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Design and Fabrication of Multi Axis Drilling Machine

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Abstract - *In this paper, controller based 3 axis drilling machines is implemented using Controller, controlling the whole operation. The main purpose of this project is to reduce the time consumed, hard work required and also to reduce the man power. This can be the new invention in the electronics industries which can increase the production rate with greater percent. We can also call it as automation because once you set all the parameters required, the machine will start working without any human interfere. Inspiring from this technology and revolutionary change in the world of digital electronics & Microcontrollers, we are presenting here an idea of "dpdt controller based 3 axis drilling machines". In old technology the main disadvantage of altering the position of the workpiece is that it reduces the accuracy of the finished components. So here in this project we have planned to use multi spindle drilling head instead of using single spindle. If we use multiple spindles than we can decrease the time required to complete the operation. This helps in reducing the cost price of drilling operation. So this system is one of the efficient process with increase in the accuracy of the operation.*

Keywords: **Mechanical, Design, Drill, Fabrication, Productivity.**

1. INTRODUCTION

Drill machine is machine which is used to rotate the drill bit at specific speed & to feed it into the workpiece being drilled. Diameter of hole is depends on size of drill bit (tool). In conventional methods drill machine is consist of the single spindle but Now a days multiple spindle drilling is used to increase the productivity. In that drilling machine multiple holes are produced cumulatively with same accuracy. In multi axis drilling machine we use multiple spindles which are fitted on the columns. All these columns are arranged in circular pattern to drill multiple holes on lateral surface of given workpiece. We can also change the angular distance between the two columns and height of the column is adjustable, hence we can drill a hole at different angular distance and at different height.

1.1 Problem Statement

In simplified manner only single hole can be drilled at a time which does not satisfies the need for increase in productivity demand. To increase productivity, we need special purpose machine which will increase productivity by performing multiple operations in one cycle. Also, to make sure the less efforts of human, there is a requirement for better equipment which is the sole concern behind every invention that we see in our day to day life.

Similarly, in our project we planner to give a cost effective and simpler solution to currently used radial drilling mechanism. Our project is made with consideration of the needs of those small-scale industries and provide them the ease of working which was previously benefited only by the large-scale industries which was having a huge capital investment.

In today's market the customer demands the product of right quality, right quantity and right cost simultaneously.

Therefore it is necessary to improve productivity and quality at a same time. The multi axis drilling machine is a best solution to the above problem. In multi axis drill machine we use multiple spindles which are placed on the columns. All this columns are arranged in circular pattern to drill multiple holes on lateral surface of give workpiece. The angular distance and height between the two columns is adjustable, hence we can drill a hole at different angular distance and at different height. This will minimize the cost and drilling time in an Industrial field. The special purpose machine is developed by using automated columns and uses the three spindle fitted on the columns.

1.2 OBJECTIVE

a. The main objective of our vision is to extend the productivity to survive in current competitive market and it are often only possible by using proper production technology.
b. In current situation various kind of drill machines are available with various features.
c. To make work easier & to realize more accuracy there's got to upgrade the planning of obtainable machine.
d. So we introduce multi axis drill machine here.it takes less time and it requires less human efforts as compared to plain machining.

2. LITERATURE REVIEW

- Prof. Ms. A. A. Shingavi,[1] during this paper they given productivity will increase with the help of multi spindle drilling machine, because using conventional drilling machine four minutes required for produce single hole with tool changing happen for various diameter hole i.e. Only few component produce in one hour. When we used multi spindle drilling head production rate is approximately double. The chance of hole missing is eliminated because multiple holes drilled at a time. When we used multi spindle drilling head machine hour cannot changed.
- P. Kishor Kumar[2] was an scientist, they studied on thrust force and torque in drilling on aluminium 6061-T6 alloy. In that study they show that as diameter of hole increases, thrust force and torque in drilling also increases. They predict the worth of the thrust force and torque by using equation then they measure the particular value by employing a drill dynamometer setup. Predicted value of a thrust force and torque is almost adequate to the observed value.
- G. Niranjana[3], from this paper we studied that drilling depth are often controlled by programmable microcontroller circuit. It is very difficult to regulate and measure the drilling depth of hole manually .in this paper they design and develop drilling machine which wont to drill holes with its different depths using programmed microcontroller system. They integrate all necessary features of IC's to regulate the depth of holes. This paper is integration of production using technology.
- R. Anandhan[4], during this paper they given idea about angular drilling machine, which is employed to bore in any direction it's very complicated to setup job. also time required to setting job is large, angular motion of drilling head is controlled with the assistance of bevel gears. Indexing plate and up and down mechanism is employed to drill holes at different angles. When they use this machine they eliminate geometrical error of drill hole. It is efficient and quick response machine.
- Mr. K. I. Nargatti[5], Proposed that the multi spindle drilling head with varying centre distance. With the assistance of this machine we will produce two holes at same time with varying centre distance between them. Size of this machine is dense then conventional drilling machine. It has better accuracy taking position from one place to a different place. So machine can be easily transported. Efficiency of multi spindle drilling machine is best than conventional drilling machine. It is power saving machine Geetanjali R, during this paper they provide idea about special purpose machine for drilling and reaming. The main purpose of this paper is to scale back the cycle time by replacing drilling machine and reaming machine by special purpose machine for drilling and reaming operation. The concept is that the component having different size and thickness, which are drill on drilling spindle first then reamed. Both the operation condemn on same machine having two separate spindles.
- N. U. Kakade[6], during this paper they studied fabrication of combine drilling and tapping machine. In this machine they proposed gearbox for achieving different speed reduction. Drilling a hole wanted high rpm than tapping and threading. They introduce worm and gear for giant speed reduction .the main aim of this machine is to locate and hold the work do drilling and tapping operation perfectly. Santosh Athashere, in this paper they develop special purpose machine for drilling an angular hole. The purpose of this machine is that to drill an angular hole on workpiece with different size and shapes. In this paper we study the planning and manufacturing special purpose machine for various drilling operations like reaming, boring, spot facing and counter boring. In this project they evolve six way drilling machine tables with automatic feed motion. This machine is compatible for both straight also as inclined hole job.
- M. Narasimha[7], during this paper they provide design adjustable multi-spindle attachment for machining T- slots in a bolster plate. They have designed grinding machine for grinding of three T-slots in a single pass. The range of T-slot spacing for this design is 40 mm – 160 mm. This study concluded that due use of this attachment three T-slots is completed in single pass which saves the time as compared to individual milling, thanks to this production rate is increased.

3. METHODOLOGY

3.1 In multi axis drilling machine we are using three spindles, to drill three holes simultaneously.

3.2 Feed is given manually to drill machine by rotating the handle which rotates the bevel gears, and power is transmitted to lead-screw with the assistance of miter gear.

3.4 The radial travel of a spindle is controlled by lead-screw mechanism, where lead screws are driven by set of bevel gears.

3.5 To control depth of the opening we use limit switch which controls ON/OFF action of drill machine. That limit switch are often adjusted in radial direction as per requirement of depth of hole, hence we will drill a hole with higher accuracy.

3.6 Drill machines are mounted on a stand so by varying height of a stand we will control vertical movement of a drill spindle.

3.7 Therefore we are ready to vary the space of hole from base also we will vary the angle between two holes.

4. BLOCK DIAGRAM

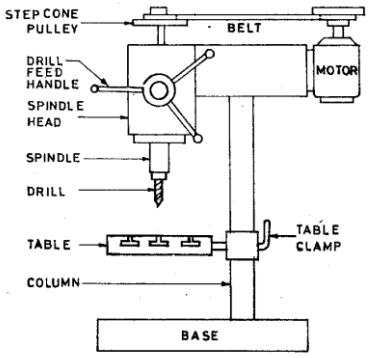

Figure 4.1: Different parts of Drilling Machine.

5. COMPONENTS/ HARDWARES

5.1 DC power source

5.2 DC motor

5.3 Rack gear

5.4 Pinion gear

5.5 Wooden boards

5.6 Dpdt switches

5.7 Channels

5.8 Sliders

6. DESIGN AND CALCULATIONS

Torque

Torque (also known as moment), it is derived from the Latin word twist, is determined as a force that produces or tends to originate rotation or torsion. A torque is generated when a perpendicular force is employed at the end of a shaft, as is shown in the torque diagram below. The value of the torque is then given by the product of this force times the radius (the distance from the pivot to the location where the force is applied), also called the moment arm.

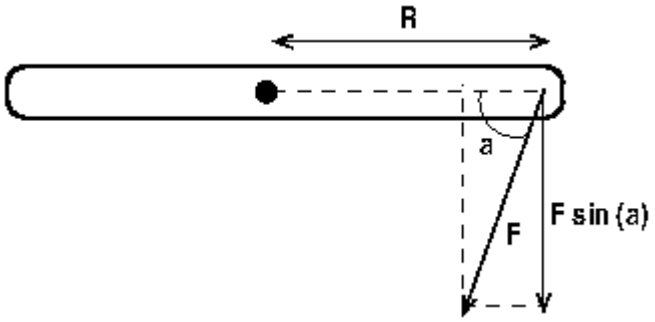

Figure 6.1: The perpendicular component of F produces the torque.

A force *F* is employed to the shaft at an angle '*a*', as shown. The perpendicular component of this force is "*Fsin(a)*" and the moment arm is *R*. Hereby the torque is disposed by

$$T = FR\sin(a)$$

The SI units of torque are 'newton-meter' (N-m) and the other units are 'inch-pound' (in-lb), 'feet-pound' (ft-lb) or 'inch-ounce' (in-oz). The following table shows some conversion units.

SI	English
1 N-m = 0.738 ft-lb	1 in-lb = 0.113 N-m
1 N-m = 0.113 in-lb	1 ft-lb = 1.356 N-m
1 N-m = 141.61 in-oz	1 in-oz = 7.062E-03 N-m

Rotational speed

Rotational or angular speed is studied in precondition of the number of revolutions a shaft makes per unit time. The Greek letter omega 'ω', is in most of the cases used to represent this quantity, and the units are radian/second (rad/s, SI unit), revolution/second (rps) or between others, revolution/minutes (rpm). When usage this parameter in computation, we must use rad/s if all the another units are in the SI system, and degrees/sec if we are usage the English system. An important conversion to flashback is the relationship amid rpm and rad/sec, given by

$$\omega_{rad/s} = \omega_{rpm}\left(\frac{2\pi}{60}\right)$$

It is also important to flashback the following conversions:

1 revolution = 360°

1 revolution = 2π radians

1 radian = 180/ π degrees

1 degree = π/180 radians

Power

In rotational motion, power is determined in precondition of the torque, as follows

$P = T_{\omega}$

The norm SI unit of power is watts (W), which is equal to N-m/s, and in the English system we commonly use ft-lb/s, or horsepower (hp). The following table shows some conversions:

SI	English
1 W = 1 N-m/s	1 ft-lb/s = 1.618 E-03 hp
1W = 0.738 ft-lb/s	1 ft-lb/s = 1.356 W
1 W = 1.341E-03 hp	

7. RESULT AND DISCUSSION

In current script, for increasing productivity we have to decrease the machining time. For deficiency of machining time we have to condemn multiple operations simultaneously. In our design ready to "we will able to drill three holes at a time". There are various method available for multiple hole drilling, but most of them aren't ready to drill on lateral surface and at various angle . Most of those mechanisms are ready to drill holes only on one plane also as by using this mechanism we aren't ready to vary the peak of hole from base.

In our design, we facilitates to the operator to drill multiple hole, with various angular distance and at various height from the base of the job. Therefore by using this mechanism we are able to increase the flexibility of operations as well as productivity.

8. CONCLUSIONS

By using 3 axis drilling head productivity is going to be increased. Because with the present process one hole produces at a time requires 12 seconds for each component i.e. 2400 parts are produced during 8 hours. Possibility of hole missing is eliminated, because anywhere holes drilled at a time. The cost per piece is reduced.

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