VIVA-TECH INTERNATIONAL JOURNAL FOR RESEARCH AND INNOVATION
ANNUAL RESEARCH JOURNAL
ISSN(ONLINE): 2581-7280

DESIGN AND FABRICATION OF MULTIANGLE DRILLING MACHINE

Padave Siddhesh[1], Pawar Bhushan[2] ,Sankhe Aniket[3], Patil Viraj[4]
(Department Of Mechanical Engineering, Viva Institute Of Technology/ Mumbai University , India)
(Department Of Mechanical Engineering, Viva Institute Of Technology/ Mumbai University , India)
(Department Of Mechanical Engineering, Viva Institute Of Technology/ Mumbai University , India)
(Department Of Mechanical Engineering, Viva Institute Of Technology/ Mumbai University , India)

Abstract : *A normal drill machine is commonly used for making holes on desired surface of the workpiece. In industries, the vertical drill machine is widely used for the purpose whereas when it cannot be used, at that time other types of drill machines are used. With the vertical drill machine we mostly makes perpendicular holes but with the use of jig and fixture or other attachment we can easily make holes at a desired angle on workpiece. So, knowingly the objective of project is to provide an alternate flexible system which can replace these thing with good performance and similar quality results with the help of CAD CAE. The project deals with designing, analysis and fabrication of multiangle drilling machine of each designed component with the existing system is modeled on SOLIDWORKS software and the analysis is done on ANSYS Workbench software and fabrication is carried out using various modification in drilling machine.*

Keywords *- Bevel Gear, Double Carden Universal Joints, Spline Shaft, Rack and Pinion, Design and Fabrication*

I. INTRODUCTION

Drilling is the process of creating required size hole by removing metal with the help of cutting tool called drill bit. Any drilling operation is normally done with the help of drilling machine in workshop. It produces cylindrical hole in a workpiece of required thickness and diameter. Drilling machine generally consist of motor, base, column, drill head, spindle, table, etc.

1.1 General Drilling Machine V/S Multiangle Drilling Machine:-

1.1.1 Drilling Machine :-

Drilling is that the operation of manufacturing a circular hole within the work-piece by employing a rotating cutter known as Drill. The machine used for drilling is termed a drilling machine. The drilling operation also can be accomplished within the shaper, within which the drill is command within the support and therefore the work is command by the chuck. the foremost common drill used is that the twist bit. it's the best and correct machine utilized in the assembly search. The work is command stationary i.e. clamped in position the drill rotates to form holes. A drilling machine could be a quite machine rotating cutter within which direction the drill feeds solely on the machine axis. Drilling is working whereas manufacturing spherical holes in piece work by employing a rotating cutter known as drill. A drill could be a tool fitted with a cutter attachment or driving tool attachment, typically a drilling bit or driver bit, used for boring holes in numerous materials or fastening numerous materials along with the utilization of fasteners.

1.1.2 Multiangle Drilling Machine:-

Sometimes there is a problem while drilling on inclined surfaces, in such case one can use the Multiangle Drilling Machine which produces drilling at the required angle on inclined surfaces and can be used to drill holes horizontally, vertically, and also upside down. So this makes it attainable for simple drilling in even sophisticated elements and surfaces. Thus the project uses bevel gear, spline shaft, universal joint, double Cardan universal joint, ball bearing, rack, and pinion arrangement for making of Multiangle Drilling Machine.This project deals with designing, analysis and fabrication of multiangle drilling machine which can drill vertical as well as inclined holes on the surface of the workpiece, which then solve the problem of the drill.

II. PROBLEM DEFINITION

There are various major problems regarding traditional vertical drilling machine, some of the problems are mentioned below:
1. Due to less flexibility of piece of work within the vertical drilling machine, planning the Multi angular Drilling Machine is finished.
2. Where as drilling on the various inclined surfaces by employing a vertical machine, it takes time for handling the piece of work by using angular vice because of its significant weight, so the time.
3. When it is required to drill on inclined surfaces of heavy workpiece and if angle vviceare used then it required more human effort because of its heavyweight.

III. METHODOLOGY

2.1 Design of Multiangle Drilling Machine:-

Multiangle Drilling Machine consists of bevel gears, rack and pinion, spline shaft and double cardan universal joint. Drilling at different angle can be carried out easily with the help of rack and pinion. There are two handles which are placed to make a forward and backward motion of the spindle. The spindle can move in various angle to perform different types of drilling.

2.2 Components used in Multiangled Drilling Machine:-

1.Bevel Gear:-Bevel gear is used to transmit power in 90 degree. The gear are widely used to transmit the power and motion between the parallel, intersection and non-interesting parallel shaft. The pitch surface of the bevel is cone. the two important concept in gearing are pitch surface and pitch angle. The pitch surface is the standard gear within the form of a cylinder whereas the pitch angle of a gear is that the angle between the face of the pitch surface and the axis. When the pitch angle is less than 90 degrees are called external bevel gears and the pitch angle greater than 90 degrees are called internal bevel gears. Bevel gears are the main part of the drill because it is turned in vertical direction, the bevel gears changes the rotation of the chuck to a horizontal rotation.

2.Spline Shaft:- A Splines are ridges or teeth on a drive shaft that mesh with grooves in an extremely pairing piece and transfer torsion to it, maintaining the angular correspondence between them**.** For instance, a gear mounted on a shaft may use a male spline on the shaft that matches the female spline on the gear. The splines on the pictured drive shaft match with the female splines within the centre of the clutch plate, whereas the smooth tip of the shaft is supported in the pilot bearing in the flywheel. An alternative to splines may be a keyway and key although splines provides a extended fatigue life, and will carry significantly larger torques for the dimensions. A driven shaft with a spline in the center and universal joints at the ends, allows to transmit torque and rotation for changes in length.

3.Double Cardan Universal Joint: Double cardan coupling (universal coupling, U-joint, Cardan joint, Spicer or Hardy Spicer joint, or Hooke's joint) could be a joint or coupling connecting rigid rods whose axes are inclined to each other, and is usually used in shafts that transmit movement. It consists of a pair of hinges set close, adjusted at 90° to each different, connected by a cross shaft. This assembly is commonly employed in rear wheel drive vehicles, where it is known as a drive shaft or propeller shaft. Even once the driving and driven shafts are at equal angles with relevance the intermediate shaft, if these angles are larger than zero, oscillating moments are applied to the three shafts as they rotate. These tend to bend them during a direction perpendicular to the common plane

of the shafts. This applies forces to the support bearings and might cause launch shudder in rear wheel drive vehicles. The intermediate shaft also will have a curving element to its angular speed, that contributes to vibration and stresses.

4.Rack and Pinion:- A rack and pinion may be a quite linear mechanism that contains a circular gear (the pinion) collaborating a linear gear (the rack), that operate to translate motility motion into linear motion. Driving the pinion into rotation causes the rack to be driven linearly. Driving the rack linearly can cause the pinion to be driven into a rotation. Rack and pinion mixtures are typically used as a region of an easy linear mechanism, where the rotation of a shaft hopped-up by hand or by a motor is regenerate to linear motion. The rack carries the whole load of the mechanism directly then the driving pinion is usually tiny, so the gear magnitude relation reduces the force required. This force, thus torsion, ought to be substantial then it's common for there to be a reduction gear instantly before this by either a gear or gear reduction. Rack gears have a much better magnitude relation, need would like a larger propulsion, than screw actuators.

2.3 Working:-

- Multiangle Drilling Machine works on the same principle that of normal vertical drilling machine.
- The rotating fringe of the drill exerts an outsized force on the workpiece and therefore the hole is generated. The removal of metal in drilling operation is by cutting and extrusion.
- By using multiangle drilling machine we can drill vertical as well as inclined hole on workpiece surface at a time.
- So it can be done multiple operation in a single feed of the machine. To achieve inclined drilling we use different mechanical components such as universal joint, spline shaft, rack and pinion arrangement, etc.
- When the drill machine starts, power from motor will transmit to bevel gear and bevel gear will transmit the power forward to multiangle axis.
- There are two rack and pinion system attached for the forward and backward moment and power will come from motor to the shaft through spline shaft and universal joint. There are two universal joint for a bending moment.
- Both the drill mechanism works simultaneously as one bevel gear transmit to vertical machine and another flexible shaft start working and at the end, the product is taken and drilling is done.

2.4 Design Calculations :

Prime Mover:-

Hole Diameter (d) = 6 mm & 7 mm
Plate Thickness (t) = 10 mm
Material of the Work piece = Cast Iron
Power Required = {D2×1.25×N×K×(1.5×Fn) +0.056)}/105
For Hole Diameter of 4 mm
Power = {62×1.25×720×1.5 × ((1.5×0.0635) +0.056)}/105
Power = 0.073 kw
For 2 Spindles = 2×0.073 = 0.146 kw
Power Required = 0.14×1.341 = 0.1957 HP For Hole Diameter of 7 mm
Power = {72×1.25×720×1.5× ((1.5×0.0635) +0.056)}/105
Power Required = 0.1 kw
For 2 Spindles = 2× 0.1 = 0.2 kw
Power = 0.2×1.341 = 0.2682 HP
Total power required to drill hole = 0.2682+0.2682
= 0.5364 HP
Therefore, we can use the motor of 1HP.

External Spline Shaft:-
Consider shaft diameter = 40 mm
Material used for shaft = Mild steel
Power (P) = 2πNT/60
Torque (T) = (0.7457×103×60)/(720×π×2)
T = 9890 N-mm
Consider there is 25% overload
T = 12362.5 N.mm
Diameter of Spindle (D) = [(16/π×τ)× Kt ×Mt]0.33
40 = [(16/π×τ)× 12362.5×2]0.33
τ = 1.7594 N/mm2
Shear stress developed in spindle is 1.7594 N/mm2. This worth of shear stress may be a smaller quantity as compare to yield stress of spindle material. (415 N/mm2).
Hence spindle style is safe and secured.

Internal Spline Shaft :-
Shaft Material = Mild Steel
Shaft diameter = 50 mm
Torque experienced by shaft = 12362.5 N-mm
For Shear Stress,
D = {(16/π×τ×(1-K4)) × Mt × Kt}0.33
50 = {(16/π×τ×(1-0.5714))×2×12362.5}0.33
Shear stress (τ)= 1.96 N/mm2
Shear stress developed in shaft is 1.96 N/mm2. This value of shear stress is less as compare to yield stress of spindle material. (415 N/mm2).
Therefore, spindle design is safe

Fig.1 Multiangle Drilling Machine(CAD Model)

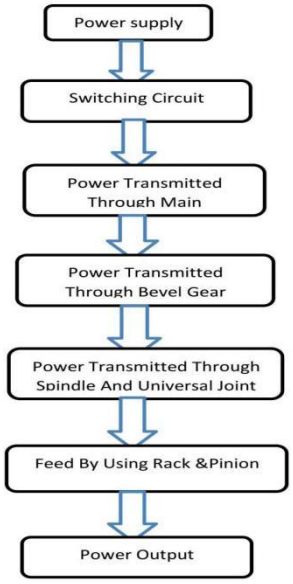

Fig 2 working principle of multiangle drilling machine

Fig 3 Bevel Gear

Fig 4 Spline Shaft

Fig 5 Double Carden Universal Joint

Fig 6 Rack And Pinion

Table No 01 Tentative Costing Of Project

PARTS	**COST**
Rack and pinion (2)	1200
Shaft with splines	2400
Bevel gear (6)	1100
Universal Joint (2)	500
Fixtures	1200
Handle (3)	1000
Column	600
Pulley	1500
Base	1000
Spline (2)	1300
Connecting Wires	500

Switches	500
Drill Bit	350
Motor 1HP	2500
Auxilary	1000
Second hand Vertical drill machine	4500
Total	21150

IV. CONCLUSION

By using Multiangle Drilling Machine we can Drill vertical as well as an inclined hole on workpiece surface at a time. Multiple operations are carried out in a single feed of the machine. Also, this machine is more advantageous than conventional drilling machines. Effective operation and competitive costs can be assured in this machine.This machine is easy to operate angular holes so it gives better control during the operations. This machine will reduce the human effort to a great extent.

REFERENCES

Journal Papers:

[1]Nandewalia Prajal, Malaviya Krunal, Prof. Chauhan Hiral, Prof. Vipul Goti, To investigate the Graphical Drilling Machine, and proposed that this drill machine can drill graphically in all direction, the drill rotates about two axes (i.e X-axis & Z-axis), Vol.5, 2018

[2].Lookesh kumar sahu,, Design & Fabrication of 360 flexible drilling machine, IJSRD- International Journal Of Scientific Research & Development, 2018

[3]Abhishek Mandal , "Static structural Analysis of Universal joint to study the various stresses and strains developed in power transmission system",(IJERT), vol.5, March 2016.

[4]Rohan R. Kurlapkar, M.M.Mirza, V M Naik, "Design And static structural Analysis of Bevel Gear," (IJETT),vol.35, May 2016.

[5] Mr. K. I. Nargatti, Mr. S. V. Patil, Mr. G. N. Rakate, Design, And Fabrication of Multispindle Drilling Head with Varying Centre Distance, International Journal of Trend in Research and Development, Volume 3(3), May-Jun 2016, Pages 506 – 508.

[6] R.Anandhan, P.Gunasekaran, D.Sreenevasan, D.Rajamaruthu, Design, and Fabrication of Angular Drilling Machine , International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, May 2016 , Pages 88 -95.

[7] Mr. Jay M. Patel, Mr. Akhil P. Nair, Prof. Hiral U.Chauhan, 3-Directional Flexible Drilling Machine, International Journal for Scientific Research & Development, Vol. 3, January 2015, Pages 1262 – 1264.

[8]Prof. M. S.A.A.Shingavi, Dr.A.D Dongare, Prof. S.N.Nimbalkar,, Design of multiple spindle drilling machine, International Journal of Research in Adevent Technology, 2015.

[9]Dhananjay Ghanshyam Pardhi, " Stress analysis of spline shaft using finite element method ," (IJMERR), vol.4, Oct 2014.

[10]10.Dhananjay S Kolekar, Abhay M Kalaje, Swapnil S Kulkarni, "Design Development and Structural Analysis Of Universal Joint", International Journal of Advanced Engineering Research and Studies(IJAERS)2013.