



# Design and Fabrication of 360 Degree Flexible Drilling Machine

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## ABSTRACT

Drilling is a cutting and material removal process in which holes are made with the help of a drill bit, often multi-point cutting tool. Drilling process involves, the drill bit to rotate at high rpm (revolutions per minute) against the surface of the workpiece. Thus, the unwanted part will be drilled, and the material will be drawn from the hole in the form of chips along the shank. Therefore, Drilling machine is one of the machines which is very important and is the heart of an industry. The purpose of our project is to make the drilling machine to rotate flexibly in 360 degrees to make it more convenient. The machine is compact and by using this machine, total cycle time will be reduced and also, once the workpiece is clamped on the base plate, there is no need to move the workpiece to different locations for the purpose of drilling, it minimizes the number of machines required and human fatigue is also minimized. With the contrast of this machine, we can drill in any direction at any angle with minimized human effort. The machine is mounted on a flat surface which is supported by legs. In this drilling machine we have used rack and pinion mechanism to move the drill in different angles, so the machine can work in less space with efficiency. Multiple operations can be done by changing the tool in the tool holder. This machine can also be used in automation.

## INTRODUCTION

360-degree flexible drilling machine is a type of drilling machine which can drill in 360-degree angle with accuracy and precision in circular cross-section. We have chosen this project as the drilling machine is the heart of any industry. It is very essential and plays a crucial role in an industry. Drilling is a cutting process in which it uses a drill bit usually multi point cutting tool to cut a hole of circular cross-section in solid materials. The drill bit cuts a hole with its sharp cutting edges and rotary motion and as the drill bit fed into the surface of the workpiece, hole will be cut. The drill bit

head makes the drill bit to rotate at hundreds to thousands of rotations per minute (revolutions per minute) which makes cutting edges of the drill bit to remove the unwanted material from the workpiece along the shank. With these high-speed revolutions of the drill bit, it can cut almost any material with accuracy and precision except for rocks. In rock drilling even these high speeds and sharp cutting edges cannot make a hole just with the drill bit and the speed. Therefore, we use a hammer, the hole usually made in rock drilling by hammering the drill bit into the hole by quick short movements and the hammering action can be

performed within the hole or can be performed outside the hole.

We have chosen this user defined project (UDP) as our final year project. Because we are decided to develop this 360-degree flexible drilling machine which can perform multiple operations like tapping, drilling, grinding, reaming, and other relative operations just by changing the tool inside the tool holder. This 360-degree flexible drilling machine uses battery as its power source for drilling and various other operations. We have tried to develop a portable drilling machine which is easy to handle, easy to carry and which can perform cutting at various locations of the same workpiece without moving the workpiece. For a small-scale industry this flexible drilling machine can be used for various operations like drilling, tapping and other similar processes. As we know that drilling machine requires electricity for functioning which makes it inconvenient. Therefore, the 360-degree drilling machine is implemented with a battery as its power source which makes it portable. Various operations can be done on this flexible machine. For an example, the tapping operations can be performed by the use of convention tap or hand tap. During operation it is necessary with a hand tap to periodically reverse rotation to break the chip formed during the cutting process, thus preventing effect called crowding that may cause defect. In convention method, main problem causes during the tapping operation for big job industries and complex job these causes are created defect on tap tool, increasing operational lead time, inaccuracy of thread geometry, more production cost and more labor cost. This machine is helpful when workpiece is massive and unable to move. By using this flexible drilling machine initial cost, maintenance cost, floor area, human fatigue etc. can be reduced with precision and accuracy. The machine supported on a flat table with supporting legs.

## METHODOLOGY

Drilling is the method of making holes in a work piece with metal cutting tools. Drilling is associated with machining operations such as trepanning, counter boring, reaming and boring. A main rotating movement is common to all these processes combined with a linear feed. There is a clear distinction between short hole and deep hole drilling. The drilling process can in some

respects be compared with turning and milling but the demands on chip breaking and the evacuation of chips is critical in drilling. Machining is restricted by the hole dimensions, the greater the hole depth, the more demanding it is to control the process and to remove the chips. Short holes occur frequently on many components and high material removal rate is a growing priority along with quality and reliability.

**Solid drilling** is the most common drilling method, where the hole is drilled in solid material to a predetermined diameter and in a single operation.

**Trepanning** is principally used for larger hole diameters since this method is not so power-consuming as solid drilling. The trepanning never machines the whole diameter, only a ring at the periphery. Instead of all the material being removed in the form of chips, a core is left round the center of the hole.

**Counter boring** is the enlargement of an existing hole with a specifically designed tool. This machine removes a substantial amount of material at the periphery of the hole.

**Reaming** is the finishing of an existing hole. This method involves small working allowances to achieve high surface finish and close tolerances.

The cutting speed, or surface speed ( $v_c$ ) in for drilling is determined by the periphery speed and can be calculated from the spindle speed ( $n$ ) which is expressed in number of revolutions per minute. During one revolution, the periphery of the drill will describe a circle with a circumference of  $\pi \times D_c$ , where  $D_c$  is the tool diameter. The cutting speed also varies depending upon which cutting edge across the drill-face is being considered.

A machining challenge for drilling tools is that from the periphery to the center of the drill, the cutting speed declines in value, to be zero at the center. Recommended cutting speeds are for the highest speed at the periphery.

The feed per revolution ( $f_n$ ) in mm/rev expresses the axial movement of the tool during one revolution and is used to calculate the penetration rate and to express the feed capability of the drill.

The penetration rate or feed speed ( $v_f$ ) in mm/min is the feed of the tool in relation to the work piece expressed in length per unit time. This is known as the machine feed or table feed. The product of feed per revolution

and spindle speed gives the rate at which the drill penetrates the work piece. The hole depth (L) is an important factor in drilling as is the radial cutting depth ( $a_p$ ) and feed per tooth ( $f_z$ ) for calculations.

#### 1) Machining holes

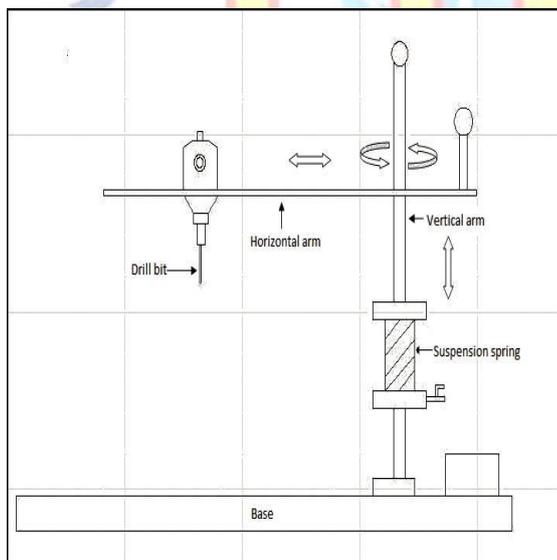
Holes are either made or finish machined. Most work pieces have at least one hole and depending upon the function of the hole, it needs machining to various limitations.

#### The main factors that characterize

A hole from the machining point of view are:

- Diameter
- Depth
- Quality
- Material
- Conditions
- Reliability
- Productivity

#### BLOCK DIAGRAM



#### ADVANTAGES

Here are some of the advantages of using this 360 Degree Flexible Drilling Machine :

- ❖ The setup of the machine is simple and compact.
- ❖ Machine is easy to handle.
- ❖ Portable Machine.
- ❖ Eco-friendly.
- ❖ The machine can drill in any direction automatically.
- ❖ Low installation cost.
- ❖ Low maintenance cost.

- ❖ Simple in construction.
- ❖ Workpiece with massive weight can be drilled without moving it.
- ❖ Less space is required.
- ❖ Less moving parts.
- ❖ It can drill in congested and difficult place.
- ❖ This method can reduce the setting time of operation.
- ❖ The handling cost of machine is reduced.

#### APPLICATIONS

The Power generated can be used in many places like

- Drilling small holes, Tapping, spot facing, reaming, counter sinking and counter boring etc.

#### CONCLUSION

Therefore, by using this 360 Degree Flexible Drilling Machine which is very compact, thick and massive workpieces can easily be drilled without moving the workpiece. It utilizes the power from a battery which reduces the overall operational cost. Due to the usage of the battery as the power source, this machine is portable, easy to carry, and easy to maintain. Lubrication costs are also reduced since it has fewer moving parts thereby reducing the overall maintenance cost of the machine. The rack and pinion mechanism of the machine makes the arm elongate or shorten according to the requirement. Various operations can also be performed on the workpiece rather than drilling by changing the tool inside the tool holder which minimizes the human effort significantly. Therefore, the machine is very affordable with quality performance.

#### FUTURE SCOPE

- ❖ This machine can be used in every industry.
- ❖ Complete Automation can be achieved.
- ❖ It will be more flexible and easier to adjust.
- ❖ The method of rotation of arm and drill can be used in machining operation.
- ❖ The portability of a machine can be increased.
- ❖ Locking of the base with the flat surface can be improved.
- ❖ This mechanism can also improve in other machinery for easy movement and increase the productivity.
- ❖ We can use servo motor in our machine to provide the automation by giving auto feed.

- ❖ We can use telescoping arm to increase the working envelope of the machine to reach in any direction easily.
- ❖ We can use hydraulic system or hydraulic lubrication to operate the machine in smooth manner without including the less fatigue of man power.

#### **Conflict of interest statement**

Authors declare that they do not have any conflict of interest.

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