DESIGN AND FABRICATION 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.**

Index Terms- Liquid Crystal Display, Electro Magnetic Field, Signal Conditional Unit

I. INTRODUCTION

The North This project is mainly developed for drilling process, with low cost. 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 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. It consists of a Drill head with motor, degree setter, feed mechanism and a vice. So this makes it possible for easy drilling in even complicated parts and surfaces. Thus we use rotating hinges and connectors with motor mount and supporting structure to design and fabricate a mini 360 degree drill for easy drilling operations. 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 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 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.

II. PROPOSED METHODOLOGY

System design is a heart of any project. This stage where planning is carried out in accordance to the project. System design is a solution, a "HOW TO" approach to the creation of new system. System design is an implementation of system recommended in the feasibility study or replaces the existing system. The major step in System design is the preparation of input and the design of the output reports in a form acceptable to the use. The system study starts with the existing system so as to determine the requirements of the proposed system. This is done by group discussion of our team members and throughout the whole process as to what are our requirements. Feasibility study is an important outcome of preliminary discussion. This study is important for our project since our primary aim to deliver a product that does not involve high cost in terms of money and labour. All the feasibility tests are conducted for the system. The new ideas are performed very quick and easy way. It provides our ideas through the drawing. This is used to implement the project as carefully planned and controlled. It can considered to be most must

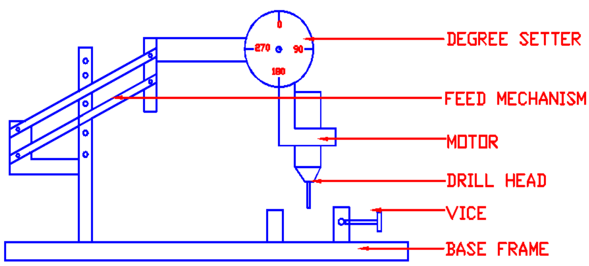

Figure 1: Proposed Methodology

give the project will work and be effective.

III. COMPONENTS

BASE FRAME

A base frame provides a surface onto which various mechanical components are mounted. Different components, e.g. Motors and gear boxes have to be mounted at different centre line heights relative to the mounting surface to provide shaft alignment. The base frame must be stiff enough to remain in correct alignment when subjected to bending, twisting and vibration effects during operation. For convenience base frames are made of channel sections welded together to form a rectangle. The dimensions of the rectangle are greater than the overall dimensions of the equipment to be mounted on the base frame. It is sound practice to arrange the channel sections with the toes pointing outwards.

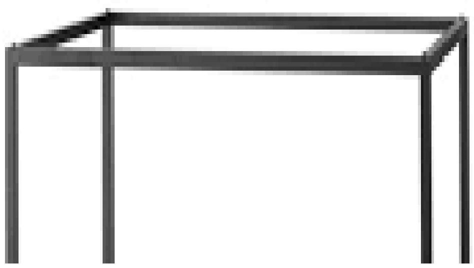

Figure 2: base frame

This allows for simpler cutting and welding as the ends of the frame cross members are welded to the flat webs of the longitudinal members. Having the toes of the channels pointing outward also allows for easy access to equipment mounting bolts. The bottom flange can be used for bolting directly to a concrete foundation.

FLEXIBLE ARM

An adjustable or flexible arm is a structural element that is capable of withstanding load primarily by resisting bending. The bending force induced into the material of the arm as a result of the external loads, own weight, span and external reactions to these loads is called a bending moment. Arms generally carry vertical gravitational forces. This is the simplest type, is not often used due to the rapid rate of wear. When it is adopted, it is usually for reciprocating motion, running in slides and there is considerable side thrust, this being a component of the thrust from the hinges and eye bolt.

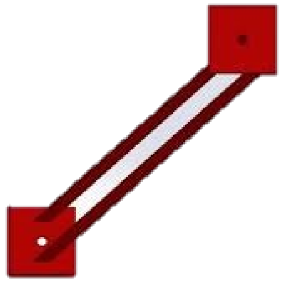

Figure 3: Flexible arm

It is mounted on the hinge arrangement and its head is fixed with adjustable type to the eye bolt. It produces the additional load on the equaliser plate. With this design the head of this arm is locked, not like other methods where moving arm gets the reciprocate acceleration.

DEGREE SETTER

A protractor or Degree setter is a measuring instrument, typically made of transparent plastic or glass, for measuring angles. Most protractors measure angles in degrees (°). Radian-scale protractors measure angles in radians. Most protractors are divided into 180 equal parts. Some precision protractors further divide degrees into arcminutes. Some protractors are simple half-discs. More advanced protractors, such as the bevel protractor, have one or two swinging arms, which can be used to help measure the angle.

A protractor is a graduated circular protractor with one pivoted arm; used for measuring or marking off angles. Sometimes Vernier scales are attached to give more precise readings. Universal bevel protractors are also used by toolmakers; as they measure angles by mechanical contact they are classed as mechanical protractors. The bevel protractor is used to establish and test angles to very close tolerances. It reads to 5 arcminutes (5′ or 1/12°) and can measure angles from 0° to 360°.

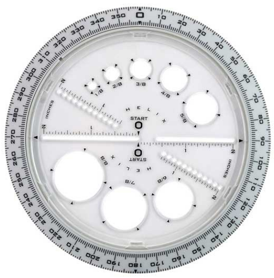

Figure 4: Degree setter

The protractor consists of a beam, a graduated dial and a blade which is connected to a swivel plate (with Vernier scale) by thumb nut and clamp. When the edges of the beam and blade are parallel, a small mark on the swivel plate coincides with the zero line on the graduated dial. To measure an angle between the beam and the blade of 90° or less, the reading may be obtained direct from the graduation number on the dial indicated by the mark on the swivel plate. To measure an angle of over 90°, subtract the number of degrees as indicated on the dial from 180°, as the dial is graduated from opposite zero marks to 90° each way. Since the spaces, both on the main scale and the Vernier scale, are numbered both to the right and to the left from zero, any angle can be measured. The readings can be taken either to the right or to the left, according to the direction in which the zero on the main scale is moved. Reading the Vernier scale: The bevel protractor Vernier scale may have graduations of 5′ (minutes) or 1/12°. Each space on the Vernier scale is 5′ less than two spaces on the main scale. Twenty four spaces on the Vernier scale equal in extreme length twenty three double degrees [clarification needed]. Thus the difference between the space occupied by 2° on a main scale and the space of the Vernier scale is equal to one twenty-fourth of 2°, or 5′.

Read off directly from the main scale the number of whole degrees between 0 on this scale and the 0 of the Vernier scale.

Then count, in the same direction, the number of spaces from the zero on the Vernier scale to a line that coincides with a line on the main scale; multiply this number by 5 and the product will be the number of minutes to be added to the whole number of degrees.

SPUR GEAR

Gears are machine elements that transmit motion by means of successively engaging teeth. The gear teeth act like small levers. Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with the teeth projecting radially, and although they are not straight-sided in form, the edge of each tooth is straight and aligned parallel to the axis of rotation. These gears can be meshed together correctly only if they are fitted to parallel shafts.

Figure 5: spur gear

Terminology for Spur Gears

In the following section, we define many of the terms used in the analysis of spur gears. Some of the terminology has been defined previously but we include them here for completeness.

Pitch surface: The surface of the imaginary rolling cylinder (cone, etc.) that the toothed gear may be considered to replace.

Pitch circle: A right section of the pitch surface.

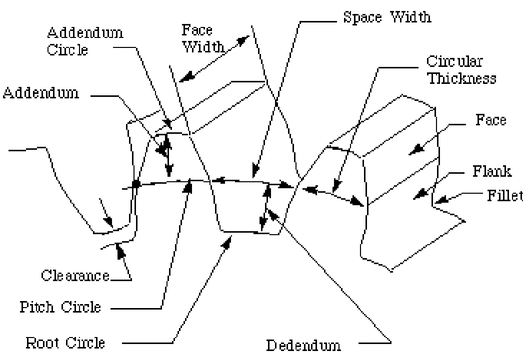

Figure 6: Spur Gear terminology

Addendum circle: A circle bounding the ends of the teeth, in a right section of the gear.

Root (or dedendum) circle: The circle bounding the spaces between the teeth, in a right section of the gear.

Addendum: The radial distance between the pitch circle and the addendum circle.

Dedendum: The radial distance between the pitch circle and the root circle.

Clearance: The difference between the dedendum of one gear and the addendum of the mating gear.

Face of a tooth: That part of the tooth surface lying outside the pitch surface.

Flank of a tooth: The part of the tooth surface lying inside the pitch surface.

Circular thickness (also called the tooth thickness): The thickness of the tooth measured on the pitch circle. It is the length of an arc and not the length of a straight line.

Tooth space: The distance between adjacent teeth measured on the pitch circle.

Backlash: The difference between the circle thickness of one gear and the tooth space of the mating gear.

Circular pitch p: The width of a tooth and a space, measured on the pitch circle.

Diametral pitch P: The number of teeth of a gear per inch of its pitch diameter. A toothed gear must have an integral number of teeth. The circular pitch, therefore, equals the pitch circumference divided by the number of teeth. The diametral pitch is, by definition, the number of teeth divided by the pitch diameter. That is,

Module m: Pitch diameter divided by number of teeth. The pitch diameter is usually specified in inches or millimetres; in the former case the module is the inverse of diametral pitch.

Fillet: The small radius that connects the profile of a tooth to the root circle.

Pinion: The smallest of any pair of mating gears. The largest of the pair is called simply the gear.

Velocity ratio: The ratio of the number of revolutions of the driving (or input) gear to the number of revolutions of the driven (or output) gear, in a unit of time.

Pitch point: The point of tangency of the pitch circles of a pair of mating gears.

Common tangent: The line tangent to the pitch circle at the pitch point.

Line of action: A line normal to a pair of mating tooth profiles at their point of contact.

Path of contact: The path traced by the contact point of a pair of tooth profiles.

DRILL HEAD

Drilling is a machine operation used to create a round hole in a work-part. Drilling is performed with a rotating cylindrical too (called a drill or drill bit) that has two cutting edges on its working end. So this machine is called drilling machine. Drilling machine is a simplest and accurate machine, the work piece is held stationary and drill rotates to make a hole. This is a light duty machine that are operated by the operator, using a feed handled, So that the operator is able to feel the action of the cutting tool cuts through the work piece.

Figure 7: drilling head

A drill is a tool fitted with a driving tool attachment, usually a drill bit or driver bit, used for drilling holes in various materials or fastening various materials together with the use of fasteners. The attachment is gripped by a chuck at one end of the drill and rotated while pressed against the target material. The tip of the cutting tool does the work of cutting into the target material. A drill head is a fixed style of drill that mounted on a column with a worktable. Drilling head have the following construction characteristics.

HEAD

The head of the drill head is composed of the sleeve, spindle, and feed mechanism. The head is bolted to the column. The head has bevel gear mechanism attached with a handle radiating from a central hub that, when turned, move the spindle and chuck vertically, parallel to the axis of the column.

SPINDLE

The spindle holds the drilling tools and revolves in a fixed position in a sleeve. In our drilling head, the spindle is vertical and the work is supported on a horizontal table.

SLEEVE

The sleeve or quill assembly does not revolve but may slide in its bearing in a direction parallel to its axis. When the sleeve carrying the spindle with a cutting tool is lowered, the cutting tool is fed into the work and when it is moved upward, the cutting tool is withdrawn from the work. Feed pressure applied to the sleeve by hand or power causes the revolving drill to cut its way into the work a few thousandths of an inch per revolution.

COLUMN

The column of drill head is circular and built rugged and solid. The column supports the head and the sleeve or quill assembly.

MOTOR

An electric motor is an electric machine that converts electrical energy into mechanical energy. The electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force within the motor. Electric motors are used t Camera Roll Camera Rollo produce linear force or torque (rotary).

Figure 8: Electric motor

An AC motor is an electric motor driven by an alternating current (AC).It commonly consists of two basic parts, an outside stationary stator having coils supplied with alternating current to produce a rotating magnetic field, and an inside rotor attached to the output shaft that is given a torque by the rotating field.

ROTOR

In an electric motor the moving part is the rotor which turns the shaft to deliver the mechanical power. The rotor usually has conductors laid into it which carry currents that interact with the magnetic field of the stator to generate the forces that turn the shaft. However, some rotors carry permanent magnets, and the stator holds the conductors.

STATOR

The stationary part is the stator, usually has either windings or permanent magnets.

AIR GAP

In between the rotor and stator is the air gap. The air gap has important effects, and is generally as small as possible, as a large gap has a strong negative effect on the performance of an electric motor.

WINDINGS

Windings are wires that are laid in coils, usually wrapped around a laminated soft iron magnetic core so as to form magnetic poles when energised with current.

COMMUTATOR

A commutator is a mechanism used to switch the input of motor consisting of slip ring segments insulated from each other and from the electric motor's shaft. The motor's armature current is supplied through the stationary brushes in contact with the revolving commutator, which causes required current reversal and applies power to the machine in an optimal manner as the rotor rotates from pole to pole.

VICE

A vice is a mechanical apparatus used to secure an object to allow work to be performed on it. Vices have two parallel jaws, one fixed and the other movable, threaded in and out by a screw and lever.A fixed jaw is a thick rectangular plate mounted with screw to the bottom end of the base plate .It is a supporting ends of the vice. It is made from the casting material, which various machining process involves. It gives the load to the job. The base with a fixed jaw forms one piece of casting and it is milled on milling machine. This Jaw plate is machined drilled and tapped in required size. Fixed jaw is a holding device specifically, a main part of vice that forms a flat surface with roughness. It gives strong clamping force to the object when movable jaws is tightened and hold the object, if that work piece. The fixed jaw under load is in stable equilibrium if a lateral force, applied between the two jaws, produces a small lateral deflection which disappears the fixed jaw and the fixed jaw returns to its original form when the lateral force is removed. It is made alike a fixed plate. It is moving along the sliding bed to freely, when give the load. It’s design with sliding bushes.

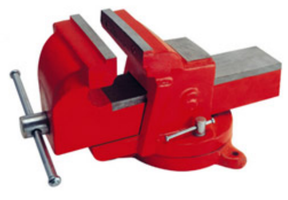

Figure 9: vice

The movable jaw is usually positioned on a clamping block and the distance to which the vice can be opened is limited. It allows a much larger piece of work to be inserted between the fixed jaw and the movable jaw. The movable jaw made with cast iron. It have a clamping position cavity. It may be used to hold the job material in place, and to help keep the work pieces from twisting on machining process. It is used to securely locate (position in a specific location or orientation) and support the work, ensuring that all parts produced using this vice will maintain conformity and interchange ability. Using this jaw improves the economy of production by allowing smooth operation and quick transition from part to part, reducing the requirement for skilled labour by simplifying how work pieces are mounted, and increasing conformity across a production run.

SCREW ROD

Screw rod consists of a screw and a nut. The nut is fixed in a cast iron frame and remains stationary. The rotation of the nut inside the frame is prevented by pressing a set screw against it. The screw is rotated in the nut by means of a handle, which passes through a hole in the head of the screw. The head carries a platform, which supports the load and remains stationary while the screw is being rotated. A washer is fixed to the other end of the screw inside the frame, which prevents the screw to be completely turned out of the nut. These screws draw the two limit switch together and hold them mated, and when unscrewed allow the forward side to be taken apart. These small screws may have ordinary screw heads that allow the user's fingers to turn the screw. Furthermore, the head sometimes has an internal female thread, with the male externally threaded screw shaft extending from that.

Figure 10: Screw rod

The large area of sliding contact between the screw threads means screws have high friction and low efficiency as power transmission linkages, around 30%–50%. So they are not often used for continuous transmission of high power, but more often in intermittent positioning applications.

BEARING

A bearing is a machine element that constrains relative motion between moving parts to only the desired motion. 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. 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. A bearing being a machine element that allows one part to bear another. The simplest bearings are bearing surfaces, cut or formed into a part, with varying degrees of control over the form, size, roughness and location of the surface. Other bearings are separate devices installed into a machine or machine part. The most sophisticated bearings for the most demanding applications are very precise devices.

Figure 11: Bearing

FRICTION

Reducing friction in bearings is often important for efficiency, to reduce wear and to facilitate extended use at high speeds and to avoid overheating and premature failure of the bearing. Essentially, a bearing can reduce friction by virtue of its shape, by its material, or by introducing and containing a fluid between surfaces or by separating the surfaces with an electromagnetic field.

LOADS

Bearings vary greatly over the size and directions of forces that they can support. Forces can be predominately radial, axial (thrust bearings) or bending moments perpendicular to the main axis.

SPEEDS

Different bearing types have different operating speed limits. Speed is typically specified as maximum relative surface speeds, often specified ft/s or m/s. Rotational bearings typically describe performance in terms of the product *DN* where *D* is the diameter (often in mm) of the bearing and *N* is the rotation rate in revolutions per minute. Generally there is considerable speed range overlap between bearing types. Plain bearings typically handle only lower speeds, rolling element bearings are faster, followed by fluid bearings and finally magnetic bearings which are limited ultimately by centripetal force overcoming material strength.

PLAY

Some applications apply bearing loads from varying directions and accept only limited play or "slop" as the applied load changes. One source of motion is gaps or "play" in the bearing. For example, a 10 mm shaft in a 12 mm hole has 2 mm play. Allowable play varies greatly depending on the use. As example, a wheelbarrow wheel supports radial and axial loads. Axial loads may be hundreds of Newton force left or right, and it is typically acceptable for the wheel to wobble by as much as 10 mm under the varying load. In contrast, a lathe may position a cutting tool to ±0.02 mm using a ball lead screw held by rotating bearings. The bearings support axial loads of thousands of Newton's in either direction, and must hold the ball lead screw to ±0.002 mm across that range of loads.

STIFFNESS

A second source of motion is elasticity in the bearing itself. For example, the balls in a ball bearing are like stiff rubber, and under load deform from round to a slightly flattened shape. The race is also elastic and develops a slight dent where the ball presses on it. The stiffness of a bearing is how the distance between the parts which are separated by the bearing varies with applied load. With rolling element bearings this is due to the strain of the ball and race. With fluid bearings it is due to how the pressure of the fluid varies with the gap (when correctly loaded, fluid bearings are typically stiffer than rolling element bearings).

IV. IMPLEMENTATION AND RESULT

A result is the final consequence of a sequence of actions or events expressed qualitatively or quantitatively. Possible results include advantage, disadvantage, gain, injury, loss, value and victory. There may be a range of possible outcomes associated with an event depending on the point of view, historical distance or relevance. Reaching no result can mean that actions are inefficient, ineffective, meaningless or flawed. Table 1 shows the experiment reading of the Project work result.

Table 1: EXPERIMENTAL READING

S.NO	DATA FOR OPTIMAL SELECTION	FIRST READING	SECOND READING	THIRD READING
1	dia / thk	10 mm	8 mm	20 mm
2	Hole degree	90^0	127^0	250^0

It was found that the capacity of the "FLEXIBLE DRILLING MACHINE" ranged from dia 6 mm to 10 mm as thickness in all degree. A model was proposed to describe the response of turning capacity of drilling machine is more mechanical efficient for industrial apply compare with other drilling machine. Economic analysis of the system was conducted to determine the long term feasibility of operating the manually controlled drilling machine. Net present worth calculations was found that the total cost of operation (measured by net present worth) approximately Rs.6000/-.

V. CONCLUSION

Efficient operation and competitive costs can be assured in this project. Since many operations and holes can be performed from this machine. It is efficient and economical as compared to other available resources. While taking consideration of its uses and price of the model. This machine becomes relatively affordable when compared to other machines. This gives the facility to work in-between the drill bit and drill bed where minimum spaces are available. In this rack and pinion mechanism used over the arms to make it a telescopic arm for increasing and decreasing the length of the arm. A magnetic base plate is also introduced for the clamping purpose of the workpiece. The size of the machine is smaller than the older machine. So, the overall space required is also minimum. The clamping of the workpiece has been eliminated due to the magnetic base plate. In this project we can drill as many holes as we required without moving the workpiece. Hence, it reduces the number of machines required and also minimize the error occurs due to human.

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