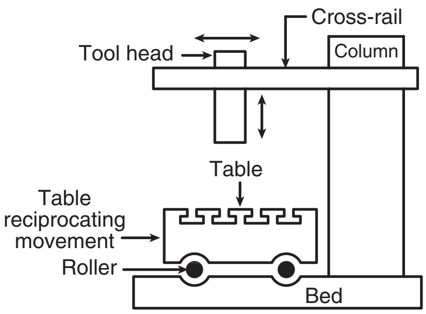
8

PLANING MACHINE

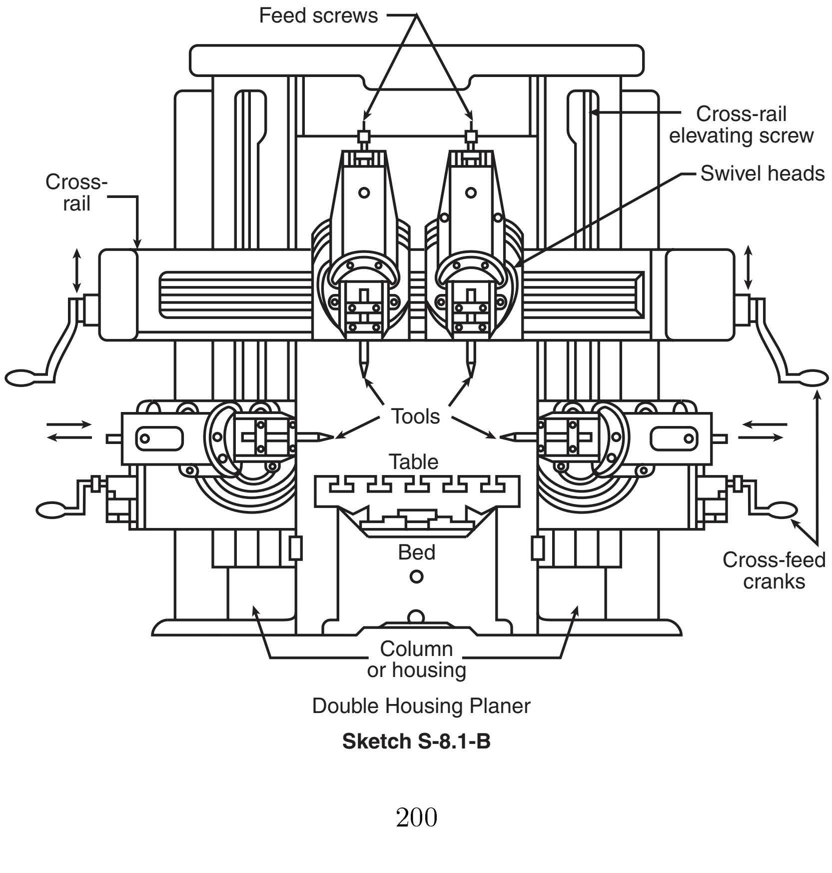
A8.1 : Planing Machine



Open Side Planer
Sketch S-8.1-A

Introduction

This is also a reciprocating type of machine like shaper. The table with T-slots for mounting workpiece, slides in the guideways of the machine bed past the stationary tool head. The tool head holding the tool, machines during the forward (or cutting) stroke of the worktable; during the cutting stroke the tool remains stationary. The tool horizontal feed is given during return (or backward) stroke of the worktable.



Double Housing Planer
Sketch S-8.1-B

[7] Divided Table Planer

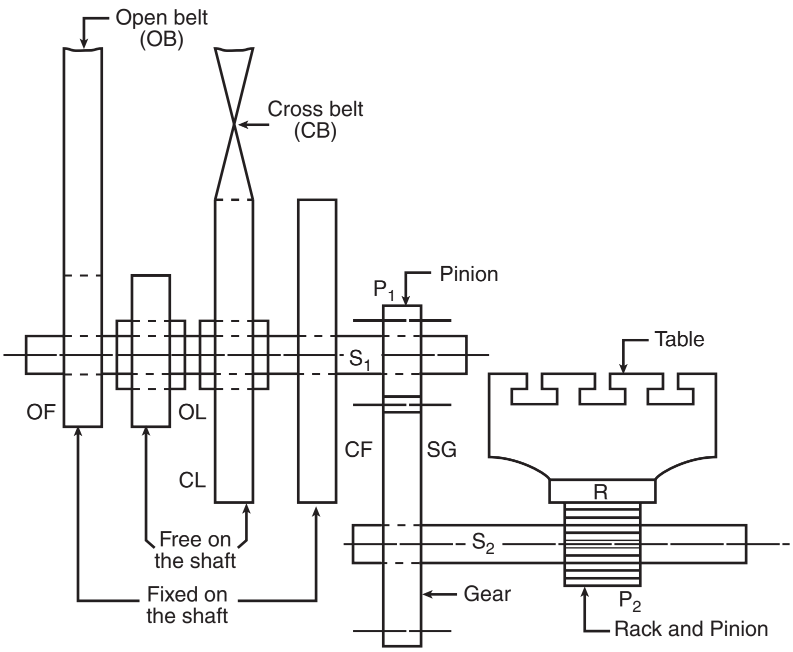
In this type of planer, the table on the bed is divided into two parts, it may be reciprocated separately or together. This type is mostly suitable for continuous production and thus reduces the machining time by saving the idle time. One of the table is used for setting up large number of identical workpieces while the other one reciprocates against the stationary cutting tool machining the workpieces. Both the tables may clamp together for holding large and heavy workpiece, and can also reciprocate together under the tool.

A8.5 : Table Drive Mechanism

The table reciprocates in the guideways on the machine bed. The mechanism used to drive the table is mainly by gear drive and the reversible mechanism is adopted by any of the following ways:

(a) By having an open and cross belt drive in which the belts are alternately used as drivers, (b) By having a reversible type of D.C. motor drive, (c) By means of a crank as employed on shapers, (d) By reversing the flow of oil from a hydraulic pump.

A8.5.1 : Quick Return Mechanism of a Planer to Drive the Table by Open and Cross Belting



Sketch S-8.5.1

In open and cross belt drive, the belts are alternatively used as drivers to reciprocate the table. The cross belt with a greater arc of contact on the larger pulley is used to drive the table on the cutting stroke or forward stroke. Greater power and less speed is essential during the cutting stroke and is being achieved by connecting the cross belt with larger diameter pulley CF, which is fixed on the shaft S_1. The power from the shaft S_1 transmits to the shaft S_2 through pinion P_1 and spur gear SG. Power again from the shaft S_2

4. Setting of proper tools (as mentioned above) in proper operational sequences. T-slot Planing tool may have to be set either to the left side or right side according to the recess operations, to the left or to the right side respectively

5. After arranging the above, the machine is started with the following steps:

   (a) By switching on the planing machine, the table holding the job reciprocates, the tool holder holding square nose planing tool feeds vertically for machining key-slot operation. Both roughing and finishing operations are done with proper cutting conditions.

   (b) Stopping the machine, changing the tool to T-slot planing tool feeds crosswise directions for T-slot operations (both left side and right side recesses) with roughing and finishing cuts are done with proper cutting conditions. Suitable spring is provided to raise the tool box automatically after each cutting stroke.

6. Measuring and checking the workpiece are necessary with proper inspecting tool(s).

A8.9 : Distinction Among Shaping, Planing And Slotting Machines

The reciprocating type Machine Tools (like shaping, planing and slotting) are primarily used to produce flat surfaces but they differ in job-tool motion, construction, work size, machining time, accuracy, use, etc.

Points	**Shaping Machine**	**Planing Machine**	**Slotting Machine**
1. Job-Tool motion	Tool reciprocates in horizontal axis and Job feeds in intermittent translatory motion	Job reciprocates in horizontal axis and Tool feeds in intermittent translatory motion	Tool reciprocates in vertical axis and Job feeds in intermittent translatory motion
2. Construction and rigidity.	Lighter in construction and less rigid	Heavier in construction and more rigid	Lighter in construction and less rigid but more rigid than vertical shaper
3. Motor Power required	Power is very less; round about 15 kW	Power is very high as compared to the shaping and slotting machines; about 5 to 10 times the shaper	Same as shaper

Contd...

Points	Shaping Machine	Planing Machine	Slotting Machine
4. Job size and fixing time	Smaller jobs can be fixed quickly and simply in a vice Job size: 900 mm cube (max.)	Bigger jobs require fixtures for fixing and hence more fixing time and skillness are required. Max. Job size: 3 m ×3 m ×18.25 m	Same as shaper
5. Number of surfaces that can be machined at a time	Only one surface at a time	Three surfaces can be machined at a time	Same as shaper
6. Machining time and type of job suitability	More time required as one tool works at a time; suitable for jobbing work and few no. of pieces	Less time required as a number of tools can work at a time; suitable for production type of work	Same as shaping machine
7. Number of tools that can be operated at a time	Only one tool can be operated at a time	Three or more tools can be operated at a time	Same as shaper
8. Tool size	Standard tool size is not so robust as used in Planing Machine	Robust tool size is required for machining bigger jobs with higher depth of cut, feed and to take up the impact forces	Same as shaper
9. Range and number of speeds and feeds	Smaller range and smaller number of speeds and feeds	Wide range and more number of speeds and feeds available	Same as shaper
10. Amount of feed and depth of cut	Heavier depth of cut and course feed is not employed	Heavier depth of cut and course feed can be employed	Same as shaper
11. Cutting return ratio	Fixed in a particular machine	Ratio can be changed independently	Same as shaper
12. Arrangement of quick return mechanism	Generally being adopted	Not generally being adopted but quick return is possible by using variable gearing arrangement	Same as shaping machine

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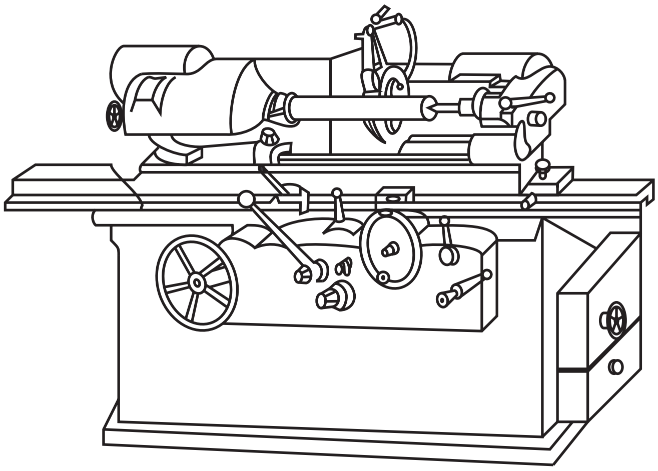
GRINDING MACHINES

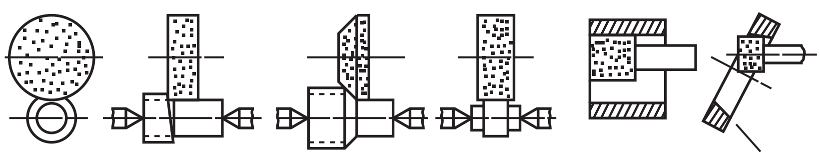
A9.01 : Introduction



(A) Cylindrical Grinding Machine

Sketch S-9.01 (A)

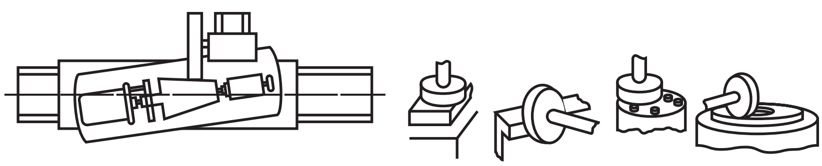
Grinding is a process of removing materials in the form of ground chips from a workpiece by mechanical action of many small abrasive particles bonded together in a grinding wheel. Each abrasive particle is acting as a small cutting tool. It is a finishing process employed for producing close dimensional accuracies and smooth surface finish.



(B) External Cylindrical Surface Grinding

(C) Internal Cylindrical Surface Grinding

Sketch S-9.01 (B, C)

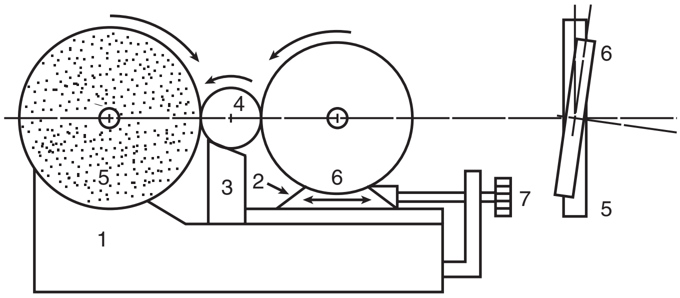


(D) Taper Grinding

(E) Flat Surface Grinding

Sketch S-9.01 (D & E)

the workpiece. The regulating wheel is having same direction of rotation as the grinding wheel. The axial movement of the workpiece is obtained a longitudinal feed, by tilting the regulating wheel at a slight angle of 1 to 8 degrees relative to grinding wheel.



1. Grinding head 2. Regulating wheel head 3. Work rest
4. Workpiece 5. Grinding wheel 6. Regulating wheel 7. End stop

Sketch S-9.09.3

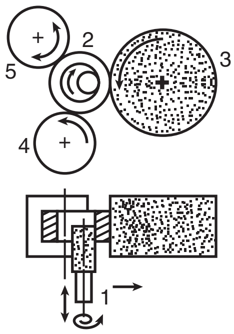
Rate of longitudinal feed of the work, $f = \dfrac{\pi D_R N_R \sin\alpha}{1000} = V_R \sin\alpha$ m/min.

where, feed, f in mm/min
peripheral speed of regulating wheel, V_R in m/min.
diameter of regulating wheel, D_R in mm
revolution of regulating wheel, N_R in r.p.m.
angle of inclination of Regulating wheel, α in degrees
speed of rotation of the workpiece, $V_w = V_R \cos\alpha$ m/min.

Peripheral speed of the grinding wheel (30 to 50 m/s) is 70 to 80 times that of the peripheral speed of the regulating wheel (10 to 50 m/min.). Thus the speed of rotation of the work is a function of the regulating wheel.

After completion of grinding, the regulating wheel is backed out, and the work is replaced by a new one.

A9.09.4 : Finishing an Internal Surface by Centreless Grinder



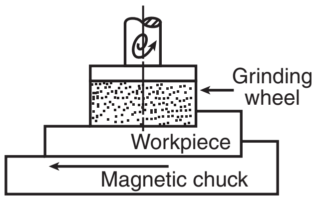
1 = Grinding wheel
2 = Workpiece
3 = Driving wheel
4 = Roller rest
5 = Pressure roller

Sketch S-9.09.4

In centreless internal surface grinding, three rollers are used to support and drive the work. They are (i) driving rollers 3, (ii) work-rest roller 4 and (iii) pressure roller 5. Automatic loading and unloading can be arranged by swinging the pressure roller out of the way at the end of the cycle. This system can eliminate the use of work-holding fixtures and can grind both straight and tapered holes.

Workpiece 2 is rotated by the driving wheel 3. The grinding wheel 1 rotates at a specified speed and effects the longitudinal feed 3 and cross-feed motion 4. The workpiece rests on work rest roller 4 in a predetermined position but the pressure roller 5 is oscillated in a manner to provide a fluctuating

[c] *Grinding by Vertical Spindle on Reciprocating Table*

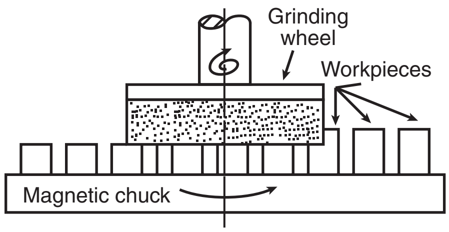


Sketch S-9.09.5 (c)

In vertical spindle surface grinding machine with reciprocating table arrangement, the workpiece, mounted on magnetic chuck or on fixture, reciprocates under the rotating grinding wheel, in its vertical axis. Vertical and cross-wise adjustment for the grinding wheel is incorporated in wheel head assembly. This type is specially adopted for grinding large surfaces.

[d] *Grinding by Vertical Spindle on Rotary Table*

In vertical spindle surface grinding machine with rotary table arrangement, the workpiece, mounted on magnetic chuck or on fixture, rotates with the rotating grinding wheel, in its vertical axis. The combination motion of the table (i.e., rotation as well as lateral movement) helps to grind the entire surface of the workpiece. Down feed is given by the wheel. This type is suitable to grind either a single large workpiece or a number of small pieces in one or more circles on the table.



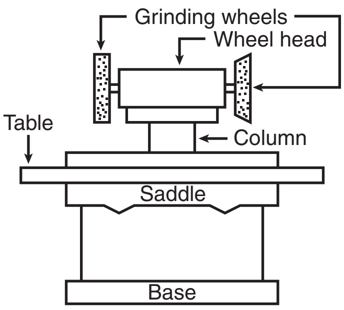
Sketch S-9.09.5 (d)

A9.09.6 : Disc Grinder

These grinders remove the stock rapidly and finish the flat surfaces by the sides of disc wheels. Single horizontal or vertical spindle disc grinders are used for repetitive work by hand operation or with simple fixture. The double horizontal spindle is mostly used for production operations.

A9.09.7 : Tool and Cutter Grinder

As the name implies, this type is mostly used to sharpen and reconditioning various types of cutters like single-point tools, milling cutters, drills, taps, hobs, etc. By using requisite attachment or fixture, this machine can also be used for grinding die, jig, fixture, light surface, cylindrical, internal surface, etc. A bench or pedestal type tool grinder is used for grinding tools by hand (known as off-hand grinding).

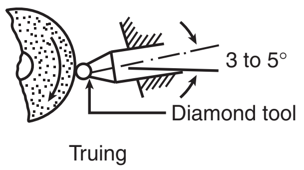
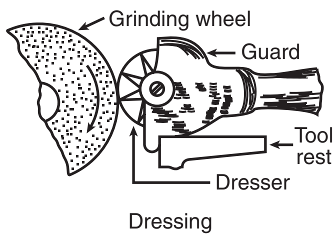


Sketch S-9.09.7

Universal-type grinder is equipped with a universal head, vice, headstock, tail stock and various attachments for holding tools and cutters. This type is most suitable for the sharpening of miscellaneous cutters.

The heavy box-type base maintains the machine's stability and rigidity. Saddle mounted on the base provides the arrangement for moving the work forward and backward. The column is mounted on saddle. The column is supporting the

A9.11 : Comparison Between Truing And Dressing Of A Grinding Wheel

Points	**Truing of a Grinding Wheel**	**Dressing of a Grinding Wheel**
Definition	Truing a wheel is the operation to create a true and concentric surface with the wheel spindle axis.	Dressing a wheel is the operation to remove glazed or other adhesion particles and to expose fresh cutting particles.
When necessary	Truing is necessary to newly manufactured wheels taken from kilns for truing to shape and dimensions	Dressing is necessary to newly manufactured or the dulled crystals, clogged with some foreign materials after it is being used for sometime on the wheel face, for the purpose of exposing new cutting particles
Tool used	Commercial diamond tool or conical point tungsten carbide inserted on a shank of cold rolled steel	Same as Truing Tool
Why necessary	To rotate the wheel in a true and concentric path	To remove the blunt surface on wheels necessary for efficient cutting
Cost of machining	More	Less
Sketch		

Sketch S-9.11

A9.12 : Cutting Speed, Feed And Depth Of Cut

Grinding Wheel Speed

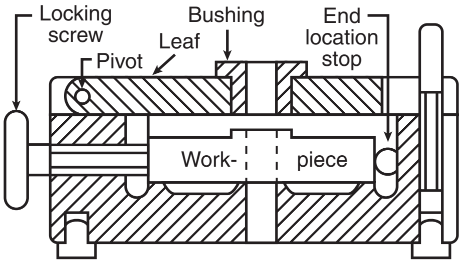
The cutting speed of a grinding wheel is the peripheral speed (or surface speed), expressed in metres/min. and can be calculated by the following expression:

$$\text{Grinding Wheel Speed in metres/min., } V_w = \frac{\pi D_w N_w}{1000}$$

where, D_w is the diameter of the grinding wheel in mm

N_w is the revolution per minute of the grinding wheel.

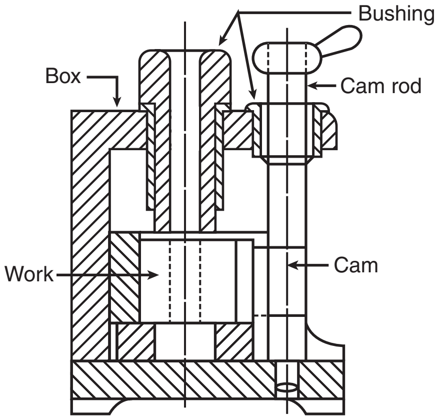
Work Speed. Similarly, surface speed or peripheral speed of the work can be determined by the following expression:



Sketch S-13.7[3]

[3] Leaf Jigs

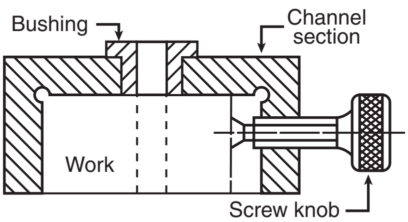
It has a leaf or cover, which can be swung open or close to load and unload the work. After locating the workpiece inside the jig, the leaf is firmly closed and locked, and the jig is then ready for use.



Sketch S-13.07[4]

[4] Box Jigs

It is box shaped, containing box structure, bush, cam, cam rod, etc. It contains bushings on two or more sides for the purpose of drilling holes on different sides of the part. For loading the workpiece on jig, the cam rod is taken out of the jig and the workpiece is placed in position inside the jig. Then the workpiece is locked by rotating the cam through cam rod.



Sketch S-13.7[5]

[5] Channel Jigs

It is a simple channel shaped trough and clamped by rotating a knurled knob of a screw. There is a drill bush to guide the tool on the top member of the channel. This jig is suitable for the workpieces of simple symmetrical shape.

[6] Diameter Jigs

These types of jigs are used to drill or ream radial holes on cylindrical or spherical workpieces. The cylindrical workpieces may be placed on fixed V-block and clamped by clamping plate and clamping bolt. There is drill bush on clamping plate for guiding the tool. [Refer to sketch S-13.3[B].

A 13.8 : Types Of Fixtures

Fixture

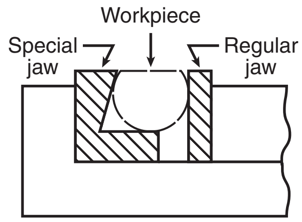
A Fixture is a device for holding a workpiece to a machine bench in a fixed position during machining operations. It does not have special arrangement for guiding the cutting tool. A fixture is used for holding and locating the workpiece only when a large number of identical parts are to be machined to justify its cost.

Types of Fixtures

Common types of fixtures are vice, lathe, boring, broaching, milling, grinding, etc.

A13.8.1 : Vice Fixtures

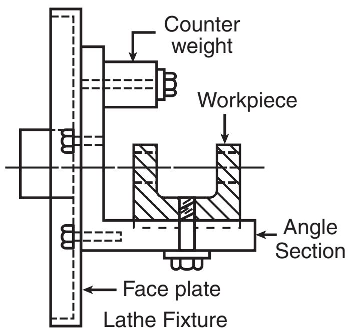
Standard machine vice with the arrangement of special jaws is provided for an easy way of holding the parts for machining. Special jaws are designed according to the requirement of individual workpieces. Small castings or forgings with irregular contours can be held in standard machine vices.



Sketch S-13.8.1

A13.8.2 : Lathe Fixtures

Most of the lathe operations can be done by using standard chucks and holding methods. But many castings and forging parts cannot easily be mounted by the standard methods and require special work holding fixtures.



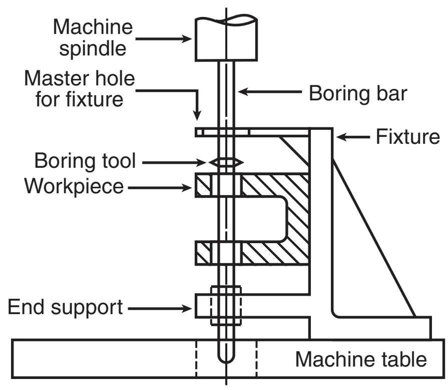
Sketch S-13.8.2

Face Plate Fixture

Face Plate Fixture is mounted to a standard lathe face plate. The flat base of fixture is bolted to the face plate. The workpiece is dynamically balanced as accurately as possible by using a suitable sliding counterweight for turning high speed operations. Accurate static balancing is satisfactory for turning low and medium speed operations.

A13.8.3 : Boring Fixtures

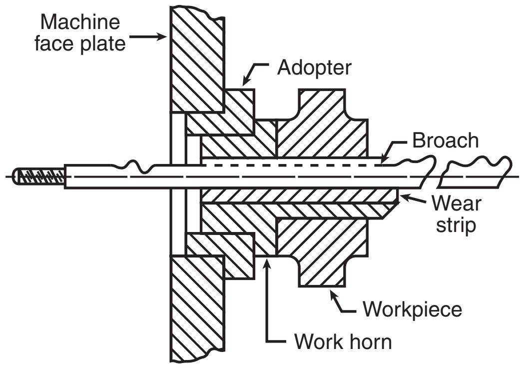
Boring fixtures may be of a drill dig or a mill fixture depending on the type of operation. Boring fixtures have the adjustment on the machine table or boring bar, may require additional holes or indicating surfaces for initial alignment. Single-piloted bar is guided on its leading end to prevent springing under cutting thrust and an end support is also provided for alignment by adjustment of the bearing block. Purpose of this fixture is to hold the workpiece in the correct relation to the boring bar.



Sketch S-13.8.3

A13.8.4 : Broaching Fixtures

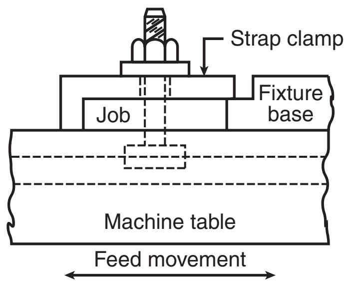
Simple plate, plug or horn fixtures locate the correct position of the workpiece in relation to the broach and machine face plate. The figure above shows a simple fixture used for broaching a keyway. Wire strip of desired thickness (made of tool steel and heat treated wear resistance) is used when to cut a keyway deeper than that can be achieved in one pass of the broach.



Sketch S-13.8.4

A13.8.5 : Milling Fixtures

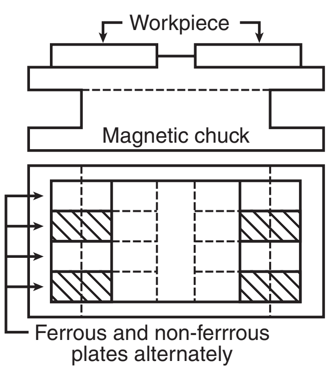
A milling fixture holds the workpiece(s) in the correct relation to the milling cutter as the table movement carries the workpiece through the cutters. The fixture consists of fixture base, strap clamp, nuts and bolts, locating points. Strap clamp should be extremely rigid to exert the cutting forces by interrupted cutting of the milling cutter.



Sketch S-13.8.5

A13.8.6 : Grinding Fixtures

Lathe fixtures may be used for cylindrical grinding. Grinding is a finishing operation, requires great accuracy and close tolerance is to be considered in designing of grinding fixtures.



Sketch S-13.8.6

The standard method of holding the workpieces for surface grinding operations is magnetic chucking. Quick loading, mounting and unloading the workpieces and also no distortion is caused by mechanical clamping. The basic fixture is made of a number of mild steel plates separated from each other by a nonferrous spacer. The magnetic flux passes from the magnetic chuck through the steel plates to the workpiece. Plates, round bars, even odd shaped workpieces can be mounted on magnetic chucks parallels, V-blocks and magnetic chucks with apoxy tooling materials respectively.