MODELLING OF FLEXIBLE DRILLING MACHINE

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Abstract:
At present the drilling process we used do not support an additional degree of freedom apart from hand drill at larger scale and also caused various problems. Some parts cannot drill due to small work space between drill bit and work piece. So here we propose a 360 degree flexible drill that can be mounted on a table or wall and can be used to drill holes horizontally, vertically or even upside down. So this make it possible for easy drilling in even complicated parts and surfaces.

I. INTRODUCTION

Drill machines have been the heart of every industry. Drilling holes in parts, sheets and other known metallic structures is very important operation in an industrial working parameter. Perfect and well aligned drilling needs fixed and strong drills. Some parts cannot be drilled using fixed drills due to less space between bit and drill bed. We need to use hand drills in such cases but hand drills have proper alignment problems while drilling. So here we propose a 360º flexible drill that can be mounted on a table or wall and can be used to drill holes horizontally, vertically or even upside down. So this makes it possible for comfortable drilling in even complex structured parts and surfaces. Thus we use rotating hinges and connectors with motor mount and supporting structure to design and fabricate a 360 degree drilling machine for easy drilling operations. Drilling machine is one of the important machine cylindrical hole of predefined diameter and depth on metal work pieces. Though holes can be made by different machine tools in a shop, drilling machine is designed specifically to perform the operation of drilling and similar operations. Drilling can be done easily at a low cost in a small period of time in a drilling machine. Drilling can be called as the operation of producing a cylindrical hole of predefined diameter and depth by removing metal by the rotating edges of a drill. The cutting tool known as drill is fitted in the spindle of the drilling machine. A mark of indent is made at the required location with a center punch. The rotating drill is pressed at the indent location and is fed into the work. The hole can be made up to a required depth. Drilled holes are characterized by their sharp edges on the entrance side and the presence of burrs on the exit side. Also, the inside of the hole usually has feed marks. Drilling may affect the mechanical properties of the work piece by creating low...
residual stresses around the whole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface.

A. Drilling Machine Construction The basic parts of a drilling machine are its base, supporting arms and drill bit. The base made of mild steel or other hard material may rest on a bench, floor depending upon the design. Larger and heavy duty machines are grounded on the floor. The arms are mounted on base with the cuboidal box at base to rotate about it. It is accurately machined and the arms can move up, down and rotate about x-axis. The drill chuck, an electric motor and the mechanism meant for driving the chuck at different speeds are mounted on the top of the upper arm. Power is transmitted from the electric motor to the drill chuck.

B. Drilling Machine Working Principle
The working principle of this flexible drilling machine is initially started from the D.C. motor through full wave rectifier. In which there is one power sources, received from the rectifier. Then the arm rotates at 360 degree and moves anywhere when drilling is required up to its maximum arm length. With the help of my project we can drill in complicated parts accurately.

II. MATERIAL AND METHODS
My project even be rotate easily drill at any direction. So that job setting operation is not complicated as well the setting time is reduced for the operation. It also takes into consideration the most effective method of controlling the drilling machine manually. Materials like wood, plastic and light metals drilled with this. The work piece is fixed on the work table. As the machine tool exert Vertical pressure to original a hole it loosely called a drill press. This Drilling is performed at Different Position in the working job. Up/Down and rotating mechanism is available in this Drilling Machine. One end of the arm is attached to a firm base while the other has a tool at its end. These arms are made up of Aluminum. The number of desired positions of the drill bit and workspace defines the degree of freedom. The main aim of the mechanical linkages are usually designed to convert a given input force and movement into a accordingly desired output force and movement.
III. LITERATURE REVIEW

[1] In Indian manufacturing sector the growth of manufacturing depends largely on its productivity. Drilling machine is used primarily in drilling holes, there are a few other functions that the multiple spindle drilling machine is capable of performing the functions include tapping, spot facing, countersinking, and counter boring to name a few. [2] Multispindle drilling attachment works mainly on planetary gear system arrangement. Multi Spindle drilling attachment main function is more than one drilling operation at a time. It has many advantages like increase the production, decrease the operation time, reducing the labor cost, increase productivity and many more. Also reduce the cycles of operations.

[3] This is not possible if carry out the production by using general purpose machines (Bankar et al., 2013). Although these multiple spindle drilling attachment performs basic drilling operations, there are some specific functions that are performed more accurately and conveniently by each of these types. [4] 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 quite difficult if we carry out the production by using general purpose machines. [5] The best way to improve the production rate (productivity) along with quality is by use of special purpose machine (Spicer et al., 2005; Bhandari). Usefulness and performance of the existing radial drilling machine will be increased by designing and development of multispindle drilling head attachment (Allen et al.). Until the 1990s, many manufacturing experts believed that CNC multi-spindle automatics would never be very successful, given their high costs, complexity and susceptibility to failure. [6] On the other hand, it could be foreseen that cam-controlled machines had no longer a future. Convincing solutions could only be achieved if multi spindle machines were designed and constructed in a completely new way with a view to CNC technology, that is, if "genuine" CNC machines were created. [7] A multi-spindle automatic can be a horizontal or a vertical lathe designed for series production according to a preestablished program with a fixed sequence of operations. The characteristic feature of these machines is, in accordance with European Standard EN 13788, the spindle drum usually comprising six or eight work spindles arranged in parallel on a pitch circle. For example, a multi spindle drilling unit manufacturer, Auto Drill designs and manufactures Multiple Spindle Drilling units for its customers.
IV. COMPONENTS

1. METALLIC LED DRIVER

The main function of the metallic LED driver is to provide a step down voltage to the drill bit. It steps down the direct supply of 240 volts to 12 volt thus reducing it to 20 times to give a proper amount of the voltage and current to supply. LED driver is an electric circuit used to power a light emitting diode (LED). The circuit must provide sufficient current to light the LED at the required brightness, but must limit the current to prevent damaging the LED. The drop voltage across an LED is approximately constant over a wide range of operating current; therefore, a small increase in applied voltage greatly increases the current. Very simple circuits are used for low-power indicator LEDs. More complex, current source circuits are required when driving high-power LEDs for illumination to achieve desired current regulation.

2. DRILL BIT

In which drill bit are used of twisted type drill. It is of material Carbon Steel. Its diameter is of 2.3 mm. This is used to make drill on wood, plastic and light metals. Drill bits are cutting tools used to remove material to create holes defined by a particular diameter almost always of circular cross-section. Drill bits come in multiple sizes and shapes and can create different kinds of holes in many different materials. In order to create holes drill bits are usually attached to a drill which powers them to cut through the different workpiece, typically by rotation. Drill bits come in standard sizes, described in the drill bit size article. There are also certain specialized drill bits that can create holes with cross-section that are not circular. Most drill bits for consumer use have straight shanks. For heavy duty drilling in industry, taper shanks bits are sometimes used. Other types of shank used include hex-shaped, and various quick release systems.

3. CUBOIDAL BOX LINKAGE

The main and the foremost linkage that is used in our project is the cuboidal box linkage that provides rotation of the arms the only problem arise of the friction between the linkages. In total there are 4 box linkages one at the bottom hinged at the base metal plate and the bottom most support is provided by the wooden support the other 2 box linkages are at the center that can slide upon rotate upon one another providing the three degrees of freedom in XYZ directions and the left out box is supported on the upper arm end supporting the drill bit and providing the 4th DOF by locking bit using screw mechanism.

4. NUTS AND BOLTS

It is used for the connection of the fixed and moving linkages there are almost 12 bolts and 38 nuts use in the assembly of the whole mechanism.

5. BASE TABLE

The bottom of the cuboidal box is held to metallic plate of MS that is further screwed to the wooden plate for providing a firm support to the whole mechanism and for bearing the weight of the drill bit.

V. SPECIFICATION

Diameter of the drill = 2.3 mm (material – carbon steel)
Length of the drill = 20 mm
LED driver voltage = 12 volt
LED driver current = 2 amp
Max power output at drill = 24 watt
VI. MACHINING CALCULATION

A. Cutting Speed (V) – \( V = \pi DN \)
   Where, \( D \) = diameter of drill in mm = 2.3 mm
   \( N \) = speed of rotation in mm = 2500 rpm
   \( V = 301.069 \text{ mm/sec} \)

B. Feed Rate (f) – \( L/TN \)
   Where, \( L \) = total length on which drilling operation is done including the
     Overtravel and approach
   \( T \) = time taken to perform drilling operation

C. Depth of Cut (d) – \( d = D/2 \) \( d = 1 \text{ mm} \)

D. Material Removal Rate – \( \text{MRR} = (\pi D^2/4)f N \)
   Now we have performed an experiment on the small thickness of wooden material of the
   length to be drilled be 7.5 mm on calculating the time taken to perform the operation was
   11.5 sec now from the above known data the value of the feed rate and MRR is calculated.

\[
\begin{align*}
F &= L/TN \\
&= (7.5+0.5D+0.5D)/11.5 \times 2500 \\
F &= 0.0204 \text{ mm/rev}
\end{align*}
\]

\[
\begin{align*}
\text{MRR} &= (\pi D^2/4)f N \\
&= (\pi \times 2.3 \times 2.3/4) \times 0.0204 \times 2500 \\
\text{MRR} &= 211.89 \text{ mm}^3/\text{min}
\end{align*}
\]

E. Torque = \( 60 \times P/2\pi N \)
   The power obtained from the metallic LED driver that has been acting as a step down
   transformer transfers a constant voltage to the drill of 12 volt and so the power output in 24
   watts and the rpm of the bit is 2500 So,

\[
\begin{align*}
\text{Torque} &= 60 \times 24/2 \times \pi \times 2500 \\
\text{Torque} &= 0.0916 \text{ Nm OR 91.6 Nmm}
\end{align*}
\]

VII. WORKING
The working is quite simple as the power supply is on the metallic driver does its function of stepping down the voltage and transferring the voltage under a safety limit to the drill bit that is 12 volt, the LED metallic driver we are using is a constant voltage type. After switching on the drill starts to rotate at an rpm of nearly 2500 and the desired action can be done further. As we know that main aim of our project design is to add an extra degree of freedom to the drill bit apart from the 3 DOF that comes in action from the linkages and cuboidal structure. For the purpose of drilling operation the lower and upper arms are free to rotate and with the help of manual force the operation of drilling can be done on any sort of workpiece.

VIII. CONCLUSION
The main aim to add an extra degree of freedom can easily be achieved and this can be extend on a larger scale at an industrial level that can lead to minimal working and operation time.

ADVANTAGE
- Quite efficient drilling operation and additional DOF
- Flexibility
- Usage is easy
- Appreciable Reduction in cost
- Minimal operation time
- Reduction in overall manufacturing cost as well as effort

APPLICATION
- It can be quite useful in furniture manufacturing industry
- With the help of servo mechanism motors and embedded system the whole drilling operation can be made automatic.
- If the joints can be replaced by servo motors than this whole structure can be used in F1 race pit stop for changing wheels more fast and accurately.

IX. REFERENCES
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