Multi-Purpose Mechanical Machine

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Abstract- *This paper presents the concept of Multi-Purpose mechanical Machine mainly useful for production based industries. Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost. Today in this world every task have been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure, every industry desires to make high productivity rate maintaining the quality and standard of the product at low average cost. We have tried to fabricate a working model of a machine which would be capable of performing different operation simultaneously, and it should be economically efficient .In this machine we are actually giving drive to the main shaft to which scotch yoke mechanism is directly attached, scotch yoke mechanism is used for sawing operation. On the main shaft we have use bevel gear system for power transmission at two locations. Through bevel gear we will give drive to drilling centre and grinding centre. The model facilitate us to get the operation performed at different working centre simultaneously as it is getting drive from single power source. Objective of this model are conservation of electricity (power supply), reduction in cost associated with power usage, increase in productivity, reduced floor space, facilitates workers which have their own shop like carpentry, or small processing industry which does not bear machine tool cost, high maintenance cost.*

Keywords- multipurpose, grinding, drilling, cutting, machine tool, rpm,

I. INTRODUCTION

The functions of metal cutting machine tools have been increasing to meet the demands of high productivity and high accuracy in machining complicated and difficult parts on one machine.

Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost. Today in this world every task have been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure, every industry desires to make high productivity rate maintaining the quality and standard of the product at low average cost.

In an industry a considerable portion of investment is being made for machinery installation. So in this paper we have proposed a machine which can perform operations like drilling, sawing, grinding, at different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually and also consume less maintenance cost and floor space.

Multi- Purpose Mechanical Machine or MPMM as we call it is a machine is made especially for the small scale industries where labors working are having very little technical knowledge. It performs multiple operations simultaneously, giving the workers more opportunity to perform their work quickly and efficiently without the hassle of using different machines for performing different operations on work piece. It has four arms on which four different operations are performed.

The aim of our project is to design and fabricate a motor operated multipurpose device. With this device a number of operations can be performed they are as follows:

1. Drilling
2. Grinding
3. Cutting

II. PROBLEM STATEMENT

a) Machine tools are still costly
b) No. of machine performing different operation is more thus it have more maintenance cost.
c) The unit operating by means of electricity has limited applications in the rural area.
d) On increasing the no. of machines requirement of floor space is also more.

III. PROBLEM DEFINITION

To meet out such problems like – high machine tools cost, high maintenance cost, more floor space, Thus we merge three machine, ultimately a single machine performing three operation with less floor space requirement and low machine cost.

IV. PROPOSED METHODOLOGY

In this project we will generally give the power supply to the shaft on which a bevel gear is mounted on it, and a second bevel gear at a right angle to it has been mounted on a drill shaft to which a drill bit is being attached, here arrangement is made. As there is no vertical movement of tool for feed, thus for it we have made arrangement to provide vertical movement to work piece through screwjack. The whole assembly is mounted on cuboidal shape frame made by L- section on which both end of the shaft is mounted on pedestal bearings on upside of frame an extended shaft portion on which pulley is mounted is transmit power from motor shaft .On the other side of main shaft another pulley is mounted of smaller diameter which is connected to a secondary shaft having comparatively large size pulley in middle portion of shat. This arrangement is made to gain the required rpm for cutting operation. One end of secondary shaft is being joined to a circular disc, through this circular disc rotary motion is converted to reciprocating motion which is required for two way hacksaw arrangement. This rotary motion converts into reciprocating motion through Scotch yoke Mechanism.

For grinding operation ,we mounted double belt pulley on motor shaft from one belt power is transmitted to main shaft and from another belt power is transmitted to grinding shaft. In down side of frame near to motor mounted, an arrangement is made a small length shaft is fitted inpedestal on its middle length both end are have no support. One end of grinding shaft pulley is mounted and on other end grinding wheel is mounted. Grinding wheel and motor rotate with same rpm.

V. WORKING PRINCIPLE

There are only three major principles on which our working model generally works:

1. Scotch-Yoke mechanism
2. Power transmission through bevel gears.
3. Power transmission through pulley belt arrangement

Scotch Yoke Mechanism: The Scotch yoke is a mechanism for converting the linear motion of a slider into rotational motion or vice-versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. The shape of the motion of the piston is a pure sine wave over time given a constant rotational speed. This mechanism incorporated in our model two way hacksaw operation.

Power Transmission through bevel Gears: Bevel gears are gears where the axes of the two shafts intersect and the tooth-bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. This gear used because of requirement to transmit power at 90 degree for drilling operation.

Power Transmission through pulley belt arrangement: Belts are the cheapest utility of power transmission between shafts that may not be axially aligned. Power transmission is achieved by specially designed pulley and belt. They run smoothly and with little noise, and cushion motor and bearings against load changes. This arrangement is made for power transmission and to reduce rpm as per requirements.

VI. WORKING OF THE MODEL

In working model of "Multi-purpose mechanical machine" we are supplying power to main shaft through motor, on the mid span of shaft a bevel gear mounted and its below drill shaft connected with main shaft ,thus power is transmitted to the drill shaft for drilling. Through pulley belt arrangement, power is transmitted to secondary shaft where scotch yoke mechanism is mounted for two way hacksaw. Similarly, pulley belt arrangement is made near to motor for grinding.

Figure 1 Multipurpose Mechanical Machine

VII. SPECIFICATION OF COMPONENTS

a) Frame = L- section iron bars
   Length = 3 ft., width = 3.5 ft. , height 3.5 ft
b) 1 hp single phase induction motor.
c) Pedestal bearings of inner dia. = 25 mm
d) Main shaft length = 4 ft. , dia. = 25 mm
e) Secondary shaft length = 1 ft. dia = 25 mm
f) Grinding shaft length 0.5 ft. dia. = 24.5 mm

g) Bevel gears Tg = 16 , Tp = 9
h) Pulleys
Motor pulley dia. = 100mm
Grinding pulley dia = 100 mm
Main shaft pulley dia. = 300 mm
Main shaft pulley dia for hacksaw = 75 mm
Secondary shaft pulley dia. 250 mm
i) Disc of dia. = 26 mm
j) V- belts
k) Hacksaw frame and blades
l) Grinding wheel dia. 6 inch
m) Screw jack
n) Drill chuck and drill bit

VIII. RESULTS AND DISCUSSIONS

We have taken some useful data from our working model and tried to evaluate the percentage deviation from the standard calculated values which is as follows:-

Since pitch radius of pinion is rp = 15 mm, pitch radius of gear rg = 35 mm.

By the relation between pitch cone angle and velocity ratio we can find the velocity ratio as we have pitch cone angle for both gear and pinion as 75 deg. and 35 deg.

$$\tan \Upsilon p = \frac{\sin\theta}{W_p/w_g + \cos\theta}$$

where θ is the angle between the shaft.

now putting θ and ϒp we get = 1.428 i.e. our velocity ratio is 1.428. Now for the two complete revolution of main shaft the Drilling shaft should have no of revolution = 2.856

But from our model the no of revolution measured at drilling axis is 2.75 i.e. two complete revolution plus 270^{o}rotation.

Percentage Error in power transmission =

$$\frac{(2.856 - 2.75)*100}{2.856} = 3.712\%$$

Now diameter of circular disc of Scotch yoke mechanism = 20 cm

Actual measured effective stroke length of yoke = 18.5 cm

Percentage error in the stroke length =

$$\frac{(20 - 18.5)}{20} * 100 = 7.5\%$$

Similarly many values of rpm at drilling axis can be measured on changing the input; in this conceptual model feed to the work piece is given through the work table.

Since the model is subjected to friction therefore there is a error of 3.712% and 7.5% during power transmission and transverse motion of sawing blade respectively.

Figure2. Gives the variation of number of strokes of Hacksaw with rpm . It is observed that the number of strokes increases uniformly with rpm. The variation in the obtained plot is due to errors in observation and due to power transmission losses.

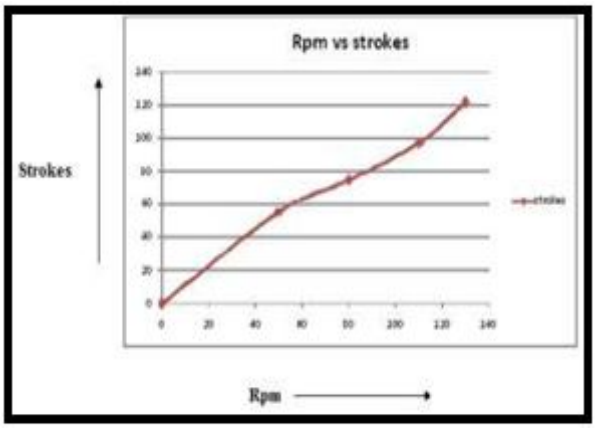

Figure 2: Variation of Number of Strokes with Rpm

Figure3 shows the variation of cutting depth with rpm. The variation in the obtained plot is due to errors in observation and due to power transmission losses.

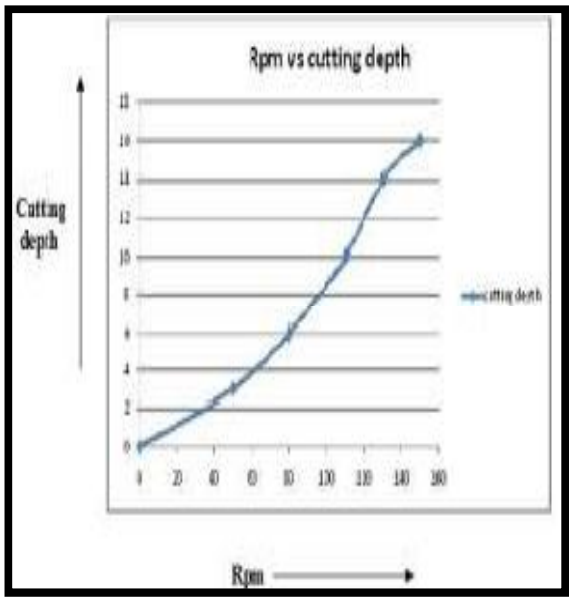

Figure 3: Variation of Cutting Depth with Rpm

IX. 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-purpose mechanical 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. In an industry a considerable portion of investment is being made for machinery installation. So in this paper we have proposed a machine which can perform operations like drilling, sawing, grinding at different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually for operating operation simultaneously.

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