10.36. THE SLOTTING MACHINE

A **slotting machine** or **slotter** has its own importance for a few particular classes of work. Its main use is in cutting different types of slots and it certainly proves to be most economical so far as this kind of work is concerned. Its other uses are in machining irregular shapes, circular surfaces and other premarked profiles, both internal as well as external. As described earlier, its construction is similar to that of a vertical shaper. Its ram moves vertically and the tool cuts during the downward stroke only.

10.37. SIZE AND SPECIFICATIONS

The size of a *slotting machine* is generally given in terms of the maximum length of stroke. It is important to note here that 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 300 mm stroke slotter, given below, will make these details clear.

Specifications

1. Stroke maximum	300 mm
2. Stroke minimum	0 mm
3. Height between table and head	450 mm
4. Max. dia accommodated when machining at centre	900 mm
5. Diameter of table	500 mm
6. Traverse of table, longitudinal	450 mm
7. Traverse of table, transverse	350 mm
8. Face of head	575 × 250 mm
9. Height overall	2,000 mm

10. Length of bed	1,375 mm
11. Width of bed	412 mm
12. Height of bed	575 mm
13. Height of head	1275 mm
14. Belt size	75 mm
15. H.P. Required	2 H.P.

10.38. MAIN PARTS OF A SLOTTER

The *main parts* of a *slotting machine* are shown by means of a block diagram, in Fig. 10.37. The parts illustrated are as follows :

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. At 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 a housing for the complete driving mechanism. At its front it carries vertical ways, along which the ram moves up and down.

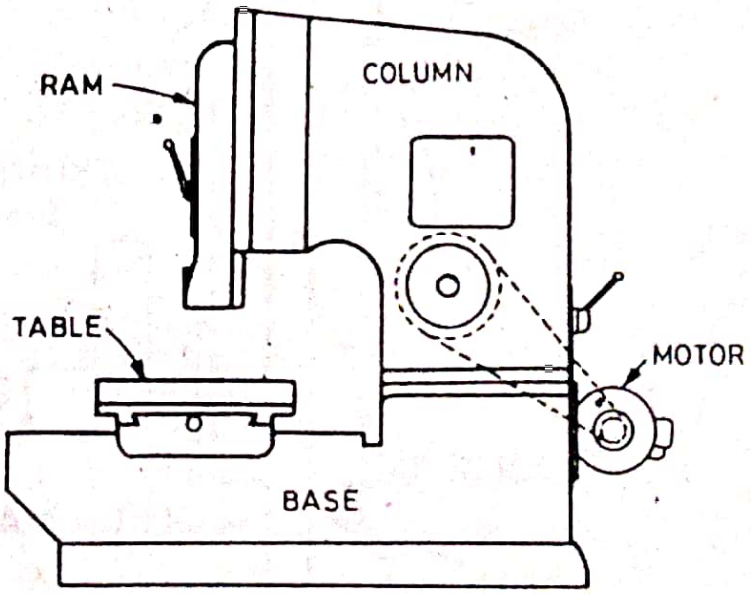

Fig. 10.37. Main parts of a slotter.

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 between 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 the ram.

11 Planing Machines

11.1. INTRODUCTION

Planing is one of the basic operations performed in machining work and is primarily intended for machining large flat surfaces. These surfaces may be horizontal, vertical or inclined. In this way, the function of a planing machine is quite similar to that of a shaper except that the former is basically designed to undertake machining of such large and heavy jobs which are almost impracticable to be machined on a shaper or milling machine, etc. It is an established fact that the planing machine proves to be most economical so far as the machining of large flat surfaces is concerned. However, a planing machine differs from a shaper in that for machining, the work, loaded on the table, reciprocates past the stationary tool in a planer, whereas in a shaper the tool reciprocates past the stationary work.

11.2. WORKING PRINCIPLE OF A PLANER

The *principle* involved in machining a job on a planer is illustrated in Fig. 11.1. Here, 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, together with the job,

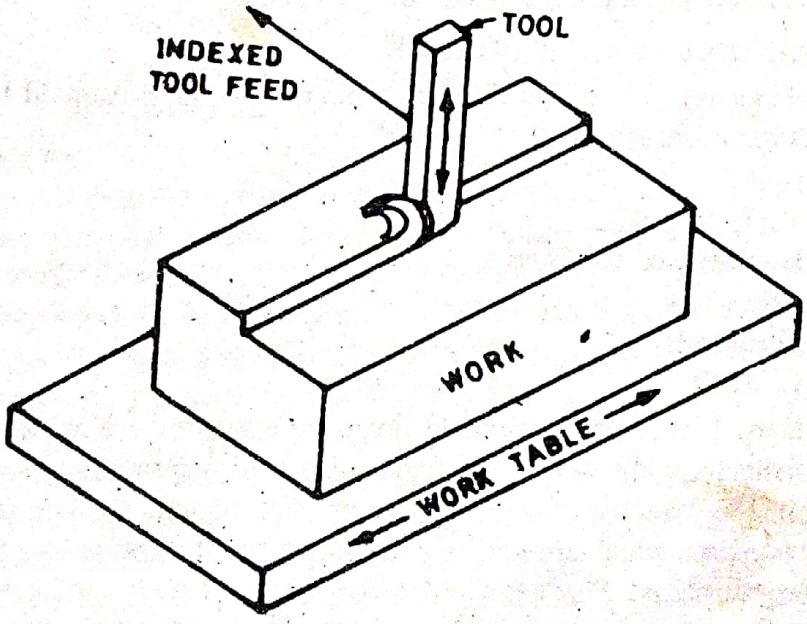

Fig. 11.1. The working principle of a planer.

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.

11.3. 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.*

The above three dimensions give the measure of the maximum size of the job that can be machined on a particular planer. Normally the first two dimemsions, of the above three, are same for the planer whereas the third one may vary according to requirement. Also, for the same reason, usually one of the first two dimensions is mentionsed. That automatically implies that the other one is the same. For example, a 120 mm planer means the one of which the distance between housings and that between table and cross-rail are both 120 mm. The above three are the principal dimensions, but while ordering for a planer a number of other particulars are also required to be given, in addition to these, in order to specify the planer fully. These particulars are the following :

1. Length of bed.
2. Length of table.
3. Method of driving—common or individual.
4. Method of driving table—geared or hydraulic, etc.
5. H.P. (or kW) of motor.
6. Number of additional tool heads required.

11.4. MAIN PARTS OF A PLANER

A planer consists of the following main parts, as illustrated by means of a block diagram in Fig. 11.2 :

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

1. Bed. It is a very large and heavy cast iron structure, which is provided with cross ribs for additional strength and stiffness, as the same supports the whole structure of the machine over it. In case of large planers the bed is sometimes made in two parts, which are properly machined and then bolted together to form a single length of bed. Devices like *levelling jacks* or *pads*, etc., are provided at its bottom for the purpose of levelling during installation. It is about two times longer than the table it carries over it. At its top, it carries either V-ways, or flat

ways (only in case of large planers), to support and guide the table. All small and medium size planer beds carry two V-ways, one on each side. Beds of large planers may, however, carry more number of ways of which some may be flat, as indicated above. All the ways are straight, parallel, accurately machined and scraped. These ways should be constantly lubricated and in view of the same all modern planers are provided with *pressure lubrication* at several points along the ways.

2. Table. The *table* or *platen* (as it is frequently called) is also made of cast iron with an accurately machined top. It may be a single piece casting or made in two pieces, bolted together in the same way as the two piece bed. It carries a box type construction, provided with strengthening ribs under it in order to make it strong enough to support the heavy work over it. At its top it carries longitudinal *T-slots* and *holes* to accommodate the clamping bolts and other devices. The work is directly mounted and clamped on the table by means of various devices using the T-slots and holes. Under the table, *chip pockets* are cast integral with it for collecting and removing the chips. On its side, the table carries adjustable stops to reverse its motion at the end of each stroke. At its both ends, it carries a *trough* to collect the *chips*. Occasionally, however, these troughs may be used to support overhanging parts of large components.

A special feature in planer tables is the provision of a suitable *safety device* to prevent the heavily loaded reciprocating table from running out in case of an electrical or mechanical failure. A common safety decice is a large cutting tool bolted under the table on its both sides and fixing of stop blocks on the bed on each side. In case of running away of the table, the tool will take a deep cut into the stop block and thus absorb the whole kinetic energy of the table, bringing it to a halt without damage to the machine or workman. Another alternative is the hydraulic device involving the use of hydraulic bumpers.

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 planer and on one side only in case of an open side planer. Inside them, they carry the different mechanisms for transmission of power to the upper parts of the machine, from the main drive *viz.*, cross-rail elevating screws, vertical feed shaft and cross feed bar, etc. At their front, they are very accurately machined to form vertical ways along which the cross rail slides up and down. Where side tool-heads are used, they also slide vertically along the same guideways.

4. Cross-rail. It is a horizontal member of heavy structure which connects the two vertical housings 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 housings. *Clamps* are provided to lock the *cross-rail* in any desired position along the columns. These clamps may be operated by hand or power. Also a suitable *levelling device* is incorporated to ensure that the cross-rail is perfectly horizontal before clamping. In order that the cross-rail is moved

up or down uniformly on both ends, both the elevating screws are rotated simultaneously by a horizontal shaft, mounted on the top of the machine, through a set of bevel gears. This shaft carries two bevel gears, one at each end, and they mesh with the corresponding bevel gears on the top of the elevating screws.

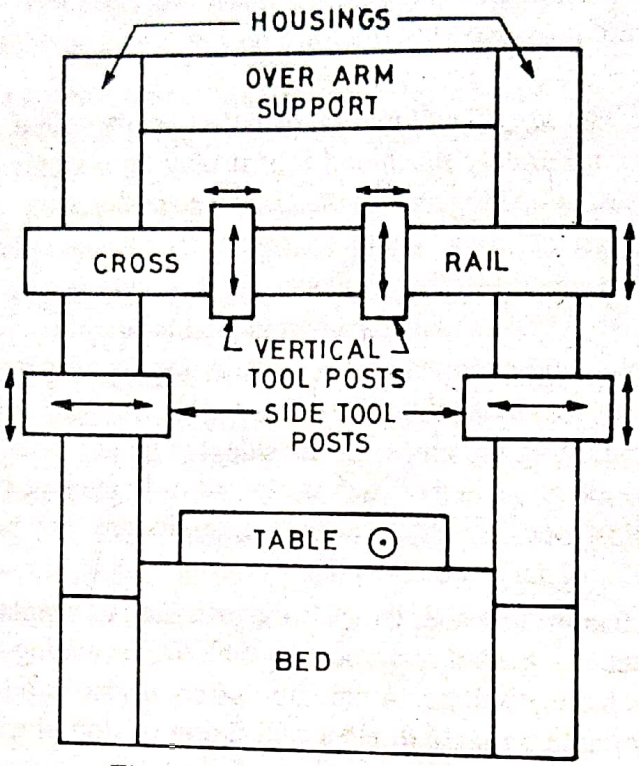

Fig. 11.2. Main parts of a planer.

Accurately finished ways are provided at the front of the cross-rail for the two vertical toolheads. Inside the rail are provided the feed rods for vertical power feed and cross feed to the tools. The rail is made sufficiently long, to project on both sides of the housings, so that one of the two tool heads can be pushed out to one end. This will enable the other toolhead to travel freely cross-wise from one end of the table to the other, covering the entire width of the job.

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 any or all of them can be used at a time. Two toolheads can be fitted in vertical position on the cross-rail and the other two on the vertical columns. Each column carries one side toolhead.

The method of mounting is similar for all the toolheads. First, the *saddles* are mounted on the horizontal ways of the cross-rail (for vertical toolheads) and vertical ways of the columns (for side toolheads). These saddles further carry machined way at their front, on which the toolheads are mounted. All the four toolheads work independently, such that they can operate separately or simultaneously, as desired.

The toolheads on the cross-rail can travel horizontally, along the rail. They

can also be raised or lowered by moving the cross-rail up or down. Also, the tools can be fed downwards by rotating the down feed screw. Similarly, the side toolheads can move up and down along the vertical column ways. Also their tools can be fed horizontally into the job or at a desired inclination. A swivel plate is incorporated between the slide and the saddle. This enables the toolhead to swivel through an angle of 70° on either side from its normal position. Exactly in the same way as in a shaper head, the apron of the planer head can also be set at an inclination whenever needed. Both hand and power feeds can be employed, for all the toolheads, but power feeds are commonly used. The clapper block is also hinged, as in shaper head, in order to avoid scratching of machined surface by the tool during the idle stroke.

6. Controls. Various controls for starting, operating and stopping the various mechanisms, automatic cutting off speed and feed regulation and similar other functions are usually provided within a quick approach of the operator of the machine. A good number of these are usually provided on a suspended pendant so that the operator can take them to any convenient position according to his needs.

11.24. 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. The common operations performed on a planer include the following :

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.

11.25. COMPARISON BETWEEN A PLANER AND A SHAPER

As stated above, the *planer* and *shaper* both have a common purpose, *i.e.*, to produce flat surfaces—horizontal, vertical and inclined. They, however, have a number of common as well as different features. Their similarities and dissimilarities are summarised in Table 11.2 below.

Table 11.2. Similarities and dissimilarities between planer and shaper

Sl. No.	*Planer*	*Shaper*
1.	It is a heavier, more rigid and costlier machine.	It is a comparatively lighter and cheaper machine.
2.	It requires more floor area.	It requires less floor area.
3.	It is used for machining large flat surfaces—horizontal, vertical and inclined.	It is also used for the same purposes but for relatively smaller surfaces.
4.	The work is usually clamped directly on the machine table by means of suitable fixtures or clamping devices.	The work may be clamped directly on the table or held in a vice or chuck.
5.	Cutting takes place by reciprocating the work under the tool.	Cutting takes place by moving the cutting tool over the job.
6.	Indexed feed is given to the tool during the idle stroke of the work table.	Indexed feed is given to the work during the idle stroke of the ram.
7.	Heavier cuts and coarse feeds can be employed.	Very heavy cuts and coarse feeds cannot be employed.
8.	Several tools can be mounted and employed simultaneously, usually four as a maximum, facilitating a faster rate of production.	Usually only one tool is used on a shaper.
9.	Because of its larger stroke length and table size a number of jobs, requiring machining of identical shapes, can be held in series and machined simultaneously in a single setting.	This is not possible on shaper until and unless the job and surface sizes are too small, which can be conveniently held on the table, say in a vice.
10.	The tools used on a planer are larger, heavier and stronger than those used on a shaper.	The tools used on a shaper are smaller and lighter.

11.26. SUGGESTED BIS CODES FOR FURTHER REFERENCE

IS : 8842 – 1978
IS : 2974(1) – 1982
IS : 2877 – 1986
IS : 11958(1) – 1987
IS : 1983 – 1985

TEST QUESTIONS

1. What is a planer ? Illustrate and describe its working principle.
2. How is a planer specified ? Explain.
3. Draw a block diagram of a standard double housing planer, showing its main parts, and briefly describe these parts.
4. How do you classify planers ?
5. What is an open side planer ? Describe its construction and use.