Fabrication of Rotatable, Multi Purpose Machine Tool for Small Scale Applications.

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Abstract:- This paper deals with the design development and fabrication of "Multi Purpose Machine Tool". This machine is designed for performing multioperations viz, Drilling, Cutting, Facing, And Turning. The initial drawings were made with the help of CATIA software. The operations are controlled by gear and pulley transmission system, BLDC motor and a hall effect sensor controller. The machining components are mounted on the rotating mechanism to reduce idle time. Constituting small capacity, portable Lathe, capable of performing drilling, cutting, facing and turning. The speed of machine can be controlled instantly with the help of the controller. The rotating mechanism can be rotated manually or automatically .A stepper motor could be used to rotate the table on a particular angle. The objectives of the model developed are conservation of electricity (power supply), reduction in cost of manufacturing, increase in productivity and reduced floor space requirement. This machine tool will prove profitable and economical for small scale application.

Keywords:- *Multipurpose machine tool, Rotating mechanism, BLDC, controller, portable lathe, hacksaw, drilling.*

I. INTRODUCTION

Industries are basically meant for production of useful goods and services at low production cost, machinery cost and low inventory cost. Nowadays, every task has been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure. Every industry desires to increase the productivity rate maintaining the quality of the product at comparatively low cost. In any industry considerable portion of investment is being made for machinery installation. The present work mainly focuses on designing and developing a new machine which can perform three different operations viz. Drilling, Grinding and Cutting. Lathe is a versatile machine tool which can perform any operation desired. However, some of them are to be carried out at different working centers where as with the present machine this need is eliminated due to the fact that the operations were performed simultaneously. According to some economists, manufacturing is a wealth-producing sector of an economy, whereas a service sector tends to be wealth-consuming. Emerging technologies have provided some new growth in advanced manufacturing, employment opportunities in the Manufacturing sector. Manufacturing provides important materials support for national infrastructure and for national defence. This is a compact machine which can do above operation simultaneously or individually which is mounted on a plate which has a rotating mechanism.

II. METHODOLOGY

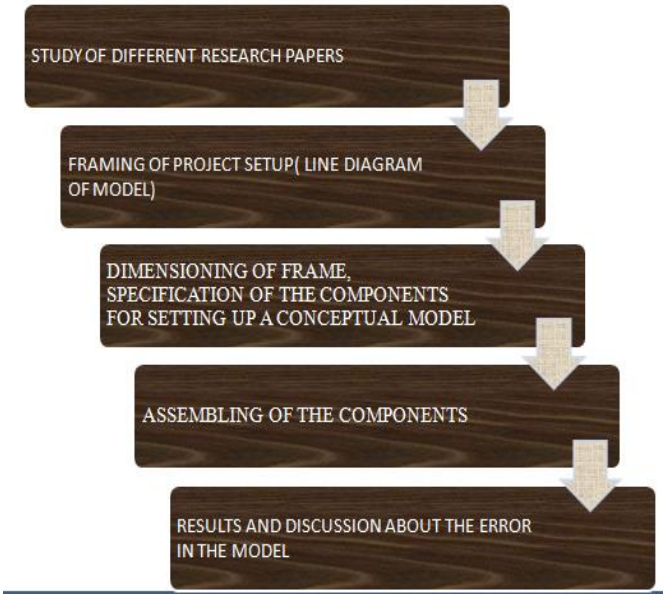

Fig 1:- Methodology

III. MULTI PURPOSE MACHINE TOOL

A. Frame (Design)

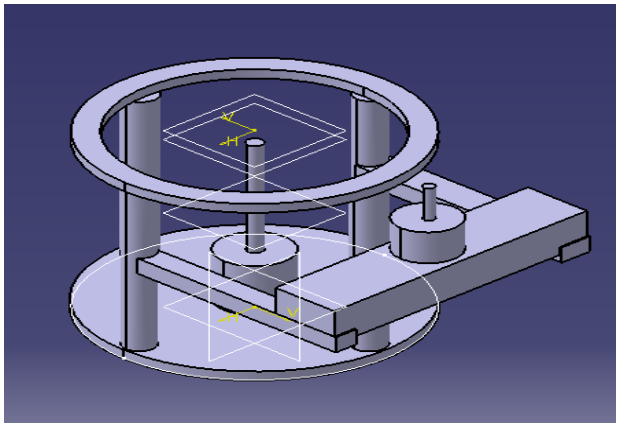

Fig 2:- Frame (Design)

Fig 3:- Rotating Table

B. Equipments

➢ *Portable Lathe*

Fig 4:- Portable Lathe

Lathe Specification And Calculations:

Length of Bed-57 cm

Breadth of Bed-14.8 cm

Height of Chuck-11 cm

RPM of Main Motor Shaft-600

RPM of Main Shaft-375

Pulley Diameter of Main Shaft (d) -3.4cm

Pulley Diameter of Lathe Spindle (D)-3.8cm

- *Belt Inclination Angle*

Sin α= (D-d)/2a = (3.8-3.4)/ (2*20) = 0.572°

For α =0.572°

β = 180°- 2a = 180°-(2*200) = -220°

β = 360°-220°=140°

- *Belt Length*

$L=2a+ (\pi/2) (d +D) + (D -d)^2/4a$

$L=2*200 +\pi/4 (34+38) + (0.4)^2/ (4*200)$

$L=400+ \pi/4 * 72 + (0.16)/ (4*200)$

L= 626.08 +0.02 = 626.1mm

Wrapping Angle = 180 – (180*D)/π*d = 180- (180*38)/ π*34

β1= 115.9° or 2 radian

β2= 2π-β1=2*π-115.9=244.8° or 4.27 radian

Torque of Lathe Spindle = 12 mm

T= (p1-p2)/r

For Small pulley;

P1/p2=e^μΦ= e^ (0.20*2) =1.48

T= (1.49 p2- p2)*34 =16.66 p2

For Large pulley;

P1/p2=e^ (.20*4.27) =2.3

T= (2.3p2-p2)*38= 49.4p2

Small: p2= 12/(1000*16.66) =0.720 =720 N

Large: p2=12/ (1000*49.40) =0.2429 =242.9 N

Diameter of job to be turned (D) = 13

Revolution of the job/min (M) = 300

Cutting Speed (S) = 12.2522 m/min

S =πDN /100(m/min)

Time of Turning = (Length of the job to be turned / (Feed/rev)*rpm)

Length of the job =30 cm

Cutting speed (S)= 12.252 m/min

Diameter of job to be turned= 1.3 cm

Revolution of the job /min (M) =289.895

- *Drilling*

Fig 5:- Drilling

Drilling Specification and Calculations

Drill bit dia. – 8mm

RPM-1000

SFM (Surface feet /min) = 0.2618*D*RPM= 0.2618*.393*1000

SFM= 102(approx.)

FOR MS, BHN= 130 and SFM= 100

Cutting Speed, VC = (RPM* π*D)/12

VC= (3.14*1000*0.314)/12= 82.16 ft /min

Feed Rate, VF = IPR * RPM

f= IPR (INCH PER REVOLUTION varies for 6mm to 13mm from 0.004 to 0.0100)

VF = 0.005* 1000 = 5 inch /min

Cross Section Area of Hole, AT= 3.14 * $(0.157)^2$ = 0.07739 in^2

MRR= Φ= VF* AT= 5*0.07739 =0.3869 $inch^3$/min

Power Requirement, PC= (D/4 *f*VC*KC)/33000*ŋ= [(0.314/4)*0.005*82.16*440000]/ 33000* 0.8

=0.517 hp or 0.378 kw

Torque MC= (hp * 5252)/ RPM = (0.517* 5252)/1000 = 2.715 ft/lbs or 3.7 Nm

Feed Force= 0.7 * .314/2 * 0.005 *440000 = 241.78 lbs

Machining Time TC= (L+H)/VF = (0.196+ 1.5748)/5 = 0.354 min/piece or 21.24 seconds/piec

IV. ACTUAL MODEL

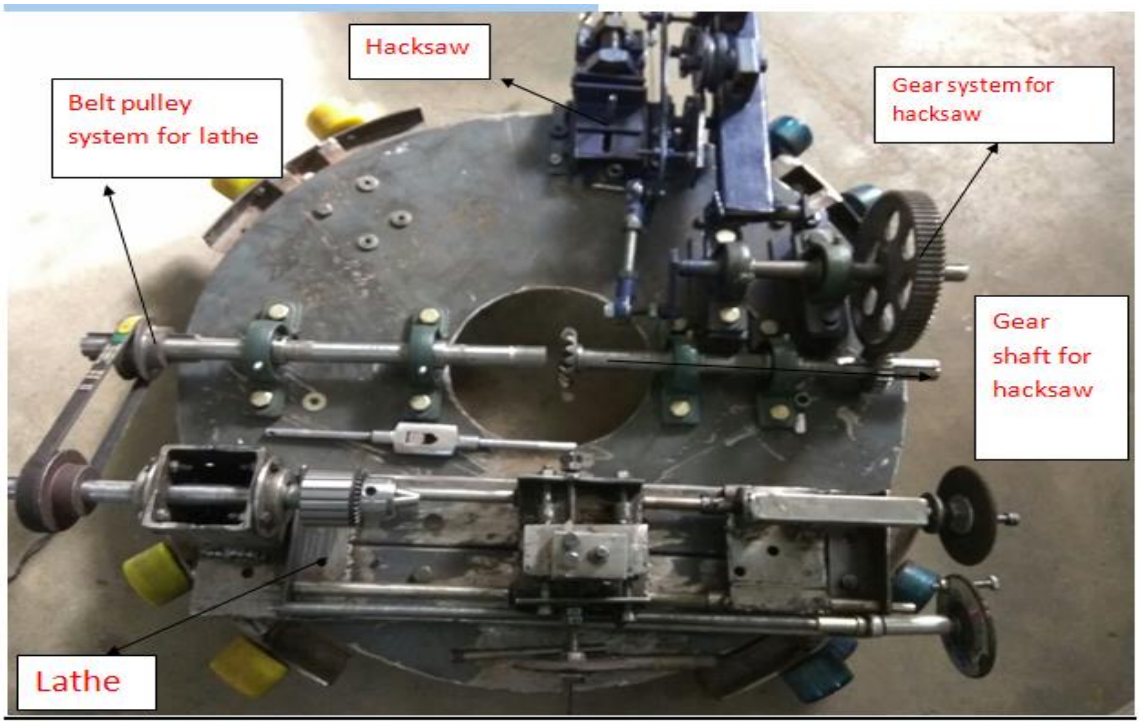

Fig 6:- Actual Model

V. ACTUAL FRAME WITH MOTOR

Fig 7:- Actual Frame With Motor

VI. RESULTS AND DISCUSSIONS

COMPARISON OF MPMT WITH OTHER MACHINES

	MPMT	DRILL MACHINE	POWER HACKSAW	LATHE	SUM OF INDIVIDUAL COST	SAVED
COST	29,000	12,000	13,000	13,000	40000	11,000RS
POWER CONSUMPTION	900WATT	600WATT	500WATT	450WATT	1550WATT	650WATT
WORKING SPACE	0.8084 METRE CUBE	0.3*0.6.0.6 METRE CUBE	0.8*0.6*1.5 METRE CUBE	0.6*0.55*1.5 METRE CUBE	1.318 METRE CUBE	0.5096 METRE CUBE
NET WEIGHT (WITH MOTOR)	200 KG	85KG	100KG	125KG	310KG	110 KG

VII. CONCLUSION

This multi purpose machine tool is mounted with different equipments and can be used with simultaneous or individual operations. We can have varying speed with the help of the controller and because we have different equipments we need to regulate the speed of each and every operation.

The machining of wood and metals can be done on small work pieces and with furnished workpiece.This machine is best usable in the small scale wood industry and polymer industries.

The machine tools are mounted on the rotating table which make it comfortable to use for a stationary worker or operator.

The best thing about this machine is the varying speed ranging from 0-3000rpm.which make it most suitable for every operation.

This machine is efficient from other machine because it takes less space, power, and weight and economically better than the other machine.

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