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Design And Fabrication of Multispindle Drilling Head with Varying Centre Distance

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Abstract-- The challenge of modern machining industries is mainly focused on the achievement of high quality, in terms of high production, less wear of cutting tools, economy of machining by considering cost saving and increase the performance of the product. With stiff competition and challenges in the present-day market, manufacturers are compelled to be more responsive to the customer's demands regarding right quality, right quantity, right cost, & at right time. Productivity can be improved by reducing the total machining time, combining the operations etc. The best way to improve the production rate (productivity) along with quality is by use of special purpose machine. Productivity and performance of the existing drilling machine will be increased by Design & Fabrication of Multiple Spindle Drilling Head. This paper deals with improvement in Design & Fabrication Process of Multiple Spindle Drilling Head for cycle time optimization of the component.

Keywords-- *Multi-spindle Drilling Attachment, Gear, Design, Manufacturing*

I. INTRODUCTION

A. Concept of Multi Spindle Drilling Head

In the conventional drilling machine only one workpiece can be drilled at a time. To improve productivity, a special purpose attachment is required which drill the holes more than one at a time.

Now a day, the customer demands the product of right quality, right quantity, and right cost & at right time. Therefore it is necessary to improve productivity as well as quality. This is achieved by multi spindle drilling attachment to conventional drilling machine.

B. Various Methods of Multispindle

The various methods of multispindle drilling head are [1]:

a. Adjustable Multispindle Drilling Head:

In this attachment the centre distance between drilling spindle can be vary according to requirement.

b. Fixed Multispindle Drilling Head:

In this attachment centre distance cannot change.
Features of both the type multispindle drilling head are:

1. By using these multispindle drilling heads, increase the productivity.
2. Time for drilling one hole is equal to the time for drilling multiple no. of holes.
3. Multispindle drilling ensures the positional accuracy. Multispindle heads can be of fixed centre construction for mass and large batch production and for batch production, adjustable centre type design is offered. Planetary gear train type adjustable multispindle drilling head is used[2][3][4].

II. EXPERIMENTAL

A. Principle of Multiple Spindle Drilling

1. As the name indicates multiple spindle drilling machines have two spindles driven by a single power head, and these two spindles holding the drill bits are fed into the workpiece simultaneously.
2. The spindles are so constructed that their centre distance can be adjusted in any position within the drill head depending on the job requirement. For this purpose, Allen bolt is used.
3. The power from the motor is transmitted by taper shaft to the central gear. Then after power at central gear is transmitted to the drilling spindle by compound gear train.

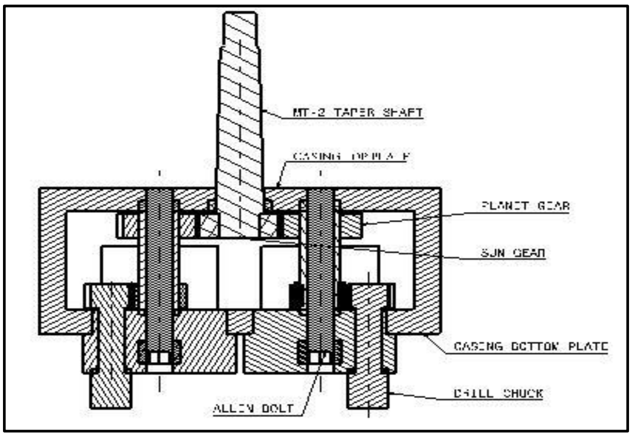

Figure1: Principle of Twin Spindle Drilling

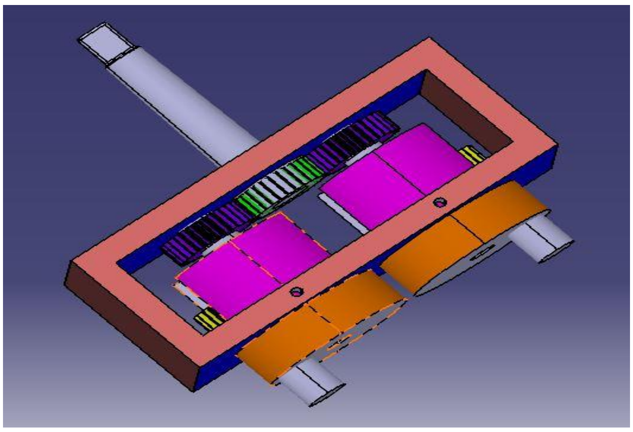

Figure 2: Principle of Twin Spindle Drilling Head

DESIGN

The total design work has been divided into two parts:

1. System design
2. Mechanical design

System design mainly concerns with the various physical constraints and ergonomics, space requirements, arrangement of various components on the main frame of machine, no of controls position of these controls, ease of maintenance scope of further improvement; height of machine from ground etc.

In Mechanical design the components are categories in two parts:

1. Parts to be purchased
2. Design parts

For design parts detail design is done and dimensions[6].

A. Cutting Speed (V)

For D=5mm

$$V=\frac{\pi DN}{1000} \quad (1)$$

$$=\frac{\pi\times5\times610}{1000}$$

V=9.59m/min

B. Select Suitable Feed(S)

This depends upon the type of material of the work piece (case hardening steel)

Feed=0.1mm/rev

C. Select Material Factor (K)

k=1.22

D. Power in Kw (P)

For D=5

$$P=\frac{1.25\times5^2\times1.22\times610\,(0.056+1.5\times0.1)}{10^5} \quad (2)$$

=0.04791 Kw

=0.06422 hp

Therefore power for 2 nos. of drill (0.06422×2) =0.1284 hp
By considering 80% efficiency of whole system of gear box, total power required

$$P=\frac{0.1284}{0.8}=0.1605 \text{ hp}$$

E. Torque (T) Kgf.m

$$T=\frac{975\times P}{N} \quad (3)$$

=0.2052 kgf-m

F. Thrust Force Coming On the Spindle

Thrust force=

$$1.16\times k\times D\times(100\times0.15)^{0.85} \quad (4)$$

=70.7095 N

=7.2077 kgf

For 2 nos. of spindle

=7.2077×2

=14.4154 kgf

G. Selection of Motor

Single phase induction motor 1 HP, 1440 rpm.

H. Design of gearbox

a. Pitch line velocity

$$V=\frac{\pi\times d_p\times n_p}{60\times1000} \quad (5)$$

$$=\frac{\pi\times30\times610}{60\times1000}$$

= 0.9582 m/s

b. Velocity Factor

$$C_v=\frac{3}{3+v} \quad (6)$$

=0.7579

1. Module

   Here the gear is considered as the beam hence module is based on beam strength.
   Assume Cs = service factor =1.5
   Fs = factor of safety
   Z_p = teeth on pinion
   N_P = speed of pinion in rpm
   b / m = 10 (STD.)
   Y = Lewis form factor for 20˚ FDI system.

$$m=\left\{\frac{60\times10^6\times0.1606\times0.746\times1.25\times1.75}{\pi\times30\times610\times0.7579\times10\times(\frac{800}{3})\times0.358}\right\}^{\frac{1}{3}} \quad (7)$$

$$=0.7230\approx1$$

Based on the module the face width, addendum, deddendum, clearance, tooth thickness is evaluated as given below:

2. Face width (b)

   b = m× 10
   =1× 10
   =10 mm

3. Data

   For Gear G_2-Number of teeth on pinion
   PCD (D_2) =30 mm

   $T_2=\frac{D_2}{m_2}=\frac{30}{1}=30$
   Speed (n_2) =610 r.p.m

   For GearG_1,
   m =1 hence
   $N_1\times D_1=N_2\times D_2$

Where,
D_1 = 30, T_1= 30

$$N_1=\frac{610\times30}{30}$$

N_1 = 610 rpm, PCD (D_1) =30mm
G_1 And G_3 are coaxial.

$$N_1=N_2=610 \text{ rpm.}$$

$(PCD)_3=D_3=m\times z$
$=1\times18$
=18 mm.
(min. no. of teeth for 20^0 full depth)

For GearG_4,

m = 1mm

$$N_4\times D_4=N_3\times D_3$$

$$N_4=\frac{N_3\times D_3}{D_4}$$

$$=\frac{610\times18}{18}$$

N_4 = 610 rpm

$(PCD)_4$ = 18 mm

4. Addendum = $2\times m=2\times1=2$ mm
5. Deddendum = $1.25\times m$ =1.25×1 = 1.25 mm.
6. Tooth thickness = $1.5708\times m$= 1.5708 mm
7. Fillet radius = $0.4\times m=0.4$ mm

Table 1: Gear Design Parameters

Gear Name	Billet Size mm	Material	PCD mm	Tooth Thickness mm	No of Teeth
Big gear	Ø40×45	EN36	30	1.5768	30
Small gear	Ø40×45	EN36	18	1.5768	18

CONCLUSIONS

With the help of this attachment, we can drill two holes at a time with provision of varying centre distance between two drilling spindle. It has advantage of portability. The size of machine is smaller than the older machine so it is very simple to move from one place to another. So this machine can be easily transported. The overall space required is also minimizing. The efficiency of this machine is better than the older machine. Large saving in power has been achieved. The machine is very simple to operate. It drills the holes at faster rate.

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References

[1] A.S.Udgave and Prof.V.J.Khot," Design and development of multiple spindle drilling head", Second International Conference on Emerging Trends in Engineering (SICETE).

[2] Bajirao H. NangarePatil, and P. R. Sawant, "Design and Development of Gearbox for Multi-Spindle Drilling Machine (SPM)", International journal of engineering research & technology (IJERT) Volume 2, Issue 5, ISSN: 2278-0181, May-2013.

[3] Prof. Ms.A.A.Shingavi, Dr.A.D.Dongare and Prof. S.N.Nimbalkar, "Design of multiple spindle drilling machine", International journal of research in advent technology (E-ISSN: 2321-9637) Special Issue 1st International conference on advent trends in engineering, science and technology (ICATEST 2015), 08 March 2015.

[4] M.B. Bankar, P.B. Kadam, M.R.Todkar, "Improvement in design & manufacturing process of multiple spindle drilling attachment", IOSR Journal of Engineering, Volume 3, Issue 1, Jan 2013, page 38-43.

[5] Shinde Nikhil , Vishwakarma Prem ,Sanjay Kumar, Godse Rahul , P.A.Patil ,"Design and development of Twin Drill Head Machine and Drilling Depth Control ",International Journal of Innovative Research in Science ,Engineering and Technology , Vol. 4, Issue 5 ,May 2015.

[6] V.B.Bhandari, "Design of machine elements ", Third edition, McGraw Hill Education (India) Private Limited, New Delhi, 2010.

[7] Dr.N.C.Pandya, Dr.C.S.Shah, "Machine Design", Seventeenth Edition, Charotar Publishing House Pvt.LTD, Gujarat, 2009.