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A PATH FOR HORIZING YOUR INNOVATIVE WORK

DESIGN AND DEVELOPMENT OF CNC DRILLING MACHINE

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Abstract: Creating small angular holes is the requirement of many industries. Holes of different size and large no. must be created with high precision. A prototype model of drilling machine is being fabricated for producing horizontal as well as inclined holes. Normally tilting the worktable is the option available for producing inclined holes. But, if the case is with small components like PLCs then it becomes tedious to get accurate holes by inclining the table. Therefore a method of turning the drill head through required angle is proposed here.

Keywords: Angular holes, drilling machine, PLC.

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INTRODUCTION

Now a day's application of small hole drilling are continuously growing. These operations are required to fabricate the products in medical science, automobile industries, in electronics systems etc. Micro drilling is not only deals in drilling holes in small parts but sometimes small ho les may be required for large parts. Small and highly accurate holes are widely required in industries.

2) PROPOSED MODEL OF ANGULER DRILLING MACHINE:

Different models are considered for drilling machine. Each was having some advantages and relative disadvantages. Our aim was to develop a steady and low vibrations drilling machine so as to produce accurate holes with minimum of vibrations so that the hole quality should fulfill the requirements.

Vibrations during drilling cause the deterioration of hole size. To avoid this a sturdy and solid model is selected as shown in following fig2.1:

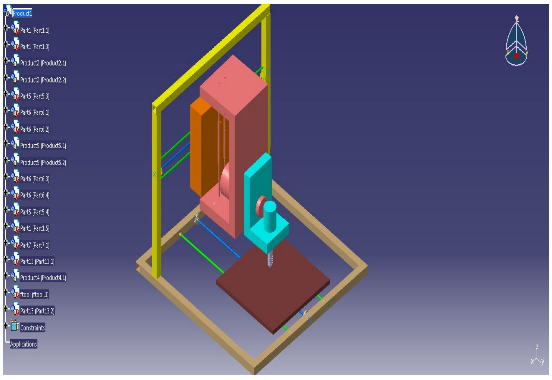

Fig.2.1 Proposed model of angular drilling machine

The model has following motions:

1) Motion of table in Y-direction.

2) Motion of drill head along X- direction.

3) Vertical up and down motion of tool (drill).

4) Turning mechanism for drill.

5) Up and down motion of drill in turned position.

The different motions are all servomotor controlled except the turning mechanism which requires stepper motor to turn the drill.

Lead screw and its selection is the most important criteria of the total project work. Selection procedure for lead screw is as follows:

For total length of screw,

$L_t = T_l + C + A$

Where,

L_t = total length of screw in mm

T_l = Threading or travelling length in mm

C = Clearance in mm

A = allowances in mm

A = (Bearing length + Length given for coupling arrangement)

According to the weight of assembly placed on the lead screw and friction force acting on screw, the total force acting on screw is calculated as:

$Fe = m \times 9.81$

Where,

Fe = External force in N

m = mass of assembly in Kg

And, $F_f = \mu \times m \times 9.81$

Where,

F_f = Frictional force in N

μ = Coefficient of friction

= 0.0015 for ball bearing

= 0.05 for sleeve plastic

= 0.13 for sleeve bronze

Hence, total force acting on screw is,

$F_t = Fe + F_f$

Where,

F_t = Total force acting on lead screw in N

Fe = External force in N

F_f = Friction force in N

The tangential force acting on the lead screw is calculated on the basis of total force acting on the screw,

$F = F_t + \tan(\alpha + ø)$

$= F_t \times [\tan\alpha + \tan ø]/[1 - \tan\alpha \tan ø]$

Where,

F = tangential force in N

The various parameters required for calculation are

Pitch p = 6mm

Major dia d_o= 20mm

Coefficient of friction = 0.0015

Mean dia $d = d_o - p/2$

$\tan\alpha = p/\pi d$

$\tan ø = \mu$

On the basis of tangential force, the torque required for the screw is calculated as,

$T = F \times d/2 + \mu_1 \times W \times R$

Where,

T = Torque in N-m

F = Tangential force in N

D = mean diameter in m

μ_1 = friction coefficient=0.05

W = Weight of assembly in N

= m×9.81

R = Radius of screw

= $d_o/2$

The speed of lead screw is given in terms of pulse per second (pps). Hence in rpm it is calculated as

1pps = 0.3 rpm

This speed can be converted into angular speed by using formula

$w = 2\pi N/60$

Where,

w = Angular speed in rad/s

N = speed of screw in rpm

The power required for rotating lead screw is calculated as,

$P = T \times w$

According to this power, the servo/ stepper motor selection is carried out.

3) INTERFACING:

Next important is the interfacing of manufactured model with the computers so as to control all the operations automatically.

Microcontroller and CNC system is required. The programming is being carried out and PLCs are used for motion control.

4) SELECTION OF COMPONENTS FOR CNC DRILLING MACHINE:

4.1) stepper/servo motors:

i. Stepper/ servo motors for controlling the motions in X and Y direction and tilting the drill head through the specified angle.

ii. Stepper motors transforms the applied voltage into pulses to control the motion of parts.

iii. It allows precise control of speeds and position generally without the necessity of feedback.

4.2) power drive:

i. It is a power electronic circuit to supply switching current to the motor windings.

4.3) electro mechanical positioning of linear axes:

i) Axes convert rotational motion of motor into linear translation motion.

ii) This facilitates the movement of tab le in XY direction and movement of tool (here drill - bit) in upward and downward direction.

iii) The axes use internal spindles and ball bearings, and transfers internal linear motion to an outside slid e which moves along a rigid guide.

iv) The axes can be placed at any direction and can be operated in a sliding mode.

5) CONCLUSION:

To develop a rigid and robust drilling machine following are the some concluded points must be taken into considerations:

1) The base structure and XY table must be designed by considering the weights appropriately so as to avoid vibrations.

2) Cutting parameters are to be optimized for producing holes with require quality.

3) Surface roughness is mostly affected by spindle speed and feed rates. If the value of spindle speed and feed rate increase, surface roughness will also increase.

4) Material removal rate (MRR) decreases when spindle speed, feed and tool diameter decrease.

5) Increased Spindle speed, feed rate and tool diameter increases the quality of hole.

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