

DESIGN AND DEVELOPMENT OF MULTI-SPINDLE DRILLING HEAD

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ABSTRACT

This Paper converse about the study of design of multi-spindle drilling machine. In the case of mass production the variety of jobs is less and quantity to be produced is large, it is essential to complete manufacturing at faster rate which is not possible using general purpose machines, and hence new manufacturing setup is required and for this purpose an attachment is proposed for a Special Purpose Machine which is Multi-Spindle drilling head. It is used for drilling multiple holes at the same time. The growth of Indian manufacturing sector depends largely on its productivity & quality. Productivity depends upon many factors, one of the major factors being manufacturing efficiency with which the operation /activities are carried out in the organization. Productivity can be improved by reducing the total machining time, combining the operations etc. This paper deals with design and development of Multi-spindle head for cycle time optimization of the component.

KEYWORDS: Multi-spindle drilling attachment, Productivity, Special Purpose Machine

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I. INTRODUCTION

Drilling is the most generally perceived machining process whereby the operation incorporates making round openings in metallic and non-metallic materials. Around 7596 of all metal-cutting method is of the drilling operation. Drills generally have a high length to diameter proportion that is fit for making significant hole, however as a result of its flexibility, vital security measure ought to be taken to keep up accuracy and keep drill from breaking. Drilled holes can be either through holes or visually blind holes. A through holes is made when a drill leaves the inverse side of the work; in blind hole the drill does not leave the work piece. During the operation, chips that are created inside the work piece must exit through the flutes to the outside of the device. As the chip is formed and removed towards the surface, it will produce friction. Friction subsequently warm is likewise created when the drill bit touch the work piece during the hole making process. In this way, chip transfer and cutting fluids are among the most essential components should be consider during this procedure. Regularly, holes created by drilling are greater than the drill diameter and relying upon its applications; the drilled holes will subjected to different operations, for example, reaming or sharpening to better surface complete and dimensional exactness.

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. Multispindle head machines are used in mechanical industries in order to improve the productivity of machining processes. It is used to drill holes for different pitch circle diameters. The centre distance between the spindles can be adjusted in any position as per the requirement of the various jobs. For keeping the centre distance between the gears connected to the main spindle by an Adjustable Transmission System (ATS). In today's market the customer demands the product of right quality, right quantity, right cost, & at right time. Therefore it is necessary to improve productivity as well as quality. The only way to achieve this is by using multi spindle drilling head. Designing of SPM is decided upon the principles of minimization of cost, improved productivity and better safety etc.

Types of Drilling Machine

Based on construction

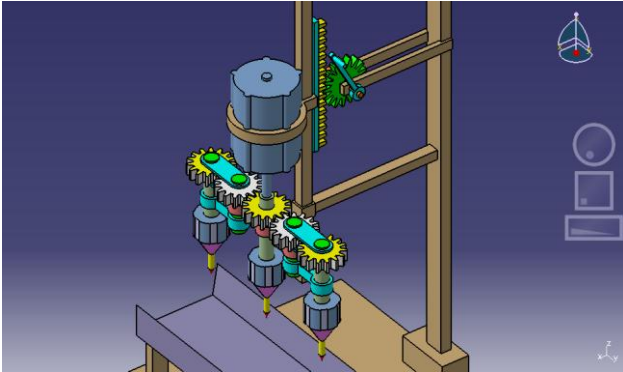
- Portable drilling machine.
- Sensitive drilling machine.
- Radial drilling machine.
- Up right drilling machine.
- Gang drilling machine.

- Multi spindle drilling machine.

Based on feed

- Hand power drilling machine.
- Power driven drilling machine.

II. BASIC PRINCIPLES OF MULTI-SPINDLE DRILLING



1. As the name demonstrates various multiple drilling machines have two spindles driven by a solitary power head and these two spindles holding the drill bits are fed into the work piece simultaneously.

2. The spindles are so constructed that their centre distance can be balanced in any position within the drill head depending upon the job requirement. For this reason Allen Bolt is used.

3. The power from the motor is transmitted by spindle to the centre gear. After the power at centre gear is transmitted to the drilling spindle by compound gear.

DESIGN OF MULTI-SPINDLE DRILLING HEAD

Design procedure

In our attempt to design a special purpose machine we have adopted a very a very careful approach, the total design work has been divided into two parts mainly;

System design

System design mainly concerns with the various physical constraints and ergonomics, space requirements, arrangement of various components on the main frame of machine no of controls position of these controls ease of maintenance scope of further improvement; height of m/c from ground etc. In Mechanical design the components are categories in two parts.

Design parts Parts to be purchased.

For design parts detail design is done and dimensions thus obtained are compared to next highest dimension which are readily available in market this simplifies the assembly as well as post production servicing work. The various tolerances on work pieces are specified in the manufacturing drawings. The process charts are prepared & passed on to

the manufacturing stage. The parts are to be purchased directly are specified & selected from standard catalogues. In system design we mainly concentrate on the following parameter such as System selection based on physical constraints, Arrangement of various components, Components of system, Chances of failure, Servicing facility, Height of m/c from ground, Weight of machine.

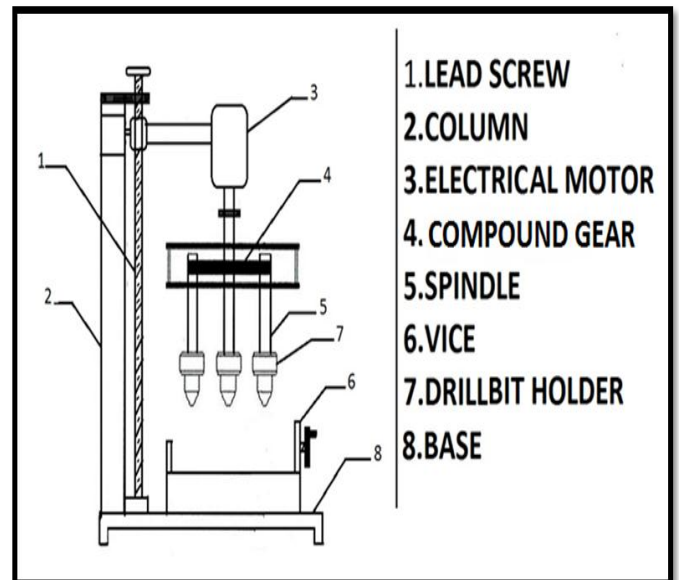


Fig Multi Spindle Setup

COMPONENTS USED

The components used in this multi spindle drill head are

1. Gears
2. Adjustable transmission systems (ATS)
3. Bearing
4. Top plate
5. Bottom plates
6. Drill chuck
7. Drill tool
8. Shank
9. Key
10. Shaft

BASIC TERMINOLOGY

LEADSCREW

Linear motion can be achieved by means other than through the use of lead screws. Chain and cable drives along with belt and pulley drives do not require pumps and support hardware as do hydraulic and pneumatic systems. They can carry very small to very heavy loads at great speeds when needed. However, these systems are not as accurate or as repeatable as lead screws, and they generally require a greater number of components, are more complicated to install, and require more maintenance during operation. In addition, recirculating or running chains, cables, or belts can be a safety hazard. Lead screw drive systems are selected for linear motion over the other possible choices when the requirements are for:

- Accuracy in Positioning
- Load Capacity
- Repeatability

Lead screw assemblies usually consist of the screw and nut assembly supported in bearings and driven with a motor. This sub-assembly is attached to the load to be moved. Because of their compactness and simplicity, lead screw assemblies lend themselves to virtually any kind of drive mechanism. Since the drive method can be directly connected to the lead screw, the motion is much easier to control precisely. If the environment is extreme or if there are special considerations as a result of the application, the choice of lead screw assembly can be severely limited. Examples of special environments might be a vacuum, very high or very low temperatures, extreme temperature variations, environments which require special lubricants or no lubricant at all, and environments that are particularly dirty.

ADJUSTABLE DRILL UNIVERSAL MOTOR

The AC/DC universal motor is found in portable tools such as electric drills, saws, sanders, etc. and in home appliances such as vacuum cleaners, electric mixers, blenders, etc., where high speed, power and small size are an advantage. However, it is closer in concept to the DC motor than to the AC motor and, therefore, has some inherent disadvantages, which could be avoided in purely AC induction motors; chiefly, the need for commutation and brushes. The universal motor is basically a series DC motor which is specially designed to operate on AC as well as on DC. A standard DC series motor has very poor characteristics when operated on AC, mainly due to two reasons:

- The high reactance of both the armature and field windings limits AC current to a much lower value than DC current (for the same line voltage).
- If solid steel is used for the stator frame, AC flux will produce large eddy currents in the frame with consequent heating. To insure satisfactory operation of the universal motor from an AC power source, some modifications are necessary.

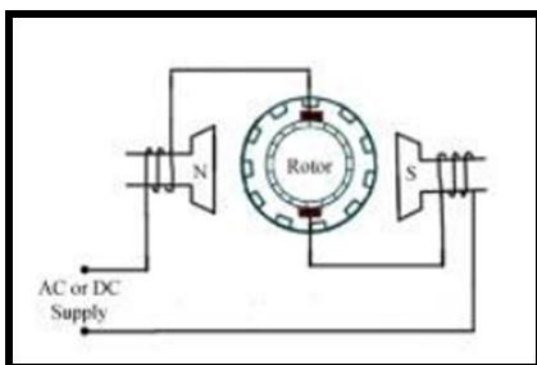


Fig Universal Motor

SPEED REGULATOR

It is a device used to control the speed of rotation of motor. It consists of a series of coils to control the speed. The reactance of the series field and armature windings must be reduced as much as practicable. The reactance of the series field winding can be somewhat reduced by using fewer

turns of heavier wire. However, it would not be practical to eliminate the reactance voltage drop due to the series field since that would also eliminate the magnetic field. The controlling winding is connected in series with the armature winding and arranged such that the ampere turns of the compensating winding oppose and neutralize the ampere-turns of the armature. Due to the inductive reactance of these windings the AC starting current will always be less than the DC starting current. Consequently, the starting torque on AC power will be lower than the starting torque for power supplied.

INDEXING MECHANISM

Two basic precision mechanisms were developed to meet the requirements for accurate spacing: the rotary or circular milling table and the dividing/indexing head. These mechanisms are called indexing devices. The rotary head and dividing head are used to index (locate) one surface or angular dimension in an exact relationship with another. These mechanisms have accessories that permit them to serve also as work holding devices.

INDEXING PLATE

The rotary table permits a work piece to be moved in a circular path. This accessory consists of a base and a rotary table. The base of a simple direct setting rotary table is graduated through 360° in increments of 1-minute. The rotary table is provided with a T-slotted face plate and possibly a chuck. The micrometre collar on the lead screw mechanism reads in degrees, minutes, and seconds. Some rotary tables are geared to the machine table and provide continuous motion.

DRILL BITS

Drill bits are cutting tools used to create cylindrical holes. Bits are held in a tool called a drill, which rotates them and provides torque and axial force to create the hole. Specialized bits are also available for non-cylindrical shaped holes. The shank is the part of the drill bit grasped by the chuck of a drill. The cutting edges of the drill bit are at one end, and the shank is at the other. Drill bits come in standard sizes, described in the drill bit sizes article. The term drill may refer to either a drilling machine or a drill bit for use in a drilling machine. In this article, for clarity, drill bit or bit is used throughout to refer to a bit for use in a drilling machine, and drill refers always to a drilling machine.

Properties	High Speed Steel	Brad Spur	Tungsten Carbide
Drill Bit Type	Twist	Twist	Twist
Point Angle	118	-	140
Helix Angle	30	30	30
Material	HSS	HSS	Tungsten Carbide



Fig: Drill bit

DRILL CHUCK :

A drill chuck is a specialized three-jaw chuck used to hold drill bits or related tools. The image shows the traditional keyed style of drill chuck with its key. The arbour is shown separately to the right. These chucks require a key to provide the necessary torque to tighten and loosen the jaws. The rotary action of the key turns the outer body which acts on an internal screw; this in turn moves the threaded jaws in or out along a tapered surface. The taper allows the jaws to encompass various sizes of drill shanks. The end view shows the three small jaws that slide within the body. Some high precision chucks use ball thrust bearings to reduce friction in the closing mechanism and maximizing drilling torque. These chucks are sometimes referred to as “super chucks”.



Fig:Drill chuck

III. PROBLEM STATEMENT

- The machines run on electricity and requires more power.
- Drilling holes individually is time consuming and not suitable for mass production.
- When various attachments are attached to machine so cost is more and machine is bulky so yet there no other machine developed which consider cutting and drilling operation in one set up, so we selected this problem for our research work which is “Design And Development Of Multi-Spindle Drilling Head

IV. METHODOLOGY

- We started the work of this project with literature survey. We gathered many research papers which are relevant to this topic. After going through these papers, we learnt about 90 degree steering system.
- After that the components were decided.
- After that we selected the materials for the components based on mechanical properties.
- We have done the calculations for the components.
- After doing the calculations of components, the 3D model is done with the help of CATIA software.
- The components will be manufactured and then assembled together. • The testing will be carried out and then results and conclusion will be drawn.

V. CONCLUSION

- By using Multi-Spindle drilling head productivity will be increased.
- Multiple holes can be drilled at a time.
- Multi-Spindle drilling head will reduce the operation cost.
- Multi drilling operation takes place in one cycle so holes will not be skipped.
- This Attachment is beneficial for mass production.

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