

Module 4 General Purpose Machine Tools

Lesson

21

Methods of mounting of
jobs and cutting tools in
machine tools.

Instructional objectives

At the end of this lesson, the students will be able to;

- (i) State the principles and conditional requirements of mounting jobs and tools in machine tools
- (ii) Illustrate how the jobs (blanks) and cutting tools are mounted in
 - a. Lathes
 - b. Drilling machines
 - c. Shaping, Planing and slotting machines
 - d. Milling machine
 - e. Grinding machines
- (iii) Point out the special requirements and methods on mounting job and cutting tools in CNC machine tools.

(i) Principles And Conditional Requirements Of Mounting Job And Cutting Tool In Machine Tools

The job or blank and the cutting tools essentially need to be properly mounted in the machine tool for achieving desired performance of the machining system. The following principles are generally followed and conditions are maintained;

(a) while mounting the job or blank in the machine tool

- appropriate selection of work holding device or system from the available resources depending upon;
 - Δ configuration of the machine tool
 - Δ shape, size and weight of the blank
 - Δ kind of machining work to be done
 - Δ order of dimensional accuracy desired
 - Δ volume (number of same job) of production
- correct location, strong support and rigid clamping of the blank against the cutting and other forces
- easy and quick loading and unloading to and from the machine tool or the holding device
- proper alignment like coaxiality, concentricity etc. of rotating jobs
- free flow of chips and cutting fluid

(b) while mounting the cutting tools

- appropriate selection of tool holder and the method of mounting
- proper positioning and orientation of the tool depending upon its
 - Δ type
 - Δ size and shape
 - Δ geometry
- proper alignment in respect of coaxiality, concentricity and machine tool configuration
- accurate and quick locating, strong support and rigid clamping
- minimisation of run out and deflection during cutting operation

- easy and quick mounting and change
- unobstructed chip flow and cutting fluid action.

(ii) Methods Of Mounting Job And Cutting Tool In General Purpose Machine Tools.

(a) Job and tool mounting in lathes

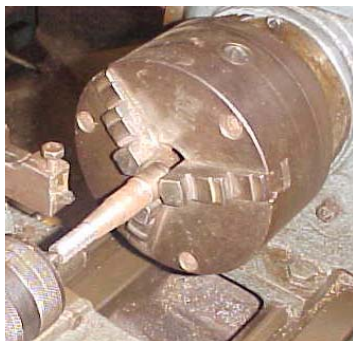
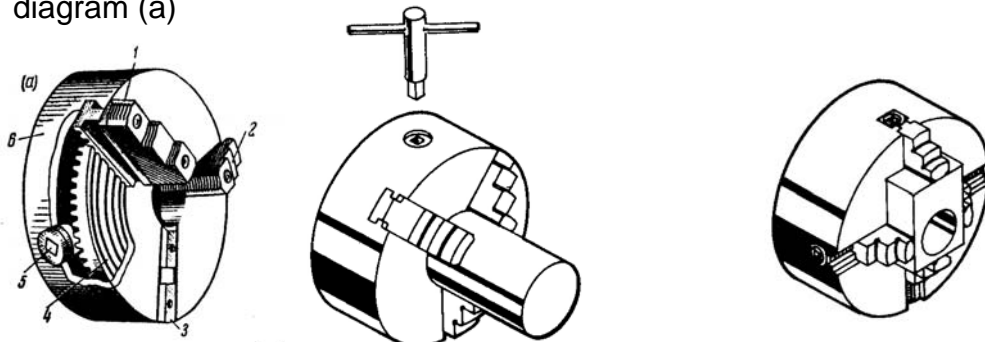
• In centre lathes

□ Mounting of jobs

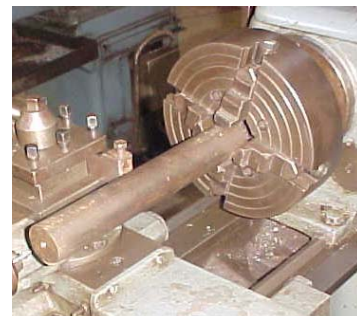
The general systems of holding jobs in centre lathes;

Δ without additional support from tailstock;

- Chucks — 3-jaw self centering chuck
- — 4- independent jaw chuck
- Face plate
- Jigs and fixture
- Fig. 4.5.1 visualises 3 – jaw and 4 – jaw chucks which are mounted at the spindle nose and firmly hold job in centre lathes. Premachined round bars are quickly and coaxially mounted by simultaneously moving the three jaws radially by rotating the scroll (disc with radial threads) by a key as can be seen in the diagram (a)



(a) 3-Jaw chuck



(b) 4-Jaw chuck

Fig. 4.5.1 Holding jobs in centre lathes by 3-jaw and 4-jaw chucks.

The four jaw chucks, available in varying sizes, are generally used for essentially more strongly holding non-circular bars like square, rectangular, hexagonal and even more odd sectional jobs in addition to cylindrical bars, both

with and without premachining at the gripping portion. The jaws are moved radially independently by rotating the corresponding screws which push the rack provided on the back side of each jaw.

- o For turning, facing, boring, threading and similar operations, jobs of odd shape and size are usually mounted on large face plate (instead of chuck) being fitted on the spindle nose as shown in Fig. 4.5.2.
- o The job may be (b) directly clamped on the face plate or (c) in case of batch or small lot production, in a fixture which is clamped on the face plate.

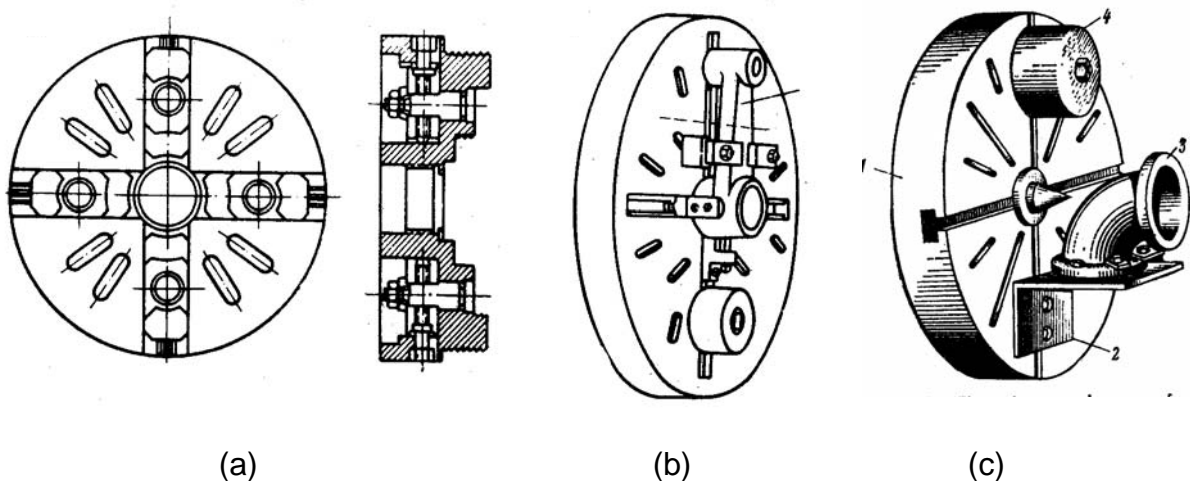


Fig. 4.5.2 Mounting of odd shaped jobs on face plate in centre lathe

- Δ Job mounting in centre lathe using support from the tailstock (centre)
- o In-between centre
 - o In-between chuck and centre
 - o In-between headstock and tailstock with additional support of rest
 - o Fig. 4.5.3 schematically shows how long slender rods are held in between the live centre fitted into the spindle and the dead centre fitted in the quill of the tailstock. The torque and rotation are transmitted from the spindle to the job with the help of a lathe dog or catcher which is again driven by a driving plate fitted at the spindle nose. Depending upon the situation or requirement, different types of centres are used at the tailstock end as indicated in Fig. 4.5.4. A revolving centre is preferably used when desired to avoid sliding friction between the job and the centre which also rotates along with the job.

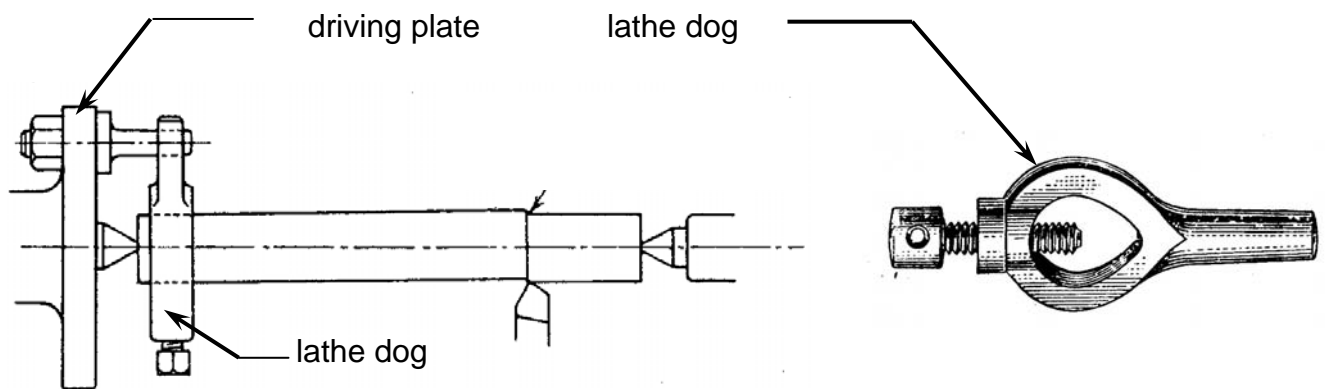
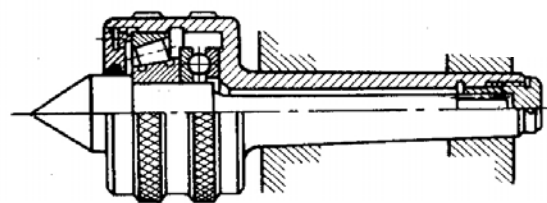
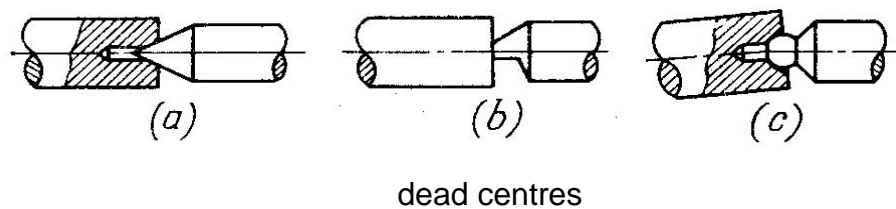


Fig. 4.5.3 Mounting bar type job in between centres in centre lathe.



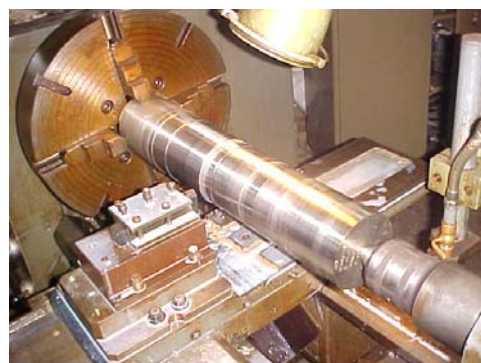
(d) revolving centre

Fig. 4.5.4 Type of dead centres and revolving centre being fitted in the quill of the tailstock.

Heavy and reasonably long jobs of large diameter and requiring heavy cuts (cutting forces) are essentially held strongly and rigidly in the chuck at headstock with support from the tailstock through a revolving centre as can be seen in Fig. 4.5.5.



(a) 3-jaw chuck



(b) 4-jaw chuck

Fig. 4.5.5 Job mounted in between chuck and centre in centre lathe

- To prevent deflection of the long slender jobs like feed rod, leadscrew etc. due to sagging and cutting forces during machining, some additional supports are provided as shown in Fig. 4.5.6. Such additional support may be a steady rest which remains fixed at a suitable location or a follower rest which moves along with the cutting tool during long straight turning without any steps in the job-diameter.

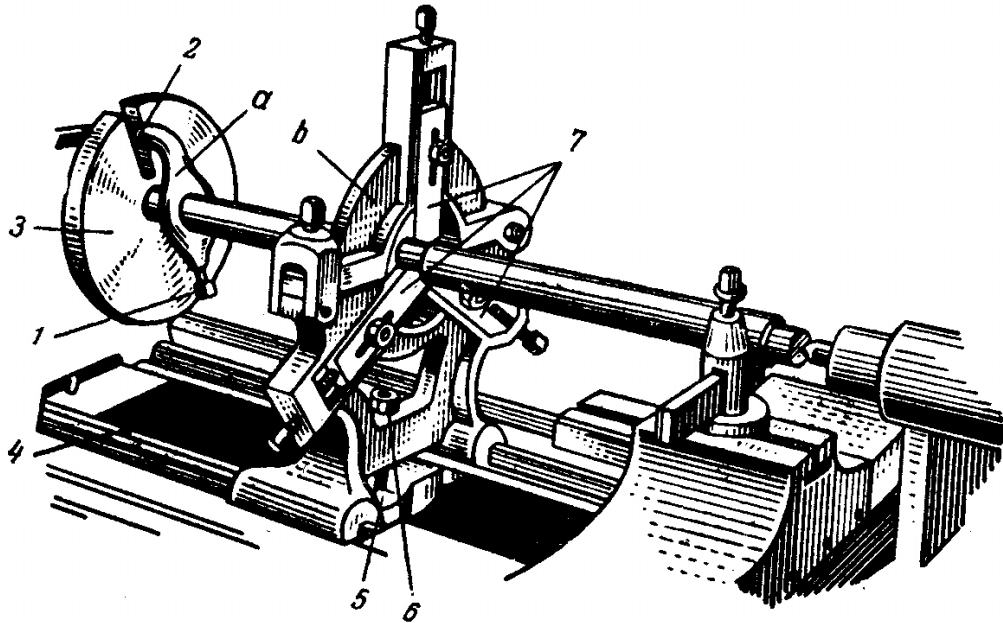
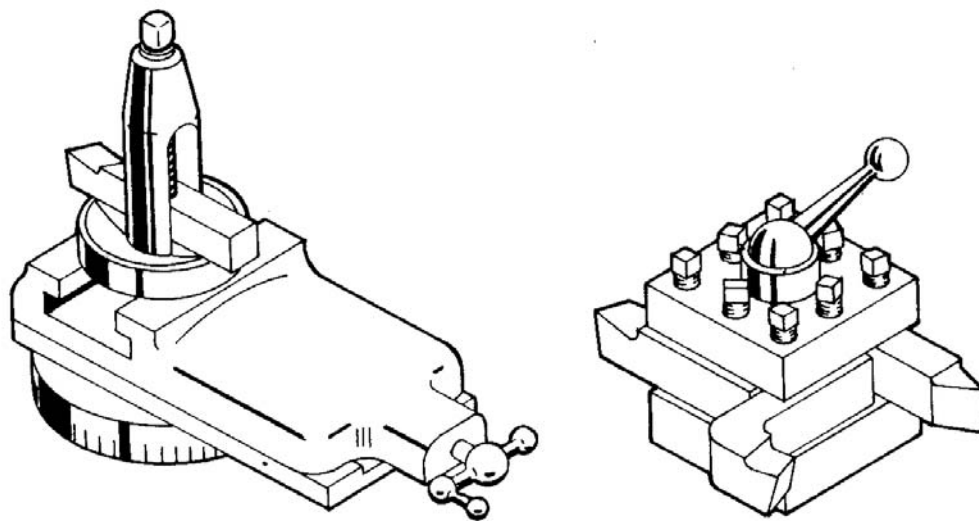


Fig. 4.5.6 Slender job held with extra support by steady rest

□ Mounting of tools in centre lathes

Different types of tools, used in centre lathes, are usually mounted in the following ways;

- HSS tools (shank type) in tool post
- HSS form tools and threading tools in tool post
- Carbide and ceramic inserts in tool holders
- Drills and reamers, if required, in tailstock
- Boring tools in tool post
- Fig. 4.5.7 is typically showing mounting of shank type HSS single point tools in rotatable (only one tool) and indexable (upto four tools) tool posts. Small tool bits are preferably fitted in a rectangular sectioned bar type tool holder which is mounted in the tool post as shown by the photograph in Fig. 4.5.5 (a).
- Fig. 4.5.8 typically shows how a circular form or thread chasing HSS tool is fitted in the tool holder which is mounted in the tool post.



(a) single tool

(b) upto four tools

Fig. 4.5.7 Mounting of shank type lathe tools in tool posts.

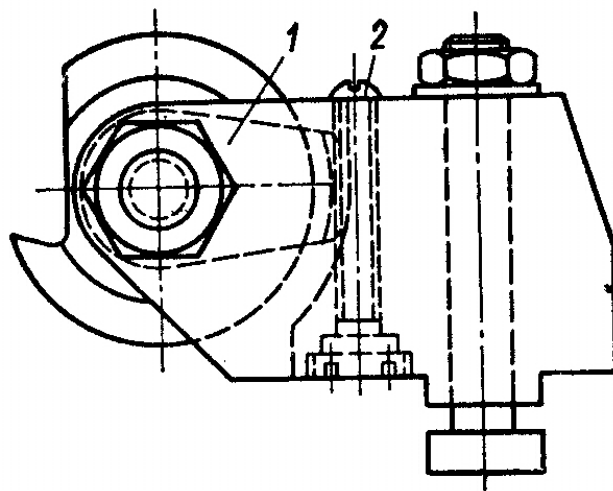
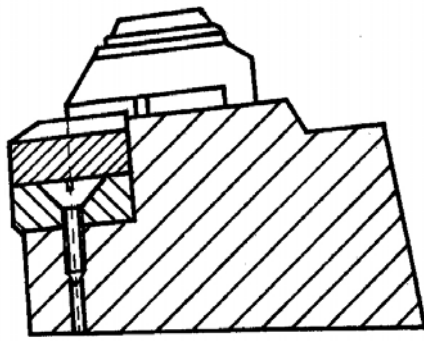
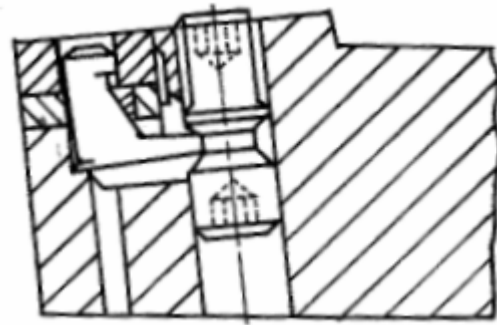


Fig. 4.5.8 Mounting of form tool in tool post.

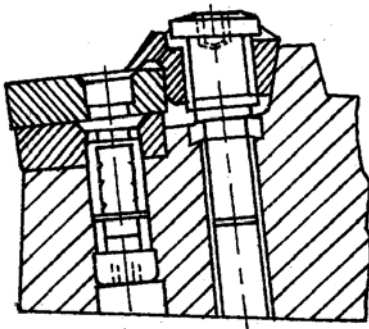
- o Carbide, ceramic and cermet inserts of various size and shape are mechanically clamped in the seat of rectangular sectioned steel bars which are mounted in the tool post. Fig. 4.5.9 shows the common methods of clamping of such inserts. After wearing out of the cutting point, the insert is indexed and after using all the corner-tips the insert is thrown away.



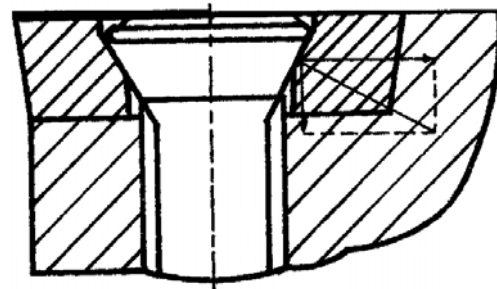
(a) clamp type



(b) lever type



(c) pin and clamp



(d) screw type

Fig. 4.5.9 Mounting of tool inserts in tool holders by mechanical clamping.

- o For originating axial hole in centre lathe, the drill bit is fitted into the tailstock which is slowly moved forward against the rotating job as indicated in Fig. 4.5.10. Small straight shank drills are fitted in a drill chuck whereas taper shank drill is fitted directly into the tailstock quill without or with a socket.

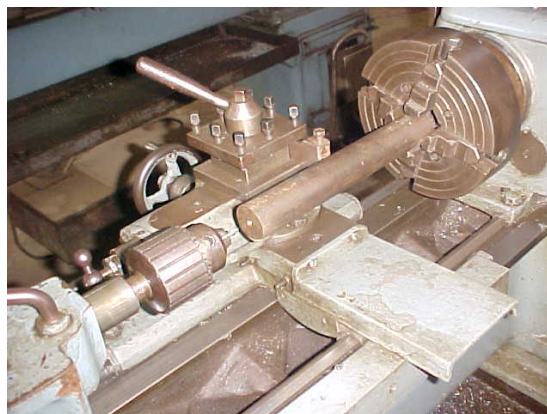


Fig. 4.5.10 Holding drill chuck and drill in tailstock.

- o Often boring operation is done in centre lathes for enlarging and finishing holes by simple shank type HSS boring tool. The tool is mounted on the tool post and

moved axially forward, along with the saddle, through the hole in the rotating job as shown in Fig. 4.5.11 (a).

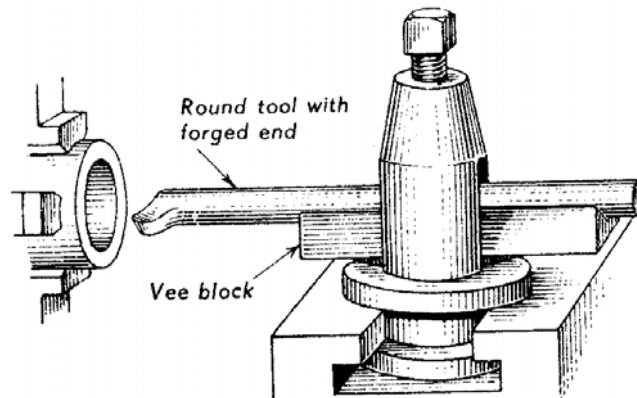


Fig. 4.5.11 (a) Boring tool mounted in the tool post in centre lathe.

For precision boring in centre lathe, the tool may be fitted in the tailstock quill supported by bush in the spindle as shown in Fig. 4.5.11 (b).

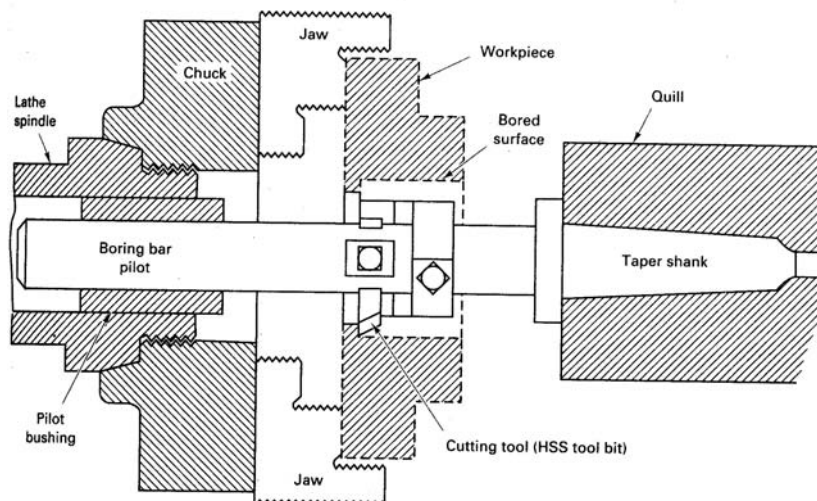


Fig. 4.5.11 (b) Precision boring in centre lathe.

- **In semiautomatic and automatic lathes**

Automation is incorporated in machine tool systems to enable faster and consistently accurate processing operations for increasing productivity and reducing manufacturing cost in batch and mass production. Therefore, in semiautomatic and automatic machine tools mounting and feeding of the job or blank and the tool are also done much faster but properly.

- **Mounting of job in semiautomatic and automatic lathes.**

Semiautomatic lathes like capstan and turret lathes work on both chucking type (disc like) and bar type jobs. But automatic lathes like single spindle automat

work on long bars of small ($\phi = 6$ to 20 mm) circular or regular polygon section (square, hexagonal and octagonal). However, there is no scope of support from tailstock at all in any of such semiautomatic or automatic lathes. Only occasionally additional support is taken through a revolving centre during heavy transverse or radial cut in a turret lathe. In that case that centre is fitted into the turret head only. The devices or systems those are commonly used to hold the job or blank quickly, coaxially (with the spindle axis) strongly and rigidly in the aforesaid semiautomatic and automatic lathes are :

- o Coventry concentric chuck – where the 3 jaws are actuated quickly and accurately by a ring cam
- o Air operated chuck – where the jaws are moved more quickly and accurately by compressed air. Often hydraulically operated quick acting chucks are used in turret lathes for heavy jobs and cuts.
- o Quick acting soft jaw chucks – preferably used where the gripping portion of the job need to be unaffected
- o Collet chuck – used for holding long thin bars of regular section passing and fed through the hollow spindle.

Collet chucks inherently work at high speed with accurate location and strong grip. The collets are actuated

- Δ manually or semiautomatically in capstan and turret lathes
- Δ automatically in automatic lathes

Basically there are three types of spring collets as shown in Fig. 4.5.12. All of those collets are splitted at their gripping end to provide springiness and enable reduce the bore diameter to grip the bar by radial force.

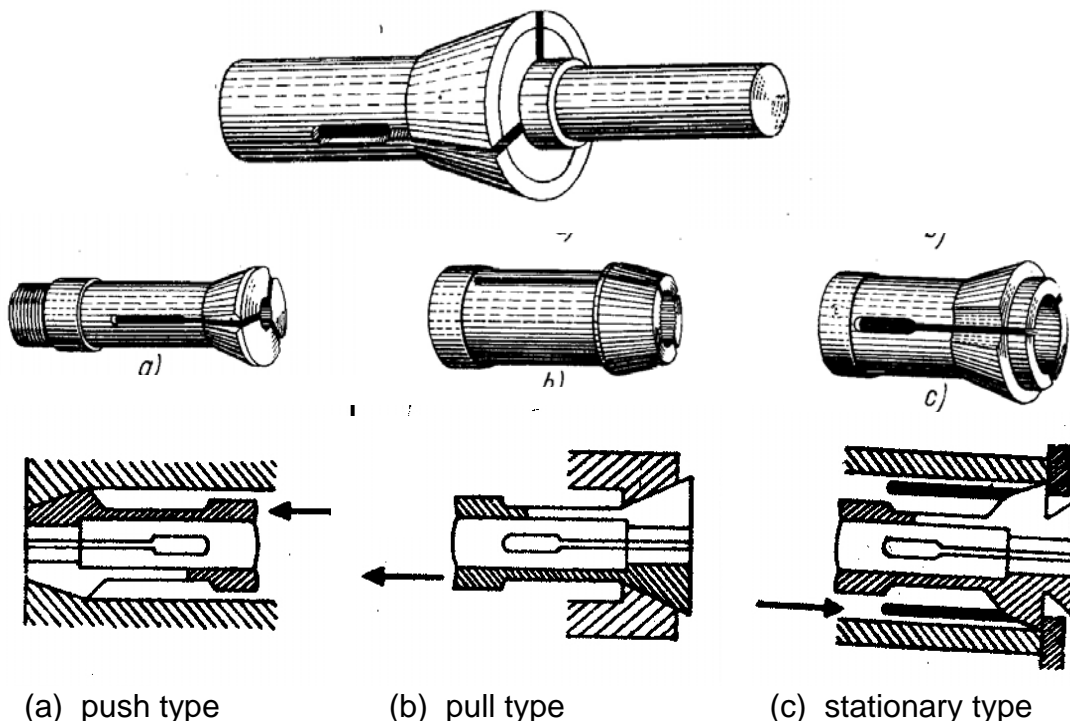


Fig. 4.5.12 Collets used to hold bar stock in semiautomatic and automatic lathes.

All the collet types; push, pull and stationary, have some relative advantages based on which those are selected appropriate for the application.

□ **Mounting of cutting tools**

△ **In semiautomatic lathes**

In semiautomatic lathes like capstan lathe and turret lathe, the cutting tools are mounted in the

(a) **Radial slides** – moving transverse to the job axis

- * Front slide – if fixed type, holds only one tool
- if turret type, may hold upto 4 tools
- * rear slide – for only one cutting tool

The cutting tools, mounted on the radial slides, are used for the external machining operations which need radial tool feed, e.g., facing, shouldering, grooving, recessing, forming, chamfering, parting etc.

(b) **Turret (mostly hexagonal)** – moving along the spindle axis

The cutting tools to be used for external or internal work requiring axial feed motions such as turning, drilling, boring, reaming, threading etc., are mounted on the faces of the turret. The turret holding upto six different tools, as shown in Fig. 4.5.13, for different machining operations moves slowly with one acting tool in front of it at desired feed rate, then after doing the particular machining operation returns at the end of which it gets indexed, i.e., rotated by 60° or multiple of it.

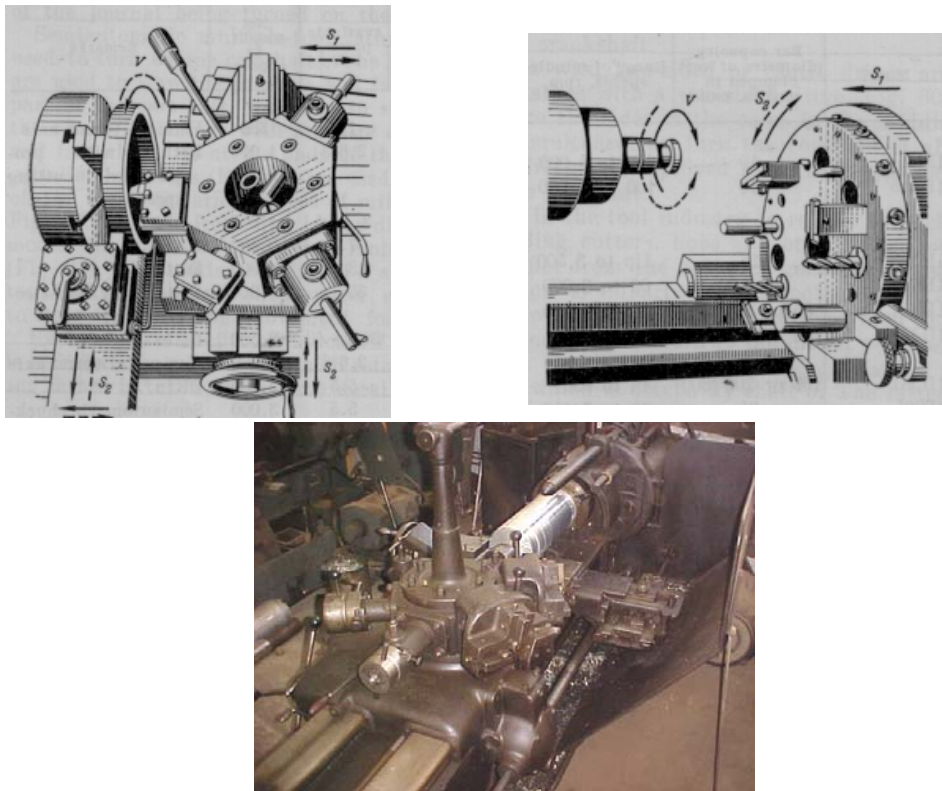


Fig. 4.5.13 Mounting of cutting tools on the turret in semiautomatic lathe.

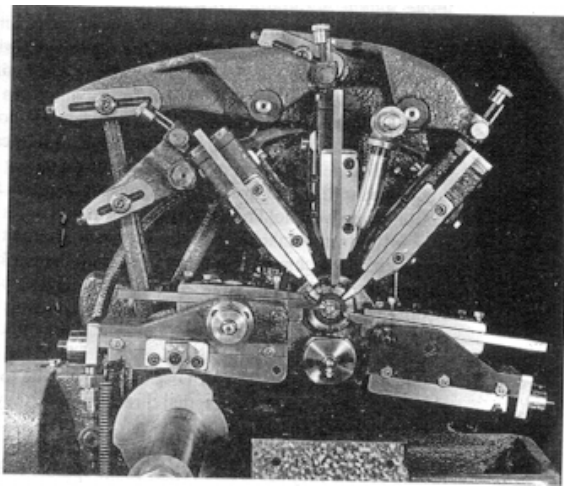
For faster production, a number of machining work, as far as feasible, are carried out simultaneously

- by compounding the cutting tool enabling more than one work
- by partially or fully overlapping the duration of action of radially moving tool with axially moving tool

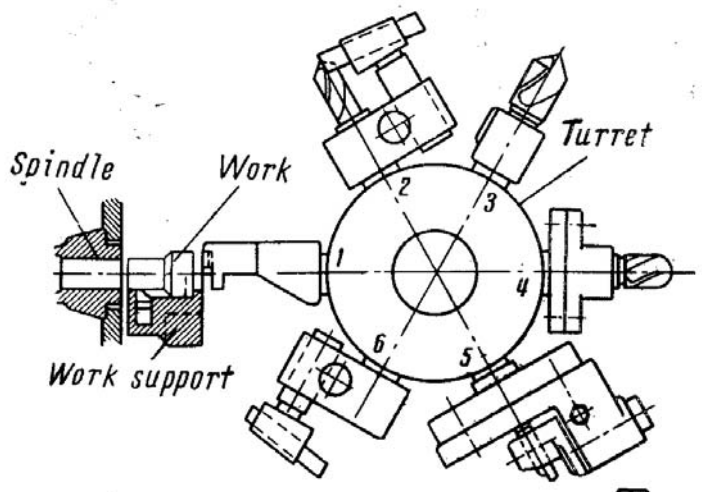
In addition to cutting tools, some other objects like stop-stock, revolving centre etc are also often need to be mounted in the turret.

Δ Mounting of tools in automatic lathes

In general purpose automatic lathes, i.e., single spindle automats also, the tools requiring transverse feed motions are mounted in the radial slides and those requiring axial feeds are mounted in the hexagonal turret which rotates with the tools about a horizontal axis for indexing as shown in Fig. 4.5.14.



(a) radially moving tools



(b) axially moving tools in turret

Fig. 4.5.14 Mounting of tools in single spindle automatic lathe.

(ii) (b) Mounting of jobs and tools in drilling machines

Mounting of job and tool in drilling machine are typically shown in Fig. 4.5.15 (a).

• Mounting of job or blank

In general purpose drilling machines like column and radial arm type, the workpiece or blank is generally mounted

- Δ by directly clamping on the drilling machine bed particularly when the job is heavy and / or of odd shape and size
- Δ in a vice which is clamped on the bed as shown in Fig. 4.5.15 (a)
- Δ in a suitable jig clamped on the bed.

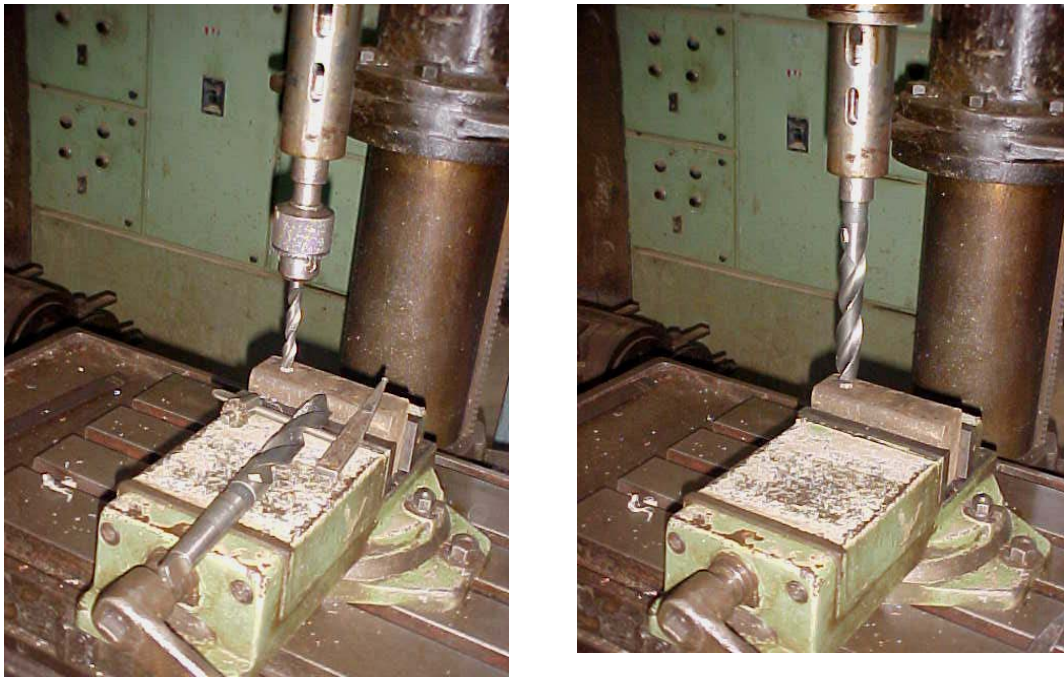


Fig. 4.5.15 (a) Mounting of job and tool in drilling machine

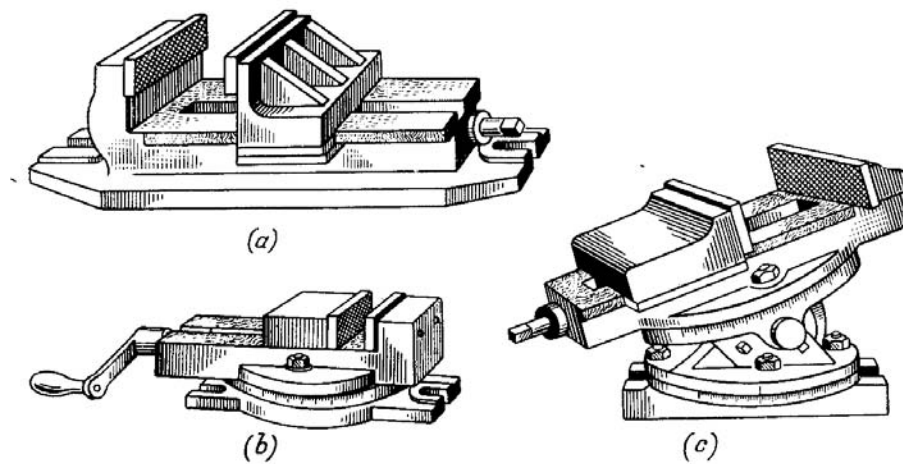


Fig. 4.5.15 (b) Vices to hold jobs in drilling machines

Direct clamping of job or clamping of the vice and jig on the drilling bed are done with the help of clamp plates, T-bolts etc., as indicated in Fig. 4.5.16. Fig. 4.5.15 (b) shows the type of vices; plain, swivelling and universal type being used for holding small jobs in drilling machines. Fig. 4.5.16 also typically shows how a job is fitted in a jig for drilling in batch production

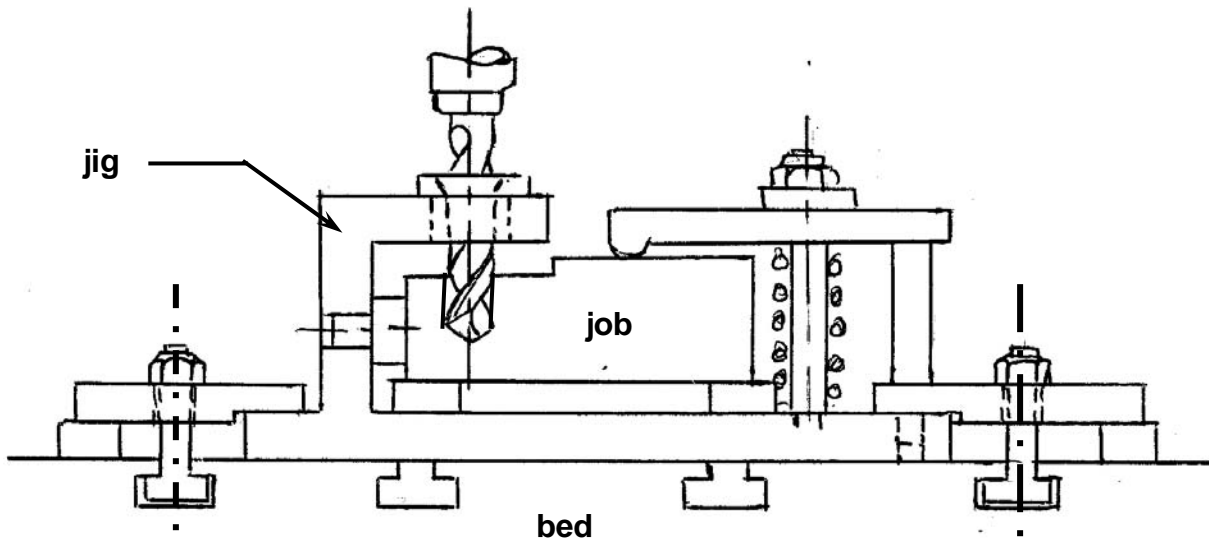


Fig. 4.5.16 Mounting of job in a jig which is clamped on the drill - bed.

- **Mounting of tools in drilling machines**

In drilling machines mostly drills of various type and size are used for drilling holes. Often some other tools are also used for enlarging and finishing drilled holes, counterboring, countersinking, tapping etc.

The basic methods of mounting drill bits in the spindle are simple as already has been typically shown in Fig. 4.5.15 (a).

Small straight shank type solid HSS and carbide drills are held in a drill chuck which is fitted in the drill spindle at its taper bore.

Larger taper shank drills are put straight in the spindle without drill chuck. However, for fitting the taper shank of the drill chuck and the taper shank drills in the spindle having larger taper bore, some sockets are put in between.

The sockets of varying size as shown in Fig. 4.5.17 are tapered inside to accommodate the taper shank of the drill chuck, drills and smaller sockets and tapered outside for fitting in the taper bore of the spindle :

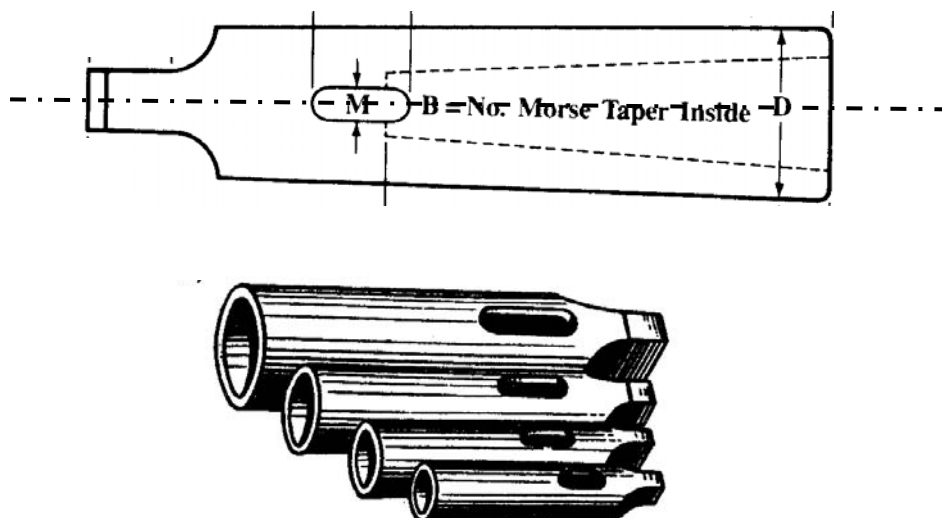


Fig. 4.5.17 Drill socket for mounting drill chuck and taper shank drills in spindle

Carbide drills are available in the form of;

- o Solid carbide with two helical flutes – usually these drills are of small diameter (≤ 6 mm)
- o Carbide tips – brazed in the steel shank
- o Carbide inserts mechanically clamped in straight or helically fluted steel shank as shown in Fig. 4.5.18.



Fig. 4.5.18 Drills with carbide inserts.

Small solid carbide drills are generally of straight shank type and held in drill chuck. The medium size (ϕ 6 to 12 mm) spade and lug type drills having carbide tip(s) brazed at its tip are provided with taper shank and hence mounted in the drill spindle directly or through taper socket(s). Mechanically clamped type carbide tipped drills are manufactured over a wide range diameter.

- the taper shank type of such drills are as usual fitted in the taper bore of the spindle with or without taper socket
- the straight shank type are fitted in suitable collets, or may be, if of smaller size, fitted in drill chuck.

(ii) (c) Mounting of jobs and cutting tools in

- Shaping machines
- Planning machines
- Slotting machines

• Job – tool mounting in shaping machines

Shaping machines with their limited stroke length and rigidity are used for machining small or medium size jobs.

- Job is mounted on the bed of shaping machine in the following ways :
 - o Relatively large and odd shaped blanks are generally directly clamped on the bed with the help of clamps, supports, and T-bolts being fitted in the T-slots in the bed. Some odd shaped jobs are often clamped on the side surfaces of the bed.
 - o Blanks of small size and geometric shape are gripped in a vice which is firmly clamped on the bed as shown in Fig. 4.5.19. For locating and supporting the blank in the vice parallel blocks and Vee-blocks are used.
 - o In case of batch or small lot production, the blank is mounted in the fixture designed and used for that purpose. The fixture remains rigidly clamped on the bed.

- Machining is done in shaping machines only by single point tools, even if it is a form tool. And only one tool is used at a time. That shank type tool is mounted, as can be seen in Fig. 4.5.19,

- △ either directly in the clapper box
- △ or in a tool holder which is fitted in the clapper box.



Fig. 4.5.19 Mounting of job and tool in shaping machine.

- **Job-tool mounting in planing machine**

Planing machines are used for machining large and heavy jobs requiring large work table, large stroke length and reasonable productivity.

- **Mounting of job in Planing machine**

- For conventional machining the large and heavy job is directly mounted on the work table and rigidly clamped with the help of number of clamps, angle plates, and T-bolts.
- Occasionally, some rod like jobs are mounted in between centres for some special work requiring rotation of the rod.

- **Mounting of tools in planing machines**

In planing machines also, only single point cutting tools are used but usually more than one tool is used simultaneously from different planes and angles. Fig. 4.5.20 typically shows the method of tool mounting in planing machine.

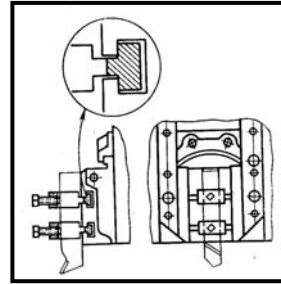


Fig. 4.5.20 Mounting of cutting tools in planing machine

- **Job-tool mounting in slotting machine**

Vertical shaper like but less rigid slotting machines are used for less volume of machining work with light cuts and lower MRR using only one single point tool at a time.

- **Job mounting on slotting machine**

It is already known that in slotting machine the flat work table can linearly slide along X and Y directions over the guides. In addition to that there is a rotary table fitted on the top of the sliding bed. On the rotary table chuck, face plate and even small fixtures can be mounted.

Depending on the types of the job and machining work required, the blank is mounted

- Δ directly on the top of the sliding bed with the help of clamps etc.
- Δ on the rotary table or in the chuck as shown in Fig. 4.5.21.
- Δ occasionally in the fixture which is clamped on the flat bed or face plate.

- **Tool mounting in slotting machine**

The method of mounting the single point cutting tool is also typically shown in Fig. 4.5.21.

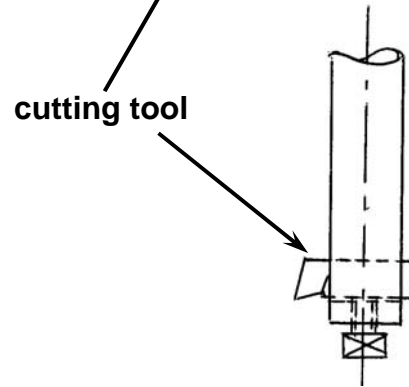
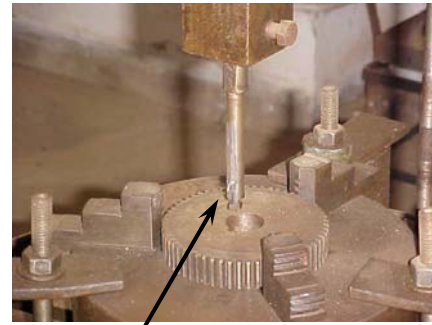


Fig. 4.5.21 Mounting of job and tool in slotting machine

(ii) (d) Mounting of Job and Tool in milling machines

□ Mounting of job or blank

Job or blank is mounted in general purpose milling machines as follows :

- relatively large and irregular shaped jobs for piece or job order production are directly mounted and clamped on the table with the help of clamps, supports, Vee-blocks, T-bolts etc.
- small components of geometrical shape are gripped in the vice which is rigidly clamped on the table
- jobs requiring indexing motion, e.g., prisms, bolt-heads, gears, splines etc. are mounted directly or indirectly (using a mandril) in a dividing or indexing head as shown in Fig. 4.5.22
- small jobs, for its repetitive or batch production, are preferably mounted (located, supported and clamped) in the fixture (designed for the purpose) which is firmly clamped on the table.

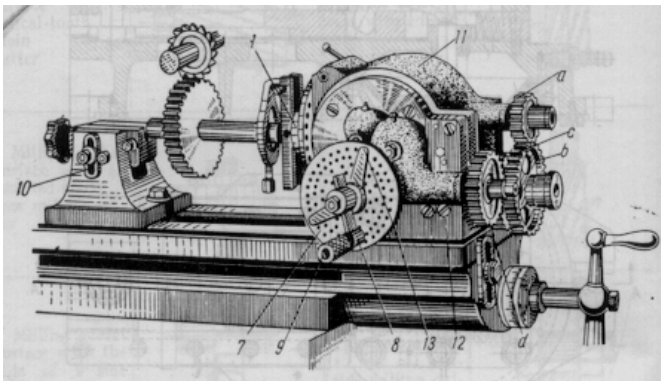


Fig. 4.5.22 Mounting of job on the dividing head in milling machine.

□ Mounting of cutting tools in milling machines

Milling cutters are rotary tools of various sizes, configurations and materials. The general methods of mounting cutting tools in general purpose milling machines are :

- Plain or slab milling cutters and disc type profile sharpened or form relieved cutters (having central bore) are mounted on horizontal milling arbour as shown in Fig. 4.5.23.
- End milling cutters with straight shank are mounted coaxially in the spindle – bore with the help of collet - chuck as shown in Fig. 4.5.24
- Shell milling cutters and heavy face milling cutters are mounted in the hollow spindle with the help of a short but rugged arbour, a fastening screw and a draw bar as shown in Fig. 4.5.25
- In case of carbide tipped milling cutters, the uncoated or coated carbide inserts of desired size, shape and number are mechanically clamped at the periphery of the plain and disc type milling cutters, large end milling cutters and face milling cutters as typically shown in Fig. 4.5.26. End mills of very small diameter are provided with one or two carbide inserts clamped at the tool – end.

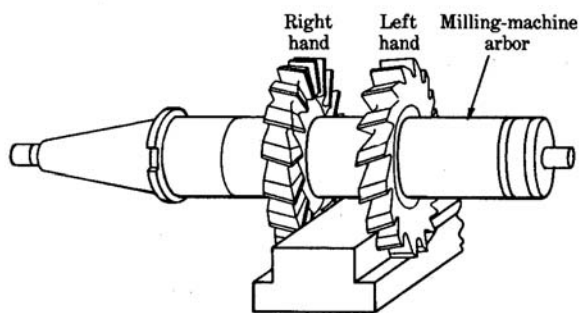


Fig. 4.5.23 Mounting of cutting tools on milling arbours.

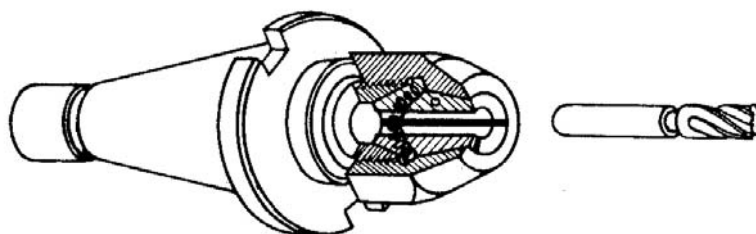


Fig. 4.5.24 Mounting of straight shank end milling cutters in spindle by collet.

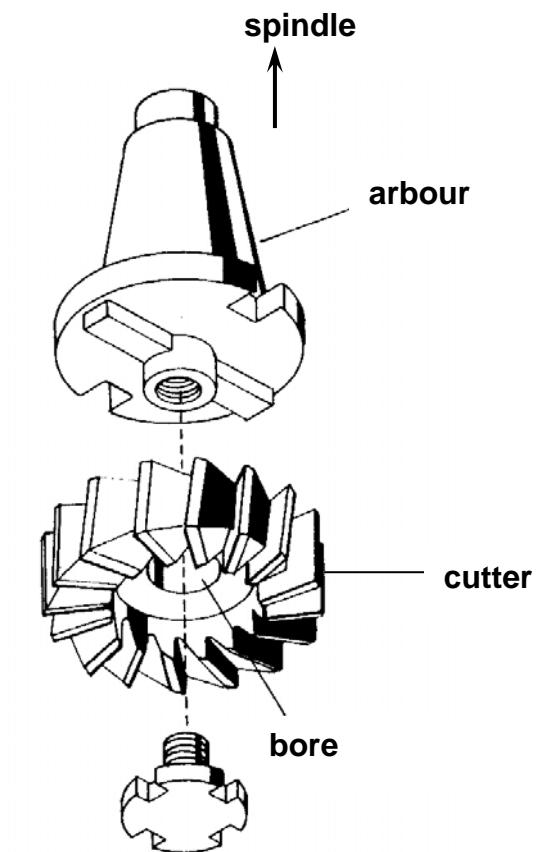


Fig. 4.5.25 Mounting shell and face milling cutters in milling machine spindle.



Fig. 4.5.26 Carbide tips clamped in milling cutters.

(ii) (e) Mounting of job and tool in grinding machines

Grinding is a finishing process in which material is removed by the large number of tiny tool like abrasive particles dispersed or embedded in a softer matrix or on a metallic substrate respectively. In grinding, the cutting tool, i.e., the wheel rotates about its axis at high speed imparting the cutting velocity and the job or workpiece moves slowly against the wheel imparting the desired feed motion as schematically shown in Fig. 4.5.27.

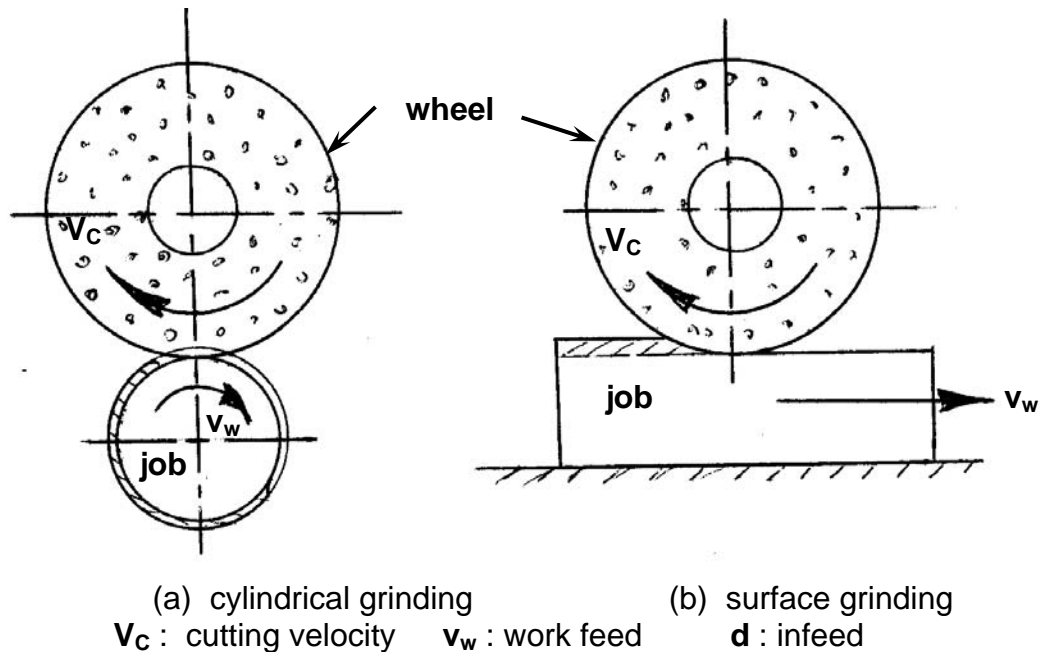


Fig. 4.5.27 Tool work interactions in grinding

The method of mounting job and tool (wheel), specially job, depends upon the type of the grinding process under consideration.

Though grinding has several applications, the basic types of grinding processes are

- Cylindrical grinding : * external
 * internal
- surface (flat) grinding : * horizontal wheel axis
 Δ reciprocating work table
 Δ rotating table
 * vertical wheel axis
 Δ linearly moving table
 Δ rotating table
- form grinding : * external
 * internal
- free form grinding : 3-D contouring
- centreless grinding : * external
 * internal

□ Mounting of job (workpiece / blank) in grinding machines

Fig. 4.5.28 schematically shows the typical methods of mounting the jobs in cylindrical grinding machines. The cylindrical job is mounted in between centres for external grinding and in chuck in internal grinding.

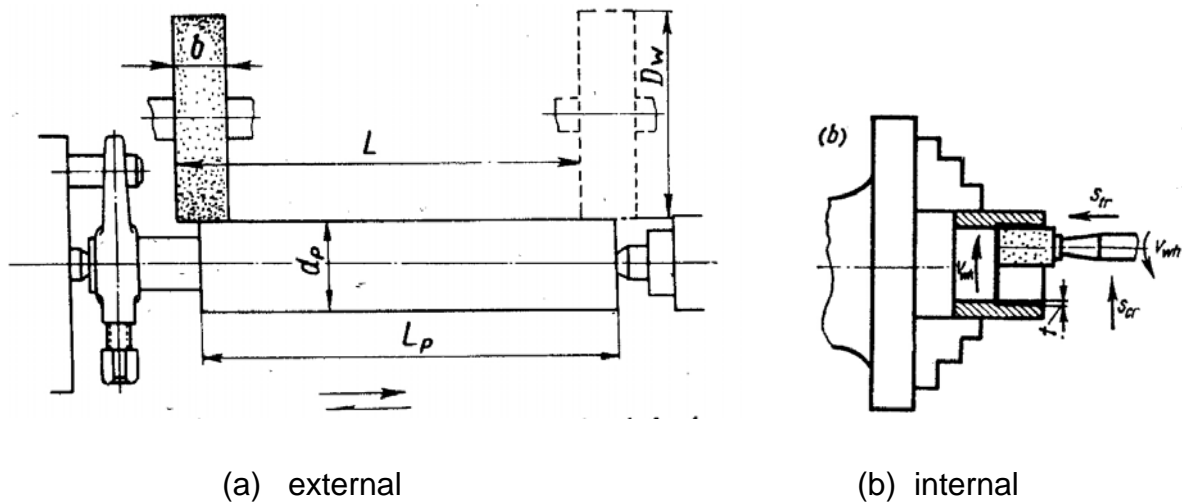


Fig. 4.5.28 Mounting of job in cylindrical grinding.

In reciprocating type surface grinding, the workpiece is mounted on the work table in four possible ways :

- On a rectangular magnetic chuck which is clamped on the table as shown in Fig. 4.5.29
- Gripped in a vice which is held on the magnetic chuck or directly clamped on the table
- Directly clamping on the table by clamps, T-bolts etc
- In a fixture which will be clamped on the table or the magnetic chuck.

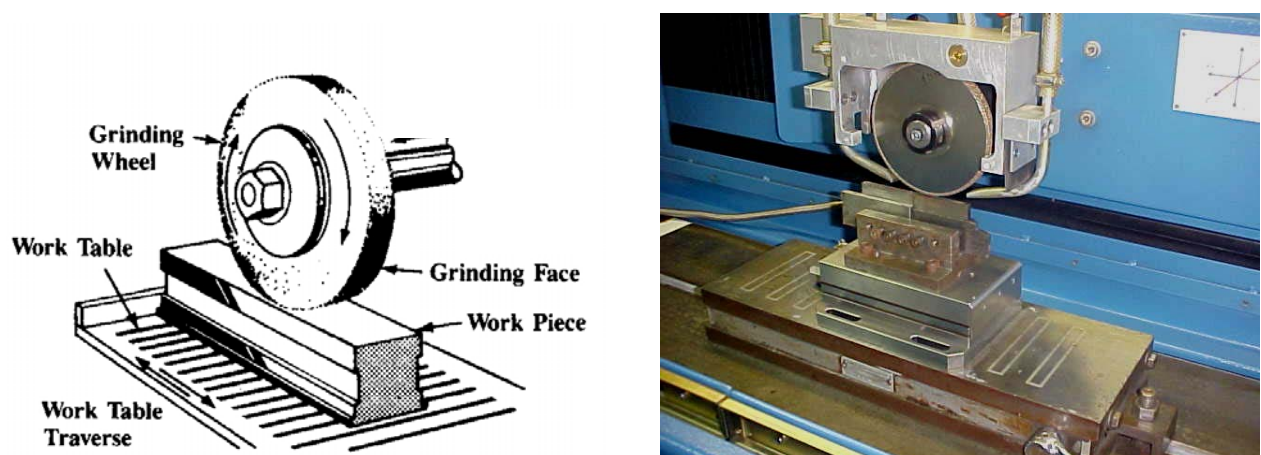


Fig. 4.5.29 Mounting job on magnetic chuck in reciprocating type surface grinding.

The methods of mounting small jobs in batches for surface grinding with horizontal and vertical wheel axis are shown in Fig. 4.5.30.

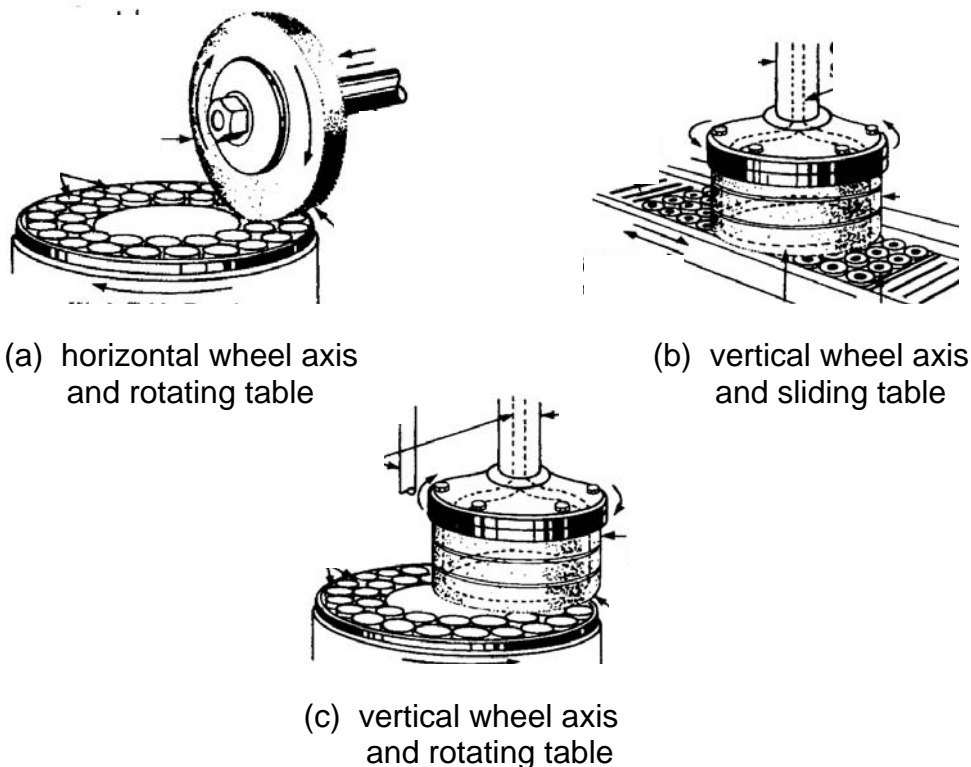
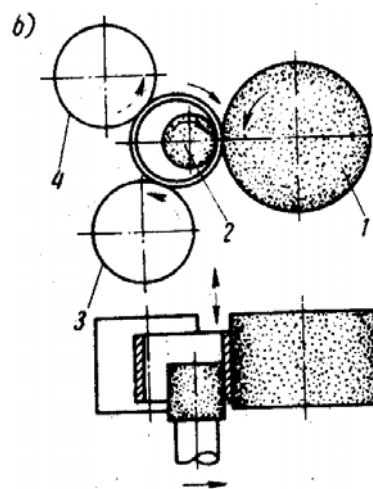
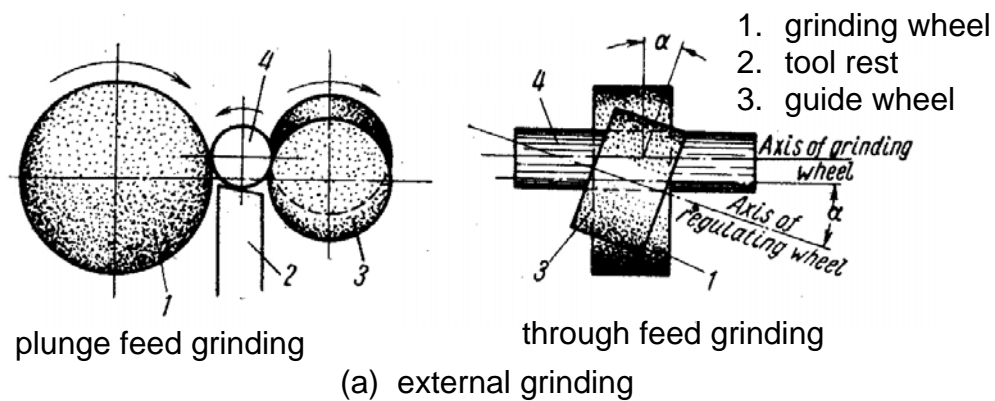


Fig. 4.5.30 Mounting of small jobs for surface grinding in batch production.

Form grinding like grinding of screw threads, gear teeth, cutter flutes etc. may be in both cylindrical grinding and surface grinding modes. Therefore, job mounting is done accordingly.

Fig. 4.5.31 schematically shows how the job is mounted and ground in centreless grinding. In external centreless grinding the rod shaped job is held in position, slowly rotated and also axially moved, if necessary, by a rest and the guide wheel which rotates slowly providing the desired work feed motions. In internal centreless grinding, the ring shaped blank is held in position by the guide wheel and the supporting wheels but attains its rotary feed motion from the rotating guide wheel only.

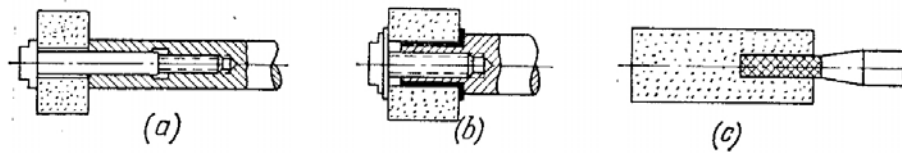


(b) internal grinding

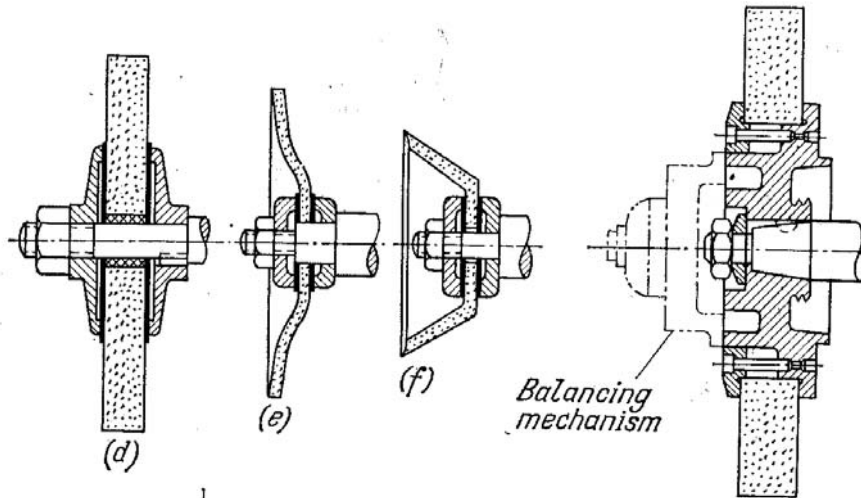
Fig. 4.5.31 Mounting of job in centreless grinding.

□ Mounting wheel in grinding machines

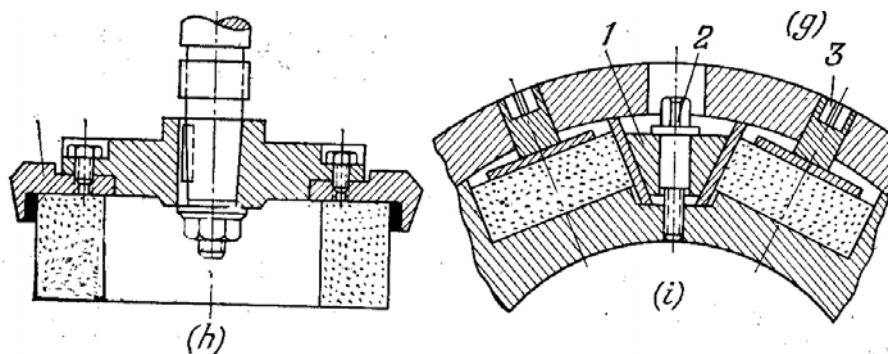
All the grinding wheels are circular shaped and rotate only about their own axis. A grinding wheel is always coaxially mounted on the spindle nose as shown in Fig. 4.5.32 which visualises the variation in the exact method of mounting of the wheel depending upon the type, size and shape of the wheels.



(i) for internal grinding



(ii) for external grinding with horizontal wheel axis



(iii) large and heavy ring shaped wheel on vertical spindle

Fig. 4.5.32 Mounting of grinding wheels on spindle

(iii) Mounting of job and tool in CNC machine tools

• Mounting of jobs

CNC machine tools are also general purpose machine tools but distinguished for;

- Flexibility through programmability enabling quick change over to new products
- Versatility
- Ability to machine complex geometry
- Dimensional accuracy

- Computer control

Successful accomplishment of the aforesaid features of CNC machines necessitates the job – tool and their mounting to have some essential characteristics :

□ **Characteristics of job – mounting**

- Easy, quick and very accurate locating, supporting and clamping
- Quick and easy loading and unloading of the unfinished and finished job to and from the machine tool, preferably by robots
- Avoidance of jigs and fixtures
- Ability to cover wide range of size and shape of the blanks
- Identification or fixation of datum surfaces

In CNC lathes and turning centres, jobs are mounted on the spindle by using quick acting collet chucks operated pneumatically or hydraulically. In CNC milling and drilling machines, the jobs are clamped directly or in a vice on the table as shown in Fig. 4.5.33. Jigs and fixtures are not used.

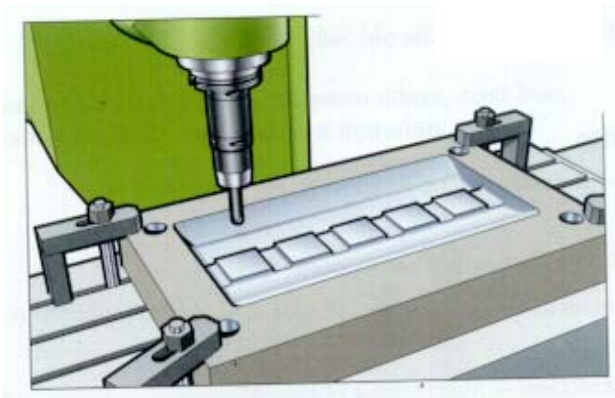


Fig. 4.5.33 Mounting of job on the bed by clamping in CNC milling machine.

□ **Characteristics of tool mounting**

- Easy, quick and accurate locating and clamping
- Large tool bank
- Quick tool change
- All the tools to be used in a specific machine tool must have same shank of standard dimensions.

Fig. 4.5.34 schematically shows tool mounting in a turret type CNC drilling machine where the tools are used in sequence according to requirement and programmed.

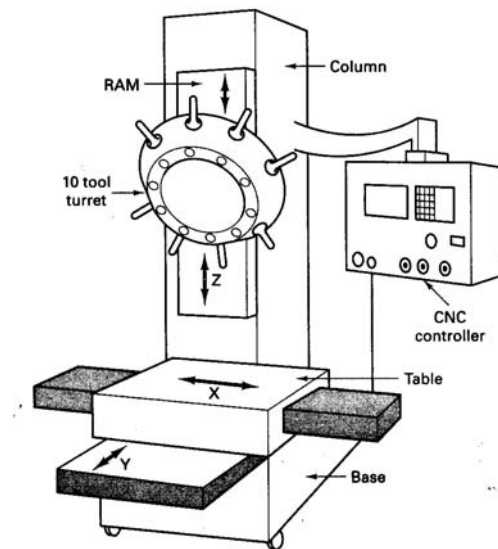


Fig. 4.5.34 Tool mounting in turret type CNC drilling machine.

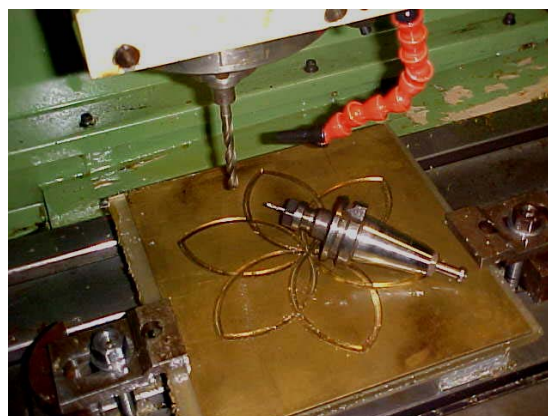
Fig. 4.5.35 typically shows (a) tool bank, (b) auto-tool-changer (ATC) and the (c) configuration of tool holder being used in versatile CNC milling machine or Machining Centre.



(a) tool bank



(b) auto-tool-changer (ATC)



(c) configuration of tool holder

Fig. 4.5.35 Tool bank, auto tool changer (ATC) and configuration of tool holder used in CNC milling machine.

The sophisticated and precision CNC machine tools are essentially characterised by quick and accurate mounting and rigid clamping of the cutting tools and also proper and rigid mounting of the blanks in appropriate positions.

