Design and Fabrication Multi Spindle Drilling Machine with Different Pitch Hole

Yaman Patle[1], Nikalas Bhandakkar[2], Prashant Wangarwar[3], Pranay Thakre[4], Sagar Awachat[5], Ms. Manisha Fande[6]

[1,2,3,4,5]Student, Dept. of Mechanical Engineering, Dr.Babasaheb Ambedkar College of Engineering and Research, Nagpur

[6]Professor, Dept. of Mechanical Engineering, Dr.Babasaheb Ambedkar College of Engineering and Research, Nagpur

---

Abstract - *This paper converse about the study of design of multi spindle drilling machine. In the case of mass production where variety of jobs is less and quantity to be produced is large, it is very essential to manufacture the job at a faster rate. This is not possible if we produce by using general purpose machines. The purpose is to minimize the production time for drilling multiple holes in a work piece of different Pitch Circle Diameters (PCD). This design employs adjustable transmission systems along with a gear arrangement. This paper deals with design and development of multispindle drilling head to maximize the improvement of cycle time of the component.*

Key Words: drilling machine, pitch circle diameter, transmission.

1. INTRODUCTION

Multiple-spindle drilling machines are used for mass production processes, a huge time saver where many pieces of jobs having multiple holes are to be drilled. Multi-spindle head machines are used in mechanical industries in order to improve the productivity of machining processes. It is used to drill holes for different pitch circle diameters. The centre distance between the spindles can be adjusted in any position as per the requirement of the various jobs. For keeping the centre distance between the drill spindles variable, they are connected to the main spindle by an Adjustable Transmission System (ATS).

In today's market the customer demands the product of right quality, right quantity, right cost, & at right time. Therefore it is necessary to improve productivity as well as quality. The only way to achieve this is by using multi spindle drilling head. Designing of SPM is decided upon the principles of minimization of cost, improved productivity and better safety etc.

1.1 LITERATURE REVIEW

Prof. Chukwumuanya- investigated Design and developed multiple spindle drilling head for mass production of Peugeot 504 automobiles brake drum. For this design they developed multi-spindle drilling head for drilling six holes at a time, in which four holes of Ø14.5mm and two holes of Ø8.5mm. They analysis the various gear forces theoretically. It concludes that mash increases production rate as compare to individual drilling operation.

Prof. M.B. Bankar- Studied Improvement in design and manufacturing of multiple spindle drilling attachment, in which they used planetary gear system for drilling operations. In this case study we briefly give information about design of drilling attachment for motor selection to its gear box. This study concludes that Multi spindle drilling attachment increase productivity reduces cycle of operation and performs drilling operation more accurately.

1.2 COMPONENTS USED

The components used in this multi spindle drill head are
1. Gears
2. Adjustable transmission systems (ATS)
3. Bearings
4. Top plates
5. Bottom plates
6. Drill chuck
7. Drill tool
8. Shank
9. Key
10. Shaft

2. CALCULATIONS

- **Motor Selection**

Thus selecting a motor of the following specifications three phase induction motor Power = 0.5 hp= 375 watt

Speed= 1440 rpm.

To calculate arbor Shaft Torque

POWER = 2 P NT/60

T=2.84 N-m

Motor is 375 watt power, running at 1440rpm, connected to drilling machine spindle by belt and pulley arrangement of 1:3 ratio, considering 65% efficiency, torque at the arbor shaft is given by,

T motor x 3 x 0.65= 2.48 x 3 x 0.65 = 4.84 N-m

- **DESIGN OF PULLEY SHAFT**

Let M = bending moment

T = twisting moment

Maximum HP (i.e. h.p. of motor) to be transmitted by pulley = 0.5 HP

N =460 rpm. (Minimum rpm required for drilling)

Angle of deflection = 0.250 Θ = 0.00436 rad.

Length of the spindle = 15 cm.

Modulus of rigidity;

G = 0.84 x 106 kg/cm2 (Plain carbon steel)

Let T = torque transmitted by shaft

T = P x 60/2 π N = 597 N.mm

- **TO FIND THE DIAMETER OF SHAFT**

Let, d = diameter of the shaft

Then using relation,

T/J=G Θ/ L

d = 22 mm.

Hence the diameter of shaft = 22 mm

- **ASME Code for Design of Shafts**

Selecting material of shaft as MILD STEEL.

Sut=440 Mpa and Syt=370Mpa

According to the ASME codes, permissible values of the shear stress may be calculated from various relations.

fs max= 0.18 x Sut = 0.18 x 440= 79.2 Mpa

OR

fs max= 0.3 x Syt = 0.3 x 370= 111 Mpa

Considering minimum of the above values;

fs max = 79.2 Mpa

According to Torsional Equation

Ds = 22.78 mm

3. CONCLUSION

the Fabricated multi drill spindle head can drill 4 holes at a time and the pitch circle diameter can be varied from 40 mm to 120 mm. Since this setup is small and portable, it can be mounted on the drilling machine. The construction is simple and can employ semi-skilled labours. This multi spindle drill head will also be useful to reduce the operation costs, eliminate the non-value added activities and increase the productivity of small and medium enterprises.

REFERENCES

1. R.K.Jain and S.C. Gupta, "Production Technology", Khanna Publishers.
2. H.M.T. Production Technology–Handbook", Tata McGraw-Hill.
3. V B Bhandari, "Design of machine elements" Tata McGraw Hill Publishing Company limited"
4. ASME Codes & Standards
5. P.S.G. Data book
6. Mechatronics and Measurement Systems By: David g. Alciatore, Michael B. Histand
7. Mechatronics – Electronic Control Systems in Mechanical and electrical Engineering – By: W. Bolton