Design and Fabrication of Flexible Drilling Machine

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Abstract- **In the present growing world of emerging technology, the drilling machining process has demanding operation in various sectors like aerospace, oil, defense, automobile, biomedical science and many industries at micro and Nano levels of manufacturing and designing. In various different types of drilling machining, drilling is one of the tool based machining operation. Generally drilling is used to fabricate micro holes in micro products. Main emphasis is drilling speed (R.P.M) and the feed rate of the spindle. In this study, the cutting speed and feed rate will be taken as process parameters. We tried to increase the accuracy by giving feed to drill spindle through lead screw instead of direct feed. Here are some aspects which are considered in the design and fabrication flexible drilling machine.**

Index Terms- **Micro, RPM, Feed rate, Universal, Torque, Flexible.**

1. INTRODUCTION

The drilling machine is one of the most common and is one of the most common and useful machine employed in industry for producing forming and finishing holes in a work piece. The unit essentially consists of:

1. The spindle which turns the tool (called drill) which can be advanced in the work piece either automatically or by hand
2. A work table which holds the work piece rigidly in position.

1.1 Working principle:
The Rotating edge of the drill exerts a large force on the work piece and the holes generated. The removal is by shearing and extrusion.

1.2 Drilling Process:
Drilling machines are generally or mainly used to originate through or blind straight cylindrical holes in solid rigid bodies and/or enlarge (coaxially) existing (pre machined) holes.

- Of different diameter ranging from about 1 mm to 40 mm.
- Of varying length depending upon the requirement and the diameter of the drill.
- In different materials excepting very hard or very soft materials like rubber, polythene etc.

2. COMPONENTS AND DESCRIPTION

2.1 Components Used
1. Motor
3. Bit
4. Connecting arms
5. Hinges
6. Wall/Table Mount
7. Supporting Frame
8. Joints & Screws

3. DESIGN AND DRAWING

3.1 Motor Specifications

Voltage	-	12 V
Frequency	-	50 HZ
Current	-	3 A
Power	-	0.48 HP
Watt	-	36W
Speed	-	500rpm
Phase	-	1ph

3.2 Motor Calculation
Electrical power equation:
Power $P=I*V$
Where,
$I=30amps$
$V=12v$
$P=I*V$
Power $P= 360$ Watts

To find torque of motor:
$P=2\pi NT/60$

T=360*60/2π*500

T=6.8 N-m

3.3 Design formulae:

Cutting Speed (v):-

It's the peripheral speed of the drill. The cutting speed depends upon the properties of the material being drilled, drill material, drill diameter, rate of speed, coolant used etc…

$V = \Pi * D * N$

Where

D = dia of the drill in m

N = Speed of rotation in rpm

Feed Rate (f):-

It's the movement of drill along the axis (rpm)

Depth of Cut (d):-

The distance from the machined surface to the drill axis.

$$d = D / 2$$

As the depth of hole increases, the chip ejection becomes more difficult and the fresh cutting fluid is not able to cutting zone. Hence for machining the lengthy hole special type of drill called 'gun drill' is used.

Material Removal Rate:-

It's the volume of material removed by the drill per unit time

$$MRR = (\Pi D2 / 4) * f * N \ mm3 \ / \ min$$

Machining Time (T) :-

It depends upon the length (L) of the hole to be drilled , to the Speed (N) and feed (f) of the drill

$$T = L / f N \ min$$

3.4 Time Calculation

Time required for drilling wooden job of 10 mm thickness manually = 30.2sec.

4.WORKING PRINCIPLE

In the conceptual model of "DESIGN AND FABRICATION OF FLEXIBLE DRILLING MACHINE".

The working operation of this Flexible drilling machine is initially started from the permanent magnet DC motor. In this, there is one power sources, received from the power supply. After that

the indexing mechanism is controlled, to fix the desired angle. A lock nut is attached to the indexing plate to avoid and deviation of angle during drilling. According to the requirement of drilling it will tilt very precisely.
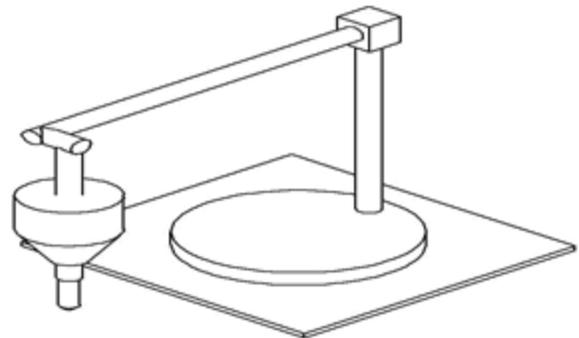
The speed of motor is controlled using Regulator. After that motor is started the desire angle and desire speed is fixed then drilling process performed. With the help our project we can achieve the drill hole very precisely. Thus our project can perform small holes and variations can be achieved.
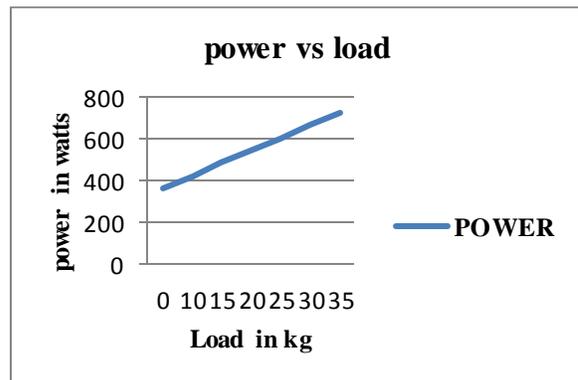
4.1 Overall Diagram

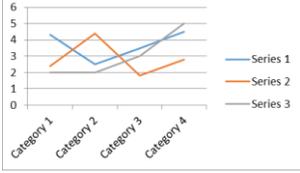Fig 5.1 Flexible Drilling Machine

4.2 3D Diagram

4.3 GRAPH

Table 4.4 Power vs Load

4.5 COMPARISON OF DRILLERS

Table 4.5 Comparison

	MINI DRILLER	FLEXIBLE DRILLING MACHINE
BATTERY	6V BATTERY	12 V BATTERY
MOTOR TYPE	AC MOTOR	DC MOTOR
SPEED	180rpm	500rpm
FREQUENCY	40HZ	50HZ
CURRENT	1amps	3amps
POWER	6watts	360watts
MAX.TORQUE	0.318 N-M	6.8 N-M
ROTATION	NO	360 degree

5. CONSTITUTES

5.1 Advantages

1. The system determines the accurate position.
2. The system reduces manufacturing lead time.
3. The system eliminated the geometrical errors.
4. Highly accurate and more efficient.
5. Compact with quick response.

5.2 Disadvantages

- Only small components can be drilled
- Hard surface drilling is not possible
- Drilling is done manually
- Loading and unloading of work piece done manually.

5.3 Applications

These types of flexible drilling machine have wide range of applications in the fields like,

- It can be used in small, medium as well as large scale industries.
- Highly suitable for production industries and workshops.
- To put angular and straight holes with high precession on heads, block and shells.
- Used in general furniture making and carpenting.

6. COST ESTIMATION

Table 6.1 Cost Estimation

Sl. No.	Parts	Qty.	Material	Amount (Rs)
i.	PMDC motor	1	Electrical	160
ii.	Ball bearings	8	steel	320
iii.	Rod	3	Mild steel	200
iv.	Plate	1	Mild steel	200
v.	Drill bit	1		20
vi.	3 way switch	1	Mild steel	40
vii.	12v Battery	1	Mild steel	1400

TOTAL = Rs. 2,340

6.2 Labour Cost

LATHE, DRILLING, WELDING, GRINDING, POWER HACKSAW, GAS CUTTING:

Cost = 1000/-

6.3 Overhead Charges

The overhead charges are arrived by "Manufacturing cost"

Manufacturing Cost=Material Cost + Labour cost

=2340 +500

=2840/-

Overhead Charges=20% of the manufacturing cost

=568/-

6.4 Total Cost

Total cost=Material Cost + Labour cost + Overhead Charges

=2340+500+560

= Rs. 3400/-

Total cost for this project =Rs. 3400/-

7. COST ANALYSIS
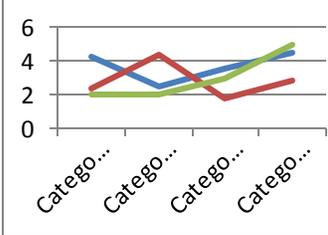
	MINI DRILLER	FLEXIBLE DRILLING MACHINE
MOTOR	800/-	160/-
BATTERY	1400/-	1400/-
TOTAL	8000/-	4000/-

8. CONCLUSION

We can see that all the production based industries wanted low production cost and high work rate which

is possible through the utilization of multi-function operating machine which will less power as well as less time, since this machine provides working at different center it really reduced the time consumption up to appreciable limit. This project is a combined effort and the goal was to produce a cost effective drilling machine which would help the small scale industry. It would help to drill holes easily at any desired angle accurately. So this project stands in line to produce fully automated portable drilling machines in the upcoming years. There are plans to develop the project in the near future. This is just the beginning.

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