

Unit One Fundamentals of Manufacturing Techniques

机械制造基本知识

Lesson 1 Machine tools

机 床

1.1 The Engine Lathe 普通车床

Lathe size is determined by the swing and the length of the bed (Fig. 1 - 1 - 1). The swing is twice the distance from the live center point of the spindle to the top of the bed, or the largest diameter that can be turned over the ways of a lathe. For example, a 10-in. lathe will turn a 10-in. diameter workpiece over the ways, but not over the carriage cross-feed slide. Sometimes two numbers are used to indicate swing, such as 17-12. The 17-in. swing would be over the bed and the 12-in. swing over the cross slide.

The length of the bed includes the part the headstock rests on. It determines also the distance between centers. A typical size might be a 3-foot bed with a distance of 23 in. between centers. Lathe beds are offered in many different lengths for each available swing size.

A lathe should have a swing capacity and distance between centers that is at least 10 percent greater than needed to do any job that may be required. Standard lathes come in a variety of designs and styles and may have a swing changing from about 9 to 53 in. They are generally classified as small, medium swing, and heavy duty.

The bed is the base or foundation of the lathe. It is a heavy,

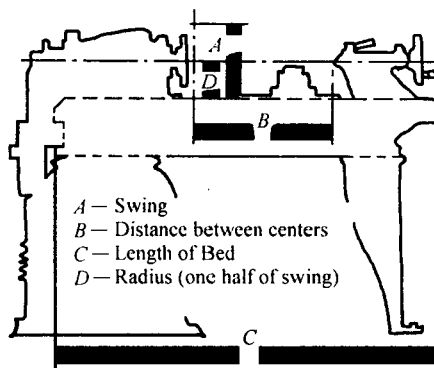


Fig. 1 - 1 - 1 Size is indicated by swing and the length of the bed

rigid casting made in one piece. It is the “backbone” of the lathe and holds or supports all the other parts. Located on the top of the bed are ways. More expensive lathes have a combination of V ways and flat ways. Less expensive lathes have flat ways only. Construction of ways varies according to the make. Some builders use ways made of hardened steel that can be replaced if necessary. Others use flame-hardened ways that are an integral part of the bed section.

The headstock assembly is permanently fastened to the left end of the lathe. It contains the headstock spindle, which is rotated by gears or by a combination of gears and pulleys. The spindle holds the attachments which, in turn, hold and turn the workpiece. Spindles come in several quality ratings and are supported in headstocks by three to five bearings. Since the accuracy of the work done on a lathe depends on the axis of rotation of the spindle holding the workpiece, the spindle and all its accessories must be built and assembled with the greatest possible care.

The tailstock can be moved along the bed ways and clamped in

position. It consists of two castings or main parts. The lower part rests directly on the ways, and the upper part rests on the lower part. Adjusting screws hold the parts together. The upper casting can be moved toward or away from the operator to offset the tailstock for taper turning and to realign the tailstock center for straight turning. The tailstock spindle moves in and out of the upper casting when the tailstock handwheel is turned. This spindle has a taper hole into which the dead center or other tools such as drills and reamers fit. Only tools having the same taper as the tailstock spindle should be placed in the spindle hole. To remove tools from the spindle, it is only necessary to back up on the handwheel until the spindle end is nearly inside the casting. The end of the screw that moves the spindle loosens the taper shank so it can be removed.

The carriage consisting of the saddle and apron is the movable part which slides between the headstock and tailstock. It controls and supports the cutting tool.

1.2 Drilling Machines 钻床

Cutting round holes in metal stock is one of the most common operations performed in the machine shop. Very few metal pieces go through a factory without having holes drilled in them. Later operations are often located by referring to these holes. Drilling machines are used to produce most of these holes. They are also used in operations such as reaming, boring, countersinking, counterboring, and tapping (Fig. 1 - 1 - 2).

The size of a drilling machine is expressed in one or more of the following four ways:

1. By the diameter of the largest disk that can be center drilled. An 18-in. drill press, for example, can drill a hole through the center of an 18-in. diameter disk.

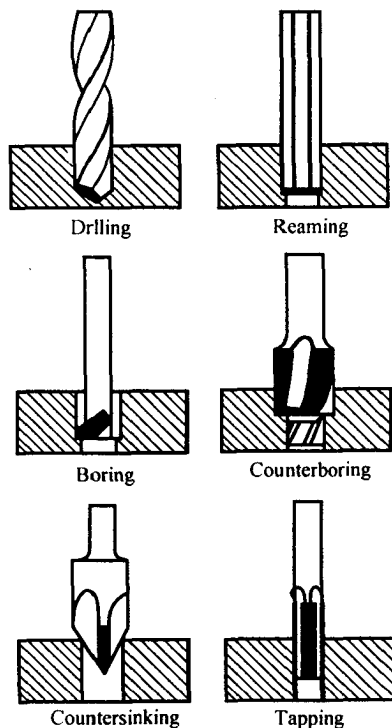


Fig. 1 - 1 - 2 The six common operation
that can be done on drilling machine

2. By the distance the spindle moves up and down.
3. By the maximum distance between the spindle and table.
4. By the distance from the column to the center of the spindle.

The principal parts of the drill press are the base (or lower table), column, table, and head. The heavy metal base and upright column have the table and drill head attached. The drill head consists of the main operating parts, including the speed and feed

mechanisms, the motor, the spindle, and the quill.

There are several types of mechanisms used to control the speed of a drilling machine. The simplest arrangement utilizes a belt for transferring power from a four-step, five-step, or six-step V pulley located on the motor to a similar pulley attached to the drill press spindle. To increase power on some belt and pulley machines, a countershaft drive is sometimes added. Another mechanism used is the variable-speed pulley, which makes it possible to change the machine's speed without stopping it. In fact, the speed must only be changed while the machine is running. Pulleys of a variable-speed drive are made of two parts having V-shaped sides. By means of an adjusting screw attached to a crank wheel, one side of the driver pulley may be opened or spread apart. As it spreads, the belt moves inward toward the smaller diameter, producing slower speed in the driven pulley that has closed to make a larger pulley. As the sides of driver pulley are brought together, the belt is forced outward toward the larger diameter. This increases the speed of the driven pulley that opens to make the smaller pulley (Fig. 1 - 1 - 3).

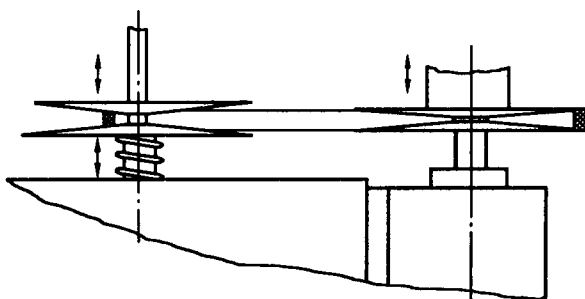


Fig. 1 - 1 - 3 Variable-speed drive

The feed on most drill presses is hand controlled with a hand-feed lever. An automatic power feed attachment is available for some

drill presses.

The spindle, which rotates and moves the cutting tool up or down, may have either a taper hole or a threaded end. Small drill presses usually have a threaded or short taper end on the spindle for attaching a drill chuck. Most medium-sized floor-type drill presses have a self-holding (No. 1 or No. 2 Morse taper) hole. Taper-shank cutting tools fit directly into this taper hole. Straight-shank cutting tools must be held in a drill chuck. A depth gage and stop, mounted on the quill, can be set when drilling holes to a certain depth.

Drill presses are normally equipped with a table that can be tilted to the right and left. Some heavier duty machines, however, have a table with an oil ring around its edge and often a T slot for clamping work. This type of table cannot be tilted.

Self - test

1. Lathe size is determined by _____ and length of the bed.
A. diameter B. swing C. radius d. height
2. Standard lathes come in a variety of designs and _____ and may have a swing changing from about 9 to 53 in.
A. makes B. types C. models D. styles
3. The _____ is the base or foundation of the lathe.
A. bed B. headstock
C. spindle D. cutting tool
4. The headstock assembly is permanently fastened to the _____ end of the lathe.
A. right B. upper C. left D. lower
5. Cutting round holes in metal _____ is one of the most common operations performed in the machine shop.
A. part B. bar C. workpiece D. stock
6. The _____ on most drill presses is hand controlled with a hand-feed lever.

- A. feed B. depth C. motion D. clamping
7. Pulleys of a variable-speed drive are made of two parts having V-shaped _____.
A. sides B. edges C. parts D. lines
8. Small drive presses usually have a threaded or short _____ end on the spindle attaching a drill chuck.
A. square B. taper C. rectangular D. round
9. Drill presses are normally equipped with a table that can be _____ to the right and left.
A. turned B. rotated C. lifted D. tilted

关键字解释

Engine lathe: the versatile engine lathe ranges in size and design from small bench and speed lathes to large floor types. The workpiece may be held between tapered centers and rotated with the powder spindle by means of a clamping device, or it may be held in a chuck, or even fixed to a rotating plate. When the work is swung between centers, the tailstock is clamped firmly in place.

普通车床 多用途的车床 其大小和设计多种多样 有小的台式车床, 高速车床, 大的落地式车床, 工件支在两个锥形的顶尖之间。通过夹紧装置随主轴一起转动, 或者工件装在夹盘上, 甚至可固定在一个转盘上。当工件在两个顶尖之间转动时, 尾轴则保持不动。

Headstock: a part of a lathe that holds the revolving spindle and its attachment.

主轴箱 车床的一部分 其上安装有主轴及附件。

Tailstock: the adjusted or sliding head of a lathe containing the dead center.

尾架: 车床上可调节的或滑动的头架, 里面有死顶尖。

Center: one of two tapered metal rods that support work in a

lathe or grinding machine and about or with which the work revolves.

顶尖 车床或磨床上两个锥形金属棒中的一个 它用来支持工件, 工件围绕着顶尖转动, 或依靠顶尖转动。

Spindle: a short shaft is a spindle. It may be slender or tapered, a spindle is capable of rotating or of having a body rotate upon it.

主轴 主轴是一个较短的轴 可能是细长的 也可能是锥形的, 主轴能转动, 或者有一物体绕其转动。

Countershaft: a secondary shaft that is driven by a main shaft and from which power is supplied to a machine part.

Reaming: a manufacturing process in which a multi-cutting-edge tool is used to enlarge or accurately size and finish an existing hole in solid material by remove of a small amount of stock.

铰孔: 一种加工工艺, 使用多刃刀具对预先钻过的孔进行扩孔 或者使其达到一定的尺寸精度及光洁度 铰孔只切去少量的原材料。

Boring: a machining process that increases the size of an existing hole in a workpiece. The usual purpose of boring is to machine a hole to a desired diameter while obtaining required accuracy and finish.

镗孔: 一种加工工艺 增加工件中原有孔的尺寸。镗孔的一般目的是将原有孔加工到所需的直径, 同时获得要求的精度和光洁度。

词 汇

- | | |
|------------|--------------------------|
| 1. lathe | n. 车床 |
| 2. swing | n. 最大的回转直径, 车床床面上的最大加工直径 |
| 3. spindle | n. (心) 主 轴 |

4. diameter	<i>n.</i> 直径
5. headstock	<i>n.</i> 头架, 车床头, 车头箱, 主轴箱 [头]
6. foundation	<i>n.</i> 基础 地金 [底机座]
7. rigid	<i>adj.</i> 刚性的 坚固的 硬式的
8. casting	<i>n.</i> 铸件 [锭模] 铸造 (法)
9. backbone	<i>n.</i> 脊骨 构架 支柱
10. way	<i>n.</i> 滑道 槽 导轨
11. make	<i>n.</i> 种类 型号 牌号
12. integral	<i>adj.</i> 整体的
13. fasten	<i>v.</i> (使) 固定 连接
14. gear	<i>n.</i> 齿轮 (齿轮) 传动装置 起落架
15. pulley	<i>n.</i> 皮带轮 滑轮
16. attachment	<i>n.</i> 附 配备 件 夹具
17. bearing	<i>n.</i> 轴承 (座) 支撑 座 架]
18. accessory	<i>n.</i> 附 零 配备 件 辅助设备
19. assemble	<i>v.</i> 装 配 [备] 安装 总装
20. tailstock	<i>n.</i> 尾架 (座) 后顶尖 [针座]
21. clamp	<i>n.</i> 夹 (紧 持 住) 卡紧 定位
22. screw	<i>n.</i> 螺旋 钉 丝 杆] 丝杆
23. handwheel	<i>n.</i> 手轮
24. reamer	<i>n.</i> 铰刀 铰钻
25. shank	<i>n.</i> (刀 手) 柄
26. carriage	<i>n.</i> (支 车 架 刀架 机床的拖板)
27. live center	机床活顶尖
28. carriage cross-feed slide	拖板横向进给滑道
29. heavy duty	<i>adj.</i> 重型的
30. hardened steel	淬火 [淬硬 钢]
31. flame-hardened	<i>adj.</i> 火焰淬火的
32. taper turning	圆锥车削
33. dead center	死点 死顶尖

34. stock	<i>n.</i> 原料 毛坯
35. reaming	<i>n.</i> 铰 扩孔
36. boring	<i>n.</i> 镗 穿 扩孔
37. countersinking	<i>n.</i> 钻 埋头 孔
38. counterboring	<i>n.</i> (用平底扩孔钻) 扩孔
39. tapping	<i>n.</i> 攻丝 攻出螺纹
40. disk	<i>n.</i> (圆 轮 盘 圆片[板 面])
41. column	<i>n.</i> (圆 立 支 柱)
42. quill	<i>n.</i> 主 钻 套管 空心 轴
43. mechanism	<i>n.</i> 机 械 结 构 (机械 装置)
44. belt	<i>n.</i> (皮 布 钢 传动 子弹 地 带)
45. transfer	<i>v.</i> 传递 [导 送 输 动 热]
46. power	<i>n.</i> (动 电 能 功 功率)
47. pulley	<i>n.</i> 皮带轮 滑轮
48. countershaft	<i>n.</i> 副 中间 并行 轴
49. crank	<i>n.</i> 曲柄 臂] 曲轴 手 摇 柄 摇把
50. lever	<i>n.</i> (杠 拉 控制) 杆 (手 柄)
51. threaded	<i>adj.</i> 车 刻 螺纹的
52. chuck	<i>n.</i> 夹盘 [具 头] 卡头 [盘]
53. gage = gauge	<i>n.</i> (测量仪 表 (计 量) 传感] 器 , 量测仪器
54. stop	<i>n.</i> 挡块
55. mount	<i>v.</i> 安装 装配
56. tilt	<i>v.</i> 摇 摆 动
57. ring	<i>n.</i> 环 圈
58. slot	<i>n.</i> 缝 隙) 槽 沟 (孔 裂 切 口)
59. machine shop	机加 金工 车间
60. drill press	(台式) 钻床
61. four-speed V pulley	四速 V形皮带轮
62. variable-speed pulley	可变速皮带轮
63. driver pulley	主 驱 动 皮带轮

64. driven pulley	被从动皮带轮
65. cutting tool	刀具
66. taper hole	锥形孔
67. heavy-duty machine	重型机 (床)

注 释

1. Located on the top ... according to the make.

车床床身的上部是滑道，较贵的机床既有 V 形滑道，也有平滑道，较便宜的车床只有平滑道，滑道的结构随型号不同而不同。

2. The upper casting can ... for straight turning.

上面的铸件可向操作工运动，也可背向操作工运动，故可在锥形车削时调整尾架顶尖，在直线车削时对尾架主轴进行重对中。

3. There are several ... to the drill press spindle.

有几种机构可用来控制钻床的速度，最简单的装置就是皮带轮，它可以装在电机上一个四级、五级或六级皮带轮上，将动力传递到装在钻床主轴上的一个相似的皮带轮上。

4. Drill presses are ... cannot be tilted.

钻床通常都有一个可左右摇动的工作台，但有些重型钻床的工作台边缘有一油环，通常还有一 T 形槽用于夹紧工件。

Lesson 2 Milling Methods

铣削方法

2.1 Introduction 引言

Milling is a process of generating machined surfaces by progressively removing a predetermined amount of material from the workpiece. The process employs relative motion between a workpiece and a rotating cutter to generate the required surface. In some applications, the workpiece is held stationary while the rotating cutter is moved past it at a given feed rate (traversed). In other applications, both the workpiece and cutter are moved in relation to each other and to the milling machine. More frequently, however, the workpiece is advanced at a relatively slow rate of movement or fed to a milling cutter rotating at comparatively high speed, with the cutter axis remaining in a fixed position. A characteristic feature of the milling process is that each milling-cutter tooth takes its share of the stock in the form of small individual chips. Milling operations are preformed on many various machines with milling cutters of different types and sizes.

2.2 Peripheral Milling 外圆铣

In peripheral milling, sometimes called “slab milling”, the milled surface generated by teeth located on the periphery of the cutter body (Fig. 1 - 2 - 1) is generally in a plane parallel to the cutter axis. Milling operations with form-relieved and formed profile

cutters are included in this class. The cross section of the milled surface corresponds to the outline or contour of the milling cutter or combination of cutters used.

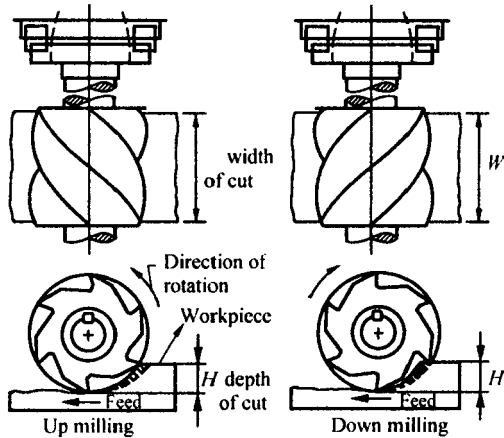


Fig. 1-2-1 Peripheral milling: up milling and down milling shown considerably exaggerated to illustrate the principle of operation.

Peripheral milling operations are usually performed on milling machines with the spindle located horizontally, but can be done with end mills on vertical-spindle machines. The milling cutters are mounted on an arbor which is generally supported at the outer end for increased rigidity, particularly when, because of the conditions of the setup, the cutter or cutters are located at some distance from the nose of the spindle. Peripheral milling should not generally be done if the part can be face-milled.

2.3 Face Milling 端铣

Face milling is done on both horizontal and vertical milling machines. The milled surface resulting from the combined action of cutting edges located on the periphery and the face of the cutter is generally at right angles to the cutter axis (Fig. 1 - 2 - 2). The milled surface is flat, there being no relation to the contour of the teeth, except when milling to a shoulder. Generally, face milling should be applied wherever and whenever possible.

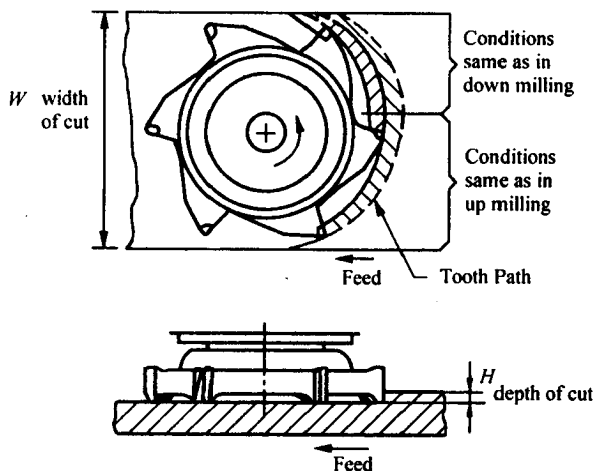


Fig. 1 - 2 - 2 Face milling shown considerably exaggerated to illustrate the principle of operation

The simplest and most easily applied method of milling is that in which one part, held in a fixture or directly on the machine table, is milled during each machine cycle. This is known as single-piece milling.

The machine operator places the part in the fixture or on the machine table, and clamps it in place. The table is then advanced at a rapid rate to locate the workpiece in position quickly for milling. Here the rate of table travel is usually changed automatically to the feeding rate by means of trip dogs. When milling has been completed, the workpiece is returned to the starting position, where it is removed and a new piece put in its place. The cycle is then repeated.

In order to effect a saving in handling time, two or more parts may be placed in a row in the direction of the feeding movement of the table so that they are milled in consecutive order as the machine is operated through the cycle. This method is known as string or multiplepart milling.

Self – test

1. Milling is a _____ of generating machined surfaces by progressively removing a predetermined amount of material from the workpiece.
A. metal B. process C. kind D. motion
2. A characteristic feature of the milling process is that each milling cutter tooth takes it _____ of the stock in the form of small individual chips.
A. profile B. action C. share D. role
3. In peripheral milling, the milled surface _____ by teeth located on the periphery of the cutter body is generally in a plane parallel to the cutter axis.
A. made B. processed
C. generated D. performed
4. Peripheral milling operations are usually performed on milling machines with the _____ located horizontally.
A. spindle B. axis C. cutter D. headstock

5. The milled surface is flat, there being no relation to the _____ of the teeth, except when milling to a shoulder.
 A. size B. profile C. type D. contour
6. The machine operator places the part in the _____ or on the machine table, and clamps it in place.
 A. base B. fixture C. shoulder D. chip

关键字解释

Milling: A production process in which the metal is removed by feeding a workpiece through the periphery of a rotating circular cutter. The multitoothed cutter of a milling machine produces a milled surface as each revolving tooth removes a portion of metal from the passing workpiece.

铣削: 一种加工工艺 在铣削时 工件进给时通过转动圆形刀具的外缘, 铣床的多齿铣刀的每个齿从通过的工件上切削掉一部分金属从而生成一个铣削面。

词 汇

- | | |
|---------------|--------------------------------------|
| 1. milling | <i>n.</i> 铣削 齿 法) 碾 磨 磨 碾 碎 |
| 2. stationary | <i>adj.</i> 不动 变的 静止 态 的 固定 (式 的 |
| 3. chip | <i>n.</i> [碎 切 铁 金属 石 木] 屑 |
| 4. peripheral | <i>n.</i> 外围 面 部 的 圆圈的; [计 算 外 围 设备 |
| 5. profile | <i>n.</i> 轮廓 外形 观] 齿 型 廓] 靠 模 , 仿形 |
| 6. outline | <i>n.</i> 外形 线 图) 轮廓 线 图) |
| 7. contour | <i>n.</i> 轮廓 线) 外形 形状 断面 |
| 8. arbor | <i>n.</i> [心 主 刀 轴 (刀 杆 |

9. rigidity	<i>n.</i> 刚性 刚度 硬度 性]
10. horizontal	<i>adj.</i> 水平的 卧式的
11. vertical	<i>adj.</i> 垂直的 立式的
12. flat	<i>adj.</i> 平坦 直展的 扁平的
13. shoulder	<i>n.</i> 轴台 路肩
14. fixture	<i>n.</i> (工件 夹具 卡具 夹紧装置
15. clamp	<i>n.</i> 夹紧 持住) 定 箝 位 使固定
16. advance	<i>n.</i> (使 前进 送进 走刀
17. cycle	<i>n.</i> 周 周期 , 一转 循环 时间) , 一个 操作过程
18. row	<i>n.</i> (一行 (一 排 行列
19. consecutive	连续不断的 顺序 次的
20. multipiepart	由几部分组成的 , 多件的
21. peripheral milling	外圆铣
22. feed rate	进给速度 率]
23. slab milling	平面铣
24. form-relieved cutter	铲齿铣刀
25. formed profile cutter	成型靠模 仿形 刀具
26. end mill	立铣刀
27. face milling	端面 铣 (削)
28. trip dogs	自动爪 , 自动停车器
29. string milling	串铣

注 释

1. A characteristic feature of the milling ... small individual chips.

铣削工艺的一个特点是每个铣刀齿切下一个个的小切屑 , 承担着它对坯料的铣削任务的一个部分。take one's share of 负 [承] 担一部分

2. Peripheral milling operations are ... on vertical-spindle