Design & Fabrication of Wooden Lathe Machine

Vaibhav Singh[1] Brijbhushan[2] Suraj Srivastava[3]
[1,2]UG Student [3]Assistant Professor
[1,2,3]BBDNITM, Lucknow, India

Abstract— Lathe machine is one of the most versatile and widely used machine tool all over the world. It is commonly known as Mother of all Machines. An engine lathe is the most basic and simplest form of the lathe. It derives its name from the early lathes, which obtained their power from engines. Besides the simple turning operation, lathe can be used to carry out other operations also, such as drilling, reaming, boring, taper turning, knurling, screw thread cutting, grinding etc. The Light Weight (wood) lathe machine is introduced to lessen the human suffering and to improve economic and technological standard, and for years Nigeria recognized that she was economically and technological poor and has been economically dependents on the western world for survival in terms of technology. To discourage this importation of technological equipment placed embargo on the importation of certain goods and this inspired our people to recognized indigenous technology though our fore father used axe, cutlass and some other sharp tools from designing woods. It is the acknowledgement of this fact that led to the design of wood lathe machine, even though this project of design and fabrication of Light Weight Lathe machine is a copied design, we tried to improve more on this machine so that it can design wood with little or no stress, utilizing the available material in order to reduced cost for production purposes and durability.

Key words: Lathe Machine, Drilling, Knurling, Grooving, Forming, Polishing

I. INTRODUCTION

It is the acknowledgement of this fact that led to the design of wood lathe machine, even though this project of design and fabrication of Light Weight Lathe machine is a copied design, we tried to improve more on this machine so that it can design wood with little or no stress, utilizing the available material in order to reduced cost for production purposes and durability.

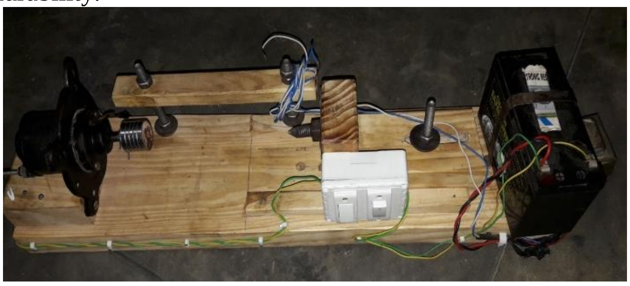

Fig. 1.1: Mini Lathe Machine

A. Components of mini lathe machine

1) Motor

DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic to periodically change the direction of current flow in part of the motor.

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications

- High Torque Voltage Current: DC 12V
- Speed: 2800RPM Motor
- Shaft Diameter: 5.8mm Mounting
- Diameter of the Motor: 55mm
- Length of the Motor(Body): 80mm
- Length of Shaft: 35mm

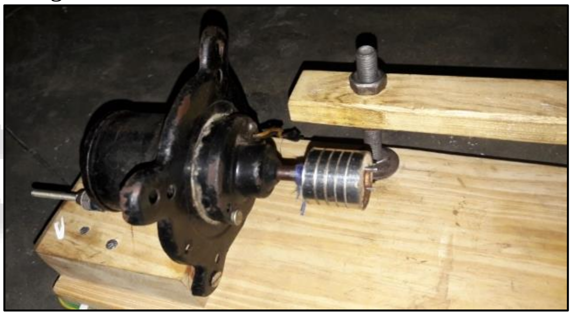

Fig. 1.2: DC Motor

2) Chuck

A chuck is a specialized type of clamp. It is used to hold an object with radial symmetry, especially cylinder. In drills and mills it holds the rotating tool whereas in lathes it holds the rotating work piece. On a lathe the chuck is mounted on the spindle which rotates within the headstock. For some purposes (such as drilling) an additional chuck may be mounted on the non-rotating tailstock. Generally chucks are used to hold the work piece or objects. Here chuck is fixed to the bearing shaft so that when the shaft rotates the work piece in the chuck rotates by means of pulley.

Fig. 1.3: Chuck

3) Working Principle

The lathe is a machine tool which holds the work piece between two rigid and strong supports called centers or in a chuck or face plate which revolves. The cutting tool is rigidly held and supported in a tool post which is fed against the revolving work. The normal cutting operations are performed with the cutting tool fed either parallel or at right angles to the axis of the work.

B. Lathe Operations

The engine lathe is an accurate and versatile machine on which many operations can be performed. These operations are:

1) Plain Turning and Step Turning
2) Facing
3) Drilling
4) Grooving
5) Forming
6) Polishing
7) Taper Turning

II. METHODOLOGY & CALCULATION

A. Step 1: Base

The core of the lathe is the base. It needs to be very solid and heavy to counteract vibrations and strong to overcome the different forces applied during turning. The plans called for two pieces of 3/4 inch birch plywood to be laminated together, but I ended up using three pieces of 1/2 inch spruce plywood. They were glued together using polyurethane construction adhesive. It is important to cut the pieces slightly oversized, and after they are glued, rip them to the final width.

I used all the clamps I had when gluing the boards together, and even then, the construction adhesive expanded a little which made gaps in the plywood in some areas.

B. Step 2: Dovetails

The top rail is attached to the base with two strips of plywood that are nested in dadoes on both sides. My table saw doesn't accept a dado stack, so I just ran the heavy chunk of wood through the saw a bunch of times to get the perfect width.

The top rail is shaped like a long dovetail, with the sides angled at 20°. I again had to glue two other piece of plywood to get the right thickness. After all the parts were cut out, I glued it all together, this time with wood glue.

C. Step 3: Headstock

The first part in building the headstock (the thing that drives the wood), was to make the bearing mounts. If you follow the specifications in the plans, it will go without a problem. The plans called for two layers of plywood on either side, but the bolt that I had wasn't long enough to handle that, so I had to use a piece of oak instead. I found an old spade bit that was slightly oversized for the bearing, and ground it down slightly so it would make a tight fit in the wood. The next step was to make a support block. It was as straight forward as gluing a block of plywood and sanding it down flush.

D. Step 4: Ball Bearing

This next part is probably the most difficult part of the build, but also probably the most important. It is basically two blocks of wood with two bolts running through embedded nuts on both sides. When you turn the bolt, it pushes against a strip of metal that moves outward, and locks the carriage against the slide. The strips are cut at a 20 degree angle as well.

E. Step 5: Setup Bed

The motor was simply bolted on a piece of 3/4 inch plywood, which was mounted on hinges onto the base. I ended up using two hinges to make it more rigid. The belt is tensioned by the weight of the motor, which ended up being plenty of tension. To finish the lathe; I painted it white and grey on the sides and edges. After it was painted, a couple coats of water-based varnish are brushed on. Remember to leave the slide untouched as it would become sticky, and unable to slide.

F. Step 6: Tool Rest and tailstock

After it is dried, the lathe is complete! I still do not have any turning tools to work with, but with a lot of difficulty I was able to use some bench chisels to turn a block of wood round. I (badly) welded a washer to a bolt and drilled some holes in it to make a small faceplate. Then I welded two nuts together and cut teeth on one end and screwed in some threaded rod to make a drive canter. Both of the two pieces easily screw onto and off of the shaft.

G. Dimensions & Specifications

Below are the dimensions and specifications as regards the fabricated wood lathe.

Total length of the machine	600mm
Total height of the machine	200mm
Width of machine bed	150 mm
Angle of inclination of the tail stock	90^0
The electric motor RPM	2800 rpm
Frequency	50 Hz
Power	50 w
Capacity	1/12 hp
Voltage	12v dc
Current	0.32 amp
Diameter of motor shaft	7.39mm
Maximum length of work	150mm
Minimum length of work	100 mm
Diameter of work piece	20 mm

Table 1:

H. Calculation of Cutting Parameters

1) Cutting Speed

When metal is cut, the work piece surface is driven with respect to the tool, or the tool with respect to surface, at a relatively high rate of speed. This is called cutting speed (C_S). Mostly the tool or work piece revolves. Almost all such machine tools are calibrated in revolutions per minute (rpm).

The cutting speed is related to the rpm and thus is conveniently expressed in meter per minute (m/min).Spindle speed (rpm) is the rotational frequency of lathe machine spindle and its determined based on the type of material to be cut. Soft steel such as aluminium alloy is suitable with high spindle speed during machining. If hard steel such as bronze applied excessive spindle speed, it will cause premature tool wear, breakage, and can cause tool chatter. Using the correct spindle speed for the material and tools will affect tool life and the quality of the surface finish.

Cutting speed (in wooden lathe for turning operation) is the peripheral speed of the work piece past the cutting tool.

Mathematically, $V = \pi DN/1000$ m/min

Where,

V = Cutting Speed, m/min

D = Diameter of the job, mm

N = Spindle Speed, r.p.m

- In a Micro Wooden Lathe

D = 20 mm

N = 2800 r.p.m

Then we can calculate the cutting speed which is:-

$V = (\pi \times 20 \times 2800) /1000$

v = 175.93 m/min

Factor which influence the selection of a proper cutting speed are:-

- Material of the cutting tool
- Hardness and Machinability of the wood to be machined
- Tool Shape
- Depth of cut
- Rigidity of the tool and work

1) Depth of Cut (d)

The depth of cut's' is the perpendicular distance measured from the machined surface to the uncut surface of the work piece. For turning operation, the depth of cut is expressed as:

$d = (D_i – D_f) / 2$ mm

Where,

D_i = Initial diameter of the work piece, mm

D_f = Final diameter of the work piece, mm

2) In a Micro wooden Lathe

D_i = 20 mm

D_f= 18mm

Then we can calculate the Depth of cut which is

d= (20 – 18) / 2

d = 1mm

Depth of cut generally depends on following factors:

- Type of work piece material
- Type of tool material
- Type of surface finish required

3) Material Removal Rate (MRR)

The material removal rate, MRR, can be defined as the volume of material removed divided by the machining time. Another way to define MRR is to imagine an "instantaneous" material removal rate as the rate at which the cross-section area of material being removed moves through the work piece.

$MRR = 1000 \times V \times d \times f$

- In a Micro wooden Lathe

V = 263.83 m/min (Calculated above)

d = 1 mm

f = 0.1 mm / revolution

Then we can calculate the cutting speed which is:-

$MRR = 1000 \times 175.93 \times 1 \times 0.1$

= 17592.92 mm^3 / min

III. Results & discussion

A. Cutting Speed

v = 175.93 m/min

B. Depth of Cut

d = 1 mm

C. Material Removal Rate

MRR= 17592.92 mm^3 / min

D. Maximum and minimum diameter of work piece between 20mm to 60mm

The major characteristic part of this process while performing several machining process the cutting speed and material removal rate will be suitable in this process.

So according to the machining process maximum and minimum dia of workpiece will be suitable for the fabrication of workpiece.

1) The sideways of Mini Lathe Machine are coated with students which checks corrosion and ensure smooth stirring of machinery parts ultimately boosting the life of the product.
2) Application of this machine is directly proportionate to economization as being low cost miniature model, acquiring less space comparatively and perfectly suited for small pocket budget.

IV. Conclusion

The lathe can be used in the production of wheels and making parts for many types of furniture and tableware, parts for mills and pumps, and many other important technological developments. Wood lathes cut down drastically on the time required to make carved wooden vessels and other implements. The items you can make using a wood lathe are more evenly carved and finished than would be possible by hand. It can also be used to hollow out the wood to make vessels such as cups, bowls, vases and decorative objects. In this project report we provide an overview of the issues concerning different aspects of micro wooden lathe .The project report focus on the principle of conventional lathe , type of micro wooden lathe tooling and machining parameters and process performance measure, which include cutting speed , depth of cut ,material removal rate . Different type of micro wooden lathe and tool used to fabricate the work piece. In micro wooden lathe has been presented. The presented results can help to plan the machining of work piece expected tolerance.

The following major conclusions may be drawn from the present project report.

1) Micro wooden lathe is derived from wood turning lathe which has been a well establish industrial processes offering attractive capabilities for handling work piece of various length to be used at micro level
2) We have presented historical development of micro wooden lathe from ancient time to modern time
3) We have explained the various parts and components of micro wooden lathe
4) Different type of micro wooden lathe and tool for micro wooden lathe has been discussed.

References

[1] Richard A. Maker (1993) Milling machine lathe attachment, 45-78.

[2] Philip H Buehrle (Jul 2, 1929) Grinding attachment for lathes.
[3] Designing and Fabrication of Multipurpose Tool Post for Lathe Machine (IJSRD/Vol. 2) All rights reserved by www.ijsrd.com 117 Daniel M. Spohn, Jr., Spohn Jr
[4] Daniel M (1978), Attachment for a rotary drive machine, 312-344.
[5] Atsushi Senoh, Washino Engineering Company, Limited (1988) Machine tool for multiple surface machining, 88-121.
[6] RichardL.Harris, Ralph W.Blader (1982) Multipurpose tool Gary F. Thompson, Thompson.
[7] Gary F. (1995) Multi-purpose lathe.
[8] W A J Chapman, Workshop Technology (vol.1), 5 thed., Elsevier science, 1972.
[9] V.B. Bhandari, Machine design book, vol (5),
[10] PSG Design Data Book, (vol 5), Kalaikathir Achchagam – Coimbatore, May2010.
[11] Ozkan & S.Ayan "Design and application of circular saw machine" Journal of engineering research and applied science, vol
[12] Luis Cristovao "Machining properties of wood.