Design and Development of Multipurpose Machine

Rahul Kajabe[1], Omkar Gunjal[2], Vishal Gupta[3], Swapnil Godase[4] , Manish Gorde[5]
[1]Assistant Professor, Department of Mechanical Engineering, JCOE Kuran, Maharashtra, India.
[2,3,4,5]U.G. Student, Department of Mechanical Engineering, JCOE Kuran, Maharashtra, India

Abstract- This project deal with design, development and fabrication of "Development of multipurpose machine". This machine is designed for the purpose of multi-operations i.e. drilling, cutting and grinding. This machine perform multipurpose operation at same lime with required speed & this machine is automatic which is controlled or operated which is run with the help of current. This machine is based on the mechanism of scotch yoke. The project aims at designing and developing a multipurpose machine tool which is capable of performing multiple tasks simultaneously. The machine is operated by giving drive to the main shaft to which worm gear mechanism is directly attached; worm gear mechanism is used for sawing operation. On the main shaft bevel gear mechanism was used for transmitting power. These bevel gears are used to transmit motion in the radial direction and drives drilling centre. The Grinding wheel is directly connected to the motor shaft. This model facilitates to complete three operations simultaneously with a single power source. This model of the multi operational machine is may be used in industries and domestic operation which can perform mechanical operation like drilling, cutting & shaping of a thin by motor metallic as well as wooden model or body.

Keyword- *Scotch Yoke mechanism, bevel gears, drilling, grinding*

I. INTRODUCTION

The world being led by innovations has headed to the accomplishment of the activities that we encounter in our day to day life to be snappier and quicker.Yet, this progression additionally requests high level investments as well as expenditures. Each and every industry is striving to make productivity at a higher rate, at the same time maintaining product's quality and product's standard to be of a normally low cost. In this work proposed, a conceptual prototype of a machine that would be fit to perform distinctive operation simultaneously was developed. The proposed system includes the feature of being more economical too.[1]

The main goals of this proposed model are conserving electricity, minimizing cost that is related to power utilization, enhanced production and reduction in floor space. A significant part of the investment is usually used up for installation purposes in machines. Therefore the work proposed was envisioned in such a way that the operations like drilling, sawing, grinding and other lathe functionalities do not consume additional costs for such operations. Various machining process in manufacturing industries are carried out by separate machining devices. It needs more space , time and investment that involves high expenses.[2]

But the fabrication of multi tool operating mechanical device encompasses three operations on a single machine. The operations are categorized as drilling, cutting, grinding. It is a new concept specially meant to reduce the work time and save the cost.

This is done to save the added investment cost that occurs during drilling and shaping the device in the industries. The machine operates the drilling machine with the bevel gear arrangements. Hence we can carry out exactly the above mentioned three operations on the machine.[3]

The need for our project was found out in industries where mass production is carried out. In mass Production the transferring of work piece from one machine to another consumes time, human effort as well as power consumption for each and every machine. Thus our project is the fabrication of machine which optimizes time, power consumpsion and capital cost.[4]

A. PROBLEM STATEMENT

To design and development of "MULTIPURPOSE MACHINE" is a structure which is designed for the purpose of multi-operations i.e. drilling, cutting & shaping. The present machines have limited work stations on single machine, and the number of operations performed on them are limited. The cost of the existing machines is high, also the efficiency is low. The time required for work piece handling is more. The floor space utilization of these existing machines is poor as they require large space. The energy consumption is also high.

B. OBJECTIVES

1. Design should be 'Simple' to operate and 'Safe'.
2. It should have 'Low Cost of Maintenance'.
3. It should require Less Man Power.
4. The design should be Robust and Reliable.
5. The design should reduce floor space requirement.
6. To increase production rate of machine.

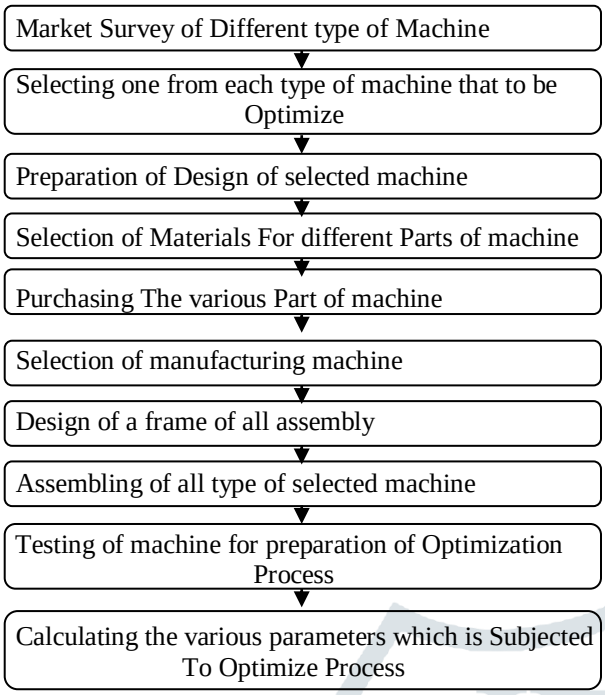
II. LITERATURE REVIEW

The purpose of the literature review is to go through design, analysis and experimental testing of multipurpose machine. Multipurpose machine is the machine performing multiple operations in a single setup. The traditional machines are operation specific so require large floor space area, larger labour attention, higher maintenance and lower economy. So this machine will optimize these performance aspects and will be most beneficial for carpenters and fabricators.

A. Scope

1. For small scale workers like fabricators, there will be floor space economy and machine cost for individual machine will be reduced.
2. This machine can also be used as portable machine so work complexity can be reduced.
3. More flexible model can work more efficiently.

III. METHODOLOGY



IV.DESIGN CALCULATION

1. Calculation of drilling speed

For drilling speed, first we calculated the speed of bull wheel i.e. the main pulley. From the relation of speed and diameter equation can be defined as,

$$Ns/Nm=Da/Db$$ [7]

Ns is the speed of the main pulley,

Nm is the speed of the motor which is 1445rpm,

Da is the diameter of the motor pulley (small) which is 90mm,

Db is the diameter of the main pulley which is 457.2mm.

So, the speed of the main pulley is given under equation,

$$Ns=(Da/Db)*Nm$$

$$Ns= (90/457.2) *1445$$

$$Ns= 284.44 \text{ rpm}$$

Therefore, bull wheel speed is 284.44rpm.

Now the drilling speed is calculated, having the values as speed of the bull wheel to be 284.44rpm, no. of teeth on gear to be 40 and no. of teeth on pinion to be 20.This is done by the relation given under equations (3.3) and (3.4),

$$Ng/Ns=Tp/Tg$$

$$Ng=(Tp/Tg)*Ns$$ [7]

These two equations give the value of the drilling speed as stated below.

$$Ng = (40/20)*284.44 = 568.88\text{rpm}$$

$$Ng=568.88 \text{ rpm}$$

The verification of the drilling speed is performed as follows. Since we used 1:2 gears, i.e. the gear has 40 teeth, and pinion has 20 teeth, the speed of drilling gets double to that of the speed of the bull wheel. This is verified by the following step.

$$Ng = 284.44*2 = 568.88 \text{ rpm.}$$

2. Calculation of grinding speed

From the relation between the speed and the diameter that derives equation and the value of Ns is calculated.

$$Ns/Nm=Da/Db$$ [7]

where,

Ns is the speed of grinding and circular cutter,

Nm is the speed of motor,

Da is the diameter of pulley used for grinding which is 45mm,

Db is the diameter of big pulley of the motor which is of 110mm.

Therefore,

$$Ns = (110/45)*1445=3532.22\text{rpm.}$$

$$Ns= 3532.22\text{rpm.}$$

Therefore the speed of grinding is 3532.22rpm.

3. Calculation of circular saw cutter

As the grinding and circular saw cutter are assembled on the same bearing block, the speed of circular saw cutter is equal to grinding wheel. Therefore, the speed of circular saw cutter (Cs) equals 3532.22rpm.

4. Calculation of hack saw cutting speed

Table no.1 shows the values of driven end's theoretical and actual revolution.

Table no.1 Selection of driven ends revolution

Sr. No.	No of revolutions offered to main shaft	Driven ends theoretical revolution	Driven ends actual revolution
1	1	1.428	1.335
2	2	2.856	2.67
3	3	4.284	4.22
4	4	5.712	5.62
5	5	7.14	7.075
6	6	8.568	8.503

where, r is the radius of the crank wheel which is 0.1397mts. Angular speed can be,

$$\text{Angular velocity}(v)=w*r$$

Angular speed(w)=(2πN)/60 in rad/sec

where, N is the speed of crank wheel in rpm which is 284.44rpm.

Therefore from above equations, the following values are obtained.

w = 2*π*284.44/60

w = 29.786rad/sec

V = 29.786*0.1397 = 4.16m/sec

V = 4.16*60 = 249.66m/min.

V = 249.66m/min

Therefore, the angular velocity of hacksaw is 249.66m/min.

5. Calculation of selection of motor-

Selection of motor is very essential because the motor should provide the power required to perform all the operations and should withstand there throughout task.

5.1 Power required for drilling

Power required for drilling = P_d

$P_{d=}=[(T*N)/975000]+[(P*f*N)/(612*10^4)]$ [8]

Where,

N=drill speed in rpm

T=torque in kg-m

P=thrust force in kg

Now,

$P=Fv+2Fv_1$

P=5+2*3=11kg

And,

$T=C*d*f^{9.7}$

Where,

C=constant depending upon material

d=drill diameter in mm

f=feed in mm/rev

$\therefore T=1.036*10^{-12}$

N=569 rpm

$\therefore P=5.11*10^{-5}$ kW

5.2 Power required for grinding

Power=Force*velocity [8]

Force=1kg=9.81N

Velocity=[(π*D*N)/1000]=221.9

∴P=2.18kW

5.3 Power required in hacksaw cutting

Cutting force=Fc

Fc=Zc*Kz*A*f in kg

Where,

Zc=no. of teeth in contact=15

Kz=specific pressure of cutting=$1800*10^{-6}$

A=thickness=1mm

F=feed=1mm/stroke

∴Fc=0.264870 N

Power=Fc*velocity=0.26487*4.16

Power=1.1018 W

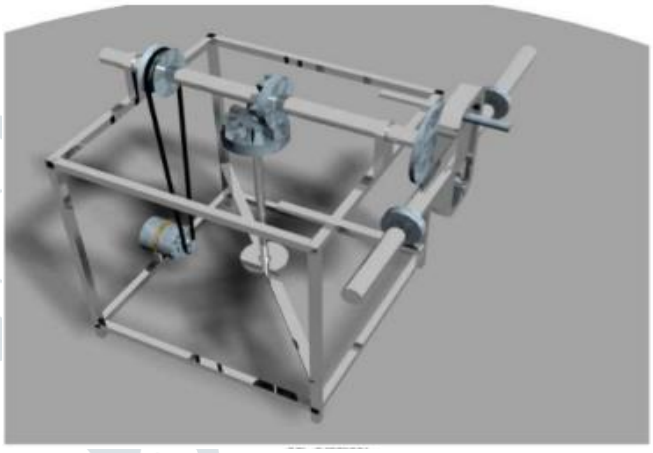
For 4 hacksaws, P=4*1.1018=4.4072 W

Total power for all the operations=2.184 kW

∴Motor power>=2.184 kW

∴Motor selected is 3HP.

3D model of assembly of reaper



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