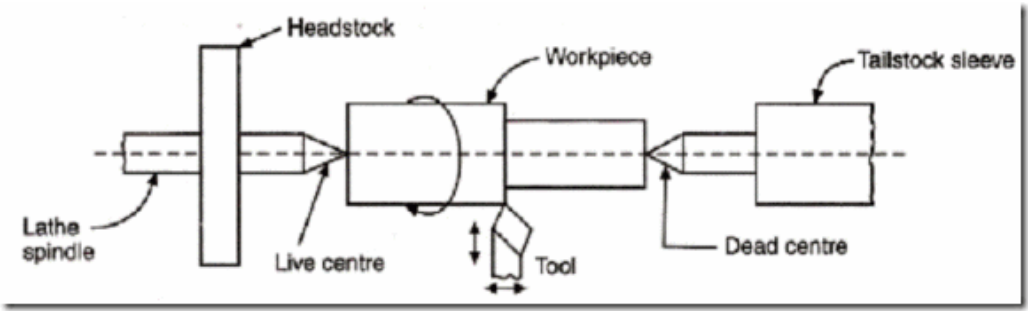
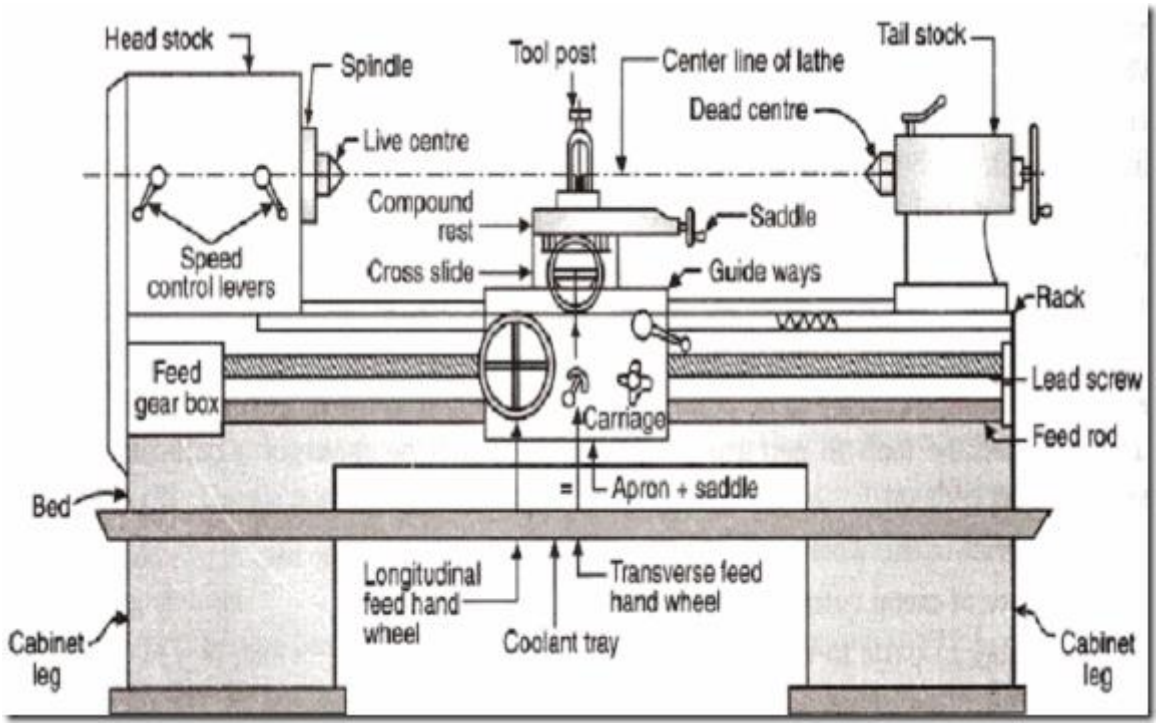
LATHE MACHINE

Working Principle: The lathe is a machine tool which holds the workpiece 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.

The cutting tool may also be fed at an angle relative to the axis of work for machining tapers and angles.



Construction: The main parts of the lathe are the bed, headstock, quick changing gear box, carriage and tailstock.



1. **Bed**: The bed is a heavy, rugged casting in which are mounted the working parts of the lathe. It carries the headstock and tail stock for supporting the workpiece and provides a base for the movement of carriage assembly which carries the tool.

2. **Legs**: The legs carry the entire load of machine and are firmly secured to floor by foundation bolts.

3. **Headstock**: The headstock is clamped on the left hand side of the bed and it serves as housing for the driving pulleys, back gears, headstock spindle, live centre and the feed reverse gear. The headstock spindle is a hollow cylindrical shaft that provides a drive from the motor to work holding devices.

4. **Gear Box**: The quick-change gear-box is placed below the headstock and contains a number of different sized gears.

5. **Carriage**: The carriage is located between the headstock and tailstock and serves the purpose of supporting, guiding and feeding the tool against the job during operation. The main parts of carriage are:

a). **The saddle** is an H-shaped casting mounted on the top of lathe ways. It provides support to cross-slide, compound rest and tool post.

b). **The cross slide** is mounted on the top of saddle, and it provides a mounted or automatic cross movement for the cutting tool.

c). **The compound rest** is fitted on the top of cross slide and is used to support the tool post and the cutting tool.

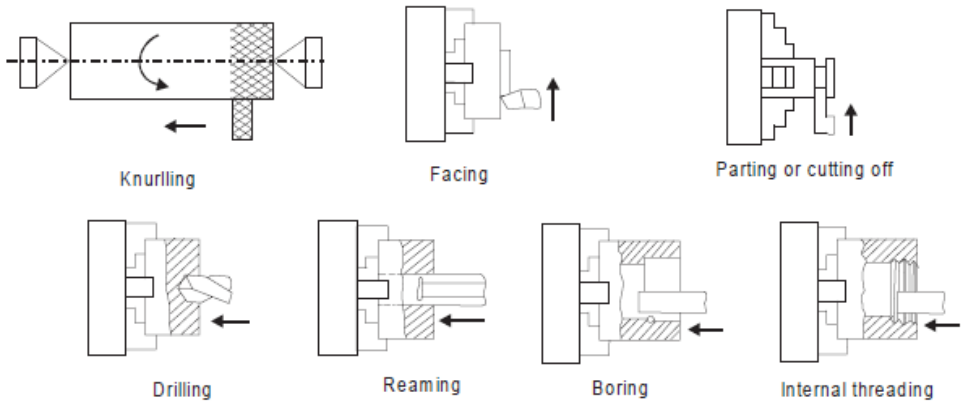
d). **The tool post** is mounted on the compound rest, and it rigidly clamps the cutting tool or tool holder at the proper height relative to the work centre line.

e). **The apron** is fastened to the saddle and it houses the gears, clutches and levers required to move the carriage or cross slide. The engagement of split nut lever and the automatic feed lever at the same time is prevented she carriage along the lathe bed.

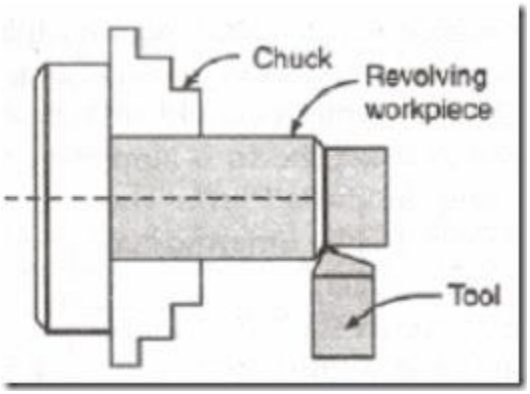
6. **Tailstock**: The tailstock is a movable casting located opposite the headstock on the ways of the bed. The tailstock can slide along the bed to accommodate different lengths of workpiece between the centers. A tailstock clamp is provided to lock the tailstock at any desired position. The tailstock spindle has an internal taper to hold the dead centre and the tapered shank tools such as reamers and drills.

LATHE OPERATIONS

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

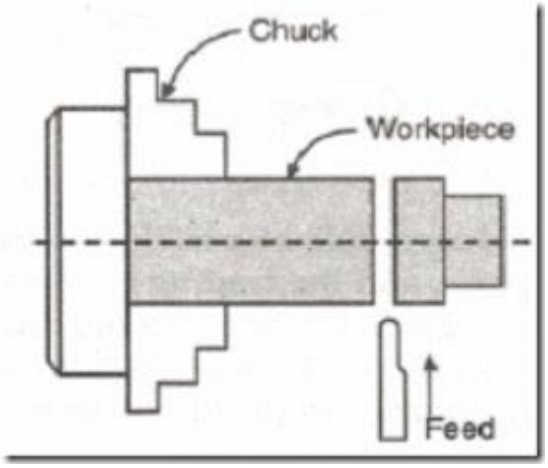


1. **Plain Turning**: Plain turning is the operation of removing excess amount of material from the surface of a cylindrical job.

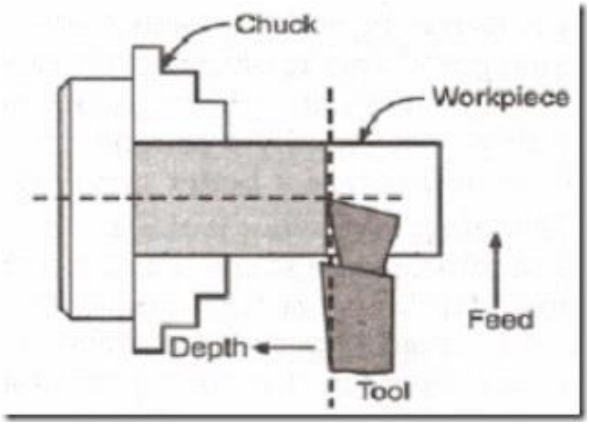


2. **Step Turning**: Step turning produces various steps of different diameters.

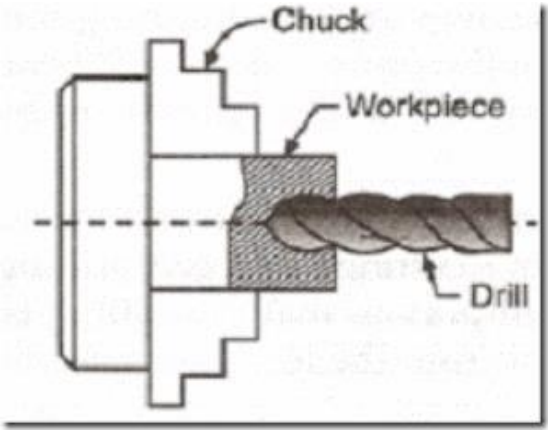
3. **Facing:** The facing is a machining operation by which the end surface of the work piece is made flat by removing metal from it.



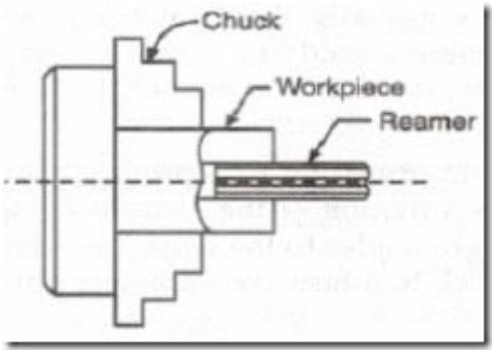
4. **Parting**: The parting or cutting off is the operation of cutting away a desired length of the workpiece, *i.e.,* dividing the workpiece in two or more parts.



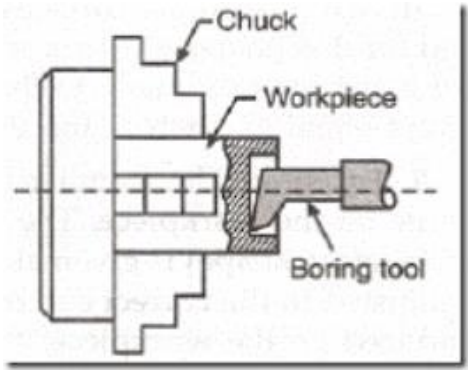
5. **Drilling**: Drilling is the operation of producing a cylindrical hole in the workpiece.



6. **Reaming**: The holes that are produced by drilling are rarely straight and cylindrical in form. The reaming operation finishes and sizes the hole already drilled into the workpiece.



7. **Boring**: The boring operation is the process of enlarging a hole already produced by drilling.



8. **Knurling**: The knurling is a process of embossing (impressing) a diamond-shaped or straight-line pattern into the surface of workpiece. Knurling is essentially a roughening of the surface and is done to provide a better gripping surface.

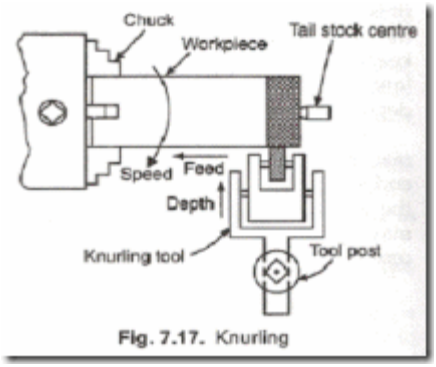
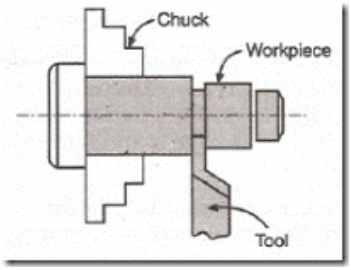
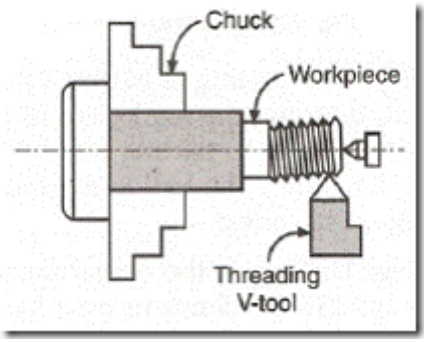


Fig. 7.17. Knurling

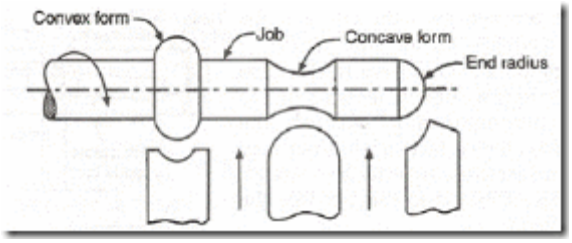
9. **Grooving**: Grooving is the act of making grooves of reduced diameter in the workpiece.



10. **Threading**: Threading is the act of cutting of the required form of threads on the internal or external cylindrical surfaces.



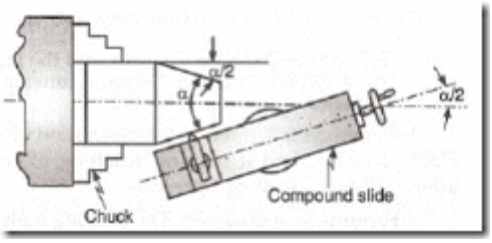
11. **Forming**: The forming is an operation that produces a convex, concave or any irregular profile on the workpiece.



12. **Chamfering**: Chamfering removes the burrs and sharp edges, and thus makes the handling safe. Chamfering can be done by a form tool having angle equal to chamfer which is generally kept at 45°.

13. **Filing and Polishing:** The filing is the finishing operation that removes burrs, sharp corners and feed marks from the workpiece. After filing, the surface quality is the workpiece is improved by the polishing operation with the help of emery cloth of fine grades.

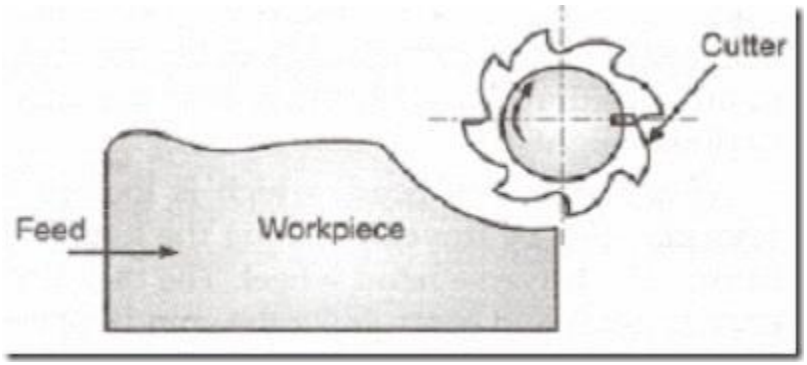
14. **Taper Turning**: The taper turning is an operation of producing a conical surface by gradual reduction in the diameter of a cylindrical workpiece.



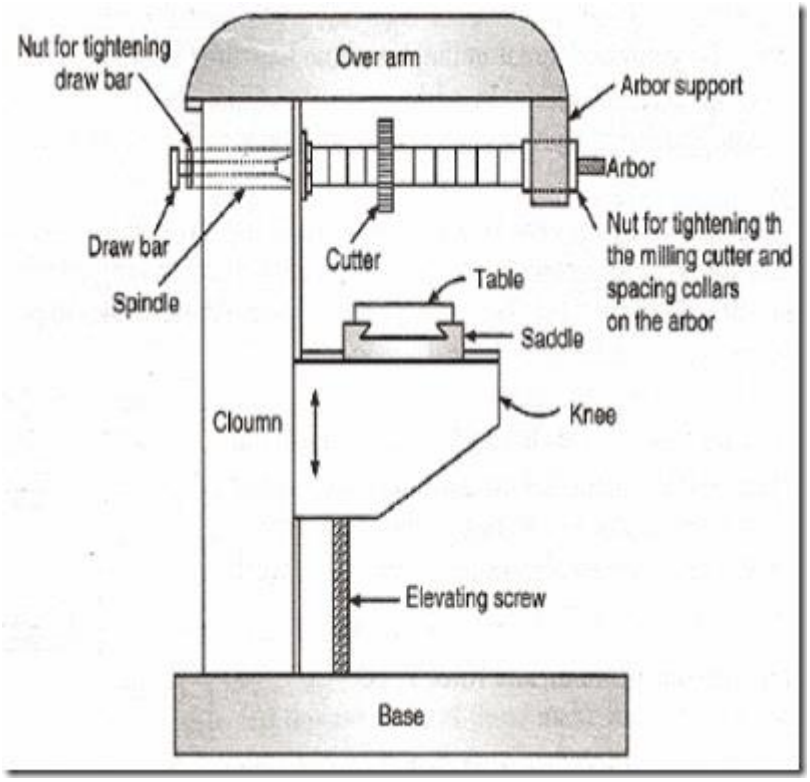
MILLING Machine

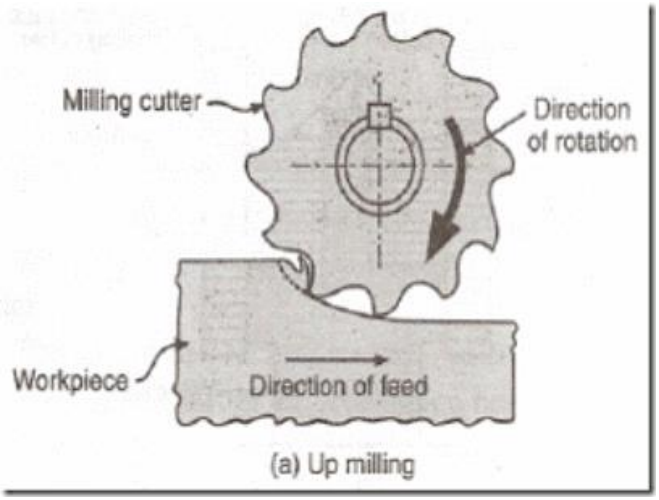
Introduction: Milling is the cutting operation that removes metal by feeding the work against a rotating, cutter having single or multiple cutting edges. Flat or curved surfaces of many shapes can be machined by milling with good finish and accuracy. A milling machine may also be used for drilling, slotting, making a circular profile and gear cutting by having suitable attachments.

Working Principle: The workpiece is holding on the worktable of the machine. The table movement controls the feed of workpiece against the rotating cutter. The cutter is mounted on a spindle or arbor and revolves at high speed. Except for rotation the cutter has no other motion. As the workpiece advances, the cutter teeth remove the metal from the surface of workpiece and the desired shape is produced.

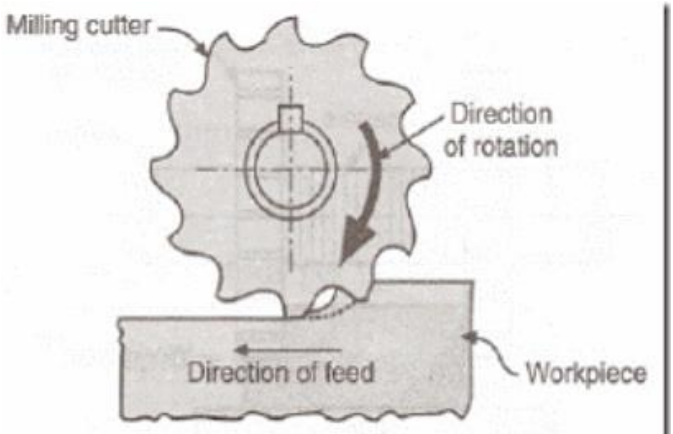


Horizontal Milling Machine Construction: The main part of machine is base, Column, Knee, Saddle, Table, Overarm, Arbor Support and Elevating Screw.





(a) Up milling



(b) Down milling

1. **Base**: It gives support and rigidity to the machine and also acts as a reservoir for the cutting fluids.

2. **Column**: The column is the main supporting frame mounted vertically on the base. The column is box shaped, heavily ribbed inside and houses all the driving mechanisms for the spindle and table feed.

3. **Knee**: The knee is a rigid casting mounted on the front face of the column. The knee moves vertically along the guide ways and this movement enables to adjust the distance between the cutter and the job mounted on the table. The adjustment is obtained manually or automatically by operating the elevating screw provided below the knee.

4. **Saddle**: The saddle rests on the knee and constitutes the intermediate part between the knee and the table. The saddle moves transversely, i.e., crosswise (in or out) on guide ways provided on the knee.

5. **Table**: The table rests on guide ways in the saddle and provides support to the work. The table is made of cast iron, its top surface is accurately machined and carriers T-slots which accommodate the clamping bolt for fixing the work. The worktable and hence the job fitted on it is given motions in three directions:

a). Vertical (up and down) movement provided by raising or lowering the knee.

b). Cross (in or out) or transverse motion provided by moving the saddle in relation to knee.

c). Longitudinal (back and forth) motion provided by hand wheel fitted on the side of feed screw.

In addition to the above motions, the table of a universal milling machine can be swiveled 45° to either side of the centre line and thus fed at an angle to the spindle.

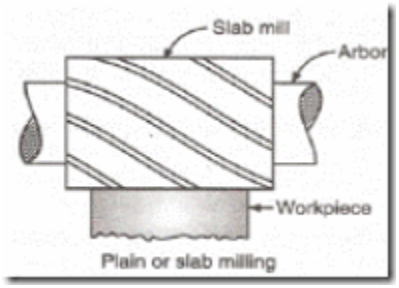
6. **Overar**m: The Overarm is mounted at the top of the column and is guided in perfect alignment by the machined surfaces. The Overarm is the support for the arbor.

7. **Arbor support**: The arbor support is fitted to the Overarm and can be clamped at any location on the Overarm. Its function is to align and support various arbors. The arbor is a machined shaft that holds and drives the cutters.

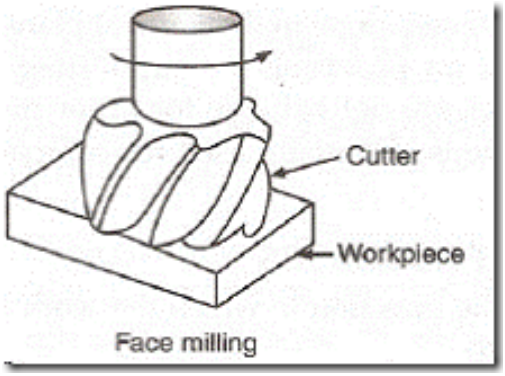
8. **Elevating screw**: The upward and downward movement to the knee and the table is given by the elevating screw that is operated by hand or an automatic feed.

MILLING OPERATIONS

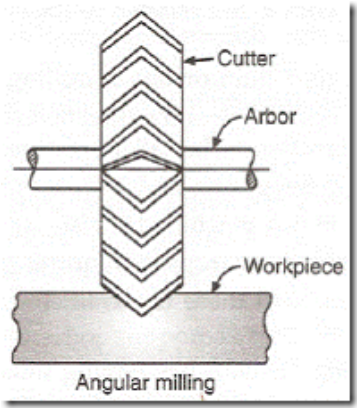
1. **Plain or slab milling:** Machining of a flat surface which is parallel to the axis of the rotating cutter.



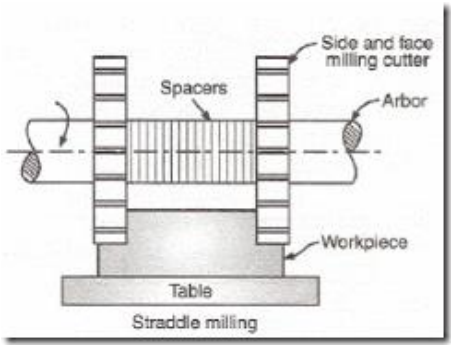
2. **Face milling:** Machining of a flat surface which is at right angles to the axis of the rotating cutter.



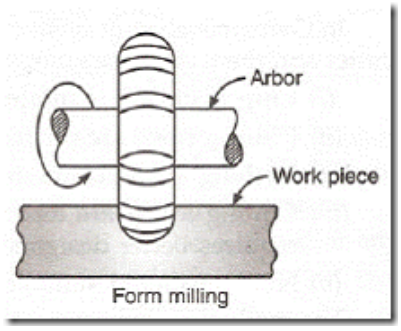
3. **Angular milling**: Machining of a flat surface at an angle, other than a right angle, to the axis of revolving cutter.



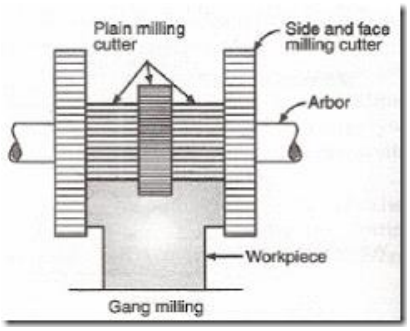
4. Straddle milling: Simultaneous machining of two parallel vertical faces of the work-pieces by a pair of side milling cutters.



5. Form milling: Machining of surfaces which are of irregular shape. The teeth of the form milling cutter have a shape which corresponds to the profile of the surface to be produced.



6. Gang milling: Simultaneous machining of a number of flat horizontal and vertical surfaces of a workpiece by using a combination of more than two cutters mounted on a common arbor.



SHAPER MACHINE

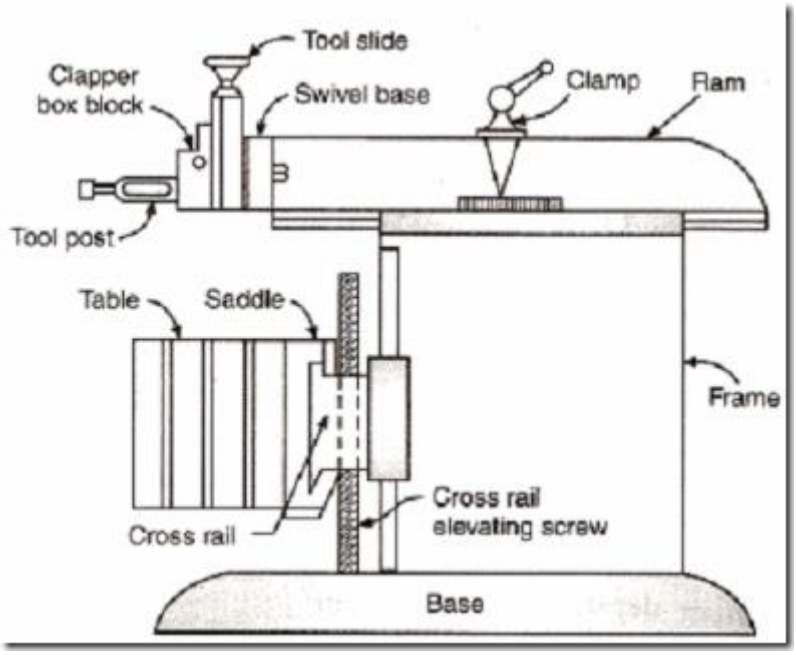
Introduction: The shaper is a machine tool used primarily for:

1. Producing a flat or plane surface which may be in a horizontal, a vertical or an angular plane.

2. Making slots, grooves and keyways

3. Producing contour of concave/convex or a combination of these

Working Principle: The job is rigidly fixed on the machine table. The single point cutting tool held properly in the tool post is mounted on a reciprocating ram. The reciprocating motion of the ram is obtained by a quick return motion mechanism. As the ram reciprocates, the tool cuts the material during its forward stroke. During return, there is no cutting action and this stroke is called the idle stroke. The forward and return strokes constitute one operating cycle of the shaper.



Construction: The main parts of the Shaper machine is Base, Body (Pillar, Frame, Column), Cross rail, Ram and tool head (Tool Post, Tool Slide, Clamper Box Block).

Base: The base is a heavy cast iron casting which is fixed to the shop floor. It supports the body frame and the entire load of the machine. The base absorbs and withstands vibrations and other forces which are likely to be induced during the shaping operations.

Body (Pillar, Frame, Column): It is mounted on the base and houses the drive mechanism compressing the main drives, the gear box and the quick return mechanism for the ram movement. The top of the body provides guide ways for the ram and its front provides the guide ways for the cross rail.

Cross rail: The cross rail is mounted on the front of the body frame and can be moved up and down. The vertical movement of the cross rail permits jobs of different heights to be accommodated below the tool. Sliding along the cross rail is a saddle which carries the work table.

Ram and tool head: The ram is driven back and forth in its slides by the slotted link mechanism. The back and forth movement of ram is called stroke and it can be adjusted according to the length of the workpiece to be-machined.

PLANER MACHINE

Introduction: The planer is a machine tool designed to produce plane and flat surface on a workpiece which is too large or too heavy. The workpiece is securely fixed on a table called platen, and it reciprocates horizontally against a single edged cutting tool. The surface machined may be horizontal, vertical or at an angle.

Operations of planer machine: The planer is used for:

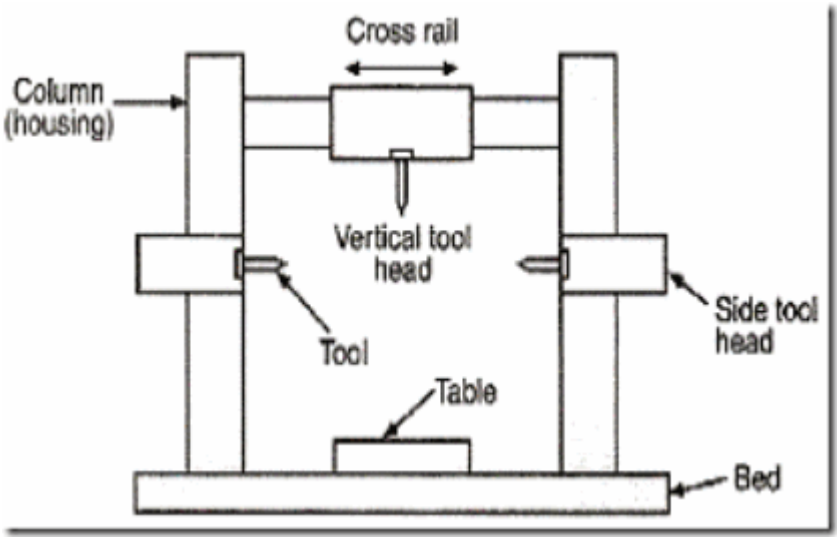
1. Planing flat horizontal, vertical and curved surfaces.

2. Planing at an angle and machining dovetails.

3. Planing slots and grooves.

The planer are available in different types for doing different types and sizes of job; the most common being the standard and double housing planer.

Construction: The main parts of the double Housing Planer machine is Bed and table, Housings, Cross rail, , Tool heads, Driving and feed mechanism.



Bed and table: The bed is a long heavy base and table made of cast iron. Its top surface is flat and machined accurately. The flat top surface has slots in which the workpiece can be securely clamped. The workpiece needs rigid fixing so that it does not shift out of its position. The standard clamping devices used on planer machine are: Heavy duty vice, T-holders and clamps, angle plate, planer jack, step blocks and stop. The table movement may be actuated by a variable speed drive through a rack and pinion arrangement, or a hydraulic system.

Housings: The housings are the rigid and upright column like castings. These are located near the centre on each side of the base.

Cross rail: The cross rail is a horizontal member supported on the machined ways of the upright columns. Guide ways are provided on vertical face of each column and that enables up and vertical movement of the cross rail. The vertical movement of the cross rail allows to accommodate workpiece of different heights. Since the cross rail is supported at both the ends, this type of planer machine is rigid in construction.

Tool heads: Generally two tool heads are mounted in the horizontal cross rail and one on each of the vertical housing. Tool heads may be swiveled so that angular cuts can be made.

Driving and feed mechanism: The tool heads may be fed either by hand or by power in crosswise or vertical direction. The motor drive is usually at one side of the planer near the centre and drive mechanism is located under the table.

The size of the planer is specified by the maximum length of the stroke, and also by the size of the largest rectangular solid that can be machined on it.

Honing

Honing is a mechanical means of stock removal that uses spring loaded abrasive stones as the cutting tool. The stone may be composed of aluminum oxide, silicon oxide, or in some cases diamond grains held together by a vitrified or organic bond. The number of stones in the tool head, their length and width, are determined by the size and nature of the work to be performed. Both horizontal and vertical honing machines are available. Engine cylinders and other parts with short bores are generated honed on vertical machines, while long holes in parts, such as cannons or rifle barrels, are honed in horizontal machines. Honing produces geometrically accurate forms by correcting various inaccuracies remaining from previous operations, such as high spots, chatter marks, out-of-roundness, taper, or deviations in axial straightness. Tolerances within 0.0001 in. are easily maintained. Honing produces a characteristic cross-hatch matte finish or lay pattern made up of "hills and valleys." Each minute scratch serves as an oil reservoir for lubricants, thus diminishing the possibility of wear on a workpiece in service by minimizing friction and heat. The surface generated by honing is free of torn, smeared, or "burned" metal.

What Requires Honing?

Parts with tight tolerances.

Parts too difficult to machine economically.

Parts too rough, needing improved microfinish.

Parts undersized in machining.

Parts out of round, out of tolerance.

Parts that shrunk in heat treat.

Lapping

The process of lapping is performed on workpieces by manual or by machine methods, principally to increase accuracy. Other important advantages which are obtained automatically as a part of the process are the correction of minor surface imperfections, improvement of surface finish, and achieving a close fit between mating surfaces. Lapping is a gentle, final operation commonly used to microfinish flat or cylindrical surfaces, but the process is also adaptable to spherical or specially formed surfaces. All lapping methods are done at low speed. Lapping is not considered a stock removal process. Standard practice is to provide only 0.0005 in. of stock allowance for lapping, and preferably less. Lapping can be performed either with cast iron laps using loose abrasives or with bonded abrasive wheel laps.

Superfinishing

Superfinishing is a proprietary name given to a microfinishing process that produces a controlled surface condition on parts which is unobtainable by any other method. It produces the ultimate

in the refinement of metal surfaces. Superfinishing is an abrading process in which the cutting medium for cylindrical work is a loosely bonded abrasive stick or stone. An abrasive cup wheel is used for flat or spherical work. The process consists of removing fragmented or smear metal from the surface of a dimensionally finished part formed by a previous operation, notably by turning or grinding, but possibly by honing or lapping. Dimensional changes are principally limited to the removal of high spots. Superfinished parts are bright and reflective with an undisturbed crystalline structure.

Mass Surface Finishing Process

Precisely controlled results can be consistently obtained by certain modifications of the mechanical grinding and honing processes. Each of these mass-finishing processes use a mixture of abrasive grain media, principally aluminum oxide or silicon carbide, together with special compounds and water. Mass surfaces finishing process include:

Barrel finishing

Vibratory finishing

Spindle finishing

Orbital or centrifugal finishing

Although not strictly considered mass-finishing processes, other surfaces finishing process explained in this section are:

Abrasive belt finishing

Polishing

Buffing

Polishing

Polishing, or flexible grinding, is an intermediate, dimensionless step in the formation of a finished surface. It is generally preceded by grinding with a solid abrasive wheel and followed by buffing. A polished surface is accomplished by the cutting action of millions of small abrasive grains adhering to an endless coated belt or flexible wheel as they wear away the metal. The complete polishing sequence usually involves several steps, first to remove the initial scratches and defects and then to gradually impart the final surface condition.

Product Applications

In addition to the many product applications already listed under belt finishing, manufacturers of cutlery and small hand tools are particularly dependent upon polishing for finishing. This process is also used for such work as "stain finishing," deburring, and for cleaning up irregularly shaped parts prior to plating or buffing.

Buffing

Buffing generally follows polishing and is usually the final operation that is performed on a workpiece. In buffing, the rubbing action is more gentle than the vigorous and aggressive cutting action employed in polishing. Buffing removes negligible amounts of material. A buffed surface is formed in two distinct steps: 1.) Cutting down and 2.) Coloring. During the initial finishing stage of cutting down, minute scratches left by polishing and other surface irregularities are reduced or entirely eliminated. It is during the final stage of buffing (coloring) that the ultimate reflective, highly lustrous surface is produced.

Buffing wheels, called "buffs," are often fabricated into a number of piles from a series of individual fabric disks of various kinds. Buffing wheel speeds are in the range 6500 to 8000 fpm.

The principle abrasive used for buffing compounds on aluminum, copper, brass, and for zinc alloy die castings is Tripoli. The buffing compounds may be manually applied to metal products in the same manner as is outlined for polishing (i.e., solid bar compound). The compound may be also be supplied to the wheel face in liquid form by using a patented airless -spraying system. Liquid compounds are highly suitable for machine or automatic buffing.

Product Applications

The decorative mirror like finish obtained by buffing is applied to a wide selection of metal products, including objects used on mobile homes, automobiles, motorcycles, boats, bicycles, as well as sporting items, tools, store fixtures, commercial and residential hardware, and household utensils and appliances. Buffing may be specified both prior to and following plating.