RESEARCH ARTICLE OPEN ACCESS

Design & Fabrication of 360° Flexible Drilling Machine

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ABSTRACT
In previous drilling machine many of the problems arise during drilling. Some parts cannot drill due to small work space between drill bit and work piece. So we use hand drills in this cases but it cause alignment problems. So here i 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.

Keywords:- 360˚, Flexibility, Drill Bit

I. INTRODUCTION
Drill machines have been the heart of every industry. Drilling holes in parts, sheets and structures is a regular industrial work. Perfect and well aligned drilling needs fixed and strong drills. Some parts cannot be drilled using fixed drills due to low space between drill bit and drill bed. We need to use hand drills in such cases but hand drills have alignment problems while drilling. So here i 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 easy drilling in even complicated parts and surfaces. Thus i 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 most important machine tools in a workshop. It was designed to produce a cylindrical hole of required 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 shorter period of time in a drilling machine.Drilling can be called as the operation of producing a cylindrical hole of required diameter and depth by removing metal by the rotating edges of a drill. The cutting tool known as drill is fitted into the spindle of the drilling machine. A mark of indentation is made at the required location with a center punch. The rotating drill is pressed at the location and is fed into the work. The hole can be made up to a required depth. Drilled holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical 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, drill head and chuck. The base made of cast iron 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 help of hinge 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. MATERIALS & METHODS
My project even be rotate easily drill at any direction. So that job setting operation is not complicated as well as reduces the setting time for the operation. It also takes into consideration the most effective

method of controlling the drilling machine by 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 for Different Position Drilling 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. These arms are made up of Aluminum. The number of parameters in the subgroup is called the degrees of freedom of the joint. Mechanical linkages are usually designed to transform a given input force and movement into a desired output force and movement.

Fig. 1: (a) Rotation of Upper Arm about Vertical Hinge

Fig. 2: (b) Rotation of Bottom Arm about Vertical Hinge

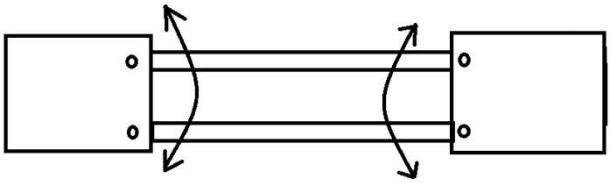


Fig. 3: (c) Up/Down Movement of Bottom Arm about Horizontal Hinge

Fig. 4: (d) Up/Down Movement of Upper Arm about Horizontal Hinge

Fig. 5: – 360 Degree Flexible Drilling Machine

III. LITERATURE REVIEW

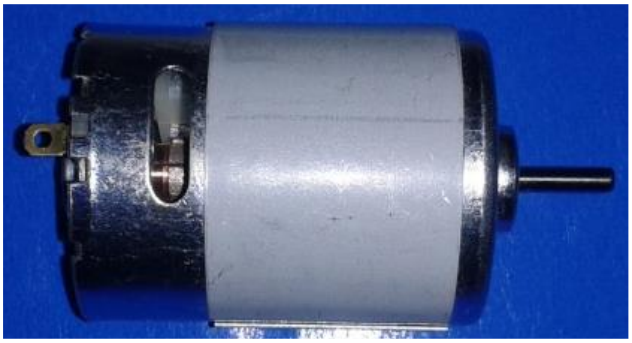
In order to model surface roughness, several methods had been used in previous research. Mr. K. I. Nargatti, Mr. S. V. Patil , Mr. G. N. Rakate (2016) developed a model in Multispindle Drilling Head with Varying Centre Distance. Multiple-spindle drilling machines are used for mass production, a great time saver where many pieces of jobs having many holes are to be drilled. Multi-spindle head machines are used in mechanical industry in order to increase the productivity of machining systems. This machine has two spindles driven by a single motor and all the spindles are fed in to the work piece simultaneously. Feeding motions are obtained either by raising the work table or by lowering the drills head. As the name indicates multiple 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 so constructed that their centre distance can be adjusted in any position within the drill head depending on the job requirement. The positions of

those parallel shafts holding the drills are adjusted depending upon the locations of the holes to be made on the job. Based on the literature review, the most parameters that widely considered when investigating the operation of a machine are feed rate, spindle speed and depth of cut. Most of the researches didn't consider the uncontrolled parameters, such as tool geometry, tool wear, chip loads, and chip formations, or the material properties of both tool and work piece.

IV.COMPONENTS

1) Motor

It is an electrical device which converts electrical energy to mechanical energy. It rotates shaft which support by bush in it when power is supply through rectifier. This shaft connect with drill bit through chuck to rotate drill bit and make hole on work piece when it is required. Is of high torque capable which required for drilling. An electricmotor is an electrical machine thatconverts electricalenergy into mechanica l energy.The reverse of this is the conversion of mechanical energy into electrical energy and is done by an electric generator, which has much in common with a motor.Most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force. In certain applications, such as in regenerative braking with traction motors in the transportation industry, electric motors can also be used in reverse as generators to convert mechanical energy into electric power.



2) Connecting Rod

It connects the two Frames to each other for supports between them to help to move when we required. It consist of metal strips of two sizes one of 12" (inch) and another is of 15" (inch). Both are of four pieces of equal length. A hinge is a mechanical bearing that connects two solid objects, typically allowing only a limited angle of rotation between them. Two objects connected by an ideal hinge rotate relative to each other about a fixed axis of rotation: all other translations or rotations being prevented, and thus a hinge has one degree of freedom. Hinges may be made of flexible material or of moving components. In a many joints function as hinges like the elbow joint. In Hinges appear in large structures such as elevated freeway and railroad viaducts. These are included to reduce or eliminate the transfer of bending stresses between structural components, typically in an effort to reduce sensitivity to earthquakes. The primary reason for using a hinge, rather than a simpler device such as a slide, is to prevent the separation of adjacent components. When no bending stresses are transmitted across the hinge it is called a zero moment hinge.

3) Pulleys

A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. In the case of a pulley supported by a frame or shell that does not transfer power to a shaft, but is used to guide the cable or exert a force, the supporting shell is called a block, and the pulley may be called a sheave. A pulley may have a groove or grooves between flanges around its circumference to locate the cable or belt. The drive element of a pulley system can be a rope, cable, belt, or chain. Hero of Alexandria identifiedthe pulley as one of six simple machines used to lift weights. Pulleys are assembled to form a block and tackle in order to provide mechanical advantage to apply large forces. Pulleys are also assembled as part of belt and chain drives in order to transmit power from one rotating shaft to another. A set of pulleys assembled so that they rotate independently on the same axle form a block. Two blocks with a rope attached to one of the blocks and threaded through the two sets of pulleys form a block and tackle.

4) Bearing

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts. Rotary bearings hold rotating components such as shafts or axles within mechanical systems, and transfer axial and radial loads from the source of the load to the structure supporting it. The simplest form of bearing, the plain bearing, consists of a shaft rotating in a hole.

5) Screws

A screw joint is a one-degree-of-freedom kinematic pair used in mechanisms. Screw joints provide single-axis translation by utilizing the threads of the threaded rod to provide such translation. This type of joint is used primarily on most types of linear actuators and certain types of cartesian robots. A Screw joint is sometimes considered as a separate type but it is actually a variation of bolted joint. The difference is that a screw is used rather that bolt, thus requiring an internal thread in one of the jointed parts. This can save space, however, continuous reuse of the thread would probably damage the coils, making the whole part unsuitable. A screw is an inclined plane wrapped around a nail. Some screw threads are designed to mate with a complementary thread, known as a female thread (internal thread), often in the form of a nut or an object that has the internal thread formed into it. Other screw threads are designed to cut a helical groove in a softer material as the screw is inserted. The most common uses of screws are to hold objects together and to position objects

6) Drill Bit

In which drill bit are used of twisted type drill. It is of material Carbon Steel. Its diameter is of 2mm. This is used to make drill on wood, plastic and light metals. Drill bits are cutting tools used to remove material to create holes, almost always of circular cross-section. Drill bits come in many 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 work piece, typically by rotation. The drill will grasp the upper end of a bit called the shank in the chuck. Drill bits come in standard sizes, described in the drill bit sizes article. A comprehensive drill bit and tap size chart lists metric and imperial sized drill bits alongside the required screw tap sizes. There are also certain specialized drill bits that can create holes with a non-circular cross-section. Most drill bits for consumer use have straight shanks. For heavy duty drilling in industry, bits with tapered shanks are sometimes used. Other types of shank used include hex-shaped, and various proprietary quick release systems. The diameter-to-length ratio of the drill bit is usually between 1:1 and 1:10. Much higher ratios are possible (e.g., "aircraft-length" twist bits, pressured-oil gun drill bits, etc.), but the higher the ratio, the greater the technical challenge of producing good work.

V. SPECIFICATION

A. Specification of Motor:

Type of Motor – D.C. Motor
Speed – Max 4000 rpm
Voltage – 12 Volt
Supply – D.C. Supply
Current – 0.2 – 1.2 AMP
Power – 2.4 – 15 watt
Frequency – 50 Hz
Controller – Hand

Weight – 150gm
Shaft dia. – 3.17 mm
Diameter – 36mm
Length (Body) – 50mm
Length (Shaft) – 16mm
Main Color – Silver Tone
Material – Metal Net

B. Specification of Drill Chuck:

Length = 15mm
Diameter = 7mm
Type of Chuck – Fibre

C. Bit:

Diameter – 2mm
Material – Carbon Steel
Type of Bit – Twist Drill Bit

VI. MACHINING & DESIGN PARAMETERS

A. Cutting Speed (V) –
$V = \pi DN$
Where, D = diameter of drill in mm = 2mm
N = speed of rotation in mm = 1750 rpm
V = 183.259 mm/sec
B. Feed Rate (f) –
40 mm/min
C. Depth of Cut (d) –
d = D/2
d = 1 mm
D. Material Removal Rate –
MRR = $(\pi D2/4)f N$
MRR = 219911.485 mm3/min

E. Machining Time –
t = L/f
Where, L = length of the hole to be drilled = 10cm
f = feed of the drill = 40 mm/min
t = 0.25 min
F. Torque –
P = 15 watts , N = 1750 rpm
$P = 2\pi NT/60$
$T = P \times 60/2\pi N$
$T = 15 \times 60/2\pi \times 1750$
T = 81.8511 N-mm

VII. WORKING

1) In which all the component is mounted on table. This support the arm to rotate freely.
2) Arm rotates manually when where it is required.
3) Motor are mounted on Arm which moves where work piece is to drill.
4) Put drill bit point on work piece area where drill is required.
5) Switch on the main supply which of A.C.
6) Then this A.C. flow through Rectifier and convert to Pure D.C.
7) This rotates motor and also bit rotates.
8) After make hole where on work piece is required.
9) Then switch off the main supply.

VIII. CONCLUSION

This project is an efficient operation and competitive cost. Since a number of operation and hole can be performed in a simple unit.
It is efficient and economical. Considering its uses and cost of project, it becomes relatively cheap when compared to other units.

A. Advantage

1) EFFICIENT DRILLING
2) 360 DEGREE ROTATION
3) FLEXIBLE
4) EASY TO USE
5) LOW COST
6) REDUCE HANDLING COST
7) REDUCE TIME
8) REDUCE OVERALL MANUFACTURING COST
9) INCREASE PRODUCTIVITY

B. Application

1) To put holes with high precision on engine heads, blocks and cylindrical shell.

2) Used in furniture making.

C. Future Scope

1) It is used in industries.

2) It is used with automation for automatic drilling.

3) In future it is used in every field where drilling is required.

4) Also use this method of rotation of arm in other machining operation.

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