## [SHAPER]

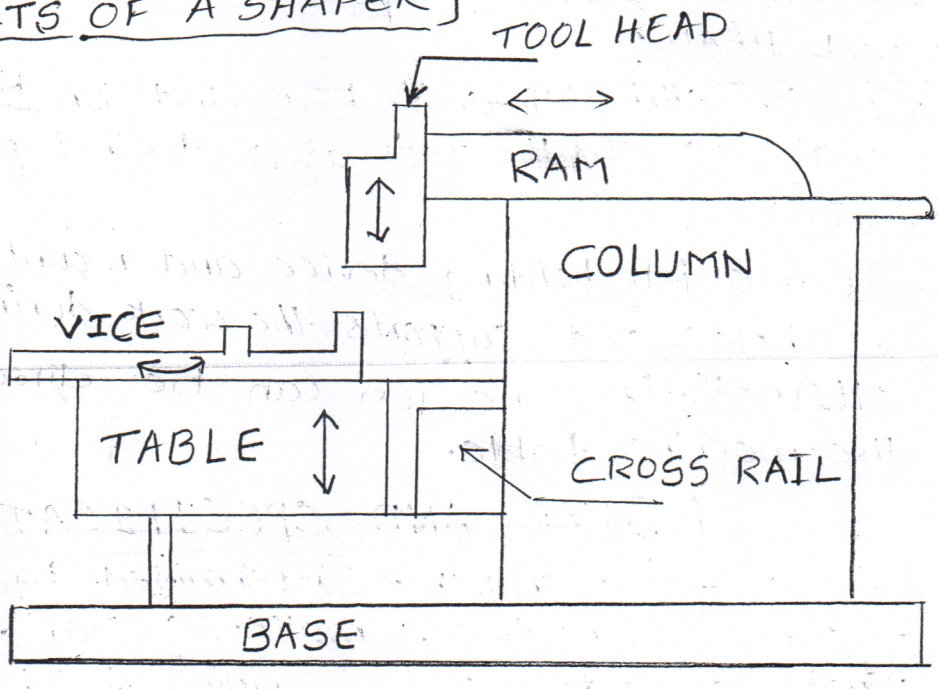
"Shaper is versatile machine which is primarily intended for producing flat surface. The surfaces may be horizontal vertical or inclined. This machine involves the use of single point tool held in a properly designed Tool box mounted on a reciprocating ram. The main significance of this machine lies in its greater flexibility on account of ease in work holding, quick adjustment and use of Tools of relatively simple design."

## [WORKING PRINCIPLE OF A SHAPER]

→ The job is rigidly held in a suitable device like a vice (or) clamped directly on the machine table.
→ The Tool is held in the Tool post mounted on the ram of the machine.
→ This ram reciprocates to and fro and, in doing so makes The Tool to cut the material in the forward stroke.
→ NO cutting of material takes place during the return stroke of idel stroke.
→ However, in case of a draw-cut Shaper, the cutting takes place in the return stroke and the forword stroke in an idel stroke.
→ The job is given an indexed feed (equel amount after each cut) in direction normal to the line of action of the cutting Tool.

## [PRINCIPAL PARTS OF A SHAPER]

1. Base
2. Column
3. Cross-rail
4. Table
5. Ram
6. Tool head
7. Vice




main parts of a Shaper

1. BASE :-
→ It is a heavy and robust cast iron body which acts as a support for all the other parts.

2. COLUMN :-
→ It is a box type cast iron body, mounted on the base and acts as a housing for the operating mechanism of the machine and the electricals.
→ On its top it carries machined ways, in which the ram Reciprocates, and vertical guideways at its front.

3. CROSS-RAIL
→ It is a heavy cast iron construction, attached to the column at its front on the vertical guideways. It carry two mechanism ; one for elevating the table and the other for Cross Traverse of the table.

4. TABLE :-
→ It holds and supports the work during the operation and slides along the Cross-rail to provide feed to the work.
→ T-slots are provided on its top and sides for securing the work to it.

5. RAM :-
→ semi-circular shape and provided with a ribbed Construction inside for rigidity and strength. It carries the tool head and Travel in dovetail guideways. to provide a straight line motion to the Tool. It Carries the mechanism for adjustment of ram position inside it.

6. TOOL HEAD :-
→ It can slide up and down and can be swung to a desired angle to set the Tool at a desired position for the operation

7. VICE :-
→ It is a job holding device and mounted on the Table It holds and supports the work during the operation Alternatively, The job can be directly clamped to the machine table.

## [SIZE AND SPECIFICATIONS]

→ The size of a shaper is determined by the maximum length of cut or stroke it can make. a standard shaper is usually capable of holding and machining a cube of the same dimensions as the length of stroke.

→ Given below are the complete specifications of a 300mm stroke Shaper.

→ This list indicates all the other details to be given to specify a shaper fully.

| | | |
|---|---|---|
| 1. length of stroke | :- | 350 mm. |
| 2. max. Horizontal Travel of Table | :- | 350 mm. |
| 3. max. vertical Travel of Table | :- | 365 mm. |
| 4. max. distance from Table to ram | :- | 12mm. |
| 5. max. vertical Travel of Tool slide | :- | 117 mm. |
| 6. Length and width of Table Top | :- | 300 x 250 mm. |
| 7. Length and depth of Table Side | :- | 241 x 317 mm. |
| 8. power of motor 2/2 HP. or | :- | 1.5/1.5 KW. |
| 9. NO. of ram cycles per min | :- | 6. |
| 10. Range of Ram Cycles per min | :- | 21 to 110. |
| 11. Tool box Takes Tool of size | :- | 16 x 22 mm. |
| 12. max. vice operating | :- | 152 mm. |
| 13. Approximate net weight | :- | 560 kg. |
| 14. Approximate gross weight | :- | 700 kg. |
| 15. floor space. | :- | 1350 x 790 mm. |

## [CLASSIFICATIONS OF SHAPERS]

Shapers are classifed in many ways i.e according to the length of stroke type of driving mechanisum. Diection of Travel of the ram, the type of work they do, the type of design of table, etc. The main. classification is as follow

1. Standard Shaper :-

This table may or may not have the vertical supports at its front. In some machines there is a provision for the table to swivel around a horizental axis parallel to the ram. It is also known as ~~plain~~ Plain Shaper.

2. Draw-cut Shaper :-

It differs from the standard shaper in that the metal cutting operation takes place during the return stroke of the ram, i.e moving towards the Coloumn. It heavy construction enables application of heavier cuts with less vibrations. This also prevents deflection of Tool.

3. Horizental shaper :-
Shaper in which the ram and hence the tool, reciprocate in a horizental plane. This type of shaper is normally used to machine flat surface.

4. Universal Shaper :-
→ It is also horizontal type of shaper, but it table can be swung about a horizental axis parallel to the ram way. Also the top of this table can be tilted about another horizontal axis which is normal to former axis.
→ If a swivel vice is fitted to this table the work can be rotated about three posible axis.

5. Vertical Shaper :-
→ This shaper has its ram reciprocates in a vertical direction. The Table is of Circular rotary type. In appearance and operation it resemble a slotting machine.
→ The ram of a vertical shaper, in addition to its vertical movement, can to be adjusted from it vertical position to about 10° on either side of the vertical, thus enabling machine of an inclined surface also.
→ The ram of a slotting machine always moves in a vertical direction only.

6. Geared Shaper :-
This type of shaper carries a rack under its ram which is driven by a spur gear (pinion). Such a driving mechanisum has, however, become obsolete so far as the modern practice is concerned.

7. Crank shaper :-
Those shapers which carry a crank and slotted link mechanisum for their ram movement fall under this category. A large number of shapers use this mechanisum these days.

8. Hydraullic shaper :-
In these shapers hydrallic pressure is used for driving the ram. The hydraulic drive has lately become very popular, and is also more efficient than both of the above two because it enables constant speed and from the start to the end of the cut.

9) Contour Shaper :-
It is nothing but a standard shaper fitted with an additional tracer mechanisum. In this a template and a follower are used to reproduce the contours of the template. This facillitates maching of those shapes which would have been impossible on any other type of shapers.

10. Travelling head shaper :-
It is a specially designed shaper for machining such heavy and large workpieces which cannot be easily held on the table. Such jobs are loaded on the base of the floor and then machined. In these machines. the ram is so designed that, in addition to reciprocation for machining. it also gets a cross movement to provide the necessary feed.

## [QUICK RETURN MECHANISUMS]

→ The cut in the forward stroke only and the return stroke is idle. The time spent in this stroke is obviously, a waste similarly, in a draw cut shaper the forward stroke is idle and the time Taken by this stroke is also wasted. However fast this idle stroke is made it will definitely Take some Time and it is not possible.

→ TO Reduce it to the Zero value. As such our endeavour it to use some such mechanisum that will Reduce this idle time to a minimum. Such mechanisum is known as a Quick Return mechanisum

The Two common mechanisum used for this purpose are
1. Crank and slotted link mechanisum
2. Hydraulic mechanisum.

### Crank And Slotted Link Mechanism

→ It consists of a slotted link, called rocker ram, pivoted at its bottom end which forms the fulcrum, At its upper end it carries another Short link which is attached.

→ The Slide Block can freely slide in the slot provided in the rocker Arm. At the Back of the Rocker Arm a large cast steel gear. called bull gear.

→ which is mounted on a pin attached to the frame of the machine. A slotted disc, carrying a T-slot is secured to the bull gear at it's front

→ The bull gear pinion is mounted on the power shaft and it actuated by the speed control mechanisum. This pinion drives the bull gear which rotating, on account of the eccentricity between it's centres and that of the crank pin, makes the roker arm swing about the fulcrum. This, in turn moves the ram to and fro.

## [WORKING PRINCIPLE OF THE CRANK AND SLOTTED ARM MECHANISUM]

→ $AP_2$ Represents the rocker arm in its extreme forward position and, $AP_1$ its extreme rear position.

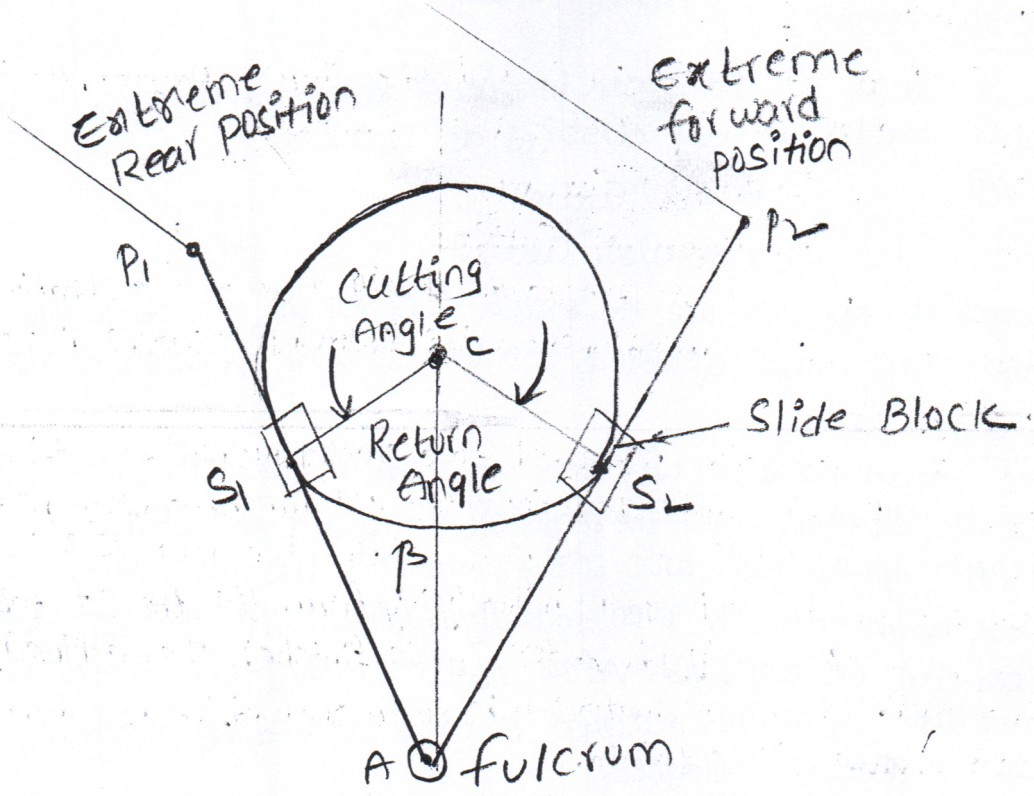
→ The Bull gear is considered rotating in a clockwise direction about it's centre 'C'.

→ As the Bull gear rotates the crank pin also rotates along with it, causing the slide Block also to rotate about C and simultaneously slide along the slot in the rocker arm $S_1$ and $S_2$ are the positions of this block corresponding to the extreme rear and forward positions. of the rocker arm respectively.

→ The distance between the centre of Rotation

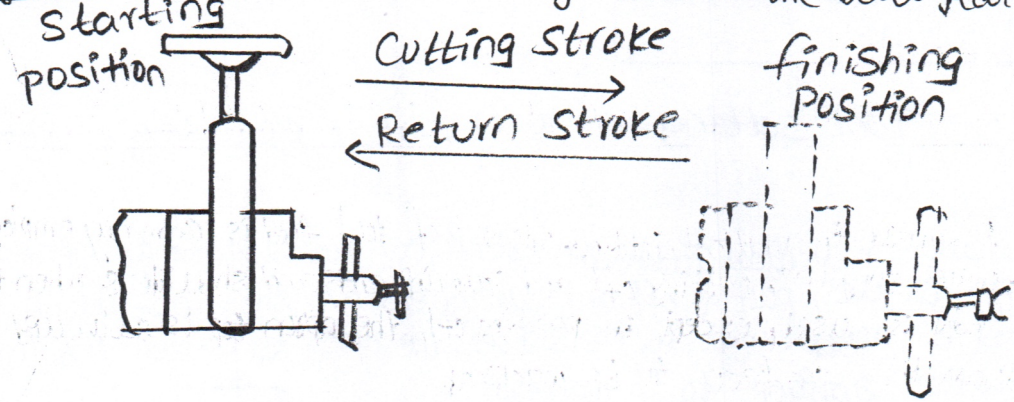
→ Now let us consider, which represents the same mechanism in a simpler form. The dotted circle represents the path of crank pin centre. since the bull gear, and so the crank pin, revolves at a Constant speed the time taken during the two strokes will be directly proportional to the corresponding angles $\alpha$ and $\beta$. Note that angle $\beta$ is smaller of the two and that is why the time taken during the return stroke is less than that spent in the forward stroke.

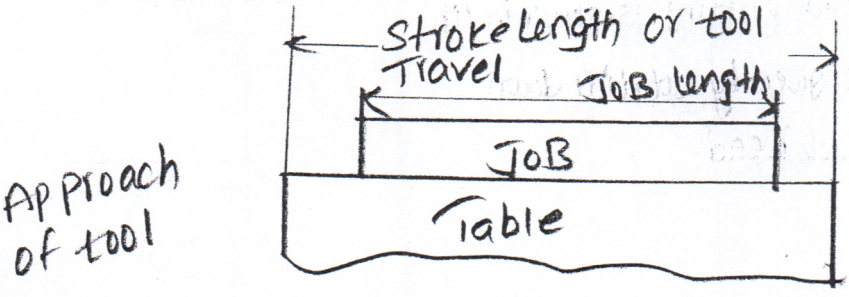
→ The ratio b/w These two angles, and hence b/w the corresponding timings, is approximately 3:2 Exact values of these angles are, however, 220° and 140° respectively.




ADJUSTING THE LENGTH OF STROKE AND RAM POSITION:

As described above, what we are required to do for varying the stroke length, is to provide a corresponding variation in the distance b/w the bull gear centre and the centre of the crank pin. Since the bull gear centre is fixed, this variation is provided by moving the slide block, and hence the crank pin, away or towards the bull gear centre, depending upon wheather the stroke length is required to be increased or ~~decreased~~ reduced. This is done by rotating the bevel gear $B_2$ by turning the spindle



## SHAPING OPERATIONS:

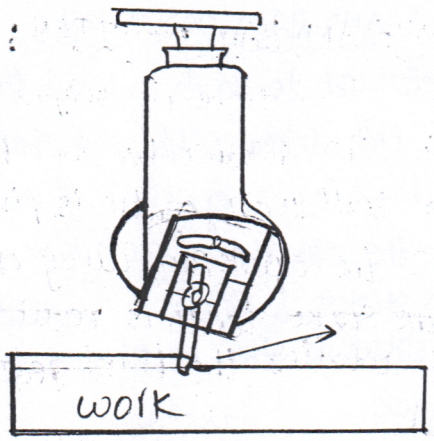
Several different shapes of Jobs can be produced on shapers. However, the basic operation done on a shaper can be broadly classifed as follows:

1. Horizontal Cutting
2. vertical Cutting
3. Angular Cutting
4. Irregular Cutting

The various shapes of surfaces are the results of either one or a combination of more than one of the above four operations. In the following operations discuss details.

### 1. Horizontal Cutting:

It is the most common operation performed on a shaping machine. In this, the work is fed in a horizontal direction under the reciprocating tool and the surface produced is horizontal and flat. parallels are used for clamping the work, if it is held in the vice. Cross feed to the table is given initially by hand, till the cut starts. After that power feed can be employed. After cut is finished, The machine is stopped and the work inspected. If more material is to be removed, the procedure is repeated till the desired surface is obtained.



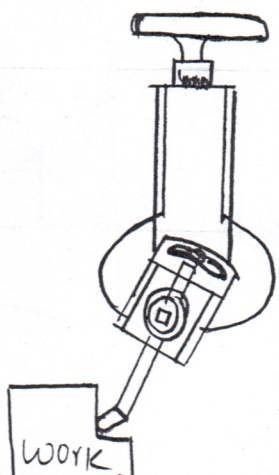

Tool setting in horizontal cutting

### 2. VERTICAL CUTTING:

→ The tool is fed downward in vertical cutting. This sort of tool feed is commonly employed in cutting grooves, key-ways, tongues, parting off and squaring ends and shoulders. when the down feed of the tool is used, except in parting off, the apron top is swivelled in a direction away from the surface to be machined.

→ A proper tool setting for vertical cutting is shown in fig.

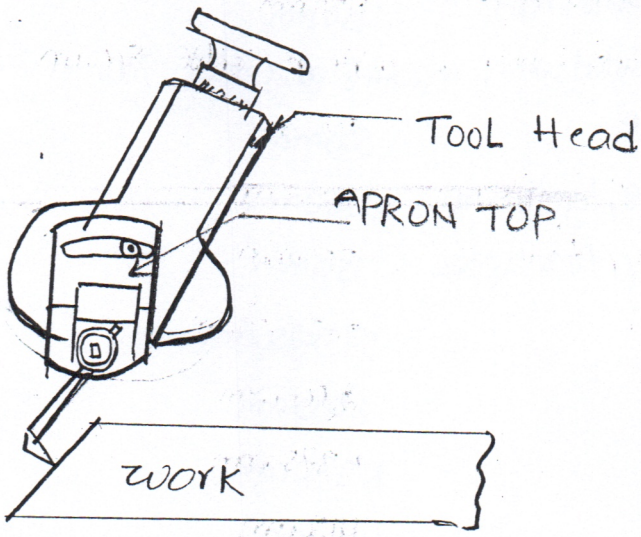
→ The down feed to the tool is given by rotating down feed screw of the tool head.




Tool setting for vertical cutting

3. Angular Cutting:

The operation of angular cutting is employed for machining inclined surfaces, bevelled surfaces and dovetails etc. Here again an important factor here also. The apron top is swivelled in a direction away from the surface to be machined as in vertical cutting.




In addition to that, the toolhead is also swivelled, as shown in above fig. Alternatively, sometimes an inclined surface is obtained by setting the job in inclined position by setting it on tapered parallels or by other suitable means.

4. IRREGULAR Cutting:

If an irregular surface is to be machined and it is approximately narrow a form tool can easily be used for machining the same. Against this, if a wide irregular surface is to be machined the shape is marked on the side of the job. The usual and preferable procedure for such machining is to first rough surface machine the surface about 1.5mm above the marked shape. Then bevel the edges at about 45° or more by means of a file and machine off the bevelled portion. Thus the job is machined right up to the marked shape.

## THE SLOTTING MACHINE:

A slotting machine or slotter has its own importance for a few particular classes of work. It's other uses are in machining, irregular shapes, circular surfaces and other premarked profiles, both internal as well as external. Its ram moves vertically and the tool cuts during the downward stroke only.

### SIZE AND SPECIFICATIONS:

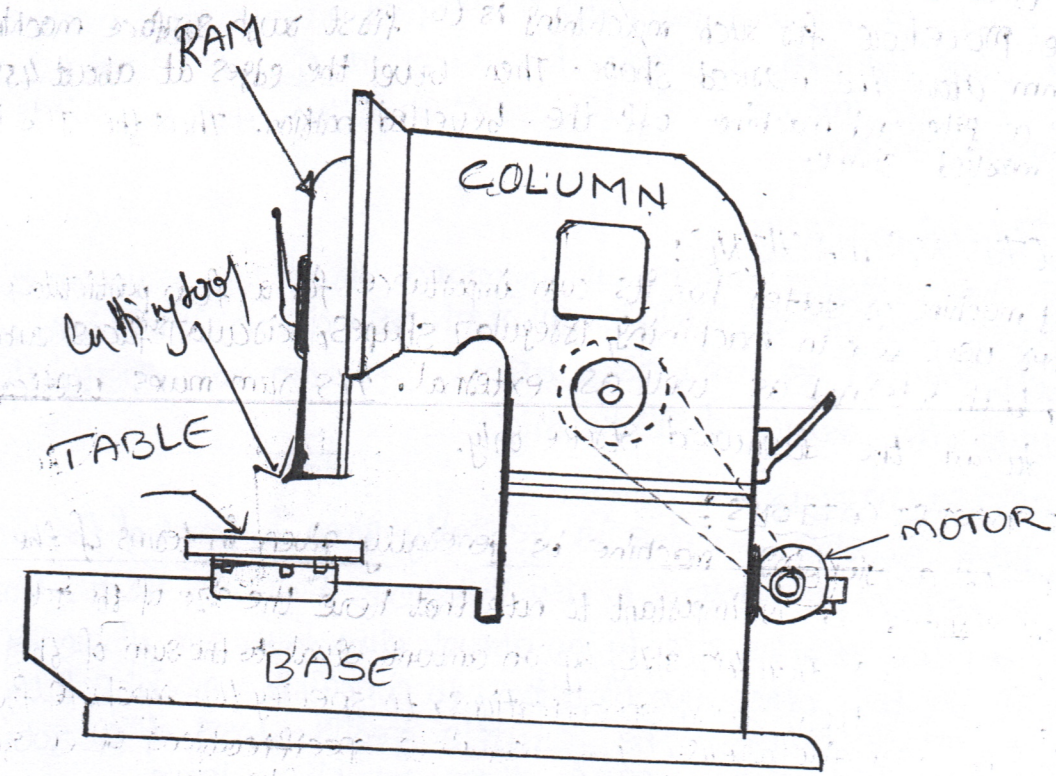
The size of a slotting machine is generally given in terms of the maximum length of length of stroke. It is important to note that here the size of the job that can be machined will be less than this size by an amount equal to the sum of the top and bottom clearances of the tool. other specifications, to specify the machine fully, are also given by the manufacturers. The complete specifications of a 300mm stroke slotter, given below, will make these details clear.

## Specifications:

| | |
|---|---|
| 1. Stroke maximum | 300mm |
| 2. stroke minimum | 0 mm |
| 3. Height b/w table and head | 450 mm |
| 4. max. dia accommodated when maching at centre | 900mm |
| 5. Diameter of table | 500mm |
| 6. Traverse of table, longitudinal | 450mm |
| 7. Traverse of table, transverse | 350mm |
| 8. face of head | 575x350mm |
| 9. Height overall | 2,000 mm |
| 10. Length of bed | 1,375 mm |
| 11. width of bed | 412 mm |
| 12. Height of bed | 575mm |
| 13. Height of head | 1275mm |
| 14. Belt size | 75mm |
| 15. H.P Required | 2 HP |

## main parts of a slotter:

The main parts of a slotting machine are shown by means of a block diagram, The parts illustrated as fallows.




Main parts of the slotter

1. Base :- It is a heavy cast iron construction and is also known as bed. It acts as support for the column, The driving mechanism ram, table and all other fittings. As its top it carries horizontal ways, along which the table can be traversed.

2. column :- It is another heavy cast iron body which acts as housing for the complete driving mechanism. As its front it carries vertical ways, along which the ram moves up and down.

3. Table :- usually a circular table is provided on slotting machines. In some heavy duty slotters, such as a puncher slotter, either a rectangular or circular table can be mounted on the top of the table are provided T-slots to clamp the work or facilitate the use of fixtures etc.

4. Ram :- It moves in a vertical direction b/w the vertical guideways provided in front of the column. At its bottom, it carries the tool post in which the tool is held. The cutting action takes place during the downward movement of ram.

TYPES of DRIVES :-

mainly three types of driving mechanisms are used in slotting machines for driving the ram.

1. slotted disc mechanism
2. slotted link and gear mechanism and
3. Hydraulic mechanism

1. The slotted disc mechanism :-

→ It is the simplest of all the methods commonly used for driving the ram of a slotting machine. The driving mechanism consists of a pinion, a gear, a slotted disc & crank. Its distance from the centre of the disc can be adjusted as desired.

The main driving pulley generally situated at the rear side of the machine, is driven by motor through belts. The crank and connecting rod mechanism converts the circular motion of the disc into reciprocating motion of the ram.

2. Slotted link and Gear mechanism :-

This another common method of drive used in slotting machines, particularly in the heavier types. The mechanism consists of two driving wheels provided with a trunnion each. These trunnions work inside the bushed bearings provided on the sides of the machine. Both the wheels carry an eccentric each. Three bolts are provided by means of which the eccentrics can be made loose or fast with the driving wheels Other end of the link is attached to the ram by means of a connecting rod. The ram carries a shackle at its top to carry one end of the counter-weight arm. The other end of the arm carries the counter weight and the same is pivoted about a point in its length somewhere on the top of the frame of the machine. The mechanism works such that as the eccentrics revolve the die slides inside the slot of the link, and in doing so, it makes the links swing about the fulcrum, provided by the crank pin.

Hydraulic mechanism: The hydraulic drive used in slotters is the same as described earlier in this chapter for shapers. of course, that axis of the cylinder in this case will be in a vertical direction. Both const. pressure and volume type drives are prevelant.

## Types of slotting machines:

Slotting machines are mainly of the following theree types.

1. puncher slotters
2. production slotters
3. Tool room slotters

**puncher slotters:** puncher slotter are heavy duty machines. Usually such as jobs are machined on these machines which are comparatively heavier and have been previously brought roughly to the required shape through other operations like sawing, forging or stamping etc. The slotting machine is then used to cut off the surplus metal and finish the work to the required shape and size. According to the nature of the work, either a square or circular table can be fitted on the machine.

**2. production slotters:**

This is common category of slotters, vastly used for general production

1. Base
2. Lower parts of frame
3. upper part of frame
4. Table
5. Ram
6. Hand lever for stroke adjustment.
7. Ram lock
8. Connecting rod
9. slotted disc
10. motor
11. Driving belts
12. longitudinal slot in ram
13. Crank pin
14. fly wheel.
15. pulley
16. pulley
17. Lever for feed reverse
18. Enclosed clutch
19. Table transverse hand wheel
20. Table cross traverse hand wheel.
21. Tool post.

It consists of a heavy cast base and a heavy frame, made usually in two parts. The upper part may be of stationary type or tilting type. In tilting type of frames a worm and worm wheel are provided at the rear side to enable the said tilting of the frame.

The drive of the ram is accomplised by means of the slotted disc and Connecting rod, as explained earlier in Art 10.40. The flywheel is fitted to prevent shock at the end of the stroke. The ram carries V-slides with hardened and ground faces. Two loose strips, fitted vertically in front of the frame, form the guideways for the ram.

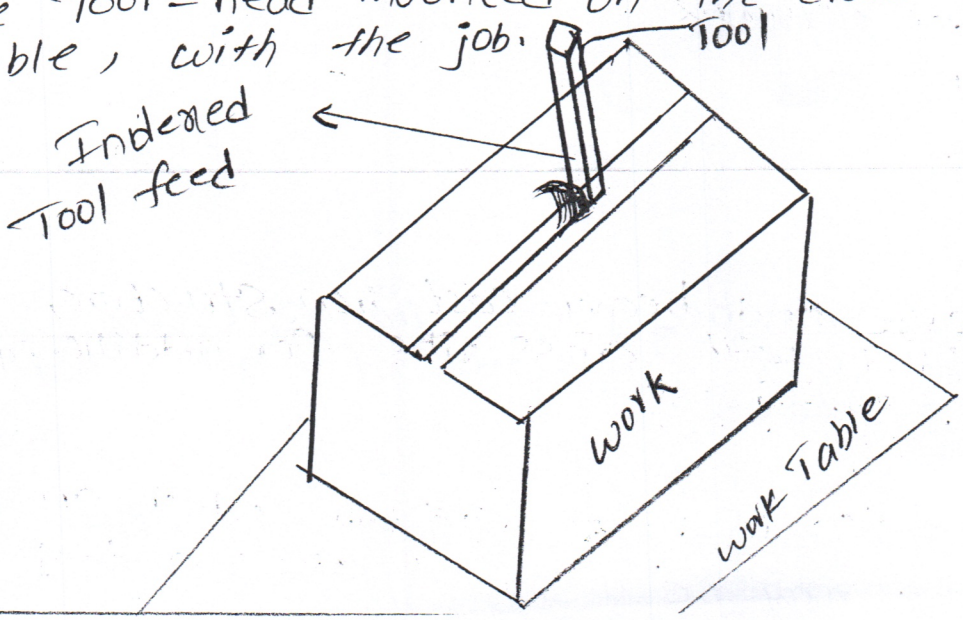
## [Planing machines]

Planing is one of the basic operations performed in machining work and is primarily intended for maching large flat surfaces. These surfaces may be horizontal, vertical (or) inclined. The function of planing machine is quite similar to that of a shaper except that the former is basically designed to undertake maching of such large and heavy jobs which are almost impracticable to be machined on a shaper or milling machine. etc.

However, a planing machine differs from a shaper in that for machining the work, loaded on the table receprocates past the stationary tool in a planer, whereas in a shaper the tool reciprocates past the stationary work.

## [Working principle of A planer]

The principle involved in machining a job on a planer illustrated in, it is almost a reverse case to that of a shaper. The work is rigidly held on the work table or platen of the machine. The tool is held vertically in the tool-head mounted on the cross-rail. The work table, with the job.



is made to reciprocate past the vertically held tool The indexed feed, after each cut, is given to the tool during the idle stroke of the table.

## [machine size And Specifications]

Planers are made in different sizes and they are specified by the following main dimensions.

1. Horizontal distance between the two vertical housings
2. vertical distance between the table top and the cross-rail, when the latter is in its topmost position
3. maximum length of table travel or length of stroke

It is the maximum size of the job that can be mainted on a particular planer. Normally the first two dimensions of the above three, are same for the planer whereas the third one may very according to require-ment. Also, for the same for the same reason, usually one of the first two dimenssions is mentionsed. That automatically implies that the other one is the same.

1. length of bed
2. length of table
3. method of driving -- common (or) individual
4. method of driving table - geared (or) hydralic
5. H.P (or kw) of motor.
6. Number of additional tool heads required.

## [main parts of the planer]

A planer consists of the following main parts as illustrated by means of a block diagram.

1. Bed
2. Table or platen
3. Housings or Columns
4. Cross-rail
5. Toolheads
6. Controls.

1. Bed :-

It is very large and heavy cast iron structure, which is provided with cross ribs for additional strength and stiffness.

2. Table :-

The Table is also made of cast Iron which an accurately top. It may be a single piece casting

→ It carries a box type construction, provided with strengthening ribs under it in order to make it stronge enough to support the heavy work over it.

[3. Housings or columns]

They are also sometimes called columns or uprights. These vertical members are situated on both sides in case of a double housing of planer. they carry the different mechanisums for transmission of power to the upper parts of the machine, cross-rail elevating screws, vertical feed shafts and cross feed bar.

[4. Cross-rail]

→ It is a horizontal member of heavy structure which connects the two vertical housing of the machine. It provides additional rigidity to the machine. By means of the elevating screws it can be moved up and down along the ways provided on the housing.

[5. Toolheads]

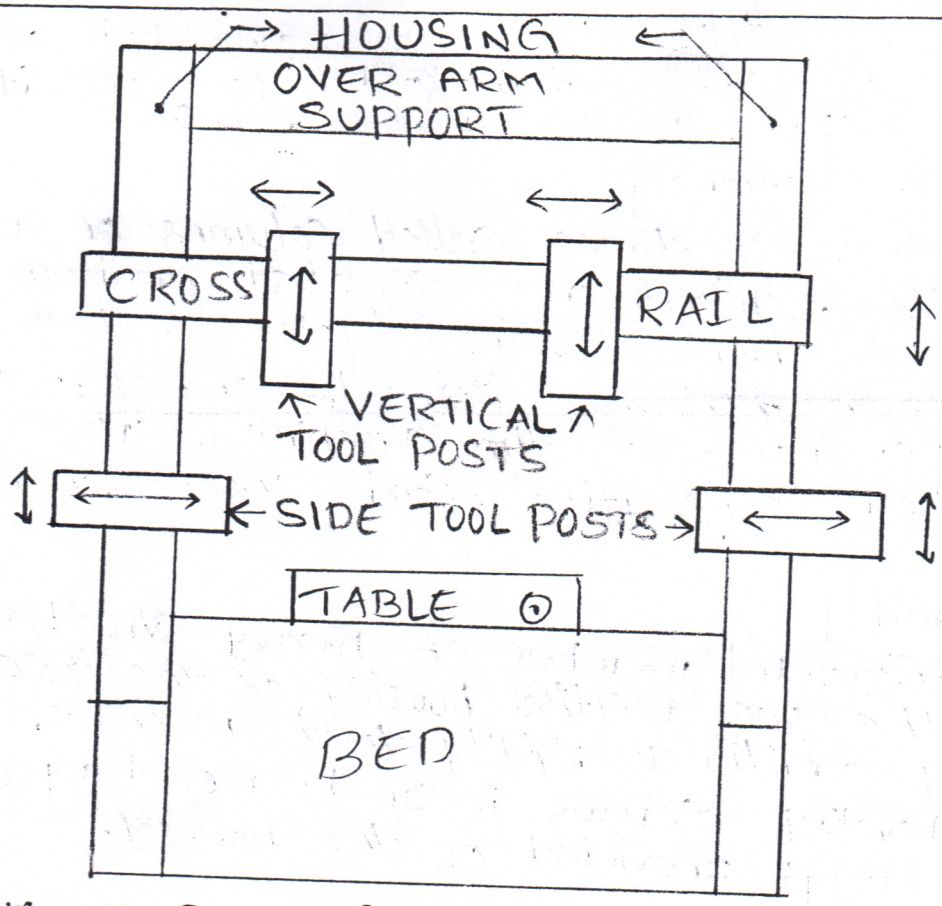
The planer toolheads both in construction as well as operation, resemble very much with the shaper toolheads At the most four toolheads can be fitted in a planer and or all of them can be used at a time.

[6. Controls]

operating and stopping the various machines, automatic cutting off speed and feed regulation and similar other functions are usavally provided with a quick approach of the operator of the machine.

[Types of planers]

1. Standard (or) double housing planer.
2. openside planer
3. planer miller
4. plate planer
5. pit planer
6. Divided table planer, and
7. plano.- Guillotine Shearing machine.




[Operations Done ON planer]

A planer performs the same operations as performed by a shaper, with the main difference that the workpieces handled on a planer are larger and heavier than those machined on a shaper. and also the surfaces machined on a planer are much larger and wider than those produced on a shaper.

1. machining horizontal flat surfaces.
2. machining vertical flat surfaces.
3. machining angular surfaces including dovetails.
4. machining different types of slots and grooves.
5. machining curved surfaces
6. machining along premarked contours