

Design and Fabrication Multi Spindle Drilling Machine

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ABSTRACT

Generally, the growth of Indian manufacturing sector is largely depends on productivity & quality. Productivity depends upon various factors, one of the major factors is efficiency with which the operation activities are carried out in the industry. Productivity can be highly improved by reducing the machining time and combining the operations etc. As the name indicates multi spindle drilling machines have two spindles driven by a single power head, and these two spindles holding the drill bits are fed into the work piece simultaneously. We can drill two holes at a time with provision of varying centre distance between two drilling spindle. It has advantage of portability. In the conventional manner only one drill can be drilled at a time, but with increase in productivity demands a special purpose machine is needed which will increase productivity by performing multiple operations in one cycle. The Multi-spindle drilling machine is an ideal solution to the above problem which is used to perform multi drilling operations at a time.

KEYWORDS: Spindle, drill, Sun gear, Planet gear, Drill chuck, Productivity, Multi spindle drilling machine, Manufacturing, Development etc

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1. INTRODUCTION

Multiple-spindle drilling machines are used for mass production processes, a huge time saver where many pieces of jobs having multiple holes are to be drilled. Multi-spindle head machines are used in mechanical industries in order to improve the productivity of machining processes. In this system, motions are obtained either by raising the work table or it can be done by lowering the drills head. The centre distance between the drill spindles are adjusted in such a way that spindle are connected to the main spindle by universal joints. In mass production work drill jigs are generally used for guiding the drills in the work piece. Therefore it is necessary to improve productivity as well as quality. If we compare between conventional machine and special purpose machine in terms of time, costs, number of steps involved, etc., the special purpose machine is preferred choice. Designing of Multiple-spindle drilling machines is decided upon the principles of minimization of cost, improved productivity and better safety etc.

2. COMPONENTS USED

The components used in this multi spindle drill head are

- A. Main frame made of rectangular section
- B. Gears and chain drive
- C. Adjustable transmission systems (ATS)
- D. Bearings
- E. Top plates
- F. Bottom plates
- G. Drill chuck
- H. Drill tool

- I. Key and shank
- J. Motor and Shaft
- K. Resting fixtures

3. LITERATURE REVIEW

In the present chapter the contribution made by different researchers and authors in the field of manufacturing were enlist in short. It includes the methods, mathematical modeling, different input parameters as well as their output result. finally the summery of literature review as: Prof. Udgave et.al. explain the importance of radial drilling machine and special purpose machine. He also compares the advantage and disadvantage of both. The growth of Indian manufacturing sector depends largely on its productivity & quality. Productivity depends upon manufacturing efficiency with which the operation/activities are carried out in the organization. The best way to improve the production rate along with quality is by use of special purpose machine. This paper deals with design and development of multi spindle drilling head for cycle time optimization of the component.[1]

Prof. Shingavi et.al. stated that the challenge of modern machining industries is mainly focused on the achievement of high quality, in terms of high production, less wear of cutting tools, economy of machining by considering cost saving and increase the performance of the product. Productivity can be improved by reducing the total machining time, combining the operations Productivity and

performance of the existing drilling machine will be increased by Design & Fabrication of Multiple Spindle Drilling Head.[2]

Prof. Nargatti et.al. explain the importance of productivity. If we reduce total machining time, Productivity can be improved. In case of mass production where variety of jobs is less and quantity to be produced is huge, it is very essential to produce the job at a faster rate. The best way to improve the production rate (productivity) along with quality is by use of special purpose machine. If we design twin spindle drilling head, then it is possible to increase the performance of radial drilling machine.[3]

Prof. Shinde et.al. explain about the growth of manufacturing sector depends largely on its productivity & quality. All manufacturing activities are carried out in organization. In case of mass production where variety of jobs is less and quantity to be produced is huge, it is very essential to produce the job at a faster rate. This is not possible if we carry out the production by using general purpose machines. Special purpose machine can be used to improve the production rate.[4]

4. EXPERIMENTAL SETUP

4.1. PRINCIPLE

As the name indicates twin spindle drilling machines have two spindles driven by a single power head, and these two spindles holding the drill bits are fed into the work piece simultaneously. The spindles are constructed in such a way that their centre distance can be adjusted in any position within the drill head. For this purpose, the drill spindles are connected to the main drive by means of universal joints.

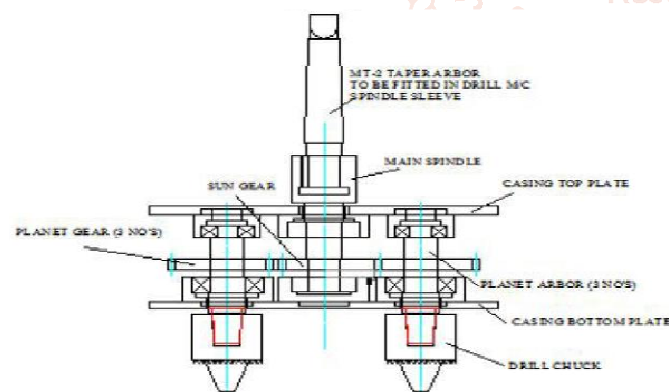


Fig.1 Twin Spindle Drilling Head

There are two planet gears and one sun gear arrangement for transmitting the power from main spindle to planet shaft.

4.2. SELECTION OF MATERIAL AND THEIR PROPERTIES

A. A medium carbon steel usually supplied untreated.

Properties-

- Good tensile strength.
- Readily machinable in any condition.
- Low wear and tear.

B. Mild Steel (Low Carbon Steel)-

Properties-

- Good Modulus of elasticity
- High yield and tensile strength

C. High Speed Steel-
Properties-

- Hardness: Resistance to penetration by diamond-hard indenter, measured at room temperature.
- Hot hardness: The ability to retain high hardness at elevated temperatures.
- Wear resistance: Resistance to abrasion, often measured by grind ability, metal-to-metal, or various other types of tests to indicate a relative rating.
- Toughness: Ability to absorb (impact) energy.

4.3. CONSTRUCTION

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.

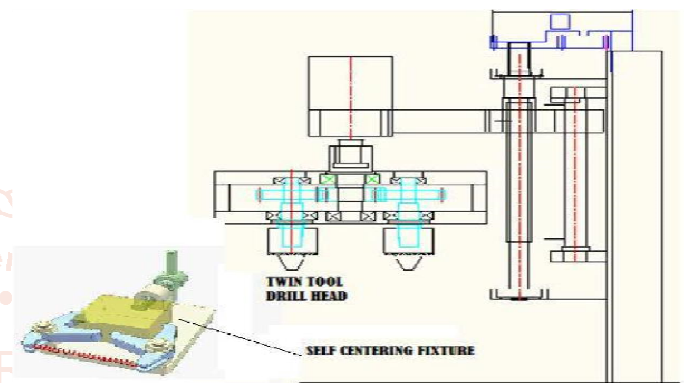


Fig.2 Construction of Twin drill head machine

4.4. WORKING

When machine is started the drilling machine spindle sleeve drives the arbor. It also drives the planet gear system and the drill chucks and respective cutting tools. At the time of feeding the drilling machine spindle in downward direction, the cutting action takes place. For enhancement and fast production an index able drill jig can be mounted on the drill machine table.

The mechanical transmission is controlled by using stepper motor. Entire process falls under the subject of Mechanics, & various fields of technologies must be included to full-fill the target. The involvement of electronic engineering, mechanical engineering, electrical engineering, & control technology helps to become a crucial part in this design. Especially the control circuit designed with microcontroller plays dominant role in this project work. The conversion of rotary to linear motion is done in this mechanism. The power screw is designed which operates a stepper motor according to the switch.



Fig. 3 Multi spindle drilling head

4.5. ASSEMBLY

Drilling is nothing but the use of a rotating multipoint drill to cut a round hole into a work piece. In a lot of manufacturing processes, one of the most indispensable machining tools is the multiple spindle drilling machine. The drilling machine is also known as drill press. It gives response to drill various sizes of holes in any surface area and to precise depths. The drilling machine is used primarily in drilling holes, Multiple spindle drilling machine is capable to perform some other functions. These functions consist tapping, spot facing, reaming, countersinking, and counter boring to name a few. This machine is very efficient. All operations are carried out successfully.

4.6. VARIOUS METHODS OF MULTI SPINDLE

4.6.1. ADJUSTABLE MULTI SPINDLE DRILLING HEAD:

In this attachment the centre distance between drilling spindle can be vary according to requirement. It can be used in many components, where we can drill two work pieces at a time and also it has adjustment lever which can separate two drilling spindle. So we can drill two work piece according to requirement.

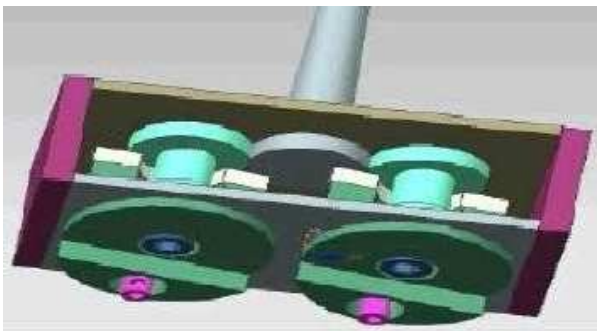


Fig.4 Adjustable Multi spindle Drilling Head

4.6.2. FIXED MULTI SPINDLE DRILLING HEAD

In this attachment centre distance cannot change. Features of both the type multi spindle drilling head are:

- A. By using these multi spindle drilling heads, increase the productivity.



Fig.5 Fixed Multi Spindle Drilling Head

Mechanical design, the components are stored on the basis of their procurement. It has two categories namely.

- A. Designed Parts
- B. Purchased Parts

5. 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;

- A. System design.
- B. 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.

In mechanical design, the components are stored on the basis of their procurement. It has two categories namely.

- A. Designed Parts
- B. Purchased Parts

If we have to make detached design, it is necessary to design part. This amplifies not only assembly but also post production servicing work. The various tolerances on the works are specified. The process charts are prepared. This process charts are passed to the manufacturing stage. The purchased parts are directly selected from various catalogues & specified so that anybody can purchase the same from the retail shop with given specifications.

Step-by-step process of implementing the project:

- Problem identification
- Defining the problem
- Conceptual design
- Selection of material and processes for machine
- Primary assembly of machine
- Trials
- Finishing required parts
- Final assembly
- Inspection

6. CONCLUSION

With the help of this attachment, we can drill multi holes at a time with provision of varying centre distance between two drilling spindle. It has advantage of portability. The size of machine is smaller than the older machine so it is very simple to move from one place to another. So this machine can be easily transported. The overall space required is also minimizing. The efficiency of this machine is better than the older machine. Large saving in power has been achieved. The machine is very simple to operate. It drills the holes at faster rate.

By using multi spindle drilling head, Productivity can be improved. It is also necessary to reduce total machining time. It is possible to drill 2 holes of different diameter can be drill at a time. This machine is very easy to operate and compact in size. Also it is very light in weight. The efficiency of this machine is very high. It has very low cost as compared to other machines.

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