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LABORATORY MANUAL

B.E/B.TECH. MECHANICAL ENGINEERING

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CONTENT

1. STUDY OF DRILLING MACHINE

Drilling is the operation of producing circular hole in the work-piece by using a rotating cutter called Drill. The machine used for drilling is called drilling machine.

- The drilling operation can also be accomplished in lathe, in which the drill is held in tailstock and the work is held by the chuck.
- It is the simplest and accurate machine used in production shop.
- The work piece is held stationary ie. Clamped in position and the drill rotates to make a hole.

TYPES OF DRILLING MACHINE

1) Based on construction:
   1. Portable,
   2. Sensitive,
   3. Radial,
   4. up-right,
   5. Gang,
   6. Multi-spindle

2) Based on Feed:
   Hand driven
   Power driven

COMPONENTS OF DRILLING MACHINE

SPINDLE

The spindle holds the drill or cutting tools and revolves in a fixed position in a sleeve.

SLEEVE

The sleeve or quill assembly does not revolve but may slide in its bearing in a direction parallel to its axis. When the sleeve carrying the spindle with a cutting tool is lowered, the cutting tool is fed into the work: and when it's moved upward, the cutting tool is withdrawn from the work. Feed pressure applied to the sleeve by hand or power causes the revolving drill to cut its way into the work a fraction of an mm per revolution.

COLUMN

The column is cylindrical in shape and built rugged and solid. The column supports the head and the sleeve or quill assembly.

HEAD

The head of the drilling machine is composed of the sleeve, a spindle, an electric motor and feed mechanism. The head is bolted to the column.

WORKTABLE

The worktable is supported on an arm mounted to the column. The worktable can be adjusted vertically to accommodate different heights of work or it can be swung completely out of the way. It may be tilted up to 90 degree in either direction, to allow long pieces to be end or angle drilled.

BASE

The base of the drilling machine supports the entire machine and when bolted to the floor, provides for vibration-free operation and best machining accuracy. The top of the base is similar to the worktable and may be equipped with t- slot for mounting work too larger for the table.

HAND FEED

The hand- feed drilling machines are the simplest and most common type of drilling machines in use today. These are light duty machine that are operated by the operator, using a feed handled, so that the operator is able to “feel” the action of the cutting tool as it cuts through the work piece. These drilling machines can be bench or floor mounted.

POWER FEED

The power feed drilling machine are usually larger and heavier than the hand feed ones they are equipped with the ability to feed the cutting tool in to the work automatically, at preset depth of cut per revolution of the spindle these machines are used in maintenance for medium duty work or the work that uses large drills that require power feed larger work pieces are usually clamped directly to the table or base using t –bolts and clamps by a small work places are held in a vise. A depth –stop mechanism is located on the head, near the spindle, to aid in drilling to a precise depth.

SENSITIVE OR BENCH DRILLING MACHINE

- This type of drill machine is used for very light works. Fig.1 illustrates the sketch of sensitive drilling machine.
- The vertical column carries a swiveling table the height of which can be adjusted according to the work piece height.
- The table can also be swung to any desired position.
- At the top of the column there are two pulleys connected by a belt, one pulley is mounted on the motor shaft and other on the machine spindle.
- Vertical movement to the spindle is given by the feed handle by the operator.
- Operator senses the cutting action so sensitive drilling machine.
- Drill holes from 1.5 to 15mm

UP-RIGHT DRILLING MACHINE

- These are medium heavy duty machines.
- It specifically differs from sensitive drill in its weight, rigidity, application of power feed and wider range of spindle speed. Fig.2 shows the line sketch of up-right drilling machine.
- This machine usually has a gear driven mechanism for different spindle speed and an automatic or power feed device.
- Table can move vertically and radially.
- Drill holes up to 50mm

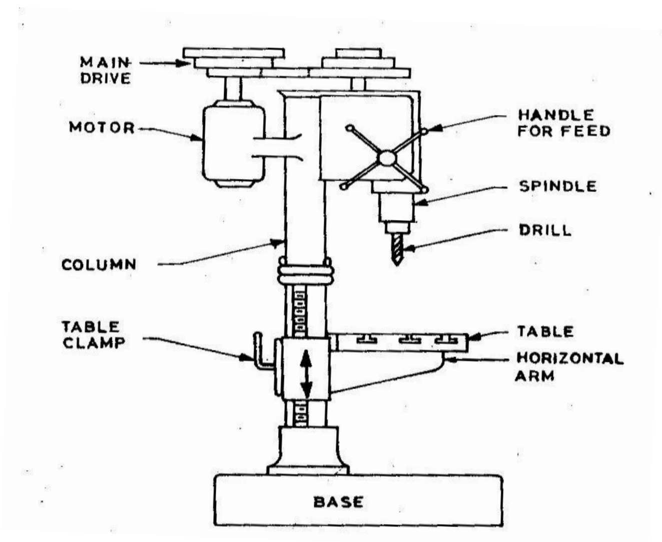

Fig.2 Up-Right Drilling Machine

RADIAL DRILLING MACHINE

- It the largest and most versatile used for drilling medium to large and heavy work pieces.
- Radial drilling machine belong to power feed type.
- The column and radial drilling machine supports the radial arm, drill head and motor. Fig.3 shows the line sketch of radial drilling machine.

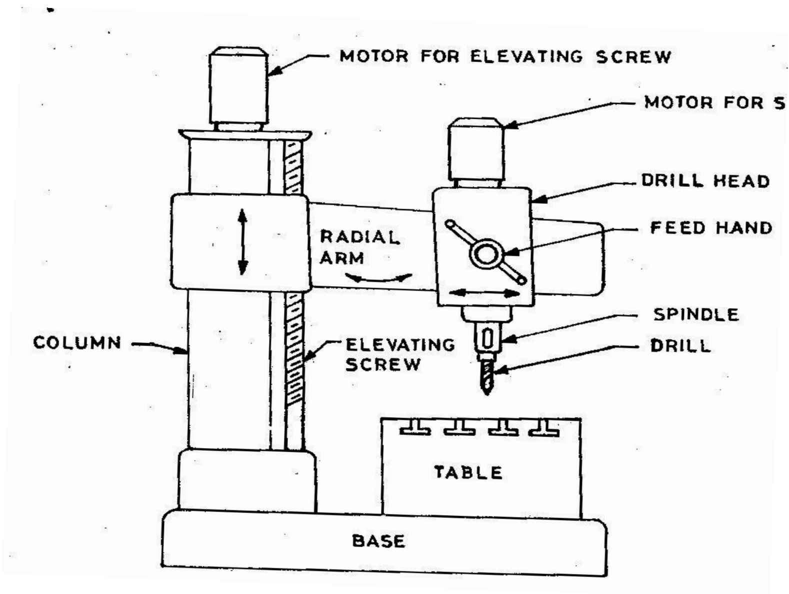

Fig. 3 Radial Drilling Machine

- The radial arm slides up and down on the column with the help of elevating screw provided on the side of the column, which is driven by a motor.
- The drill head is mounted on the radial arm and moves on the guide ways provided the radial arm can also be swiveled around the column.
- The drill head is equipped with a separate motor to drive the spindle, which carries the drill bit. A drill head may be moved on the arm manually or by power.
- Feed can be either manual or automatic with reversal mechanism.

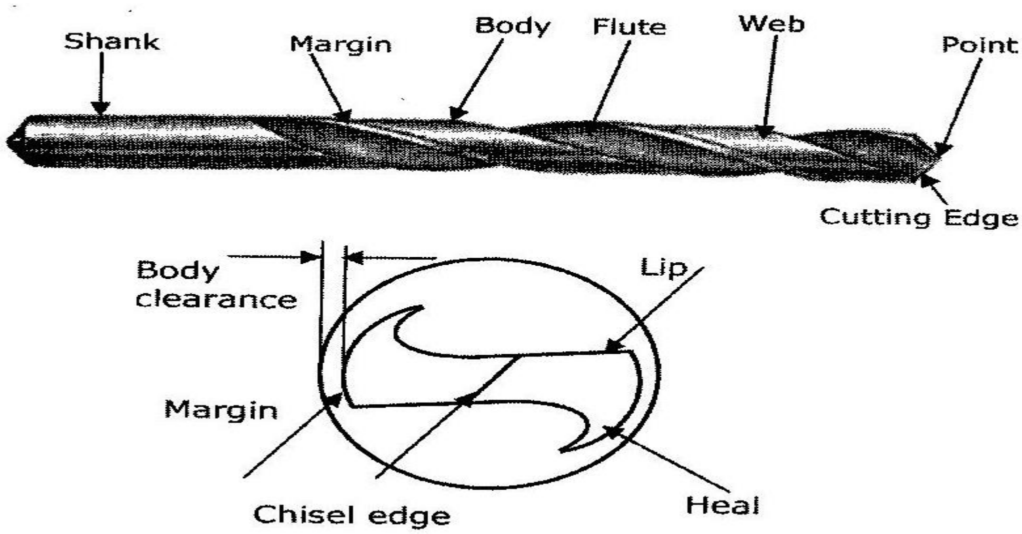

Fig. 4 Nomenclature of twist drill

TOOL HOLDING DEVICES

Fig.5 shows the different work holding. The different methods used for holding drill in a drill spindle are

- By directly fitting in the spindle hole.
- By using drill sleeve
- By using drill socket
- By using drill chuck

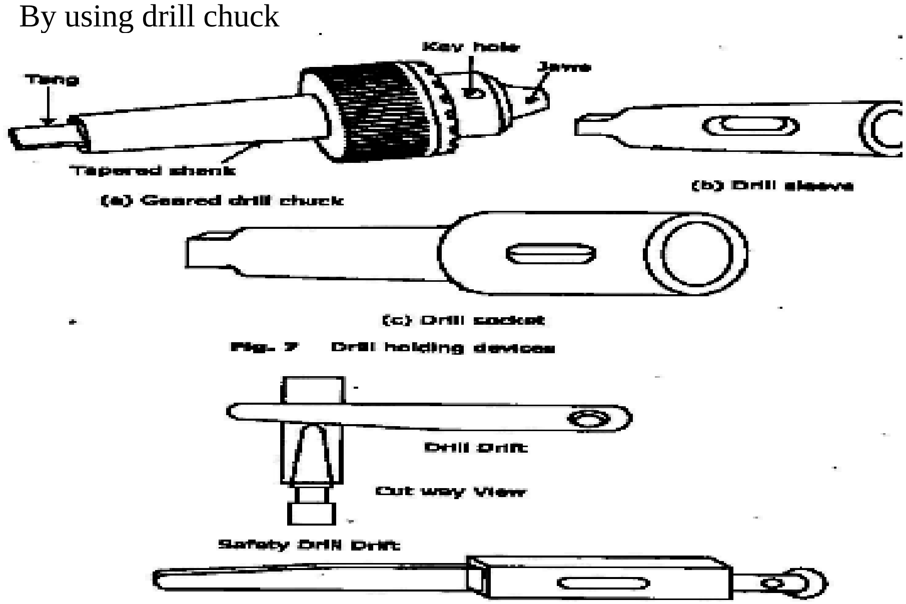

Fig. 5 **Tool Holding Devices**

DRILLING OPERATIONS

Operations that can be performed in a drilling machine are

- Drilling
- Reaming
- Boring
- Counter boring
- Countersinking
- Tapping

Drilling:

It is an operation by which holes are produced in solid metal by means of revolving tool called ‘Drill’. Fig. 9 shows the various operations on drilling machine.

Reaming:

Reaming is accurate way of sizing and finishing the pre-existing hole. Multi tooth cutting tool. Accuracy of ±0.005mm can be achieved

Boring:

Boring is a process of enlarging an existing hole by a single point cutting tool. Boring operation is often preferred because we can correct hole size, or alignment and can produce smooth finish. Boring tool is held in the boring bar which has the shank. Accuracy of ±0.005mm can be achieved.

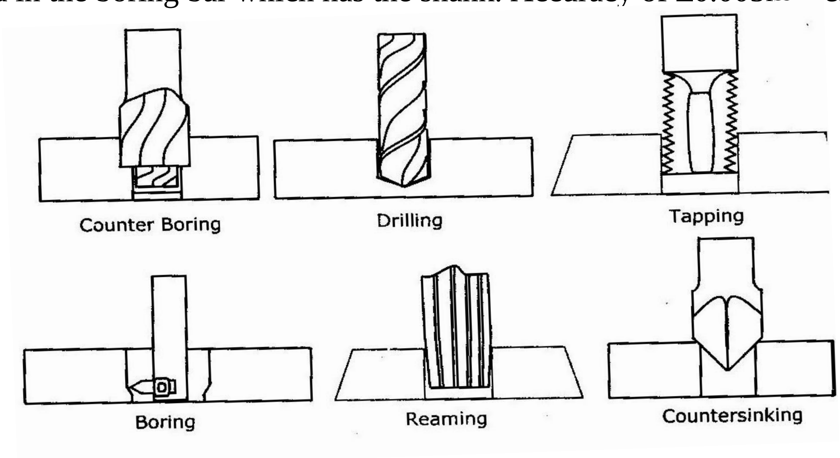

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Fig. 6 various operations on drilling machine

Counter Bore:-

This operation uses a pilot to guide the cutting action to accommodate the heads of bolts. Fig. 10 illustrates the counter boring, countersunk and spot facing processes.

Countersink:-

Special angled cone shaped enlargement at the end of the hole to accommodate the screws. Cone angles of 60°, 82°, 90°, 100°, 110°, 120°.

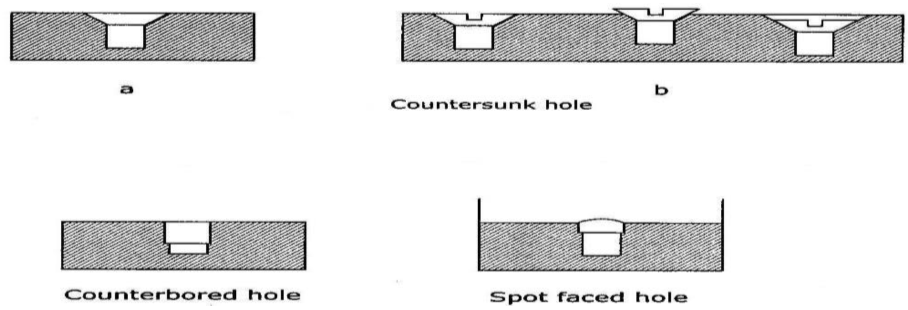


Fig. 7 Counter boring, countersunk and spot facing

Tapping:-

Tapping is the process by which internal threads are formed. It is performed either by hand or by machine. Minor diameter of the thread is drilled and then tapping is done. Fig. 11 shows the tapping processes.

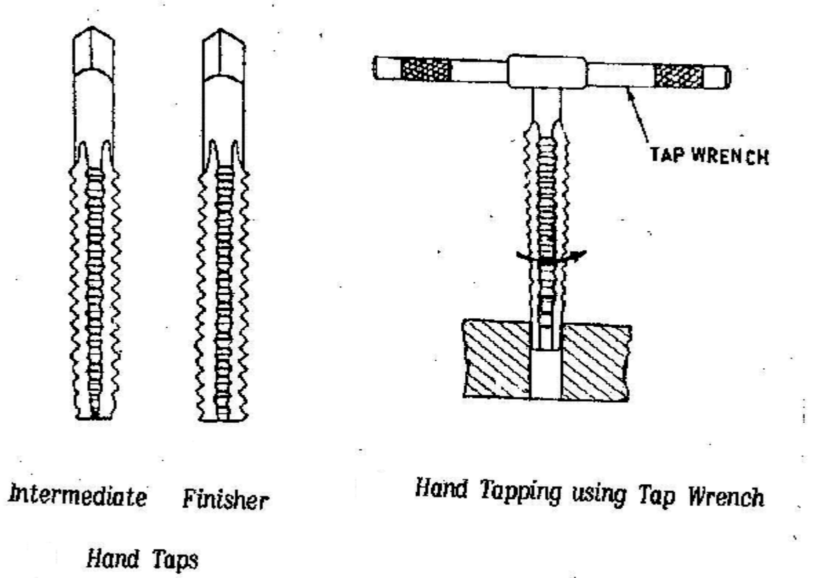


Fig. 8 Hand taps and tapping process using tap wrench

CONCLUSION

Thus, the basic functioning and mechanism of was studied.

2.STUDY OF MILLING MACHINE

Aim

To study about the Milling machine.

INTRODUCTION

Milling is a machining process which is performed with a rotary cutter with several cutting edges arranged on the periphery of the cutter. It is a multiple point cutting tool which is used in conjunction with a milling machine. This process is used to generate flat surfaces or curved profile and many other intricate shapes with great accuracy and having very good surface finish. Milling machines are one of the essential machines in any modern machine shop.

BASIC MILLING PROCESS

Generally, there are two types of milling processes. These are called (a) Up milling or conventional milling process, and (b) Down milling or climb milling process.

In up milling, the direction of rotation of milling cutter and the direction of work piece feed are opposite to each other; whereas in down milling, they move in the same direction at the point of contact of the cutter and the work piece. In up milling, the thickness of chip at the start is nil and is maximum when the cutting teeth leave the surface of the work piece. In down milling, it is vice-versa. In up milling, the cutting teeth try to up root and lift the work piece from the machine table, in down milling, reverse happens. Technically, down milling is a superior process, but up milling is commonly used. Down milling is not used unless the milling machine is fitted with a backlash eliminator.

From Fig. 4.1, basic milling operation can also be understood. The milling cutter is circular and a large number of cutting edges (or teeth) are arranged along its circumference. The cutter is rotated at a speed of N r.p.m. If the cutter diameter is D, then cutting speed at the tip of teeth can be calculated as

π DN meters/minute and it should conform to the recommended values. The depth of cut is clearly shown in the figure and the thickness of the work piece will reduce by this amount in one pass. Usually, the width of the milling cutter is more than the width of the work piece; hence one pass is all that is required.

Feed of the work piece is measured in terms of mm/minute. Actually, the correct measure of feed is movement of work piece per revolution of cutter per teeth. If a milling cutter has z number of teeth and if the table feed is ‘f’ mm/minute, feed per rev per teeth will be f / NZ mm. It should therefore be clear that metal removal rate in milling operation is much higher than in shaping or planing operations.

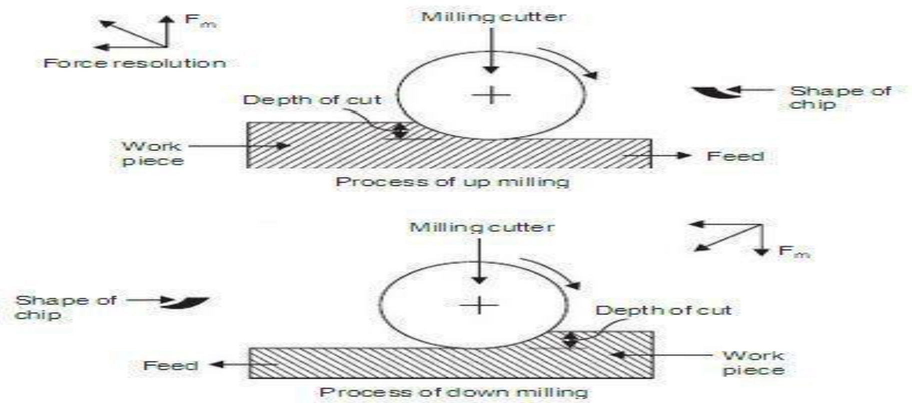


Fig. 4.1 Up and down milling processes

However, as in shaping or planing operation, the stroke length is always a little more than the length of the job, in milling operation also, the minimum table traverse required is L+ D, where L is the length of job and D is the milling cutter diameter. D /2 are the minimum overlap required on either side of job, so that the cutter becomes clear of the job.

Unlike turning, the milling process involves intermittent cutting and the chip cross-section is not uniform. The high impact loads at entry as well as fluctuating cutting force make milling process subject to vibration and chatter. This aspect has great influence on design of milling cutters.

Rotary movement to the cutters, and feed to the work piece and arrangement for clamping, automatic feed etc.

Milling machines come in three basic models:

1. Horizontal milling machines,
2. Vertical milling machines, and
3. Universal milling machines (This is also of horizontal type with a few special features).

Other configurations of the milling machine have been developed for special applications, but above three are most common.

(1).HORIZONTAL MILLING MACHINE

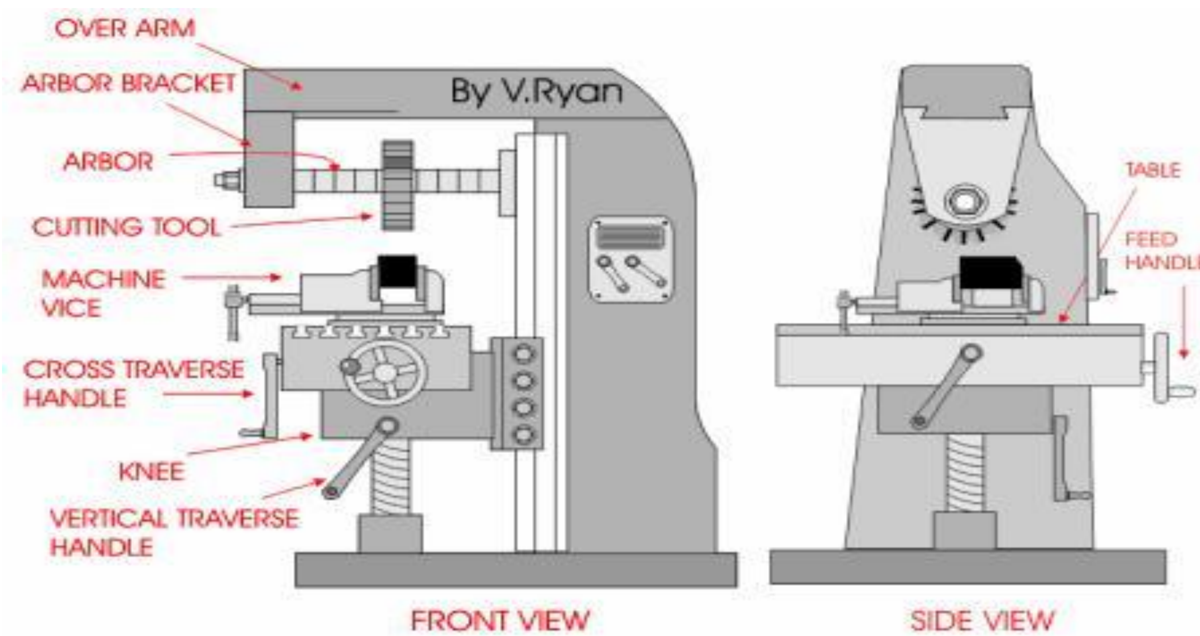
The most common type of milling machine is the horizontal knee type; so called, because of the over-hanging ‘‘knee’’ which can slide up and down the front of the machine and which carries the cross slide and the table. A diagram of the horizontal milling machine is given in Fig. 4.9.

Horizontal milling machines may be either plain or universal type. The main difference between the two is that the table of the universal type is mounted on a turn table and may be swiveled in a horizontal plane. This feature permits the cutting of helix. In addition, the standard accessories provided on the universal machine include a ‘dividing head’ for indexing. There are some other minor refinements, which make the universal horizontal machine very useful for tool room work.

The plain version of the horizontal machine is much more robust and more suitable for production work. In the diagram, the arbor on which peripheral cutters are mounted is not shown. It is fitted in the spindle nose 'C' and extends a little beyond arbor supporting bracket 'B'.

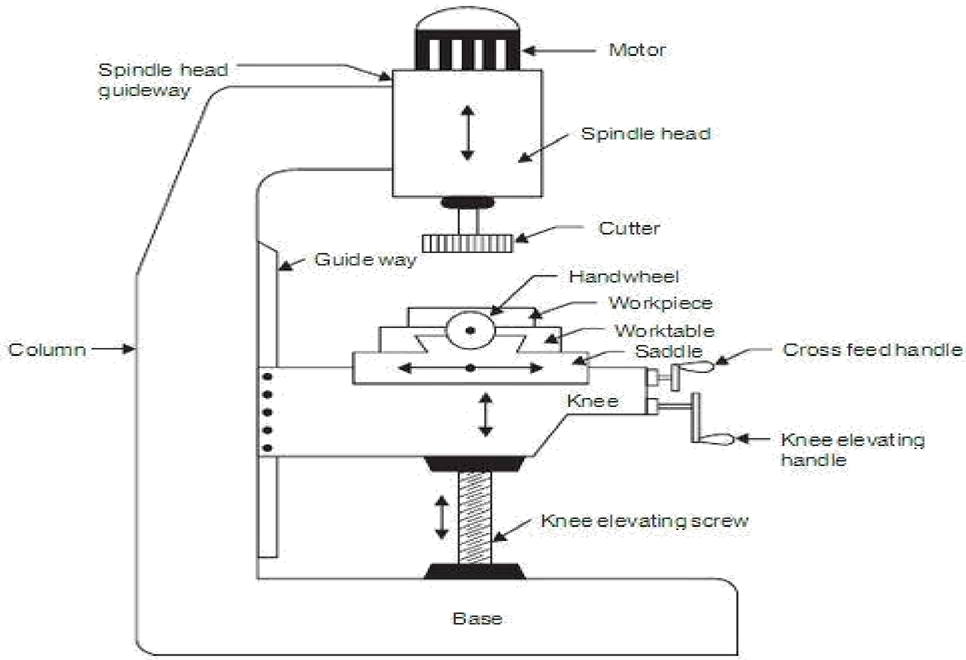
The table of the horizontal milling machine can be given either hand feed or auto feed. It is also capable of being traversed at high speed.

With these features, the machine proves really useful.



2).Vertical milling machine:

The application and technique of this machine differ from that of a horizontal milling machine. It does not have an arbor and instead has a vertical spindle into which the taper shank of end mills and facing milling cutters and drills etc. can be fitted. The arrangement and movement of table are similar to the table of a horizontal milling machine. This machine used for making, flat surfaces, grooves, slots, pockets and guide ways etc. in work pieces using end mills and facing mills etc.



<u>Conclusion:</u>

There are many accessories and fittings, which, if provided greatly improve the performance and range of work which can be carried out on a milling machine.

3. STUDY OF SHAPING MACHINE

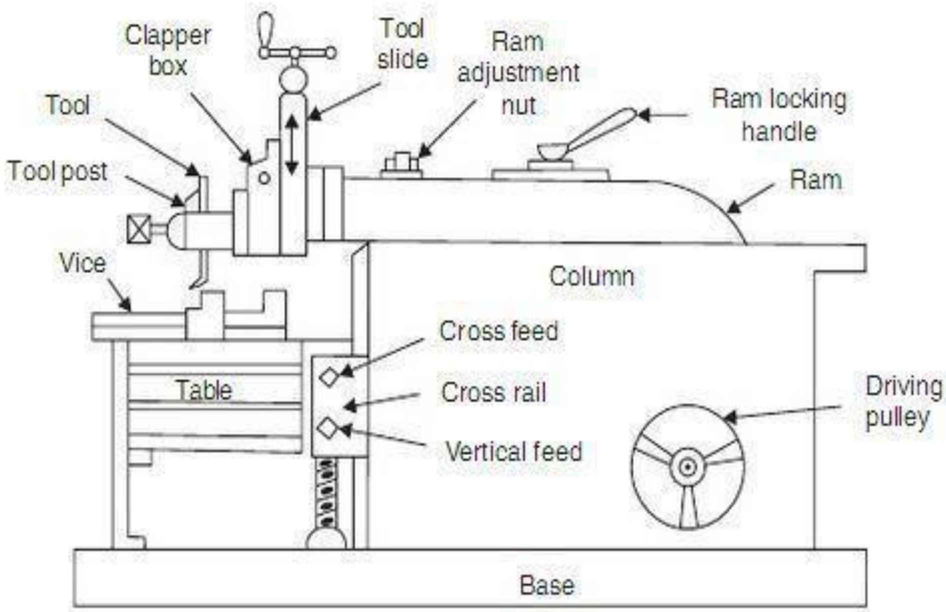
Aim

To study about the shaping machine.

INTRODUCTION

Both shapers and planers are machine tools which produce a flat surface. They are capable of machining a horizontal, vertical or inclined flat surface. They employ single-point cutting tools which are essentially similar to single-point cutting tools used on lathe. In both these machine tools, the cutting tool is subjected to interrupted cuts, the tools cuts in forward direction and is idle in the return direction. Cutting tool is in moving condition where as work piece is stationary . small length work piece only workable in shaper these are the main difference between planer and shaper

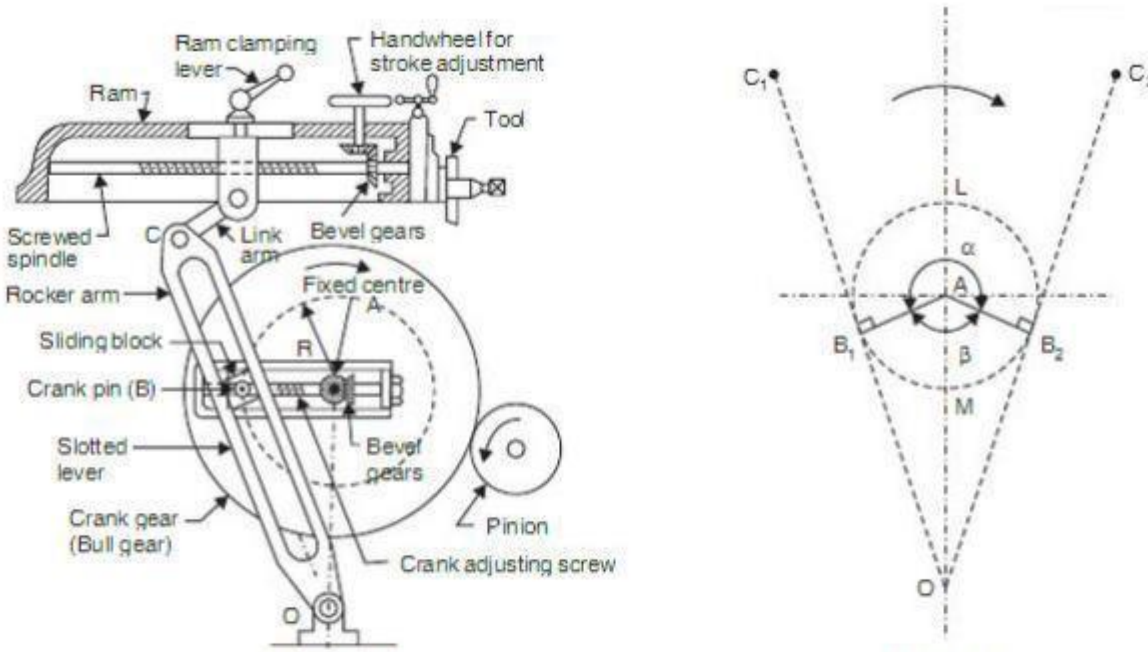
Principle of Working



Shaper consists of a hollow machine bed made of cast iron which rests on the ground. Inside the hollow portion the machine drive mechanism is housed. This mechanism is called slotted lever quick return mechanism and it drives a horizontal ram which reciprocates in the guide ways provided on the top surface of the machine frame. In the front face of the ram, a tool post is fitted. This is a very special kind of tool post. It carries a slide which can be operated by a hand wheel and the entire tool post can be lowered or raised. Besides, the tool slide can be swiveled in a vertical plane and its inclination to the vertical (amount of swiveling) can be read off on a scale marked in degrees. The tool is inclined, when an inclined surface has to be machined. In the front portion of the base, a table is fitted. The table can be raised or lowered to vary its height. It can also be moved horizontally to left or right. A vice to hold the work piece is provided on the table top. The tool does useful work i.e., cutting only in the forward stroke of the ram. It does not cut i.e.; it is idle during the return stroke of ram. In order that while returning, the tool may not rub and spoil the strip of the metal machined in the forward stroke, a special device called the “clapper box” is provided in the tool post. It lifts the tip ofthe tool during the return stroke.

DRIVE

Since useful work is done only during the forward stroke of ram, the mechanism driving the ram is so designed that the return stroke is completed in much less time than the forward stroke. The slotted lever quick return mechanism is illustrated in Figs. 2.2(a) and 2.2(b).



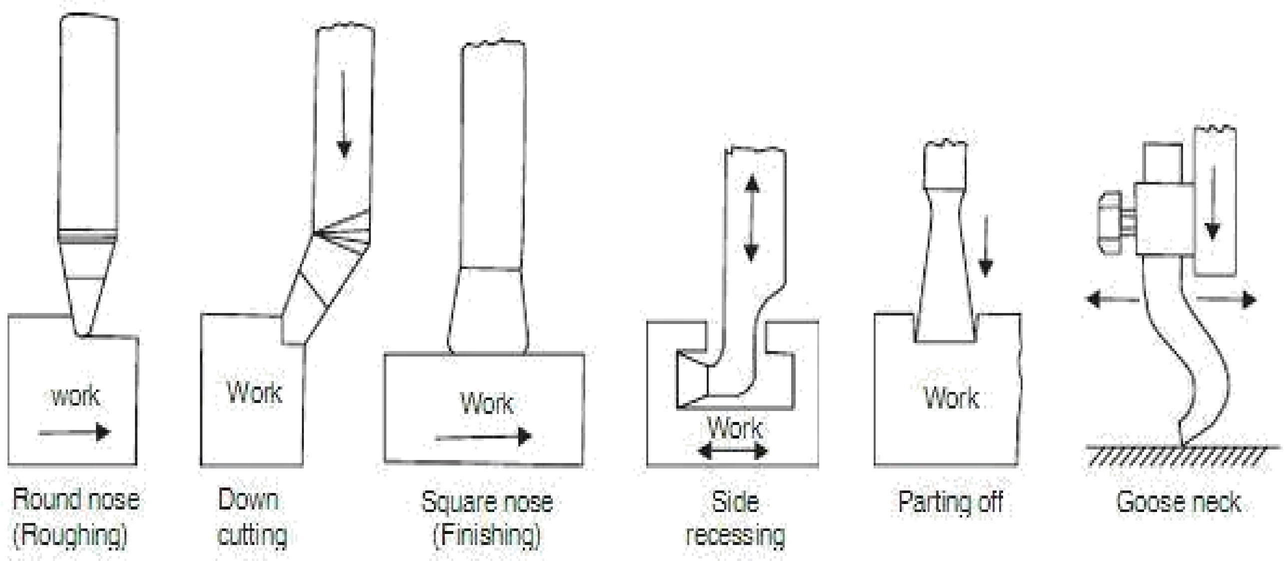
(a) Mechanism (b) Principle

The crank AB (of adjustable length R) rotates with a uniform angular speed. The crank pin B is in the shape of a die block which is free to slide inside the slot in the slotted lever OBC. This slotted lever is pivoted at O and the other end C is connected to the ram by a short link arm as shown in Fig. 2.2 (a).

When the crank AB rotates clockwise from position AB1to AB2, the ram moves forward from left to right and when it rotates from position AB2to AB1the ram returns back to its original position. Clearly the time taken to complete forward stroke is proportional to angle α(refer to Fig. 2.2 (b))and the return stroke is completed in less time which is proportional to angle β.

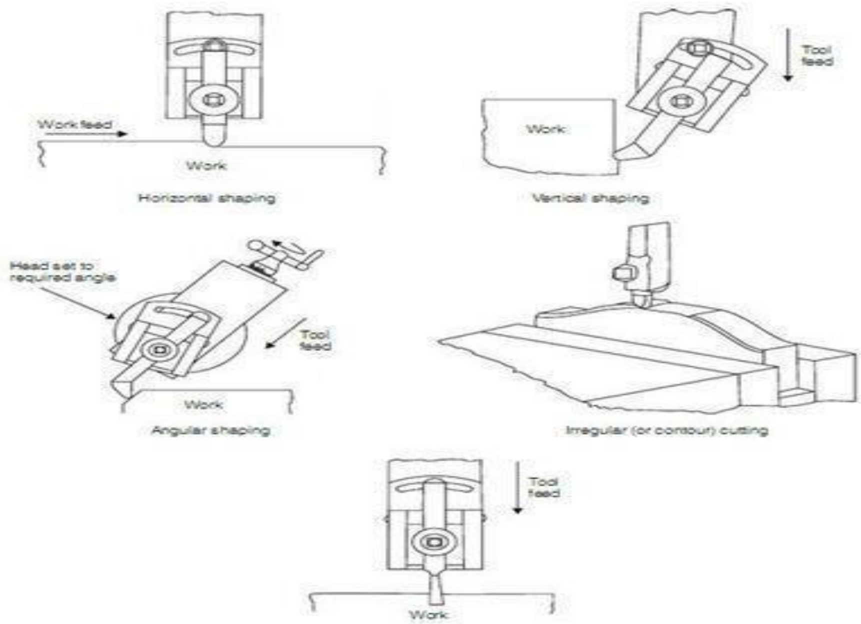
CUTTING TOOLS USED IN SHAPING

The cutting tools for shapers are generally made of H.S.S., either solid or with brazed tips. Due to interrupted cuts, tungsten carbide tools are not preferred for shaping work. These tools are made sturdy with fairly generous size for shank and tip. Various types of tools useful for shaping are shown in Fig. 2.3.



OPERATIONS PERFORMED ON SHAPERS

On a shaping machine, relatively small jobs can be machined. The size of a shaper is denoted by the maximum length of stroke of its ram and work pieces longer than the maximum stroke cannot be machined. The first step in machining a job is to mount the job on the shaper-table and clamp it tightly in the vice or on the table by means of T -bolts etc. The second step is to adjust the stroke of ram according to the length of work piece. The ram stroke is kept about 60–70 mm longer than job. The stroke can be reduced or increased by altering the length of the crank AB . Now by changing the position of the location where short link arm is connected to the ram, the stroke is made to overlap the job, so that the stroke starts 30–35 mm before the job and covers the whole length of work piece and ends 30–35 mm beyond it. A tool is now selected and clamped in the tool post. The depth of cut is given by rotating the hand wheel and lowering the tool slide. Depth of cut is not given by raising the table height. Table height is adjusted only at the time of fixing the job according to the height of job. Feed is given by shifting the table laterally. The feed to the table can be given either manually or automatically. The feed is given during the return stroke of ram. Operations performed on a shaper can be easily understood from Fig. 2.4.



Contour cutting is a very skillful job as it calls for simultaneous operation of horizontal table feed as well as vertical hand feed of the cutting tool. It can be performed only by a very skilled operator.

Conclusion:

There are many accessories and fittings, which, if provided greatly improve the performance and range of work which can be carried out on a shaping machine.

4.SLOTTING MACHINE

4.1 INTRODUCTION

A slotting machine or slotter is used for cutting different types of slots and it certainly proves to be most economical. Its other uses are in machining irregular shapes, circular surfaces and other premarked profiles. Its construction is similar to that of a vertical shaper. Its ram moves vertically and the tool cuts during the downward stroke only.

4.2 TYPES OF SLOTTER

4.2.1 PUNCHER SLOTTER

The puncher slotter is a heavy rigid machine designed for removal of large amount of metal from large forgings or castings. The length of stroke of a puncher slotter is sufficiently large.

4.2.2 PRECISION SLOTTER

The precision slotter is a lighter machine and is operated at high speeds. The machine is designed to take light cuts giving accurate finish. The precision machines are also used for general purpose work and are usually fitted with whit worth quick return mechanism.

4.3 SLOTTER SIZE

The size of a slotter like that of a shaper is specified by the maximum length of stroke of the ram expressed in mm. The size of a general purpose or precision slotter usually ranges from 80 to 900 mm. To specify a slotter correctly the diameter of the table in mm, amount of cross and longitudinal travel of the table expressed in mm, number of speeds and feeds available, h.p of the motor, floor space required etc. should also be stated.

4.4 SLOTTING MACHINE PARTS

4.4.1 BASE OR BED

The base is rigidly built to take up all the cutting forces and entire load of the machine. The top of the bed is accurately finished to provide guide ways on which the saddle is mounted.

4.4.2 COLUMN

The column is a vertical member which is cast integral with the base and houses driving mechanism of the ram and feeding mechanism.

The front vertical face of the column is accurately finished for providing ways on which the ram reciprocates.

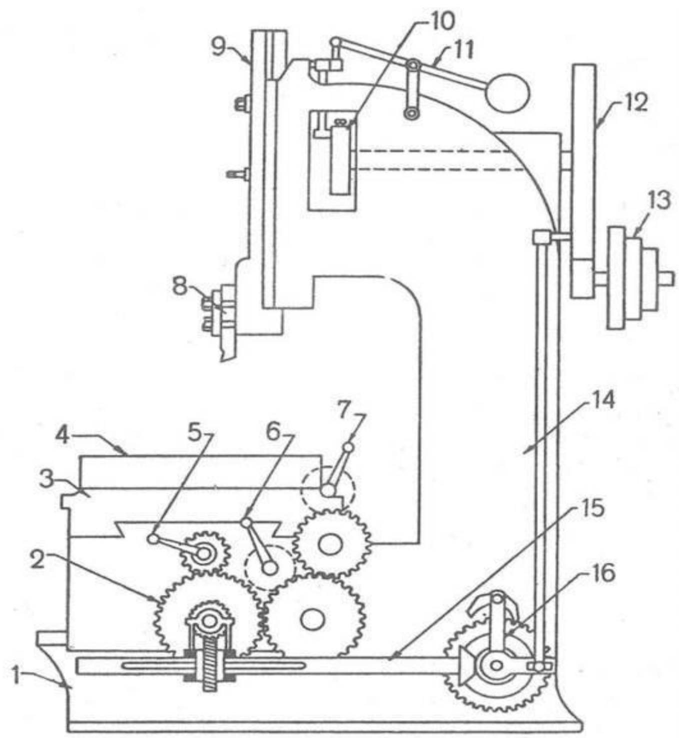


Figure: Slotting Machine

1. Base, 2. Feed gear, 3. Cross-slide, 4. Table, 5. Cross feed handle, 6. Longitudinal feed Handle, 7. Circular feed handle, 8. Tool, 9. Ram, 10. Crank disc, 11. Lever for counterbalance weight, 12. Bull gear, 13. Cone pulley, 14. Column, 15. Feed shaft, 16. Pawl actuating crank.

4.4.3 SADDLE

The saddle is mounted upon the guide ways and may be moved towards or away from the column either by power or manual control to supply longitudinal feed to the work. The top face of the saddle is accurately finished to provide guide ways on the base.

4.4.4 CROSS SLIDE

The cross slide is mounted upon the guide way of the saddle and may be moved parallel to the face of the column.

4.4.5 ROTARY TABLE

The rotary table is a circular table which is mounted on the top of the cross slide. The table may be rotated by rotating a worm which meshes with a worm gear connected to the underside of the table. In some machines the table is graduated in degree that enables the table to be rotated for indexing or dividing the periphery of a job in equal lumber of parts. T-slots are cut on the top face of the table for holding the work by different clamping devices.

4.4.6 RAM AND TOOLHEAD ASSEMBLY

The ram is the reciprocating member of the machine mounted on the guide ways of the column. It supports the tool at its bottom end on a tool head. A slot is cut on the body of the ram for changing the position of stroke.

4.5 RAM DRIVE MECHANISM

A slotter removes metal during downward cutting stroke only whereas during upwards return stroke no metal is removed. The usual types of ram drive mechanisms are

1. Whitworth quick return mechanism
2. Variable speed reversible motor drive mechanism
3. Hydraulic drive mechanism.

4.2.6 FEED MOVEMENTS

In a slotter, the feed is given by the table. A slotting machine table may have three types of feed movements.

1. Longitudinal

2. Cross

3. Circular

If the table is feed perpendicular to the column towards or away from its face, the feed movements termed as longitudinal. If the table is feed parallel to the face of the column the feed movement is termed as circular

4.7 WORK HOLDING DEVICES

The work is held on a slotter table by a Vise, T-bolts and clamps of by special fixtures. T-Bolts and clamps are used for holding most of the work on the table. Before clamping packing pieces are place below the work so as to allow the tool to complete the cut without touching the table.

4.8 SLOTTER OPERATIONS

The operations performed in a slotter are

1. Machining flat surfaces:
2. Machining cylindrical surfaces
3. Machining irregular surfaces and cam machining
4. Machining slots, keyways and grooves.

4.9 SLOTTER TOOLS

The tool in a slotter removes metal during its vertical cutting stroke. This changed cutting condition presents a lot of difference, in the tool shape. In a slotter the cutting pressure acts along the length of the tool. The rake and the clearance angle of a slotter tool apparently look different from a lathe or a shaper tool as these angles are determined with respect to a vertical plane rather than the horizontal. Slotter tools are provided with top rake front clearance and side clearance, but no side rake is given. The-nose of the tool projects slightly beyond the shank to provide clearance.

Conclusion:

There are many accessories and fittings, which, if provided greatly improve the performance and range of work which can be carried out on a Slotting machine.

5. STUDY OF GRINDING MACHINES

5.1 INTRODUCTION

Grinding is a process of material removal in the form of small chips by the mechanical action of abrasive particles bonded together in a grinding wheel. It is basically a finishing process employed for producing close dimensional and geometrical accuracies and smooth surface finish. However in same applications, the grinding process is also applied for higher material removal rates and is referred to as abrasive machining. Generally, in other methods of machining, the work piece is shaped by removing chips using cutting tools having designed geometry, with the tool material is harder than the work material. In such types of machining the process has the following limitations.

1) The difference in the hardness of the tool and of the work is often limited, resulting tool wear and tool failure.

2) In the process of removing materials by way of chips, a considerable amount of heat is generated which, when it exceeds a specific level, affects the tool hardness. These conditions always limit the applicable cutting speed.

5.2 TYPES OF GRINDING

Grinding is done on surfaces of almost all conceivable shapes and materials of all kinds.

Grinding may be classified broadly into two groups.

1. Rough or non-precision grinding. 2. Precision grinding.

5.2.1 ROUGH GRINDING

The common forms of rough grinding are snagging and off-hand grinding where the work is held in the operators hand. The work is pressed hard against the wheel, or vice -versa. The accuracy and surface finish obtained are of secondary importance.

Snagging is done where; a considerable amount of metal is removed without regard to the accuracy of the finished surface. Examples of snag grinding are trimming the surface left by sprues and risers on castings, grinding the parting line left on castings, removing flash on forgings, the excess metal on welds, cracks and imperfections on alloy steel billets.

5.2.2 PRECISION GRINDING

This is concerned with producing good surface finish and high degree of accuracy. Grinding in accordance with the type of surface to be ground is classified as

1. External cylindrical grinding
2. Internal cylindrical grinding
3. Surface grinding
4. Form grinding

5.3GRINDING MACHINES

Grinding machines are broadly classified into cylindrical grinding machines, internal grinding machines, surface grinding machines and tool & cutter grinding machine, depending on the shape of the ground surface and the type of grinding they do.

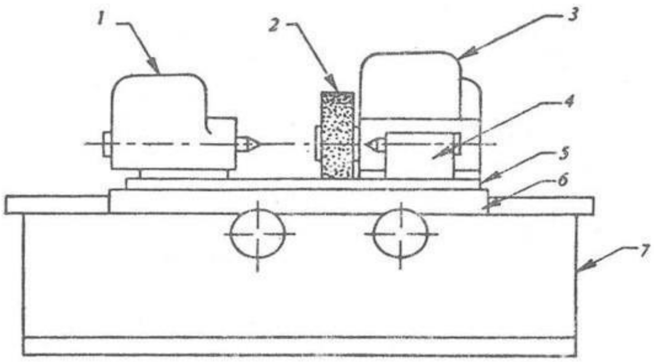
5.3.1 CYLINDRICAL GRINDING MACHINES

Cylindrical grinding machine is performed to remove material, to produce precise geometry, and to obtain the desired surface finish on external surfaces of round work pieces. These surfaces may be cylindrical, tapers, fillets, grooves, shoulders and other formed surfaces of revolution.

5.3.1.1 Centre type cylindrical grinding machine

Centre type grinding machine is used for single and multi-diameter shafts, especially when the concentricity must be held between diameters ground in the separate operations. In these type of machines, the work piece is supported in between the centre for stock removal.

Such machines basically consist of a bed, a wheel head (swiveling or non- swiveling type) and a tail stock. The head stock and tail stock are mounted on a swivel table which is moves to and fro in the bed guide ways. Centre type grinding machines may be manually operated, semi-automatic or fully automatic.



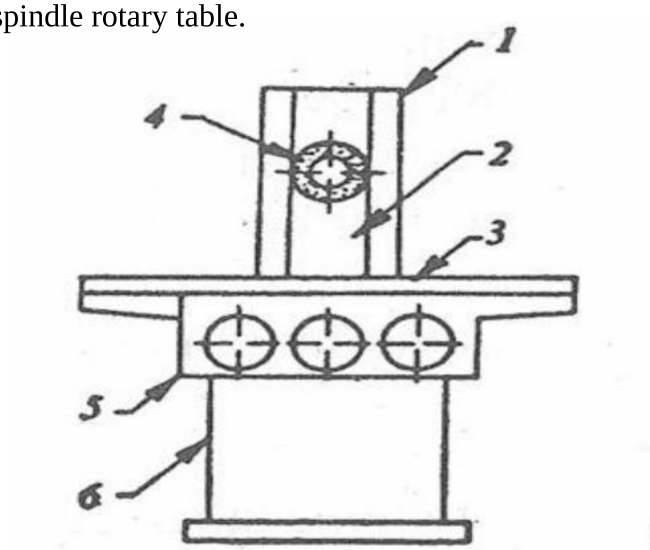
Block diagram of a plain centre-type grinder
1. Headstock, 2. Grinding wheel, 3. Wheelhead,
4. ailstock, 5. Upper table, 6. Lower table, 7. Base

5.3.1.2 SURFACE GRINDERS

Surface grinding machines are employed to finish plane or flat surfaces. They are also capable of grinding irregular, curved, convex, and concave surfaces. Conventional surface grinders may be divided into two classes: One class has reciprocating tables for work ground along straight lines, while the other covers the machines with rotating work tables for continuous rapid grinding. Surface grinders may also be classified according to whether they have horizontal or vertical grinding wheel spindles. So there may be four different types of surface grinders:

Horizontal spindle reciprocating table.

1. Horizontal spindle rotary table.
2. Vertical spindle reciprocating table.
3. Vertical spindle rotary table.



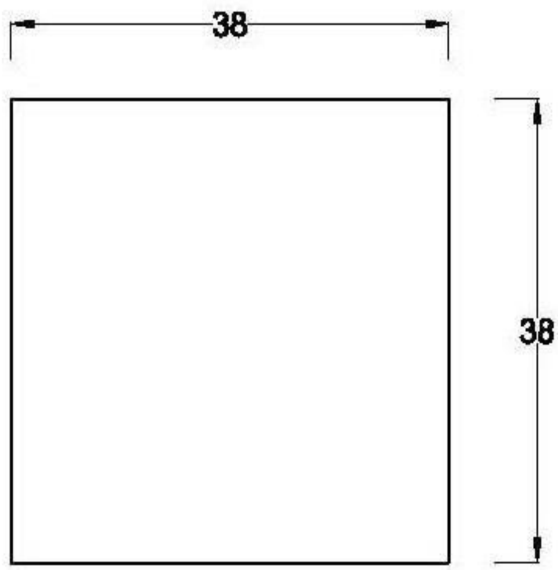
Block diagram of a horizontal spindle surface grinder
1. Column,2. Wheel head 3. Table Wheel,5. Saddle, 6. Base

Conclusion:

Thus the study of grinding machine is discussed briefly.

SQUARE HEAD SHAPING

JOB DRAWNG



All dimensions are in mm

Materials Supplied: Mild steel:

Tool Material: High Speed Steel (H.S.S)

Ex. No: **Date:**

ROUND BAR TO SQUARE HEAD IN SHAPING

Aim

To machine the given round bar into rectangular block in shaping machine

Tools Required

Round nose tool

Vernier caliper

Steel Rule

Hammer, Punch, Scriber

Try square

Vernier height gauge

Procedure

1. The given raw material rectangular block is measured. The machining allowances are noted. Then the job is coated with white chalk for marking purpose.
2. The job is position in the marking table. The vernier height gauge is set to the correct dimensions as per the part drawing dimensions
3. After, the height -- mm is corrected in the vernier height gauge; the vernier scriber is marked in the face sides of the rectangular block.
4. To identify the dimensions of the job, the marking lines are punched
5. The work piece is placed in the shaping machine work holding device in correct position. Tool is held in the head in suitable position.
6. The stroke length and initial cutting position are corrected by adjusting the ram and table manually
7. The tool is held in the tool post in vertical position
8. Now, the machine is switched ON. The tool moves over the work, the materials is removed from the work by the tool cutting force.
9. By giving cross-feed movement to the table, the total length of work is machined, after completion of one cut, the depth of cut is adjusted in the tool head. Then the next cut is taken.
10. By repeating the above same procedure, the other faces are machined to the required dimensions
11. After completion of six faces, the work is removed from the vice, cleaned and inspection is carried out. The job No / Roll No are punched in the face side of the work.

Result

The given work piece rectangular block is machined as per the dimension in the shaping machine.

VIVA QUESTIONS

1. Write down any four operations performed by a shaper?
Machining horizontal surfaces. Machining vertical surfaces. Machining inclined surfaces. Machining irregular surfaces.
2. . Define cutting ratio of the shaper.
The ratio between the cutting stroke time and the return stroke time is called as cutting ratio.
Cutting stroke time
Cutting ratio m= Return stroke time.
3. Briefly describe the importance of quill mechanism.
If the taper shank of drill is smaller than the taper in the spindle hole, a sleeve is used. The sleeve with drill is fitted in the hole of the spindle. The sleeve has outside taper surface. This fits into the tapered hole of the spindle.
4. Explain the cutting shaping process?
The required shape of metal is obtained by removing the Unwanted material from the work piece in the form of chips is called cutting shaping. Ex: turning, drilling, milling, boring, etc
5. Mention the differences between shaper and planer.

S . NO	SHAPER	PLANER
1	Tool reciprocates and the work is stationary	Tool is stationary and work reciprocates
2	Less accuracy due to overhanging of ram	It gives more accuracy as the tool is rigidly supported during cutting.

Exp. No. **Date:**

Drilling, Tapping and Reaming

AIM

To perform the drilling, Boring and Reaming in a drilling Machine on the given work piece for the given dimensions.

MATERIALS REQUIRED

Mild steel Plate of Length 50x50 mm

TOOLS REQUIRED

Steel rule,

Flat file (rough and smooth),

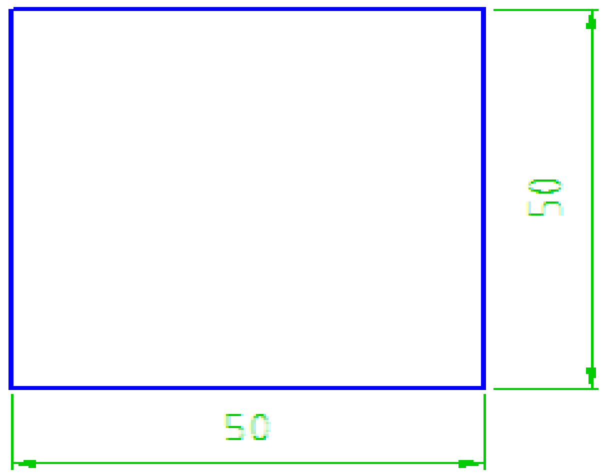
Drill bit (8 mm, 10 mm, 10.5 mm),

Reaming tool,

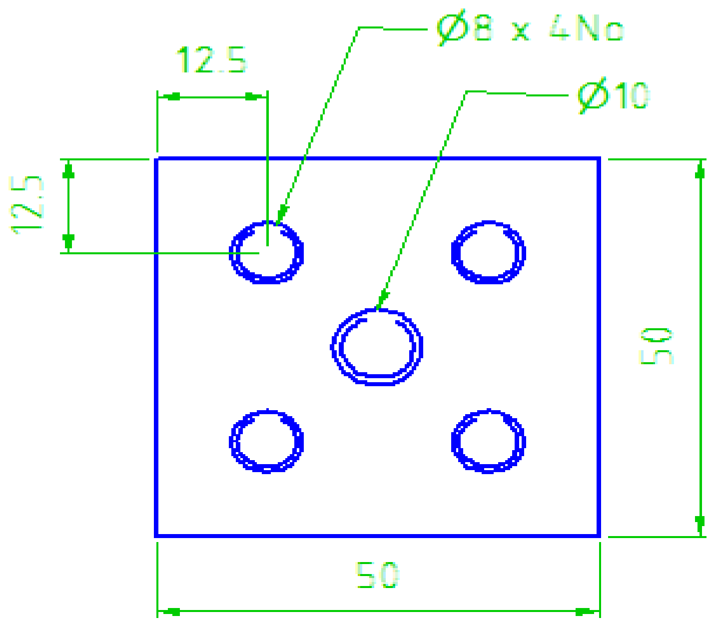
Try square

PROCEDURE

1. The work piece was fitted in the vice and filed to the required dimensions.
2. The squareness of the work piece was checked.
3. Drawing punches were made for various drills.
4. The job was fitted on the radial drilling machine.
5. The 10 mm & 8 mm drill bit were used for drilling in the required place and drilling operation was made on the work piece.
6. Boring was done on the 10mm hole using the boring tool.
7. Reaming was done on the 8 mm hole using the Reaming tool size of 8 mm diameter.
8. The work piece was removed from the radial drilling machine.



BEFORE MACHINING



AFTER MACHINING

All dimensions are in mm

RESULT

Thus the work piece for the required dimensions is obtained by performing drilling, Boring and Reaming in a drilling Machine.

1. What is meant by drilling?

Ans: Drilling is the process of producing hole on the work piece by using a rotating cutter called drill.

2. Mention any four specification of drilling machine?

Ans:
1. Maximum size of the drill in mm that the machine can operate
2. Table size of maximum dimensions of a job can mount on a table in square meter
3. Maximum spindle travel in mm
4. Number of spindle speed & range of spindle speeds in r.p.m.

3. List any four machining operations that can be performed on a drilling machine?

Ans:
1. Drilling
2. Counter sinking
3. Tapping
4. Trepanning

4. What are the different ways to mount the drilling tool?

Ans:
1. fitting directly in the spindle
2. By using a sleeve
3. By using a socket
4. By means of chucks

5. What is the function of cutting fluids?

Ans:
1. It is used to cool the cutting tool & the work piece.
2. It improves the surface finish as stated earlier.
3. It causes the chips to break up into small parts.
4. It protects the finish surface from corrosion.
5. It prevents the corrosion of work & machine.

6. What are the properties of cutting fluid?

Ans:
1. High heat absorbing capacities.
2. It should have good lubricant properties.
3. High flash point.
4. It should be odourless.
5. It should be non-corrosive to work & tool.

Exp. No. **Date:**

Plain milling

AIM

To perform the plain milling in a horizontal milling Machine on the given work piece for the given dimensions.

MATERIALS REQUIRED

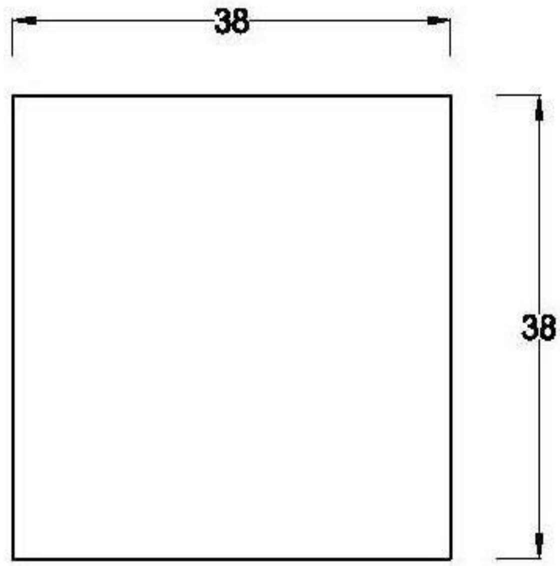
Mild steel Plate of Length 50x50 mm

TOOLS REQUIRED

Steel rule, Flat file (rough and smooth), Try square.

PROCEDURE

1. The work piece was fitted in the vice and filed to the required dimensions.
2. The squareness of the work piece was checked.
3. Drawing punches were made for milling operations.
4. The job was fitted on the radial drilling machine.
5. Milling operation is made for entire work piece to attain required dimensions.



All dimensions are in mm

Materials Supplied: Mild steel:

Tool Material: High Speed Steel (H.S.S)

VIVA QUESTIONS

1. How do you classify milling cutters?
They are classified based on following factors (i) According to the shape of the teeth. (ii) According to the type of operation (iii) According to the way of mounting on the machine.

2. What is cam milling?
Cam milling is operation of producing cams in the milling machine by the use universal dividing head &a vertical milling attachment.
3. What is meant by up milling and down milling?
In up milling, cutter rotates opposite to the direction of feed of the work piece whereas in down milling, the cutter rotates in the same direction of travel of the work piece.
4. What is a shell mill?
A shell mill is a large type of face or end mill, rather than having an integral shank. Typically there is a hollow or recess in the centre of the shell mill for mounting hardware on to a separate arbor.
5. What is meant by up-milling and down milling?
In up milling, cutters rotates opposites to the direction of a feed of the work piece whereas in down milling, the cutter rotates in the same direction of travel of the workpiece.
6. What is thread milling?
A thread milling has no chamfer. The mill is inserted into the hole along the axis of the spindle, deep enough to produce full thread depth required.

Ex. No: **Date:**

SQUARE HEAD SHAPING

Aim

To machine the given rectangular block in the shaping machine

Tools Required

Round nose tool

Vernier caliper

Steel Rule

Hammer, Punch, Scriber

Try square

Vernier height gauge

Procedure

1. The given raw material rectangular block is measured. The machining allowances are noted. Then the job is coated with white chalk for marking purpose.
2. The job is position in the marking table. The vernier height gauge is set to the correct dimensions as per the part drawing dimensions
3. After, the height -- mm is corrected in the vernier height gauge; the vernier scriber is marked in the face sides of the rectangular block.
4. To identify the dimensions of the job, the marking lines are punched
5. The work piece is placed in the shaping machine work holding device in correct position. Tool is held in the head in suitable position.
6. The stroke length and initial cutting position are corrected by adjusting the ram and table manually
7. The tool is held in the tool post in vertical position
8. Now, the machine is switched ON. The tool moves over the work, the materials is removed from the work by the tool cutting force.
9. By giving cross-feed movement to the table, the total length of work is machined, after completion of one cut, the depth of cut is adjusted in the tool head. Then the next cut is taken.
10. By repeating the above same procedure, the other faces are machined to the required dimensions
11. After completion of six faces, the work is removed from the vice, cleaned and inspection is carried out. The job No / Roll No are punched in the face side of the work.

Result

The given work piece rectangular block is machined as per the dimension in the shaping machine.

VIVA QUESTIONS

6. Write down any four operations performed by a shaper?
Machining horizontal surfaces. Machining vertical surfaces. Machining inclined surfaces. Machining irregular surfaces.

7. . Define cutting ratio of the shaper.

The ratio between the cutting stroke time and the return stroke time is called as cutting ratio.

Cutting stroke time

Cutting ratio m= Return stroke time.

8. Briefly describe the importance of quill mechanism.

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9. Explain the cutting shaping process?

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10. Mention the differences between shaper and planer.

S . NO	SHAPER	PLANER
1	Tool reciprocates and the work is stationary	Tool is stationary and work reciprocates
2	Less accuracy due to overhanging of ram	It gives more accuracy as the tool is rigidly supported during cutting.

Ex. No: **Date:**

Internal key way cutting in slotter

Aim:

To cut internal key to the required dimensions in slotting machine

Tools Required:

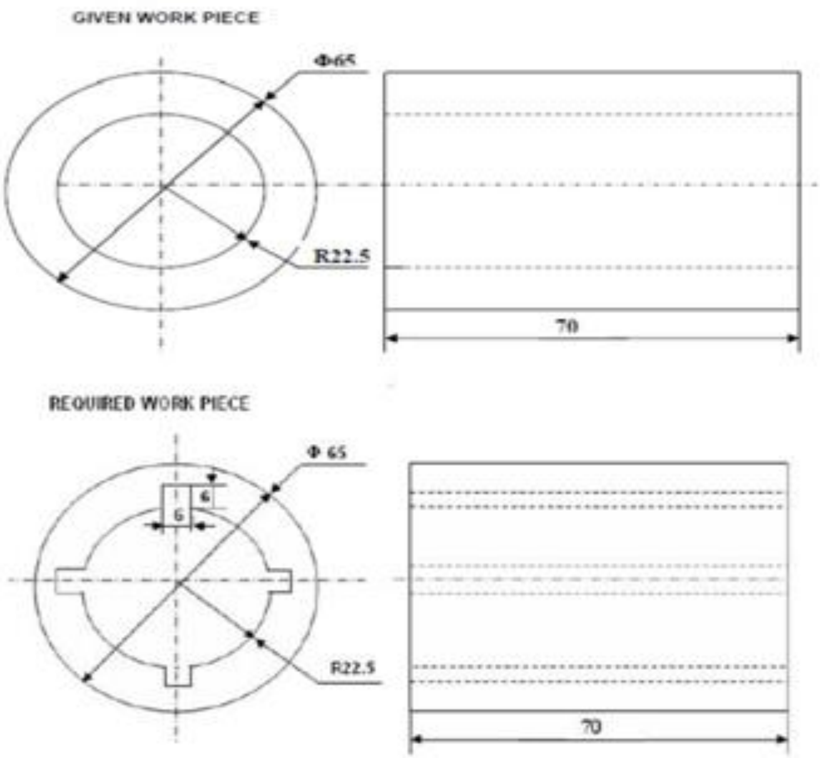
Steel rule
Tipped tool
Scriber
Dot punch
Anvil
Surface gauge
Steel rule

Procedure

1. The tool is fixed to the tool post such that the movement should be exactly perpendicular to the table.
2. The work piece is then set in the vice such that the tool is just above the work piece. Adjust the length of the stroke of the ram.
3. Slotting operation is performed and makes one slot on the work piece to the required dimensions.
4. Then bring the tool to the initial position.
5. Rotate the work table by an angle 90o and continue the process for the second slot.
6. Repeat the process for the remaining slots.

RESULT: The job is completed successfully and safely.

Internal key way



All dimensions are in mm

VIVA QUESTIONS

1. What is slotter?

It is falls under the category of reciprocating types of machine tool similar to shaper.

2. What is the difference between shaper and slotter?

In shaper ram reciprocate about horizontal axis but slotter the ram reciprocate about vertical axis.

3. What is the difference between vertical shaper and slotter?

In vertical shaper the holding the tool may also reciprocate at an angle to the horizontal table in addition to the vertical stroke.

4. What is the use of slotter?

It is used to cutting groove, keyway, and slots of various shapes.

5. What are the types of slotter?

1. Puncher slotter, 2. Precision slotter.

6. What is puncher slotter?

The puncher slotter is heavy, rigid machine designed for removal of large amount of work pieces. It is driven by a spiral pinion meshing with the rack teeth on the underside of the ram.

7. What are the parts involved in slotter?

1. Base 2. Column 3. Saddle 4. Cross slide 5.Rotating table. 6. Ram and tool head.

8. List the ram driving mechanism used in slotter.

    1. Whit worth quick return mechanism
    2. Variable speed reversible motor drive mechanism.
    3. Hydraulic drive.

9. List the feed involved in slotter.

    1. Longitudinal feed
    2. Cross feed
    3. Circular feed.

10. List the slotter operation.

1. Machining flat surfaces 2. Cylindrical surfaces 3. Irregular surfaces. 4. Slot, key ways and grooves.

Ex. No: **Date:**

CYLINDRICAL GRINDING

AIM: To grind the cylindrical surface of the given materials as per the given dimensions .

APPARATUS REQUIRED:

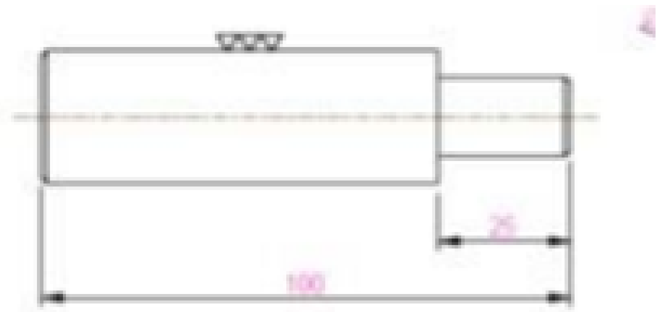
1. Grinding Machine
2. Grinding Wheel
3. Work Piece
4. Steel rule.
5. Outside calipers.
6. Cutting tool.

PROCEDURE:

1. The given work piece is first fitted in the chuck of the lathe.
2. By fitting the tool in tool post the work piece will be reduced to given dimensions.
3. First reduce the diameter to 23mm size then reduced the diameter to 15mm and 18mm at the middle.
4. By facing the work piece to the tool work piece is reduced to 70mm.
5. After the preliminary lathe operation, the work piece is held in the ends of the cylindrical grinder.
6. The grinding wheel is turned on and it is moved towards the work piece such that the surfaces of the cylindrical position are grinded to +-0.2mm.

RESULT

Thus the required dimension of cylindrical surface is obtained.



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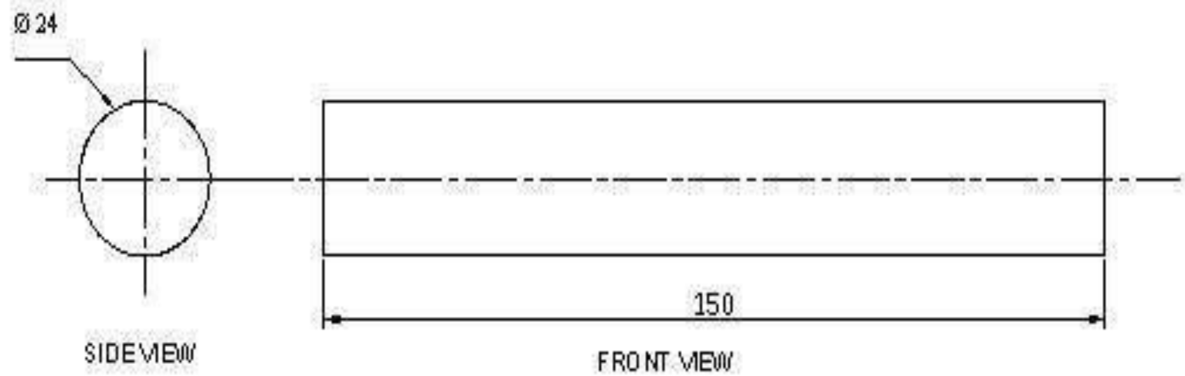


Ø 24
150
SIDE VIEW
FRONT VIEW

1. Define Grinding

Ans: A process of material removal in the form of small chips by means of rotating abrasive particles bonded together in a grinding wheel to produce flat, cylindrical or other surfaces is known as grinding.

2. Define Grinding Wheel

Ans: A wheel composed of hard and sharp edged abrasive grains held together by a bonding material and is used to finish within close tolerances on various surfaces by its abrasive action is known as grinding wheel.

3. Define Grinding Machine.

Ans: The machine tool designed for finishing within close tolerances to the flat, cylindrical or other surfaces by the abrasive action of a rotating wheel is called a grinding machine or simply grinder.

4. Name the elements which are considered in the construction of a grinding wheel.

Ans: Six important elements which are considered in the construction of a grinding wheel are as follows:

(a) Abrasive
(b) Grain Size
(c) Bond and bonding material
(d) Grade
(e) Structure
(f) Wheel shape

5. Define abrasives used in grinding wheels.

Ans: Abrasives used for making grinding wheels may be classified as follows:

1. Natural abrasives
2. Artificial abrasives.

6. Name some natural abrasives.

Ans: The commonly used natural abrasives are as follows:

1. Sand stone or quartz
2. Emery
3. Corundum
4. Garnet
5. Diamond

7. Name some artificial abrasives.

Ans:

1. Silicon carbide
2. Aluminium Carbide

8. Define grain size in connection with grinding wheel.

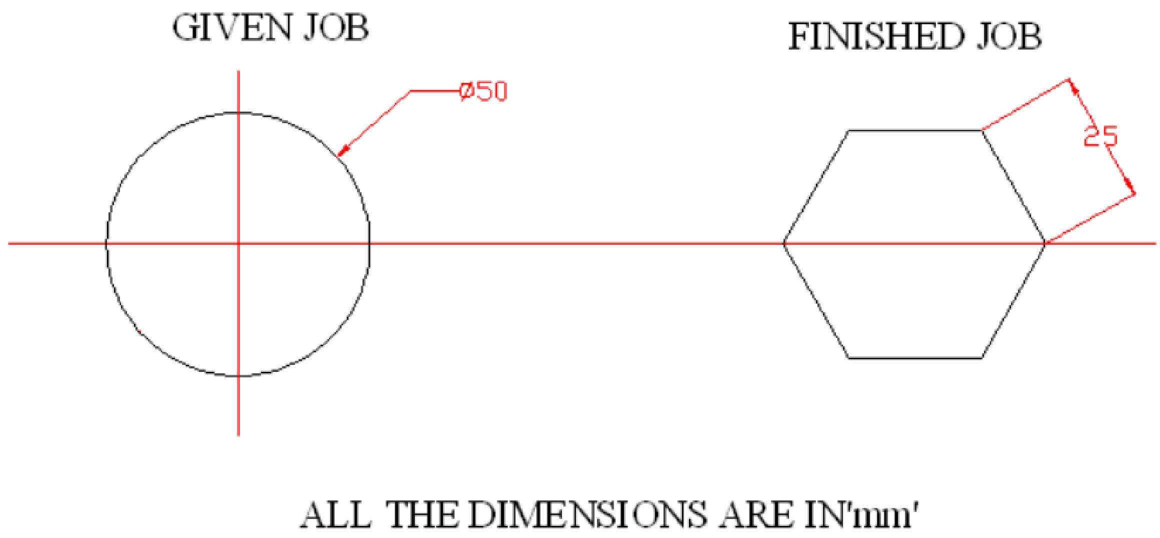
Ans: The abrasives are produces by grind mills. The size of grains produced by this process is called grain size.

9. Name different types of grinding wheels.

1. Built-up wheels
2. Cone and plug shape wheels
3. Mounted wheels
4. Diamond wheels

10. Define dressing of grinding wheels.

Ans: Dressing may be defined as the operation of sharpening dull abrasive grains or exposing fresh sharp grains on the face by cutting a portion of the wheel.



Materials Supplied: Mild steel:

Tool Material: High Speed Steel (H.S.S)

Ex. No: **Date :**

HEXAGONAL BLOCK

Aim:

To machine a hexagon in the given work piece to the dimensions as shown in the figure using Milling Machine

Tools Required:

Milling Machine,

Scriber, Divider,

Steel Rule,

Chalk piece,

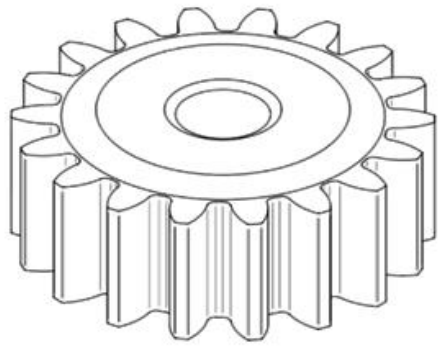
Bevel Protractor.

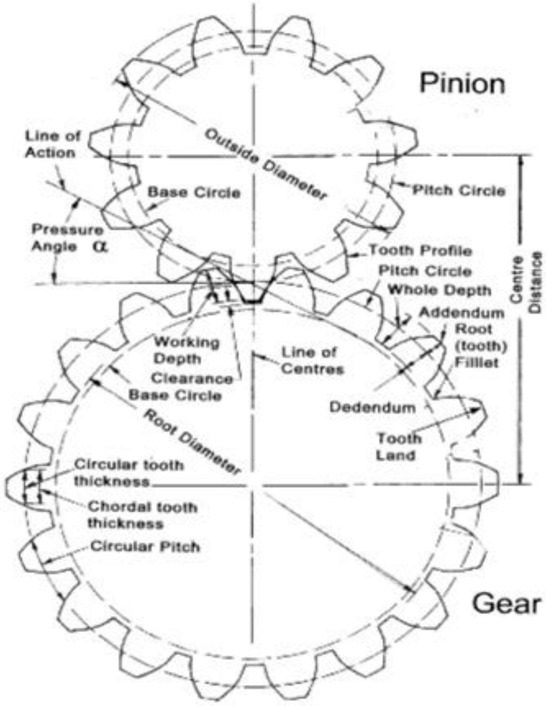
Procedure:

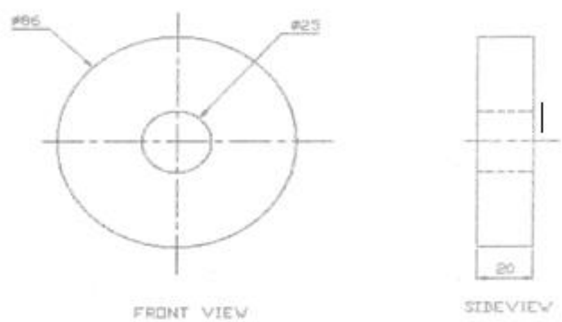
1. The given work piece is measured for its initial dimensions.
2. With the help of scriber, mark the hexagon dimensions in the work piece.
3. Fix the work piece in the vice of the Milling machine.
4. After fixing the work piece and the stool, allow the ram to reciprocate.
5. Start the shaping process by giving the required depth by lowering the tool.
6. Slowly increase the depth of cut and repeat the procedure to make the hexagon shape.
7. The work piece is now checked for final dimensions.

Result:

Thus, a hexagon is machined in the given work piece to the dimensions as shown in the figure using Milling Machine.




Pinion
Line of Action
Outside Diameter
Base Circle
Pitch Circle
Pressure Angle α
Tooth Profile
Pitch Circle
Whole Depth
Addendum
Root (tooth) Fillet
Centre Distance
Working Depth
Clearance
Line of Centres
Base Circle
Dedendum
Root Diameter
Tooth Land
Circular tooth thickness
Chordal tooth thickness
Circular Pitch
Gear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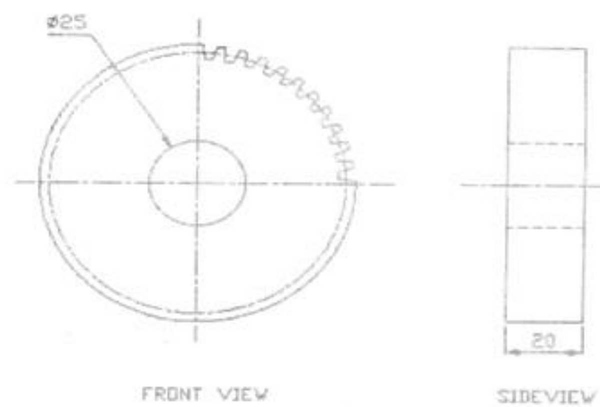
FRONT VIEW
SIDEVIEW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FRONT VIEW
SIDEVIEW

Ex. No: **Date :**

SPUR GEAR CUTTING

AIM

To make spur gear on plane milling operation on the given specimen (mild steel)

MATERIALS REQUIRED

Mild steel specimen.

Vernier calipers

Plane (face) milling cutter

Steel rule, scriber

Work holding fixtures: work piece supporting fixtures

PROCEDURE

Calculate the gear tooth proportions.

Blank diameter = (Z + 2) m

Tooth depth = 2.25 m

Tooth width = 1.5708 m

Z = Number of teeth required

m = module Indexing calculation

Index crank movement = 40 /Z

1. The dividing head and the tail stock are bolted on the machine table.
2. Their axis must be set parallel to the machine table.
3. The gear blank is held between the dividing head and tailstock using a mandrel. The mandrel is connected with the spindle of dividing head by a carrier and catch plate.
4. The cutter is mounted on the arbor. The cutter is centered accurately with the gear blank.
5. Set the speed and feed for machining.
6. For giving depth of cut, the table is raised till the periphery of the gear blank just touches the cutter.

1. The micrometer dial of vertical feed screw is set to zero in this position.
2. Then the table is raised further to give the required depth of cut.
3. The machine is started and feed is given to the table to cut the first groove of the blank.
4. After the cut, the table is brought back to the starting position.
5. Then the gear blank is indexed for the next tooth space.
6. This is continued till all the gear teeth are cut.

Calculation:

Z = No. of teeth = 23

m = module = 2 mm

Blank Diameter = (Z + 2) m

= (23 + 2) 2 = 50 mm

Tooth Depth = 2.25 m

= 2.25 * 2 = 4.5 mm

Indexing Calculation = 40 / Z = 40 / 23 = 1 17/23

RESULT:

The given work piece as is subjected to gear generating operation to become a finished work piece

VIVA QUESTIONS

1. What is gear hobbing?

The process of generating a gear by means of rotating a cutter called HOB is known as HOBBING.

2. Mention the applications of gear shaping process?

Gear shaping used for generating both internal & external spur gears. 2. Helical gears can also be generated using special attachments.

3. What are the limitations of gear hobbing?

Internal gears cannot be generated. 2. Hobbing process cannot be applied very near to shoulders.

4. What are the advantages of gear planning process?

Any given model can be cut using a single cutter. 2. It is a simple flexible &accurate method of generating gears

5. List the various gear finishing processes?

1. Gear shaving. 2. Gear burnishing. 3. Gear grinding. 4. Gear lapping.

6. Mention the advantages &limitations of gear shaving process?

Advantage: The process can be used for both internal & external gears.

7. What are the other forming methods for manufacturing gears?

1. Gear cutting by single point form tool.
2. Gear cutting by shear speed shaping process.
3. Gear broaching.
4. Template method.
5. Gear milling using a formed end mill.

. *8.* What are the other forming methods for manufacturing gears?

- Gear cutting by single point form tool.
- Gear cutting by shear speed shaping process.
- Gear broaching.
- Template method.

9. Mention the applications of gear shaping process?

1. Gear shaping used for generating both internal & external spur gears.
2. Helical gears can also be generated using special attachments.

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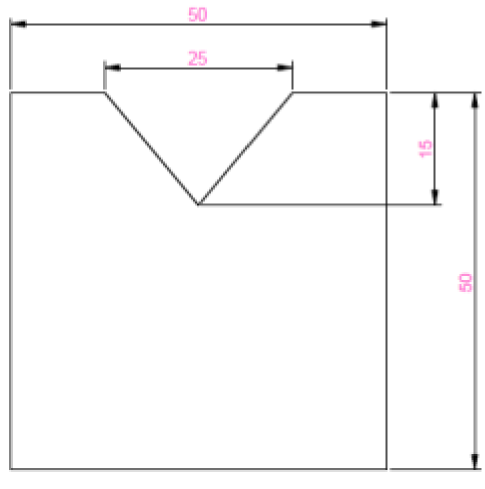
- Gear burnishing.
- Gear grinding.
- Gear lapping.

SHAPING INCLINED SURFACE –SHAPING MACHINE



All Dimension are in MM

Ex. No: **Date:**

SHAPING INCLINED SURFACE –SHAPING MACHINE

AIM: To make an Angular surface by using a shaping machine.

MATERIALS REQUIRED

Cast iron blank of Φ 50 x Φ 50

TOOLS REQUIRED

1. Machine handle
2. Vice handle
3. Round nose tool
4. Vernier caliper
5. Vernier height gauge
6. Tri-square
7. Surface plate
8. Hammer and punch.

PROCEDURE:

1. Check the machine is in proper condition.
2. Check the work piece given in suitable size.
3. Select and set the correct stroke length, speed and feed.
4. The job is marked and punched. The punched job is set over the vice.
5. Hold the work piece in the vice and fix the tool in tool holder in correct position and start the machine.
6. Remove the material as per the size.
7. Remove the job and also remove the burrs with the help of files.

RESULT: Thus the shaping of angular surface operation is performed on the given work piece as per the dimension.

VIVA QUESTIONS

1. What is shaper?

   The machine, which is having a reciprocating type of machine tool with a single point cutting tool, used to produce flat surfaces called as Shapers.

2. List any four important parts of a Shaper?

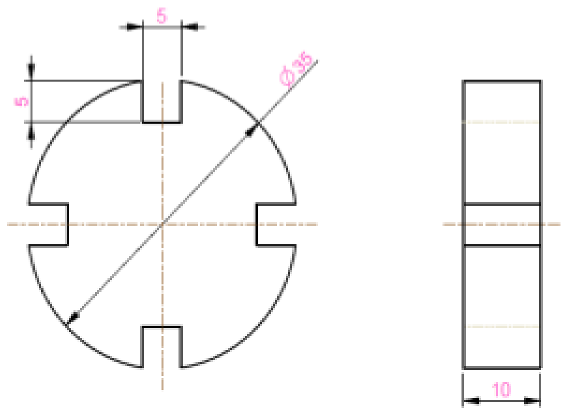
   Table, Tool head, Ram, Cross rail

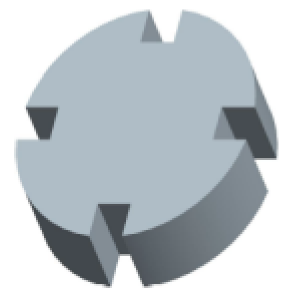
3. How the feed & depth of cut is given to the shaper?

   Feed is given by rotating the down feed screws of tool head depth of cut is given by rotating by raising or elevating the table

4. Mention any four-shaper specification?
   1. Maximum length of stroke
   2. Type of driving mechanism
   3. Power of the motor
   4. Speed &feed available
5. How the planer differs from the shaper?

   In planner-the work reciprocate while the tool is stationary In shaper-the tool reciprocate while the work is stationary





All Dimension Are in MM

Ex. No: **Date :**

EXTERNAL KEYWAY USING MILLING MACHINE

AIM: To cut a External keyway on the given specimen as per the dimensions using Milling machine.

MATERIALS REQUIRED

Cast iron blank of Φ 50mm x 10mm.

TOOLS REQUIRED

1. Steel rule
2. Vernier caliper (0-150mm)
3. T bolt strap
4. Spanner
5. punch

PROCEDURE:

1. First the given work piece is fitted on chuck and it is turned along the diameter to the required dimension are marked.

2. Then the facing operation is done on both the sides of the work piece.

3. Then the work piece is fixed in the Milling machine.

4. Indexing was done on the Milling machine.

5. By adjusting the feed hand wheel the key way are cut outer diameter of the work piece.

6. Then the same procedures are repeated for next key way.

RESULT: Thus the key way is made on the work piece by slotting machine.

VIVA QUESTIONS

1. Write any ten nomenclature of plain milling cutter?

Body of cutter, cutting edge, face, fillet, gash, lead, land, outside dia, root dia, cutter angles.

2. What are the advantages of milling process?

1. It does not require a backlash eliminator.

2. Mild surface does not have built up edge.

3 .what are the down milling processes?

1. Cutter with higher rake angle can be used. This reduces power requirements.

2. Cutter wear is less because chip thickness is maximum at the start of cut.

4. List out the various milling operations?

1. Plain or slab milling. 2. Face milling. 3. Angular milling. 4. Gang milling. 5. End milling. 6. Gear cutting.

5. What does term indexing mean?

Indexing is the process of dividing the periphery of a job into equal number of divisions.

6. What are the three types dividing heads?

1. Plain or simple. 2. Universal. 3. Optical.

7. What are the different types of thread milling?

1. Thread milling by single form cutter. 2. Thread milling by multi form cutter.

8. What is the function of cutting fluids?

1. It is used to cool the cutting tool & the work piece.
2. It improves the surface finish as stated earlier.
3. It causes the chips to break up into small parts.
4. It protects the finish surface from corrosion.
5. It prevents the corrosion of work & machine.

9. What are the properties of cutting fluid?

a. High heat absorbing capacities.
b. It should have good lubricant properties.
c. High flash point.

d. It should be odourless.
e. It should be non-corrosive to work & tool.

10. State any two comparisons between plain &universal milling machine?

- In plain milling machine the table is provided with three movements, longitudinal, cross & vertical. In universal milling machine in addition to these three movements, there is a forth movement to the table. The table can be swiveled horizontally & can be fed at angles to the milling machine spindle.
- The universal milling machine is provided with auxiliaries such as dividing head, vertical milling attachment, rotary table etc. Hence it is possible to make spiral, bevel gears, twist drills, reamers etc on universal milling machine.

11. What are the other forming methods for manufacturing gears?

1. Gear cutting by single point form tool.
2. Gear cutting by shear speed shaping process.
3. Gear broaching.
4. Template method.
5. Gear milling using a formed end mill.

12. List the various type of milling attachment?

1. Vertical milling
2. Universal milling
3. High speed milling
4. Rotary
5. Slotting
6. Rack milling