

X-Y Cutting Profile Machine

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Abstract: A router is a tool used to rout out (hollow out) an area in the face of relatively hard workpiece, typically of wood or plastic. The main application of routers is in wood working, especially cabinetry. The hand tool form of router is the original form. It is specialized type of hand plane with a broad base and narrow blade projecting well beyond its base plate. The operation such as Drilling Hole saw cutting Square hole drilling Sq. Elliptical template cutting profile contouring etc, Are difficult to perform using a single machine, i.e. different, machines are required to perform them. This will take added cost and time. Another disadvantage being that every time we have mark or layout the job and then use different machines to complete the operation. This will lead to following difficulty: Time wasted in laying each and every job in accuracy as the operations are done manually. No repeatability i.e., every job will be different from other hence there is need of special machine which will perform above. This machine uses a high speed cutter that can be fed up or down to give depth of cut where as the x-y axes table is given motion using a pantograph mechanism that copy or scale the template or shape that is to be produced on the job, this is an accurate method so also first job will be same as the last job, i.e. it is repeatable operation. So also with accuracy and repeatability. X-Y Profile Cutting Machine: This machine uses a high speed cutter that can be fed up or down to give depth of cut where as the x-y axes table is given motion using a pantograph mechanism that copy or scale the template or shape that is to be produced on the job, this is an accurate method so also the first job will be the same as the last job, i.e. it is repeatability. Advantages: Operator does not have to carry the heavy power tool in hand hence it is easy to work in standing position looking up-side. Due to low weight of cutter less fatigue and tiredness to operator. As power tool is not in hand lesser vibrations transmitted to hands whereas vibration of them/c are damped by the anti-vibration elliptical leaf mounts. Flexible shaft design of the tool holder makes it possible to operate with easy and accuracy, reach into difficult positions. Applications: Furniture and false ceiling making for residential/commercial installation. Control panel manufacturing. Electrical wiring and cable work in residential and commercial places. Automobile industry.

Keywords: Profile, Cutting, Machine

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 variety 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.

Routing is applied to relatively weak and brittle materials, typically wood as these materials are weak in small sections, routers may be run at extremely high speeds and so even a small router may cut rapidly. Owing to inertia at these high speeds, the normal wood cutting mechanism of Type I chips cannot take place. The cutter edge angle is blunt, approaching 90, and so a Type III chip is formed, with the waste material being produced as fine dust. This dust is a respiratory hazard, even in benign materials. The forces against the cutter are light, so routers may be hand-held.

When milling metals, the material is relatively ductile, although remaining strong even at a small scale. The cutters are thus run more slowly, even when used in multi-horsepower milling machines. The cutters are sharpened with acute edge angles, forming a Type II chip and waste may be produced as continuous swarf. Cutter forces are high, so milling machines must be robust and rigid, usually substantial constructions of cast iron.

Intermediate materials, such as plastics and sometimes soft aluminium, may be cut by either method-although routing aluminium is usually more of an improvised expedient than production process and is infamously noisy and hard on tools.

1.2 Process Characteristics

1.2.1 Makita laminate trimmer

Usually routing is limited to soft metals (aluminium etc.) and rigid nonmetals. Specially designed cutters are used for a variety of patterns, cuts, and edging. Both hand controlled and machine controlled/aided routers are common today.

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 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 seeing 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;
Ø4 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 = 0.16×0.425
= 0.068 Kw. = 68 watt
= 0.064343 HP

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;

$T_s = \text{torque at spindle (kg-m)}$

$N = \text{power (KW)}$

$N = \text{speed (rpm)}$

$T_s = 975 \times 0.18 = 0.0585$

$T_s = 0.57N\text{-m}$

Considering 25% overloaded;

$T_{\text{design}} = 1.25T_s$
 $= 1.25 \times 0.57$

$T_{\text{design}} = 0.727N\text{-m}$

Design of main spindle

$T_{\text{design}} = 0.727N\text{-m}$
 $= 0.727 \times 10^3 N\text{-mm}$

Selection of main spindle material

designation	Ultimate tensile strength N/mm ²	Yield strength N/mm ²
EN24	800	680

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

- STD-Standard 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

SR NO	Description	QTY	Cost
1	Motor	01	975
2	Linear Bearing	08	1000
3	Grub Screw	09	36
4	Bearings	01	180
5	Gear Box	01	1200

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
- [3] Machine Design-Khurmi Gupta
- [4] Design of machine Elements: V B Bhandari.