utilizing various drilling machines depending on the requirements. One of the most significant machine tools in a workshop is the drilling machine. It was created to drill a cylindrical hole of the desired diameter and depth in metal or woodwork. Though many machine tools in a workplace can make holes, a drilling machine is built particularly to do drilling and comparable activities. A drilling machine can quickly drill at a low cost and in a shorter amount of time. Drilling is the process of removing metal with the spinning edges of a drill to create a cylindrical hole of the desired diameter and depth. The drill is a cutting instrument that is attached to the drilling machine's spindle. A center punch is used to make an indentation mark at the necessary place. The spinning drill is inserted into the work after being pushed into place. The hole can be dug to the specified depth.

[4] Sainath patil, Dr. S. R Basavaraddi (SEP 2017) Most local brake component manufacturing companies in developing nations like India still use two or more drilling heads on two or more machines to drill holes in casting parts. This buildup creates a storage issue and promotes idle time. A gang-drilling (or multiple spindle drilling) equipment that can do all of the drilling operations in one go. A Multiple-Spindle Drilling Head (MSDH) was created in response to this. The machine was created as an add-on (accessory) to a primary drill, from which it draws power to operate. In the mechanical sector, multi spindle head machines are used to enhance the productivity of machining equipment. Spindle heads with numerous tools for conducting machining operations are included in such machines. The cycle time is the most notable benefit of multi-spindle machines; owing to parallel machining, overall operating time is drastically reduced. Additional advantages include a lower risk of mistake, a lower cumulative tolerance error, and the elimination of tool modifications. An item to be machined is mounted on the table of a multi-spindle machine.

4.0 Design

4.1 Gear calculation: -
HELICAL GEAR: -

4.1 GEARS

• **Calculation of master gear**
Normal module = 2.5 mm
No. Of teeth = 36
P.C.D. = 93.175 mm
Addendum = 2.5 mm
Dedendum = 1.25 * addendum
= 3.125 mm
Helix angle =15^{o}

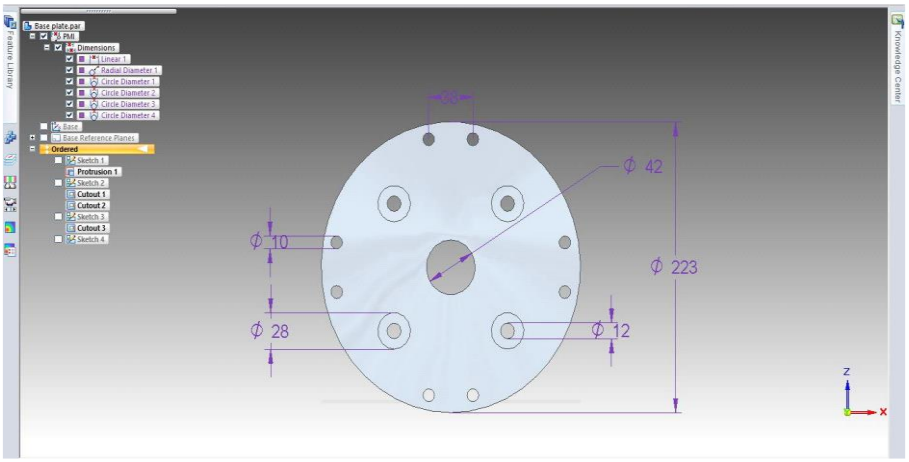
Addendum diameter = (no of teeth/ cos15 +2) * module
= (36/cos 15 + 2) * 2.5
= 98.17 mm
Dedendum diameter = (no of teeth/cos 15-2) * module
= (36/cos 15 -2) * 2.5
= 86.92 mm

Small gear: -

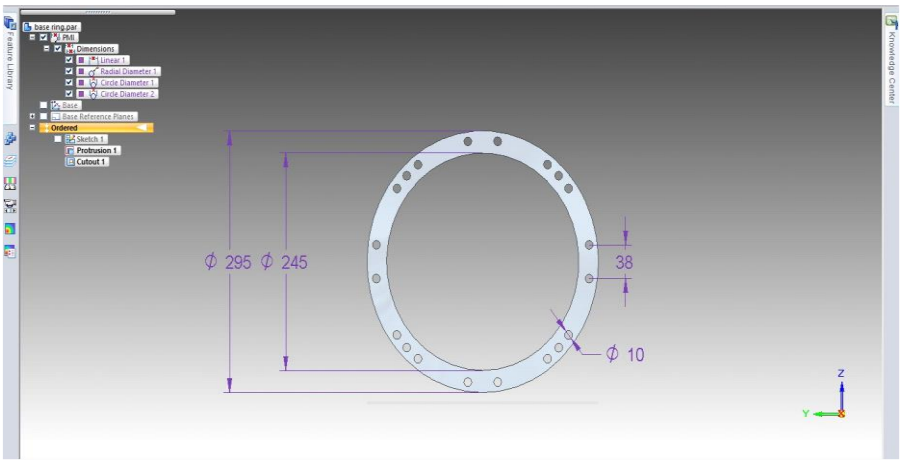
Normal module = 2.5 mm
No. Of teeth = 18
P.C.D. = 46.78 mm
Addendum = 2.5 mm
Dedendum = 1.25 * addendum
= 3.125 mm
Helix angle =15^{o}
Addendum diameter = (no of teeth/ cos15 +2) * module
= (18/cos 15 + 2) * 2.5
= 51.58 mm
Dedendum diameter = (no of teeth/cos 15-2) * module
= (18/cos 15 -2) * 2.5
= 40.33 mm

4.2 Design of parts: -

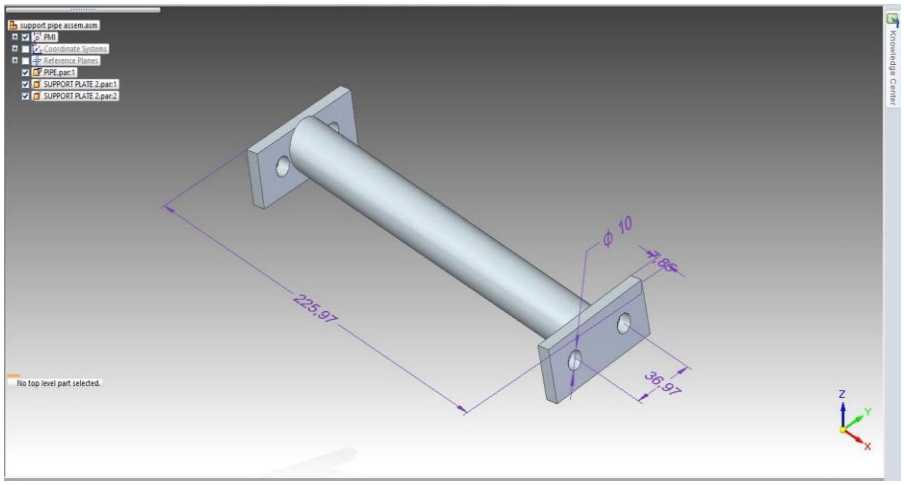
4.2.1 Base Plate



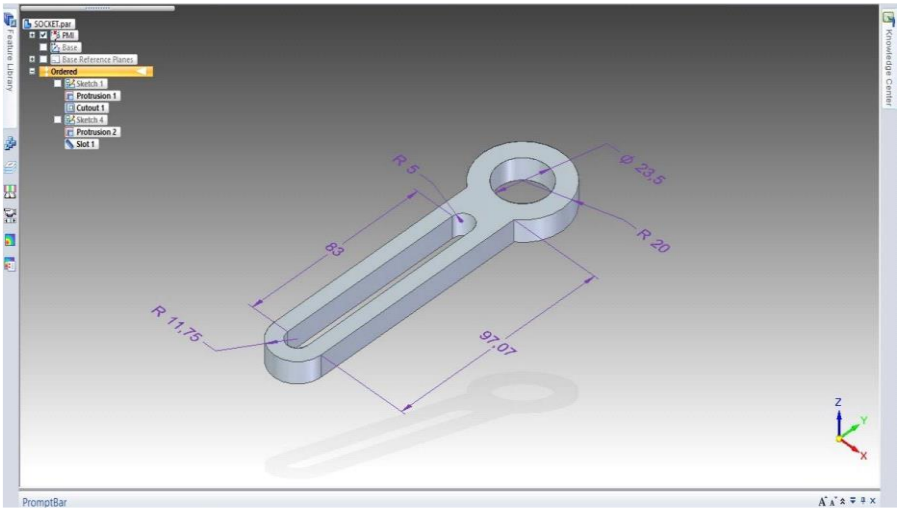
4.2.2 Base Ring



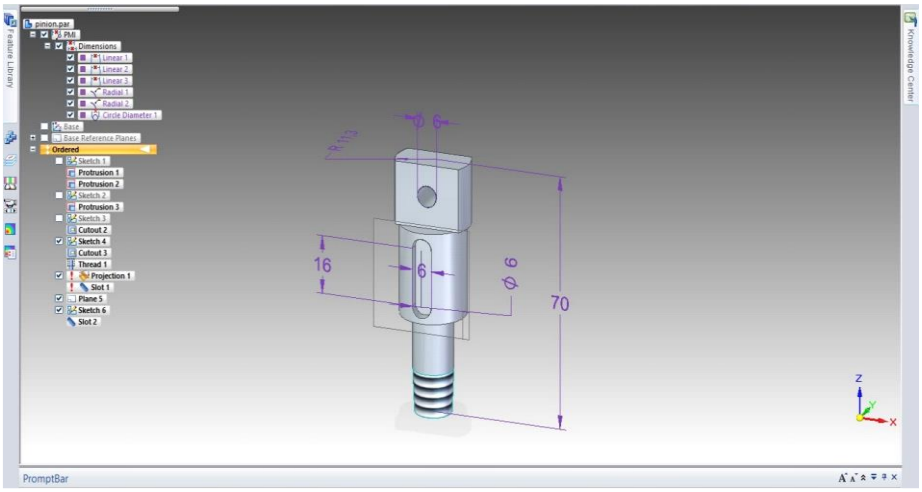
4.2.3 Rod



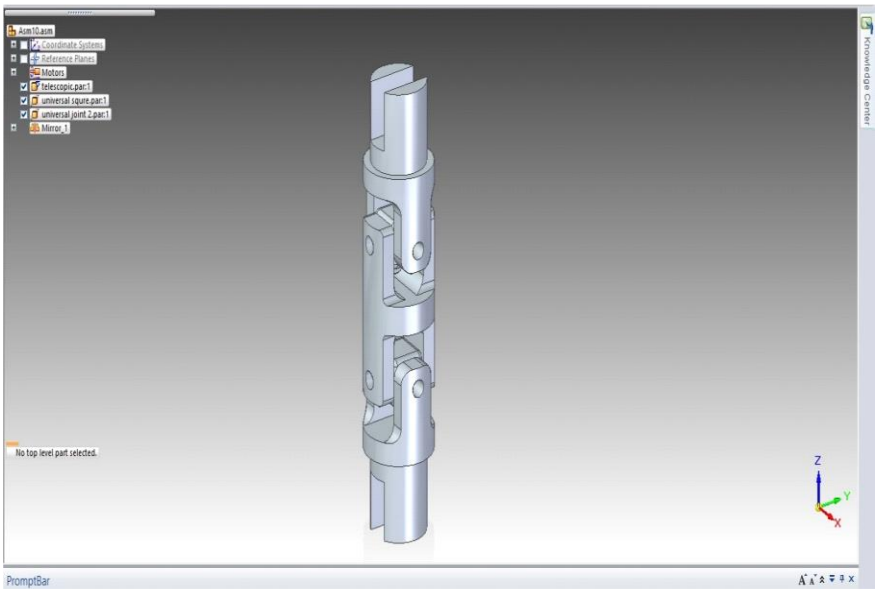
4.2.4 Socket



4.2.5 Pinion



4.2.6 Universal joint



4.3 Assembly

4.3Adjustable Multi Spindle Drilling Attachment

4.4 Design methodology

Design consists of application of scientific principles, technical information and imagination for development of new or improvised machine or mechanism to perform a specific function with maximum economy & efficiency. Hence a careful design approach has to be adopted. The total design work has been split up into two parts;

1. System design.
2. Mechanical Design.

System design is related with the various physical constraints and ergonomics. It also relates with space requirements, arrangement of various components on main frame at system, man + machine interactions, No. of controls. System design is related with position of controls, working environment of machine, safety measures to be provided, servicing aids, ease of maintenance, scope of improvement, weight of machine from ground level, total weight of machine and a lot more.

5.0 Advantages

- With the aid of this attachment, idle time such as setting time is minimized and production rate is enhanced.
- Throughout the drilling process, accuracy and repeatability are maintained.
- Drilling holes and different adjustable locations are possible with this attachment.
- The drills have a larger range of adjustability and lateral movement in respect to each other.
- It can execute many operations at once with different diameter drilling instruments.
- This attachment may be installed with any regular drilling machine rather than a multi-spindle drilling machine (SPM). We were able to lower the capital cost of the production shop in this way.
- Attachment includes interchangeable components, one of which is a drilling machine, and the other is a cleaning, repair, and oiling attachment. Worker is free of headaches throughout the process, and skill workers are not necessary.

6.0 Conclusion

We may drill two holes at once with the aid of this attachment, which allows us to change the center distance between the four drilling spindles. It has the benefit of being portable. Because the machine is smaller than the previous model, it is very easy to transport from one location to another. As a result, this machine is portable. The total amount of space required is likewise shrinking. This machine has a higher efficiency than the previous one. There has been a significant reduction in electricity use. The machine is really easy to use. It drills the holes more quickly.

Productivity can be increased by utilizing a multi-spindle drilling head. Reduced overall machining time is also required. At the same time, four holes of various diameters may be drilled. This machine is both simple to use and small in size. It is also quite light in weight. This machine has a very high efficiency. When compared to other devices, it is relatively inexpensive.

References

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