Proceeding of NCRIET-2015 & Indian J.Sci.Res. 12(1):162-167, 2015 ISSN: 0976-2876 (Print)
ISSN: 2250-0138 (Online)

DESIGN AND FABRICATION OF MACHINE PERFORMING MULTIPLE WOOD WORKING OPERATIONS

RAVI TEGGIN[a1], SHIVANAND KAVADIMATTI[b] AND SHASHANK HEBBAL[c]

[abc]Departmentof Mechanical Engineering, Basaveshwar Engineering College, Bagalkot Karnataka, India

ABSTRACT

This paper discuss about the Design and Fabrication of Multi-Purpose Wood Working Machine. Wood working is anything that performing any operation on wood in any way for some useful work. This multipurpose wood working machine has ability to perform four operations such has Planing, Edge forming, Cutting, and Drilling on a single machine. All the four tools driven by single motor. The belt drives are used can be engaged and disengaged whenever necessary. In this competitive world people are very passionate for their home interior design. In order to produce interior design models carpenter are using separate machines for conducting particular operations so which leads to more cost, material handling is more. In order to avoid these problems this concept is developed. Hence, using this is all about combining planing, drilling, forming and sawing machines in a single platform to reduce the investment cost and floor area and made work easy.

KEYWORDS: Planning, drilling, forming, cutting, sawing

Along with stone, mud and animal parts, wood was one of the first materials worked by early humans. Micro wear analysis of the Mousterian tools used by the Neanderthals show that many were used to work wood. The development of civilization was closely tied to the development of increasingly greater degrees of skill in working these materials.

The progenitors of Chinese woodworking are considered to be Lu Ban and his wife Lady Yun, from the spring and Autumn Period. Lu Ban is said to have introduced the plane, chalk-line, and other tools to China. His teachings were supposedly left behind in the book Lu Ban Jing ("Manuscript of Lu Ban"). Despite this, it is believed that the text was written some 1500 years after his death. This book is filled largely with descriptions of dimensions for use in building various items such as flower pots, tables, altars, etc., and also contains extensive instructions concerning FengShui. It mentions almost nothing of the intricate glue-less and nail-less joinery for which Chinese furniture was so famous [W A J Chapman, 1972].

Many people love to work with wood and when they do it is called Woodworking. Woodworking is anything that involves working with wood in any way, whether it is carving, painting, sawing, or anything else. It has been done as long as man has been on the face of the earth. The first man did make weapons out of wood, so this involved carving. Early man also made crude statues from wood that were to help the tribe win the favor of the animals that they were going to hunt; and later to please the gods which they believed in [V.B. Bhandari, 2011].

Wood is generally used from a countries own natural resources and it wasn't until trade was developed from city to city and country to country, that different types of wood became available in Woodworking. Humans have decorated wood in such detail that Woodworking had become a prominent state of art. It has always been human nature to ornament every single article that a person owned. In some ancient civilizations, people used staffs carved with the story of their heritage. This is proven during the middle ages with all the wooden statues that still stand all around the world. Almost every- European city has some of these historical statues preserved in some type of sanctuary, and the statues are taken very good care of. The middle ages was not the only civilization which showed extreme patients in their Woodworking as a person can see when they look at some Byzantine art, or Gothic art. These figurines and statues show how people literally loved the art of Woodworking[Ozkan, 2012].

The only downfall with working with wood is that over time wood tends to split and crack. Ancient wooden sculptures have long been lost due to deterioration. No one really knows when man first began painting their Woodwork. It is thought that color was not only used to bring a Woodworking statue to life, but that it was also painted to protect the wood from the elements as well as insects which would eat away at the wood.

[1]Corresponding author
Organized by Department of E&CE, Bheemanna Khandrre Institute of Technology Bhalki, Bidar, India

NEED IDENTIFICATION AND PROBLEM DEFINITION

Need Identification

Now a days carpenter workers are using more than one machine to perform the various operations. It requires more floor areas and the cost of installation of all machines is high. In the present work, we are planning to design and fabricate a machine that performs many operations. This in turn reduces the overall cost and usage of different machines.

Problem Definition

It is required to design and build a mechanism so that all the operations (i.e., cutting, planing, drilling, and forming) can be carried out in a single machine.

- Operating time must be low.
- Minimization of machine cost.

LITERATURE REVIEW

Study of Wood working concept

Around 2000 B.C. the Egyptians used wood to make furniture, such as beds, tables, chests, and many other items. Wood has been used by every civilization in the world, and is still used today to make manufacture paper, furniture, buildings, and a huge variety of everything else. During the 20th century Woodworking was considered to be not only time consuming but expensive to have done, so Woodworking as a skill literally stopped and left up to individual craftsmen, who sell the Woodworking art at flea markets and yard sales. However, many of these Woodworkers are still around in other countries throughout the world.

Study of Existing machines

Earlier days carpenter are manufacture the furniture's by using hand tools. As the industrial evolution is started, the machines are developed to perform the varies operations like cutting, planing, forming etc… The continuous innovation on the woodworking machines is going on to made work easy. Following machines are used for woodworking.

DESIGN AND ANALYSIS OF MECHANISM

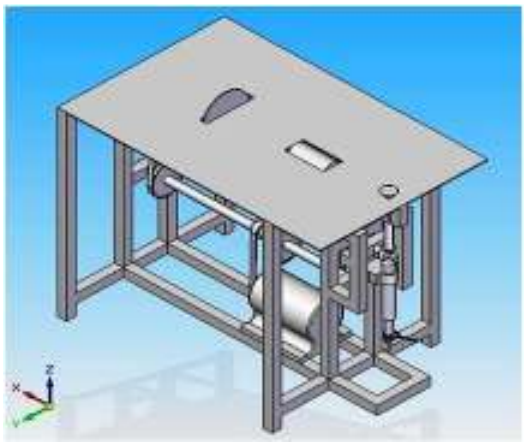

Figure 1: Assembly design (Isometric view)

Detailed part drawing

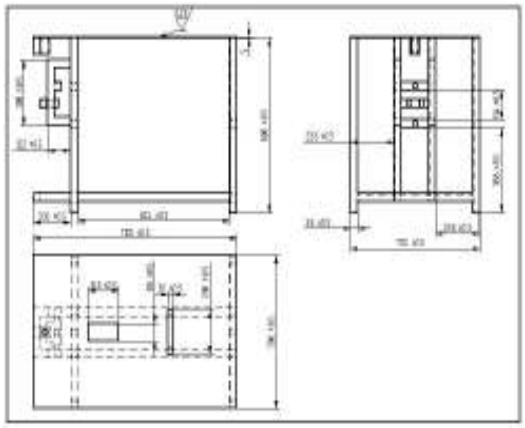

Figure 2: Table

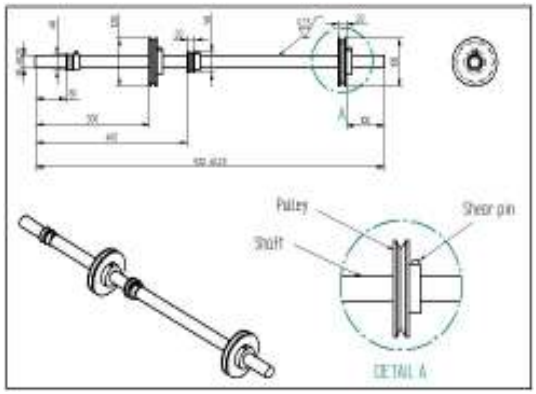

Figure 3: Main shaft

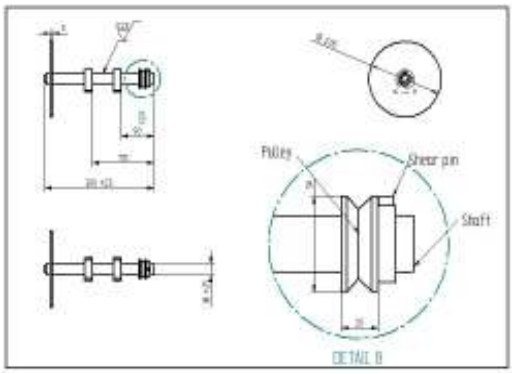

Figure 4: Straight cutting shaft

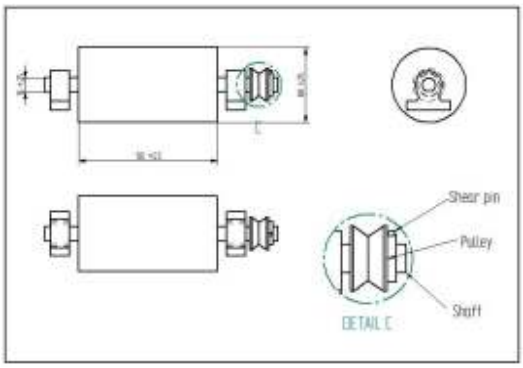

Figure 5: Planing shaft

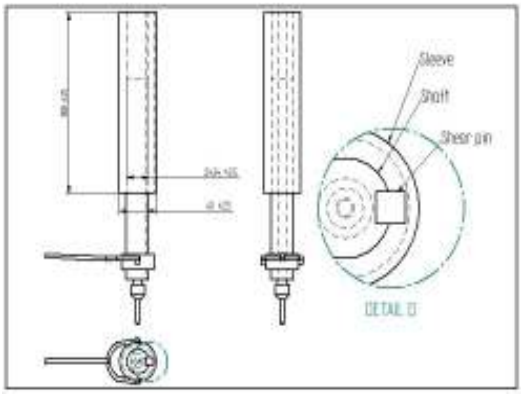

Figure 6: Drilling bit assembly

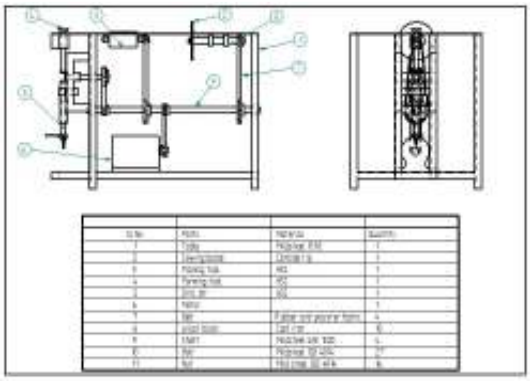

Figure 7: Detailed assembly drawing

Concept of mechanism

In the present scenario the power required for the operations i.e. (Cutting, Drilling, Forming, planning) are achieved by using V-Belts. The power to the main shaft is supplied from Motor (3 phase).Each operation is equipped with different shaft which is driven by main shaft.

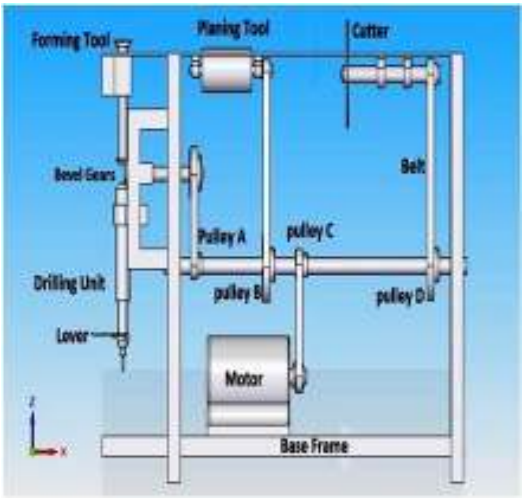

Figure 8: Multi-purpose woodworking machine

Pulleys are mounted on each shaft to drive the cutter. The size of the pulleys depends on the speed required for specific operations. Each pulley is provided with shear key so that it can be engaged during the operation and disengaged whenever not required. Also it plays important role in safety aspect for the various tools due to heavy load.

The speed and power required for all the operations processed on this machine are achieved by using the 3-phase motor. The motor is mounted at the base frame of the table. Main shaft is located at the center of the table and is supported between the bearings. There are four pulleys mounted on this shaft as shown in figure 4.0. Pulley 'A' is used to drive the forming and drilling shafts, there is a bevel gear arrangement is made to get forming and drilling operations separately from the same shaft. Pulley 'B' is used to drive the shaft on which planing tool is mounted. Pulley 'C' is used to drive cutting shaft. Drilling unit is located at the left side of the machine as shown in fig. ( ) and feed is given by lowering the lever.

ANALYTICAL CALCULATIONS

Design of main shaft

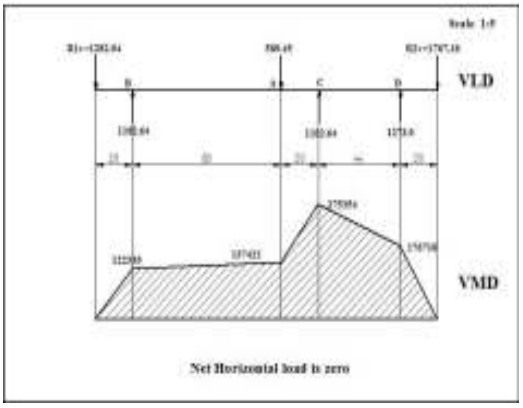

Figure Load and bending moment diagram

Motor Specification

P = 2.24 KW

N = 1400RPM

Standard diameters of Pulleys from data hand book

D_{Motor}= 50 mm

d_A= 50 mm d_B = 120 mm d_C = 120 mm d_D=40 mm

Angle of Contact of Belt

$\theta_A = 180^0$

$\theta_B = 168^0$

$\theta_C = 166^0$

$\theta_D = 165^0$

Torque Transmitted from the Motor

$$P = \frac{2\pi NT}{60}$$

$$T = \frac{P \times 60}{2\pi N} = \frac{2.24 \times 60 \times 1000}{2 \times \pi \times 1400}$$

$T = 15.28 \text{ x } 10^3 N - mm$

Tensions in the Belts

For Pulley 'A'

$$\frac{T_{1A}}{T_{2A}} = e^{\mu\theta} \qquad (\because \mu = 0.3)$$

$T_{1A} = 2.56 \ T_{2A}$

$T = (T_{1A} - T_{2A}) \times r$

$15.28 \times 10^3 = (2.56 \ T_{2A} - T_{2A}) \times 25$

$T_{2A} = 326.153 \text{ N}$

$T_{1A} = 2.56 T_{2A}$

$T_{1A} = 834.95 \text{ N}$

Similarly for Pulley 'B'

$T_{2B} = 341.47 \text{ N}$

$T_{1B} = 850.27 \text{ N}$

For Pulley 'C'

$T_{2C} = 341.47 \text{ N}$

$T_{1C} = 850.27 \text{ N}$

For Pulley 'D'

$T_{2D} = 382.55 \text{ N}$

$T_{1D} = 891.35 \text{ N}$

*** Vertical Forces**

For Pulley A = 580 + 8.9 = 589.45 N

For Pulley B = $T_{1B} + T_{2B} - w_B$

$= 1182.81 \text{ N}$

For Pulley C = $T_{1C} + T_{2C} - w_C$

$= 1182.84 \text{ N}$

For Pulley D = $T_{1D} + T_{2D} - w_D$

$= 891.35 + 382.55 - 8.9$

$= 1273.9 \text{ N}$

***Net Horizontal Forces is zero.**

Consider VLD

$$(R_{1V}+R_{2V})=(1182.84+1182.84+1273.9)-589.45$$

$$= 3060.13 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\sum R_{1V} = 0$$

$R_{2V} \times 920 = ((1273.9 \times 820) + (1182.84 \times 600) - (590 \times 500) + (1183 \times 100))$

$R_{2V} = 1767.18$ N

$R_{1V} = 1282.94$ N

Bending Moment:

$@\ R_{2V}=0 \quad \& \quad R_{1V}=0$

BM @ D = 176718 N-mm

C = 275354 N-mm

A = 137422 N-mm

B = 122335 N-mm

Maximum BM = 275354 N-mm

According to Maximum Shear stress Theory

$$d=\left[\frac{16}{\pi\tau_{ed}}\left[\sqrt{M^2+T^2}\right]\right]^{\frac{1}{3}}$$

Take, $\tau_e = 122.5 N/mm^2$ and FOS=1.5 for Commercial Cold rolled material and σ_e=241 N/mm^2

d = 26.51 mm

According to maximum normal stress theory

$$d=\left[\frac{16}{\pi\sigma_e}\left(M+\sqrt{M^2+T^2}\right)\right]^{\frac{1}{3}}$$

d = 25.67 mm

so we select the size of the shaft as d=26.51 mm

Standard size of Shaft diameter = 32mm

Design of Straight Cutting Shaft

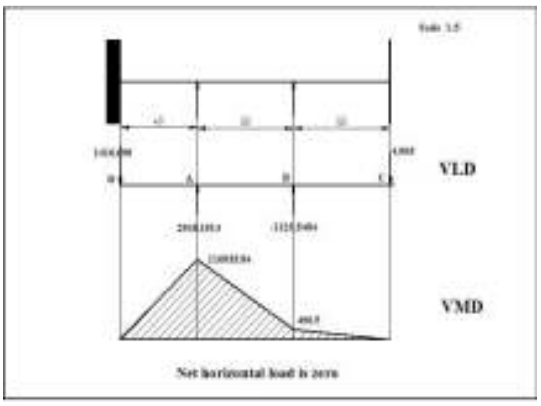

Figure Load and bending moment diagram

Design for planing cutting shaft

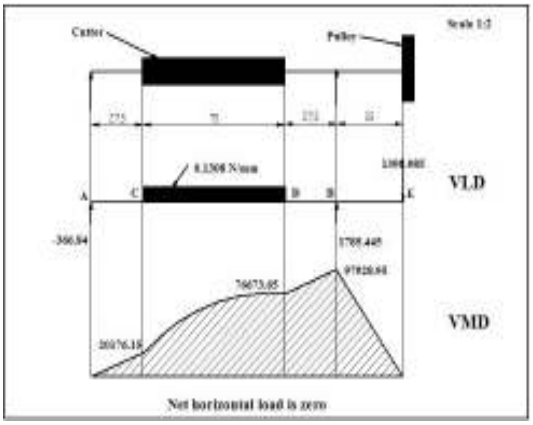

Figure Load and bending moment diagram

RESULTS AND DISCUSSION

Prototype Testing

Figure 9: Final working model

RESULTS

CONCLUSIONS AND FUTURE SCOPE

In this which incorporates wood cutting tool, forming tool, planning tool, drilling tool, are the very basic equipment's for every wood working processes. The machine is highly efficient and economically feasible for wood workers. The power consumption is also less and works with all kinds of wood. The machine is constructed based on worker safety and space available to carryout work and has less vibration (has a strong base made with MS metal). Finally the machine is comfortable for working and recommended to use.

This work entitled "Multi-purpose woodworking Machine" can perform cutting, planning, forming and drilling operation. And also turning operation will be added in future. Noise and vibration will be reduced. This can be used for mass production of wooden furniture's.

REFERENCES

W A J Chapman, Workshop Technology (vol.1), 5 thed., Elsevier science, 1972.

V.B. Bhandari, Machine design book, vol (5),ISBN-13:978-0-07-068179-8,pp330-333, 2011.

PSG Design Data Book, (vol 5), Kalaikathir Achchagam – Coimbatore, May2010.

Ozkan & S.Ayan "Design and application of circular saw machine" Journal of engineering research and applied science, vol (1), pp26-33, June 2012.

Luis Cristovao "Machining properties of wood", vol(1),pp17-21, 2013.

Hameed Shoripour "Development of automatic cutting system", Journal of agriculture research, vol 7(17), pp 2683-2687, May 20.