X-Y Cutting Profile Machine

Pourmina Wagh

Abstract: A router is a tool used to rout out (hollow out) an area in the face of a relatively hard workpiece, typically of wood or plastic. The main application of routers is in woodworking, especially cabinetry. The hand tool form of router is the original form. It is a specialized type of hand plane with a broad base and narrow blade projecting well beyond its base plate (gaining it the nickname old woman’s tooth). Today the power tool form of routers, with an electric-motor-drive spindle, is the more common form, and the hand tool is now often called a router plane. Although the hand tool has a few advantages over the power tool and retains favour with some workers, it has been mostly replaced by the modern spindle router, which was designed for the same work. Some workers consider it to be the single most versatile tool, it has been mostly replaced by the modern spindle router, which was designed for the same work. Some workers consider it to be the single most versatile woodworking power tool. Becoming more popular is the use of CNC wood router, which implements the advantages of CNC (Computer Numerical Control). Related to the router is a smaller, lighter version designed specifically for trimming laminates. It can be used for smaller general routing work. For example, with an appropriate jig it can be used for recessing door hinges and recessing lock faceplates, even rotary tools can be used as routers when the right bits and accessories (such as a plastic router base) are attached. Routing is a high speed process of cutting, trimming, and shaping wood, metal, plastic and a verity of other materials.

1. Introduction

A router is a tool used to rout out (hollow out) an area in the face of a relatively hard workpiece, typically of wood or plastic. The main application of routers is in woodworking, especially cabinetry. The hand tool form of router is the original form. It is a specialized type of hand plane with a broad base and narrow blade projecting well beyond its base plate (gaining it the nickname old woman’s tooth). Today the power tool form of routers, with an electric-motor-drive spindle, is the more common form, and the hand tool is now often called a router plane. Although the hand tool has a few advantages over the power tool and retains favour with some workers, it has been mostly replaced by the modern spindle router, which was designed for the same work. Some workers consider it to be the single most versatile woodworking power tool. Becoming more popular is the use of CNC wood router, which implements the advantages of CNC (Computer Numerical Control). Related to the router is a smaller, lighter version designed specifically for trimming laminates. It can be used for smaller general routing work. For example, with an appropriate jig it can be used for recessing door hinges and recessing lock faceplates, even rotary tools can be used as routers when the right bits and accessories (such as a plastic router base) are attached. Routing is a high speed process of cutting, trimming, and shaping wood, metal, plastic and a verity of other materials.

1.1 Chip Formation

Routing and milling appear similar, but are applied to different materials and so require tools that are significantly different in detail. The mechanisms of chip formation for both tools are different, according to the materials.
1.2.2 Workpiece geometry
Routing is shaping process used to produce finished edges and shapes. Some material that proves difficult to shape with other processes, such as fiber-glass, Kevlar, and graphite, can be shaped and finished neatly via various routing techniques. Apart from finished edges and shaping, cutaways, holes, and contours can also be shaped using routers.

1.2.3 Tools and equipment
The set up includes an air or electric driven router, a cutting tool often referred to as a router bit, and a guide template. Also the router can be controlled easier. In general there there are three types of cutting tools.
1. Fluted cutter(used for edging and trimming)
2. Profile cutters(used for shaping and trimming)
3. Helical cutters (used on easily machined materials, for drilling, shaping, trimming)

2. Moulding
The spindle router is positioned at the finer end of the scale of work done by a moulding ` spindle. That is to say it is able to cut grooves, edge moulding, and chamfer or radius the edge of piece of wood. It is also possible to use it for cutting some joints. The shape of cut that is created is determined by the size and shape of bit (cutter) held in collet and the depth by the depth adjustment of sole plate.

2.1 Jig saw for wood profile cutting
A jigsaw is versatile power tool useful in cutting shapes in variety of materials. This article should help you choose the jig saw and blade best suited for your project, and help you use it more safely and efficiently.
- Power source. Battery operated jigsaws are more portable than saws with power cords, but they are also heavier, and likely will not have the motor torque heavy cutting requires.
- Scrolling saws have a knob on top that allows the blade to be rotated without having to rotate the whole saw assembly, making it useful in tight working areas.
- Orbital action saws can actually provide thrust to blade while it moves in its normal up and down motion, greatly increasing its cutting speed.
- Speed control may be important in your work, and jigsaws may come with multiple speeds, variable speeds, and single speed functions. Variable speed saws are best for cutting different materials, particularly metal, where a lower blade speed will increase blade life, and plastics, where very low cutting speeds will prevent the material from melting, rather than cutting.
- Blade locking mechanisms can either use a quick change, tool-less type, or an Allen or machine screw clamping system. For obvious reasons, the quick change blades are especially useful when performing different types of cuts frequently.
- Built in lights and dust blower are also helpful when trying to cut accurately where your cut mark is difficult.
- Amperage should be considered when you plan to cut thicker or harder top cut material, such as thick hardwood lumber. A saw with low amperage rating (4 amps or less) will not perform like heavy duty saw with rating of 8 or 9 amps.
- Pivot base jigsaw allow you to make cuts are various angels, up to about 45 degrees depending on the length of your blade and the thickness of the materials you are cutting.

2.2 Operations performed
1. Drilling
2. Hole saw cutting
3. Square hole drilling
4. Sq. Elliptical template cutting
5. Profile contouring etc,

Are difficult to perform using a single machine, i.e. different machines is required to perform them. This will take added cost and time. Hence there is need of special machine which will perform above operations so also with accuracy and repeatability.
1. Select the correct blade for the material you are going to cut.
2. Prepare your workpiece for your cut.
3. Measure and mark the cut line you need for your project.
4. Place the material you are cutting on saw horses or a workbench, or clamp it in a vice, depending on which is best suited for your purpose.
5. Make sure you have sufficient light to see your cutting marks easily.
6. Position the blade close to the edge of the material where you will begin your cut.
7. Guide your saw along its path by twisting the back of the saw in the opposite direction you want the blade to travel, keeping the blade aligned with the cut line.
8. Stop the saw if sawdust or debris accumulates blocking your view of the cut line, or if this material interferes with the travel of the saw.
9. Complete your by continuing through the material, being careful to support any piece that may drop when the cut is finished until the blade is free of it.

3. Design Consideration
Part – A

Analysis for Power Requirement of Machine

1. Catalogue Method
Cutter uses for bar cutting applications are;
04 mm end mill
These wheels have following performance characteristic
1) Material Removal Rate (MRR) = 0.15 CM Sq./Sec.
2) Available Power = 0.20 KW/inch of wheel. ....for wood
3) Max Operating Speed = 6000 RPM

Target: - Application is PVC conduit cutting;
Max diameter=Ø4mm=0.16“

To CUT
Material = wood
= Power Requirement at m/c spindle = 0.16 x 0.425
= 0.068 Kw. = 68 watt
= 0.064343 HP

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Let us round off the Input power to; ¼ HP… this is standard motor available

**Input Power =1/4HP**

**Motor Selection**
1 phase AC/DC motor
Make: ronak electric motors
230volts; 50Hz
POWER=1/4HP (180WATT)
Speed=0TO6000 RPM (VARIABLE)
Frame size=36
Current=1.70AMP

**TEFC Constructions**
Torque Analysis
Torque at spindle is given by
\[ T_s = 975N/n \]
Where;
\[ T_s = \text{torque at spindle (kg-m)} \]
\[ N = \text{power (KW)} \]
\[ N = \text{speed (rpm)} \]
\[ T_s = 975 \times 0.18 = 0.0585 \]
\[ T_s = 0.57N-m \]

Considering 25% overloaded;
\[ T_{design} = 1.25T_s = 1.25 \times 0.57 \]
\[ T_{design} = 0.727N-m \]

**Design of main spindle**
\[ T_{design} = 0.727N.m \]
\[ = 0.727 \times 10^3N.mm \]

Selection of main spindle material

<table>
<thead>
<tr>
<th>Designation</th>
<th>Ultimate tensile strength N/mm²</th>
<th>Yield strength N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN24</td>
<td>800</td>
<td>680</td>
</tr>
</tbody>
</table>

**4. Future Work**

a) **Fabrications**

Suitable manufacturing methods will be employed to fabricate the components and then assemble the machine set up

b) **Testing:** Testing of machine on following materials:

i. Wood
ii. Aluminium

c) **Material Procurement**

Material is procured as per raw material specification and part quantity. Part process planning is done to decide the process of manufacture and appropriate machine for the same.

- General material used
- EN24-Alloy Steel
- EN9-Plain Carbon Steel
- MS-Mild Steel
- STD-Stand Parts Selected from PSG Design Data/Manufacture Catalogue

d) **Raw material cost**

The total raw material cost as per the individual materials and their corresponding rates per Kg is as follows, Total raw material cost=Rs1600/-

e) **Cost of Purchased Parts**

<table>
<thead>
<tr>
<th>SR NO</th>
<th>Description</th>
<th>QTY</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Motor</td>
<td>01</td>
<td>975</td>
</tr>
<tr>
<td>2</td>
<td>Linear Bearing</td>
<td>08</td>
<td>1000</td>
</tr>
<tr>
<td>3</td>
<td>Grub Screw</td>
<td>09</td>
<td>36</td>
</tr>
<tr>
<td>4</td>
<td>Bearings</td>
<td>01</td>
<td>180</td>
</tr>
<tr>
<td>5</td>
<td>Gear Box</td>
<td>01</td>
<td>1200</td>
</tr>
</tbody>
</table>

The cost of machine= RS 3391/-

f) **Total Cost**

Total cost= Raw Material Cost+ cost of purchased parts+ overheads

Hence the total cost of machine=Rs5441/-

**References**

[1] Production technology-P C Sharma
[2] PSG design data handbook