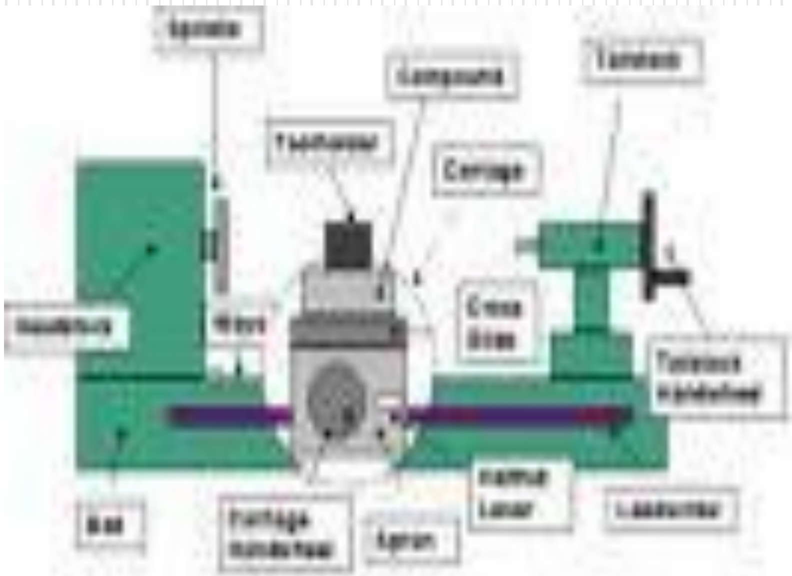
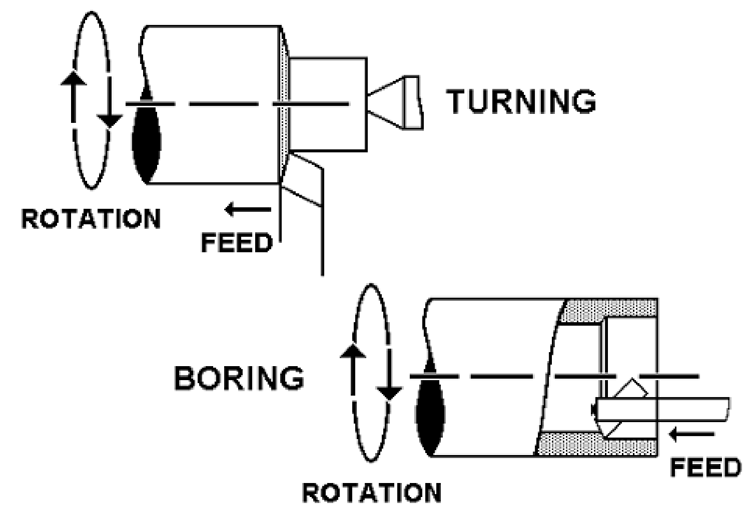
Workshop Practice
TA 102
Lec – 8: Turning Operations





By Prof.A.Chandrashekhar

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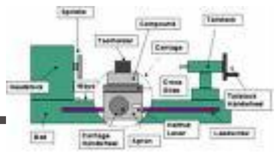


- used for producing the cylindrical machined surfaces
- It is the oldest, most basic, most versatile, and most widely used of all the machine tools.
- It is known as **mother of machine tools**.
- The job to be machined is rotated (or turned) and the cutting tool is moved relative to the job. For this reason lathe are also known as turning machines and metal cutting operations on lathes are called turning operations.

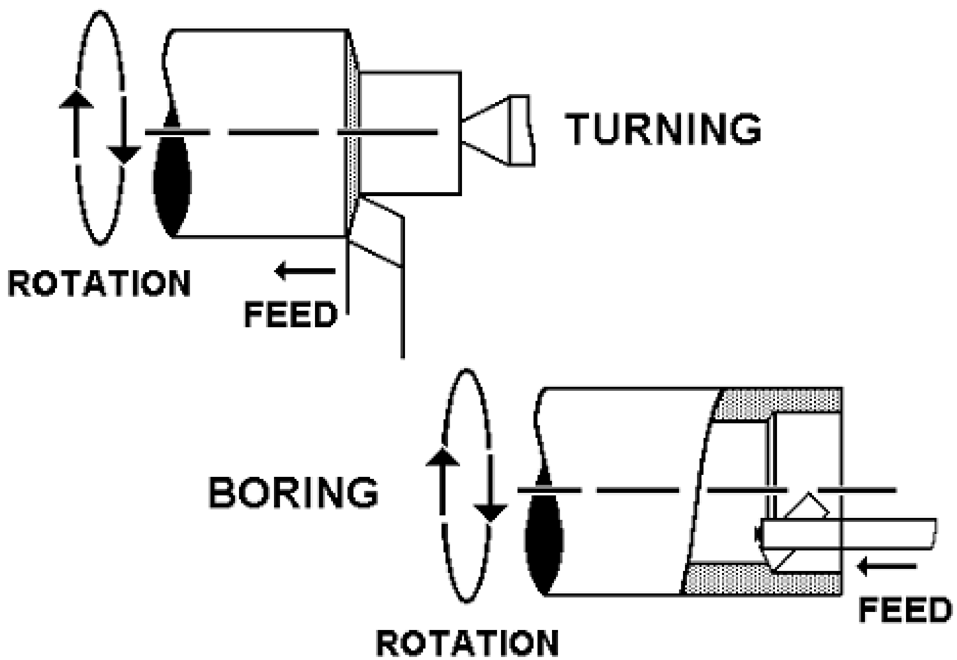
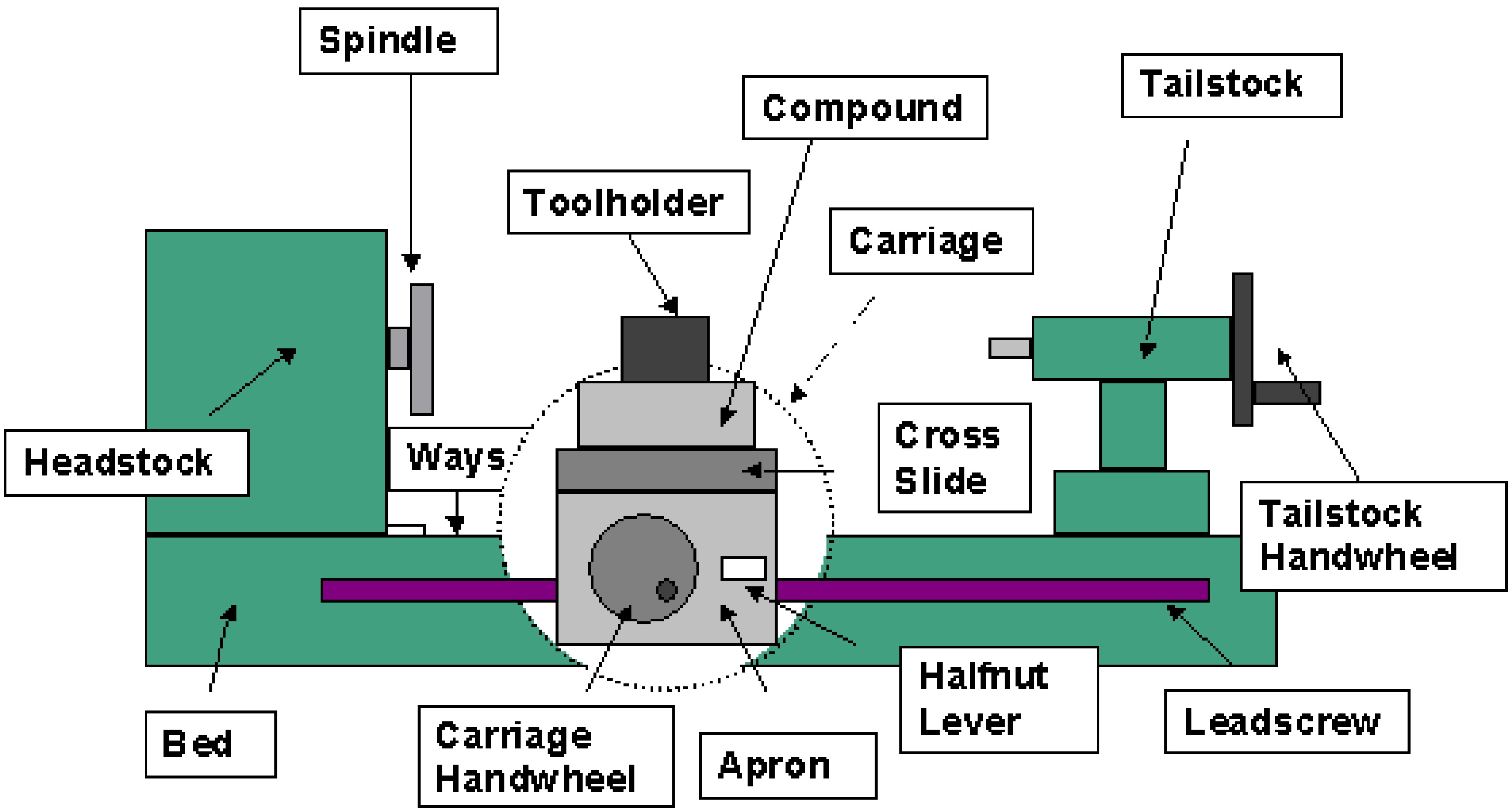
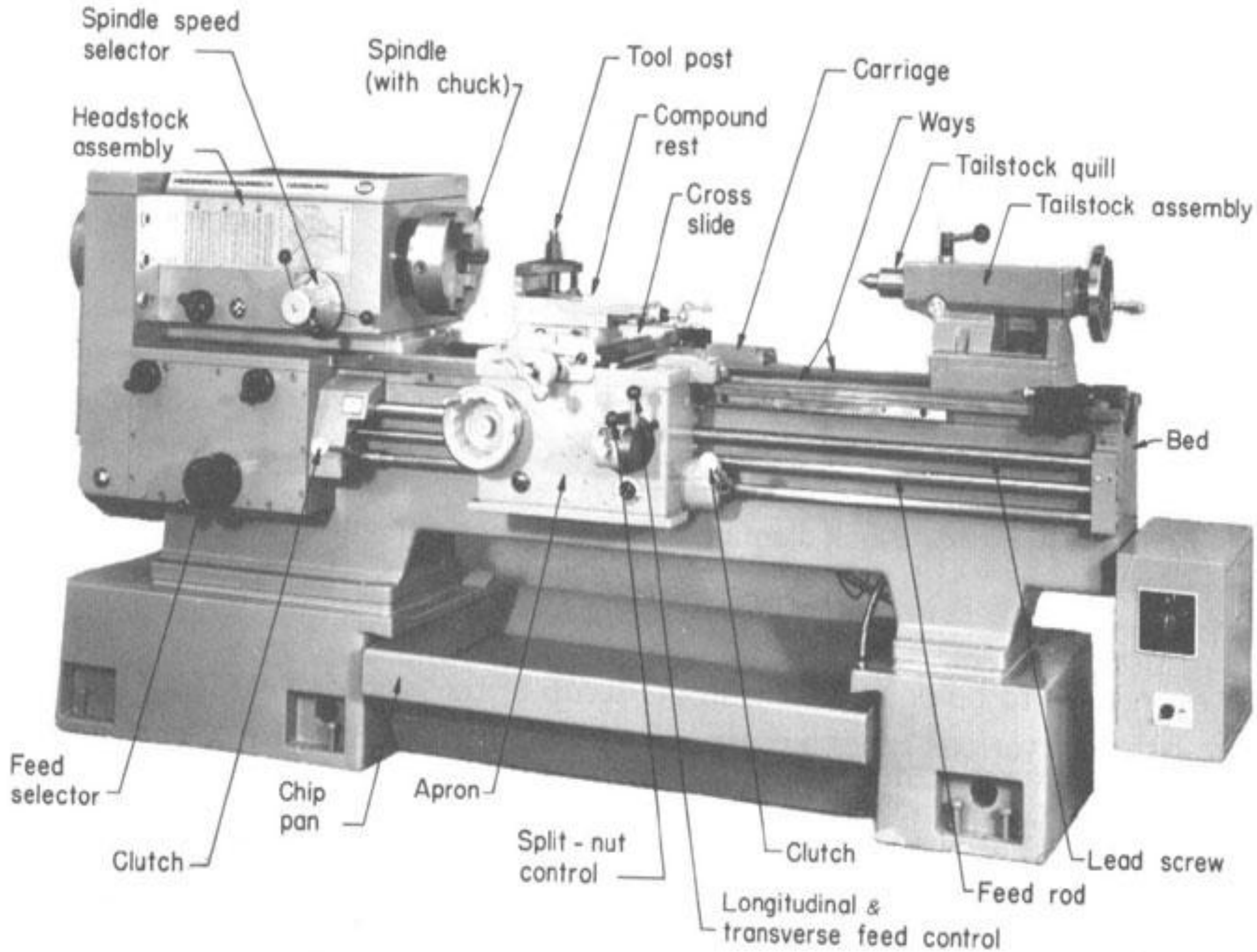

TURNING
ROTATION
FEED
BORING
ROTATION
FEED

Diagram Showing Lathe Parts




Spindle speed selector
Spindle (with chuck)
Tool post
Carriage
Headstock assembly
Compound rest
Ways
Tailstock quill
Cross slide
Tailstock assembly
Bed
Feed selector
Chip pan
Apron
Clutch
Split - nut control
Clutch
Lead screw
Feed rod
Longitudinal & transverse feed control

Lathe Tools

LATHE

Lathe may be equipped with a variety of attachments and accessories to facilitate the machining and to perform the specialized tasks.

BED :

the bed is the base of the lathe and it supports all the other major components of the lathe. Beds have a large mass and are built usually from gray cast iron to resist deflection and absorb vibrations.

The three main parts of lathe are

Head stock

Tail Stock

Carriage

- HEAD STOCK

The head stock is secured permanently at the left hand end of the lathe bed.

It supports the spindle and is equipped with the power driven mechanism for the spindle

TAIL STOCK (loose head stock)

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The tail stock is located at the right hand end of the bed.

It can be moved along the guide ways and can be clamped in any position on the bed.

The main function of tailstock is to hold the dead centre and to support the long work pieces during machining.

- **Carriage:**

The carriage slides along the guide ways between the head stock and tail stock and consists of an assembly of the cross slide, the tool post, the compound rest and apron.

the main functions of the carriage is to hold the cutting tool and move it to give longitudinal and/ or cross feed to it.

Compound rest or compound slide

- is used for obtaining angular cuts and short tapers
- Compound rest swivels the tool for positioning and adjustment.
- the tool post is located at top of the compound rest to hold the tool and to enable it to be adjusted to a convenient working position.
- The Apron is equipped with mechanisms for both manual and mechanized movements of the carriage and the cross-slide, by means of lead screw and feed rod.

- **Feed rod and Lead screw**

the feed rod is powered by a set of gears from the head stock. It rotates during the operation of the lathe and provides mechanized movement to the carriage or the cross-slide by means of gears, a friction clutch, and a key way along the length of the feed rod.

the Lead screw is also powered by a set of gears from the head stock and is used for providing specific accurate mechanized movement to the carriage for cutting threads on the work piece.

Size of a Lathe

A lathe is usually specified by

- The maximum diameter of the work piece that can be machined
- The maximum distance between tail stock and head stock centers and
- The length of bed

Operating Conditions In a lathe

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- **operating conditions or cutting conditions refers to Speed, feed and depth of cut**

Cutting Speed

Cutting speed is the peripheral speed of the work piece past the cutting tool.

For a work piece , say a circular bar of diameter D rotating at N revolutions per minute (rpm),

The peripheral speed is given by

S = Peripheral Speed = πDN/1000 m/min

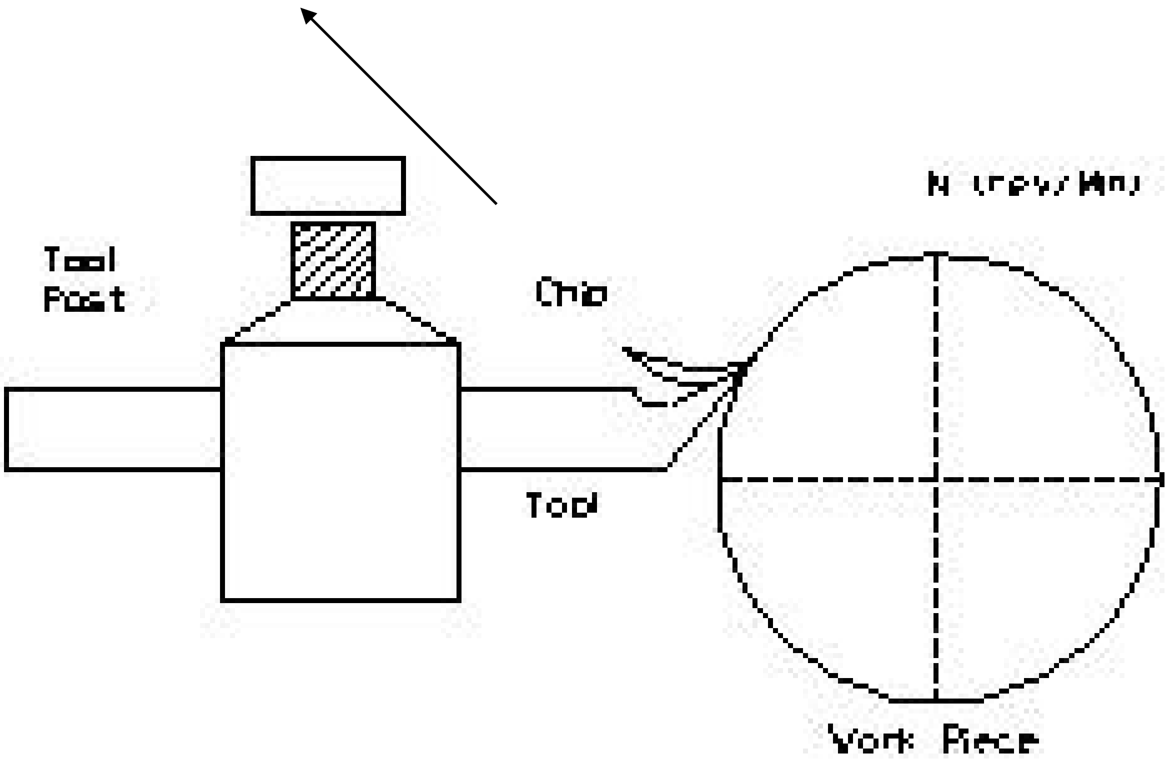
Where,

D – Diameter of the job in mm and

To get speed in m/min conversion factor of 1000 mm/m is used.

=Cutting speed = Peripheral Speed = S = πDN/1000

Turning Speed



- Feed

The Distance that the tool advances for each revolution of the work.

It is expressed in mm/revolution.

Ex: feed = 2mm/revolution implies tool moves 2mm for every revolution of the job

- **Depth of cut:**

the depth of cut is the perpendicular distance measured from the machined surface to the uncut (or previous cut) surface of the work piece.

For the turning operations,

the depth of cut = d = $D_1 - D_2 / 2$ mm

Where,

D_1 = original diameter of the work piece in mm

D_2 = final diameter of the work piece in mm

in turning operation if the depth of cut is 1mm, then the diameter will be reduced by 2mm

Material Removal Rate (MRR)

- It is the volume of material removed per unit time.
- Volume of material removed is a function of speed, feed and depth of cut.

D – original diameter of work piece in mm

d – represents depth of cut

f – feed in mm/rev

Material removed per revolution = πD and

Whose area = d X f

Volume of material removed in one revolution =

$\pi \times D \times d \times f$ mm^3

Since job is making N revolutions per minute

MRR = $\pi \times D \times d \times f \times N$ $mm^{3/min}$

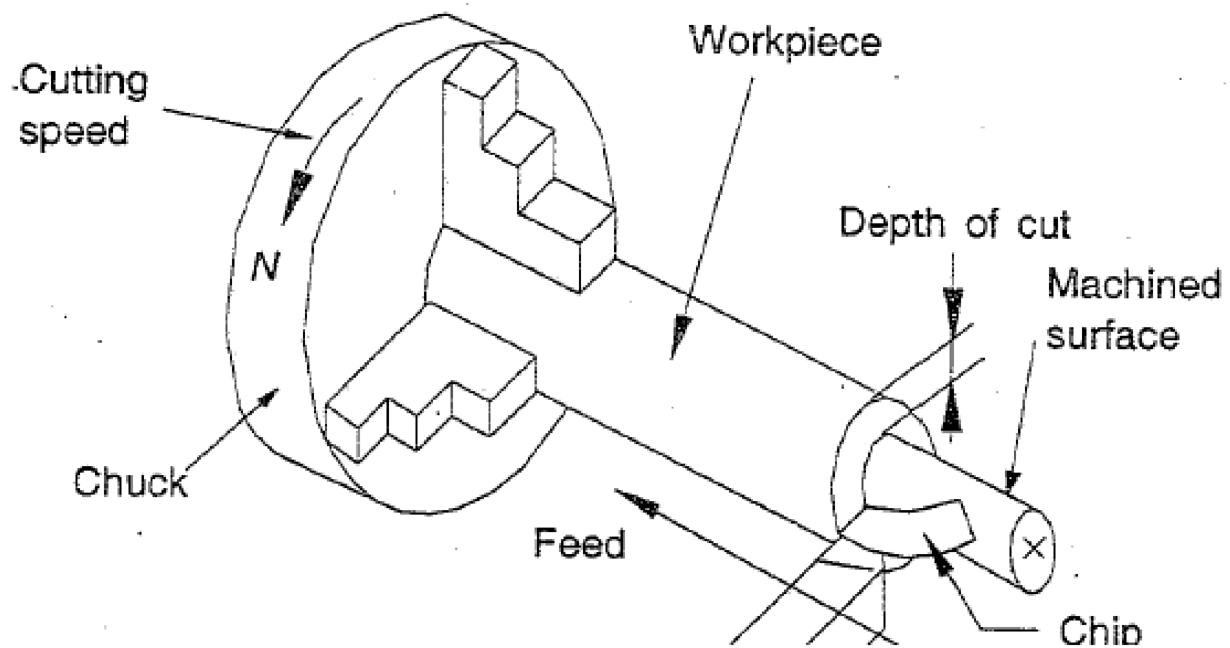
Operations on lathe

- Though lathe is used for producing cylindrical jobs, with special accessories and attachments, it can be used for machining of non cylindrical jobs.
- The different operations that can be done on cylindrical job include

  turning, facing, Knurling, grooving, form turning, parting, chamfering, eccentric turning, taper turning, thread turning, thread cutting and drilling.

TURNING

Turning is the most basic lathe operation in which excess material from the given work piece is removed to reduce its diameter.



FACING

•Facing is the operation of machining the end or face of the job held in a chuck or face plate.
•Facing is used for reducing the length of the work piece by machining or cutting the end face of work piece.
•Facing operation is carried out using turning tool The operation involves feeding the tool perpendicular to the axis of rotation of the work piece from outer surface to centre.
•Length of tool travel is half the diameter of the job.

FACING

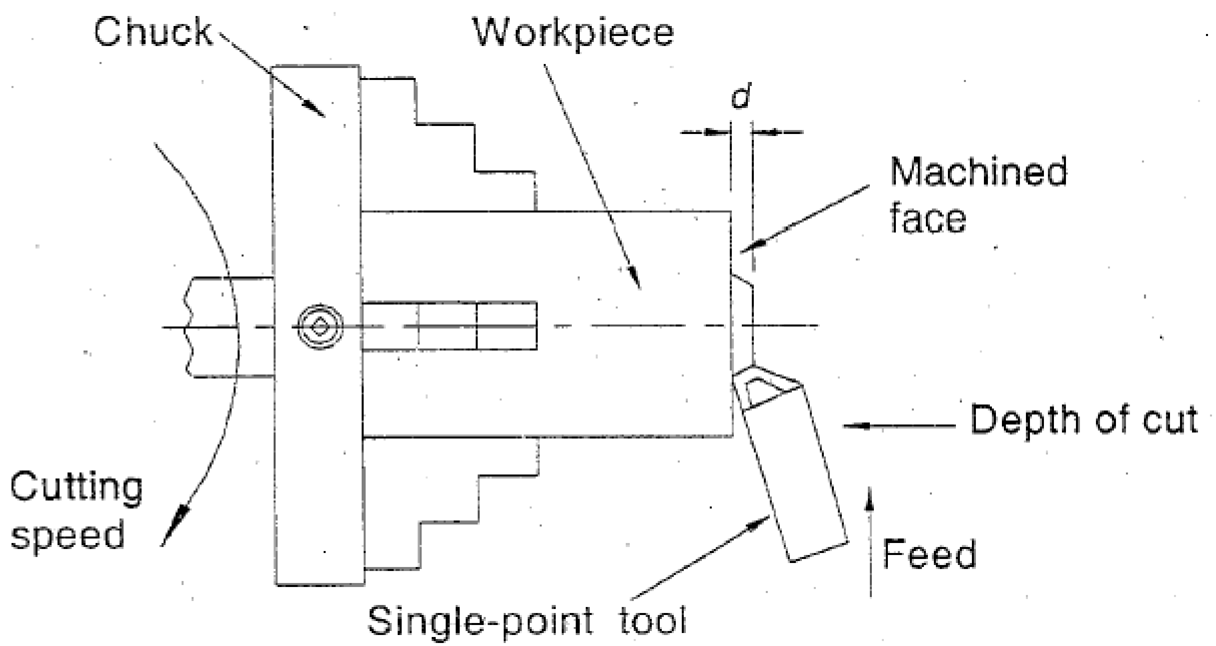


Figure 5.12 Facing operation.

KNURLING

- A knurling operation, carried out on a lathe, is used to produce regular patterned rough surface
- Knurling is the process of embossing a diamond shaped regular pattern on the surface of work piece using a tool called Knurling tool.
- Knurling is not a metal cutting process. It is a method of squeezing the metal hard enough to cause plastic movements of metal in to peaks and troughs.

KNURLING

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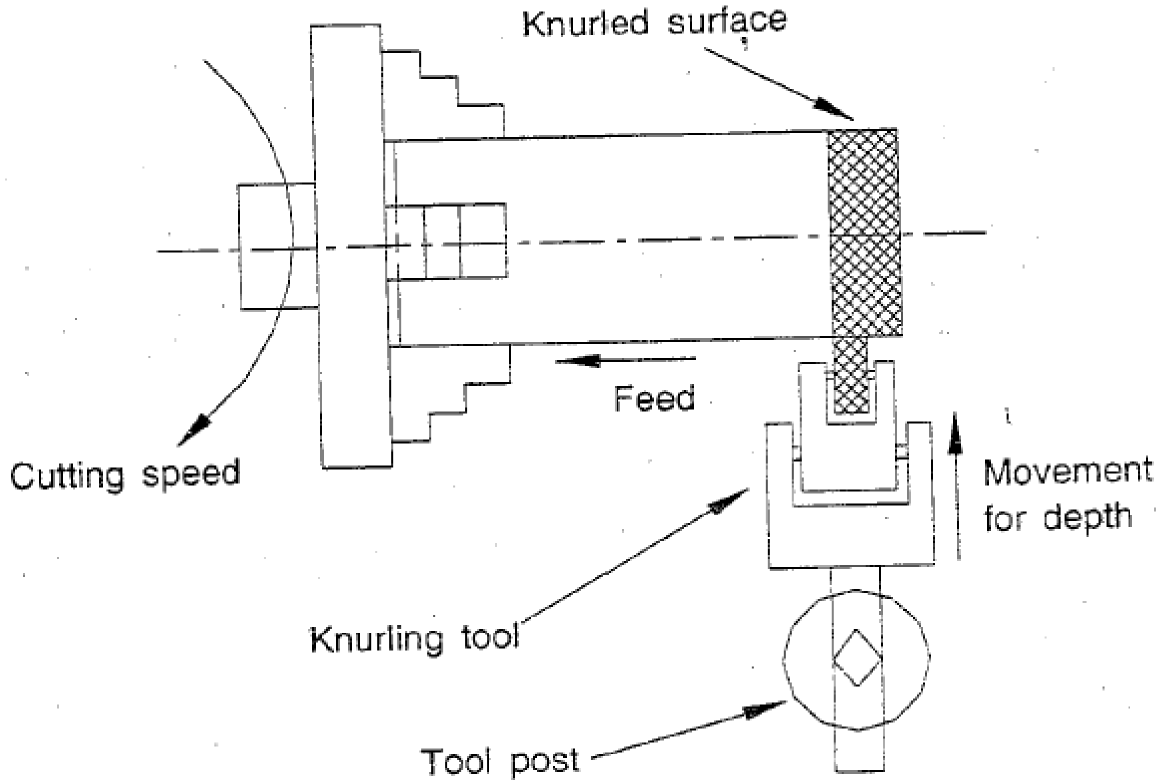
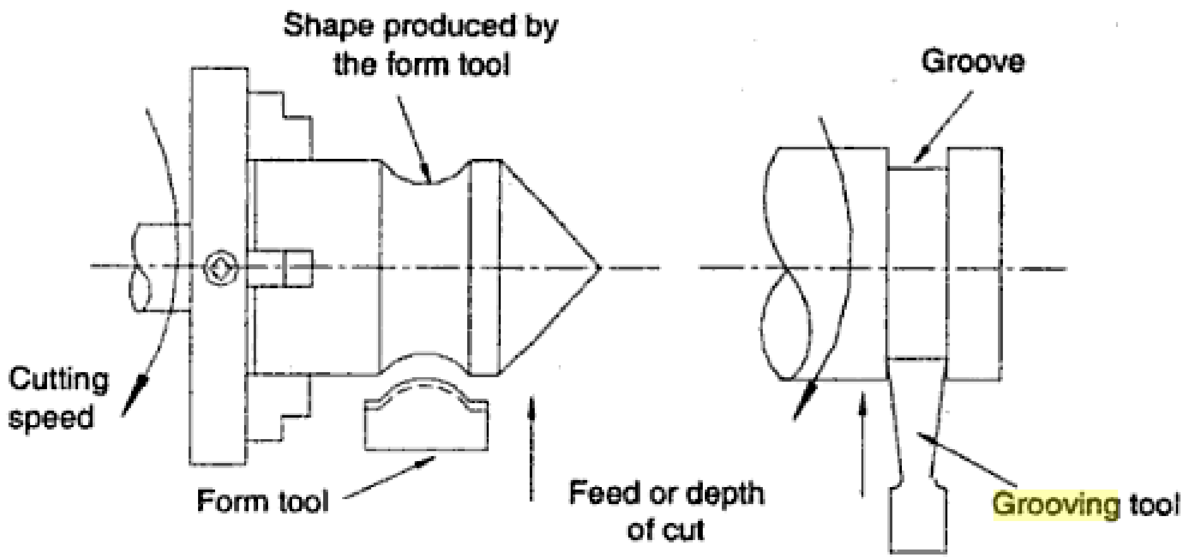


Figure 5.13 The knurling operation.

Grooving

•Groove or grooving is the process of producing a narrow groove on the surface of a cylindrical job. There is no feed in groove operation



Parting

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•Parting is the operation of cutting a work piece in to two parts.
•If slow feed is used, the tool will not cut continuously but will ride on the surface for a revolution or two, and then bite in suddenly. This phenomenon is known as hogging.

Turning Operatio

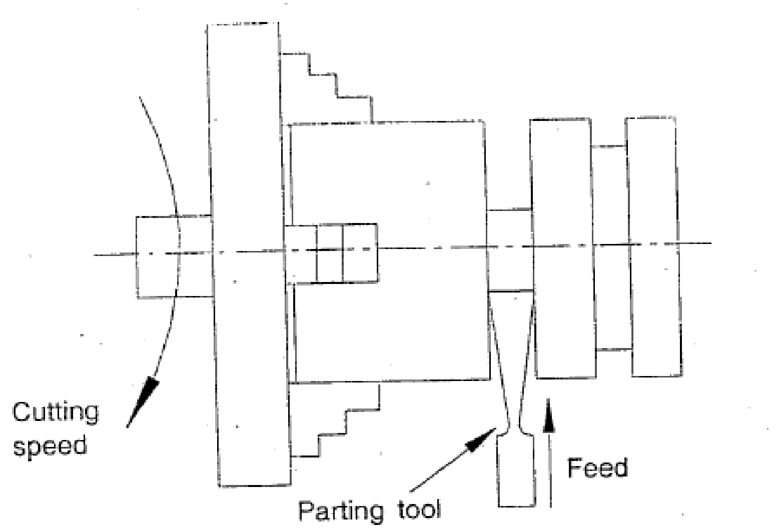

Figure 5.15 Parting operation.

Chamfering

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•Chamfering is the operation of beveling the sharp ends of the work piece to avoid any injuries to the person using the finished product.

•Chamfering angle usually 45^0

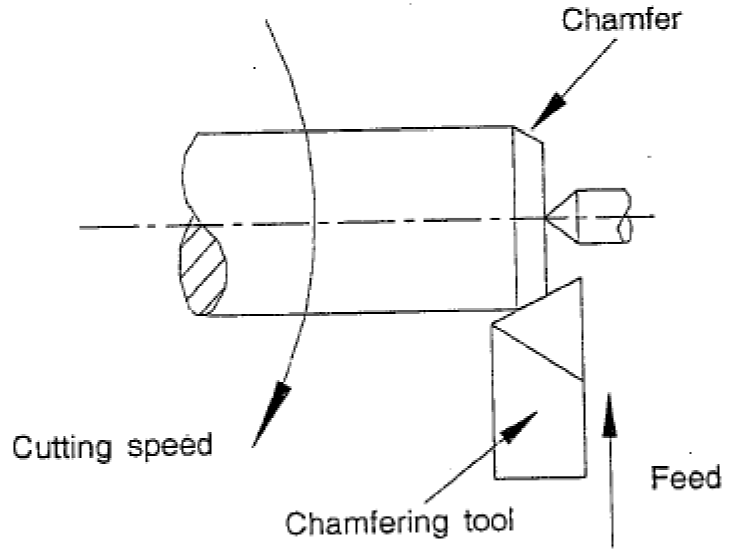

Figure 5.16 Chamfering operation.

Eccentric turning

- If the turning operation is carried out at a certain distance away from the center of the work piece, it is called eccentric turning.

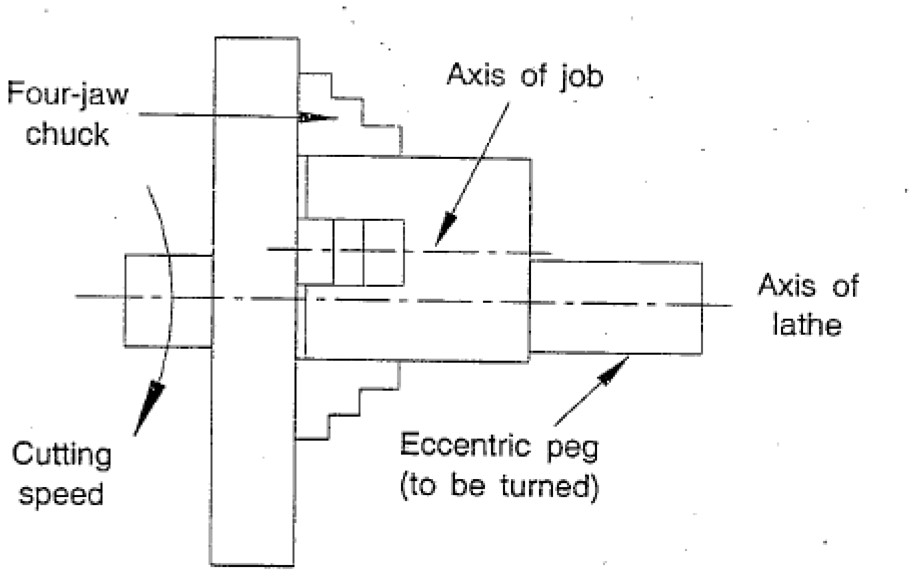

Figure 5.17 Eccentric turning.

Taper turning

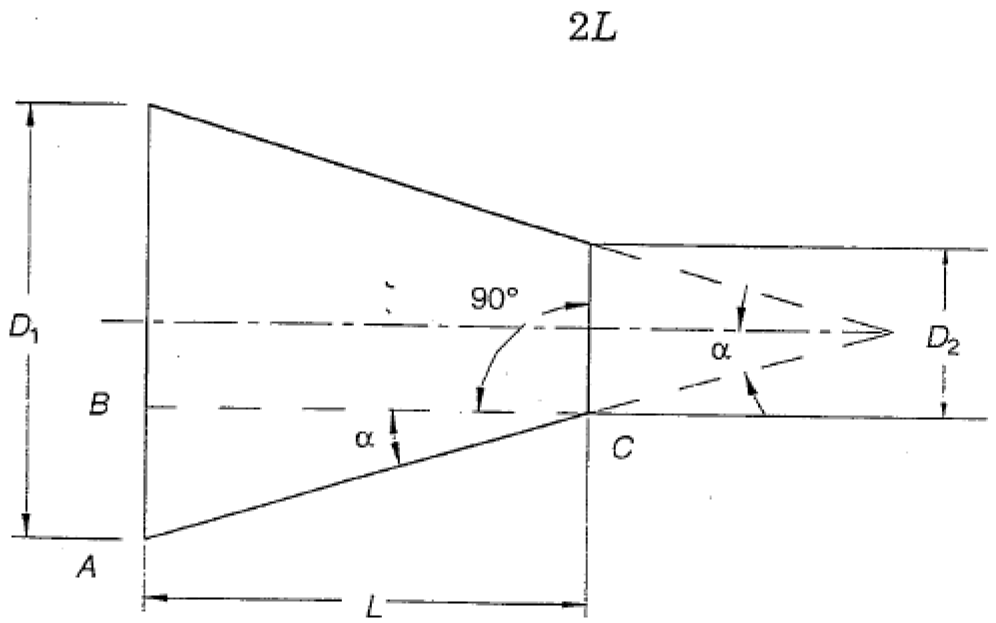

Figure 5.18 A tapered job showing taper angle.

Taper turning using a form tool

The form tool has a straight cutting edge set at the desired taper angle. Form tool is a replica of the taper to be produced, i.e., the angle between the straight cutting edge and the rational axis of the job equals taper angle ∞ or one half the included angle of the taper.

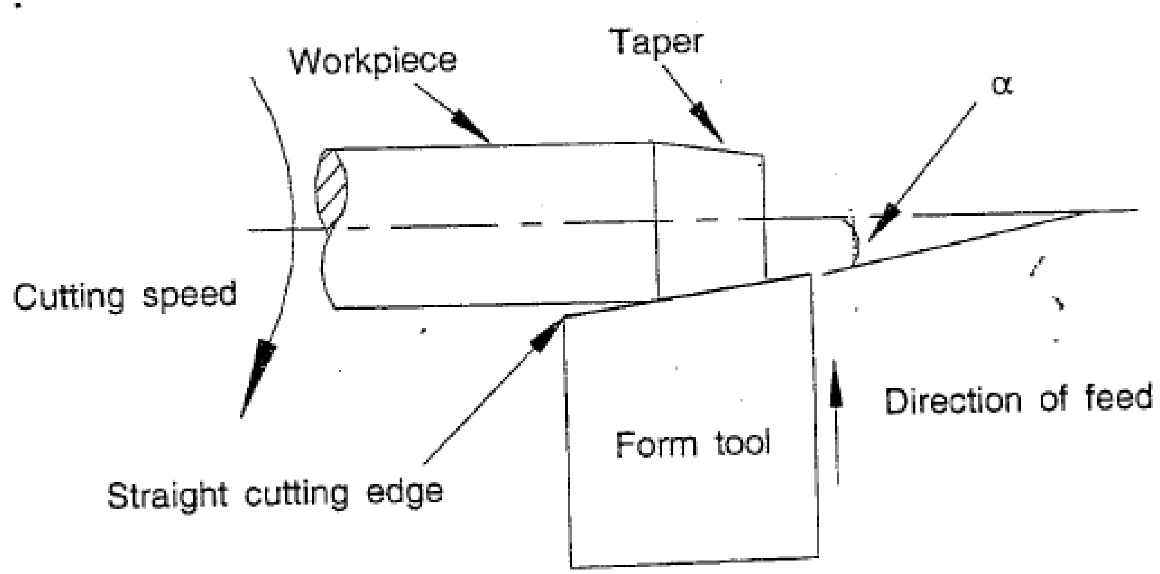

Figure 5.19 Taper production using form tool.

TAPER TURNING

- A tapered job is one whose diameter decreases or increases gradually so that it assumes conical shape.

$$\textbf{Tan } \alpha = D_1\text{-}D_2/2L$$

A = angle of taper,

D_1 = larger diameter in mm,

D_2 = smaller diameter in mm,

L = Length of taper in mm.

The conicity K of the taper is defined as

$$K = D_1\text{-}D_2/L$$

Taper turning by Swiveling the compound rest

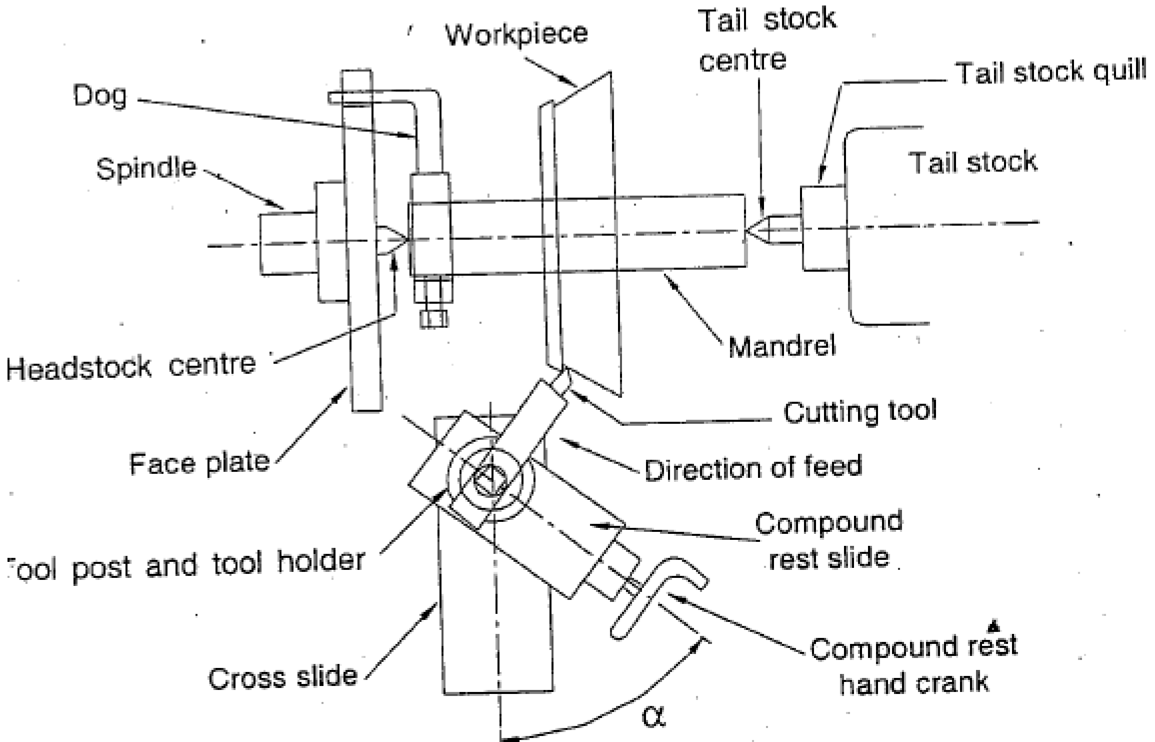

Figure 5.20 Taper production by swivelling the compound rest.

The compound rest has a circular base graduated in degrees, which can be swiveled at any angle.

Drilling

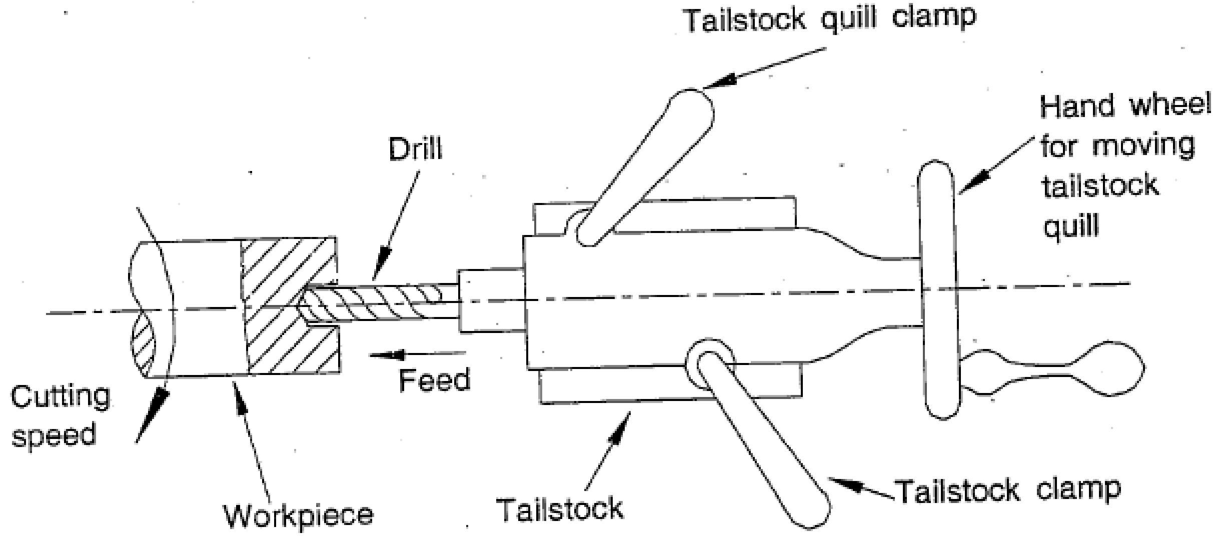

Figure 5.21 Drilling operation on a lathe.

It is the operation of production of a hole in a work piece.

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Thread cutting

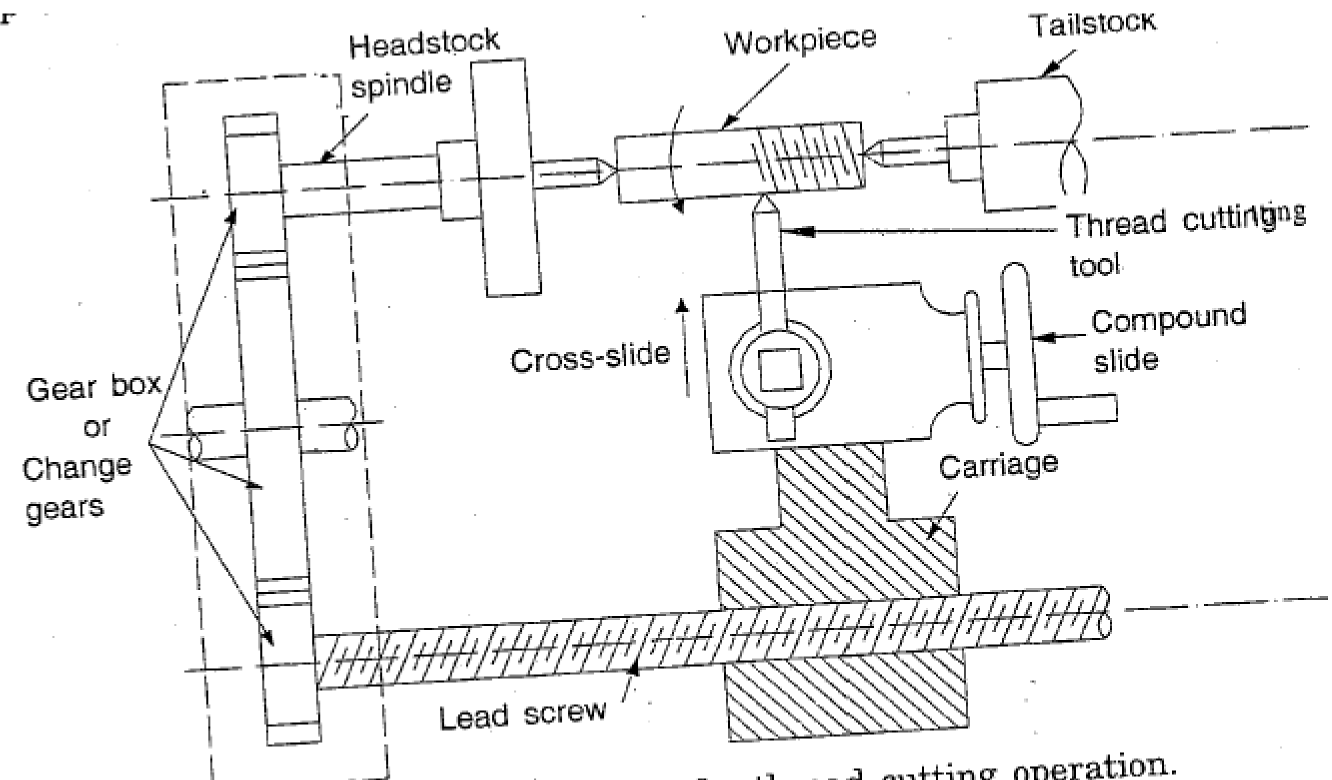


Figure 5.22 Lathe set-up for thread cutting operation.

Thread cutting

- It is the operation of producing a helical groove of specific shape, say 'V' or square on a cylindrical surface.
- Thread cutting operation is done on lathe using a single point tool called thread cutting tool.

Process sequence

for Workpiece of 45 X 30 mm

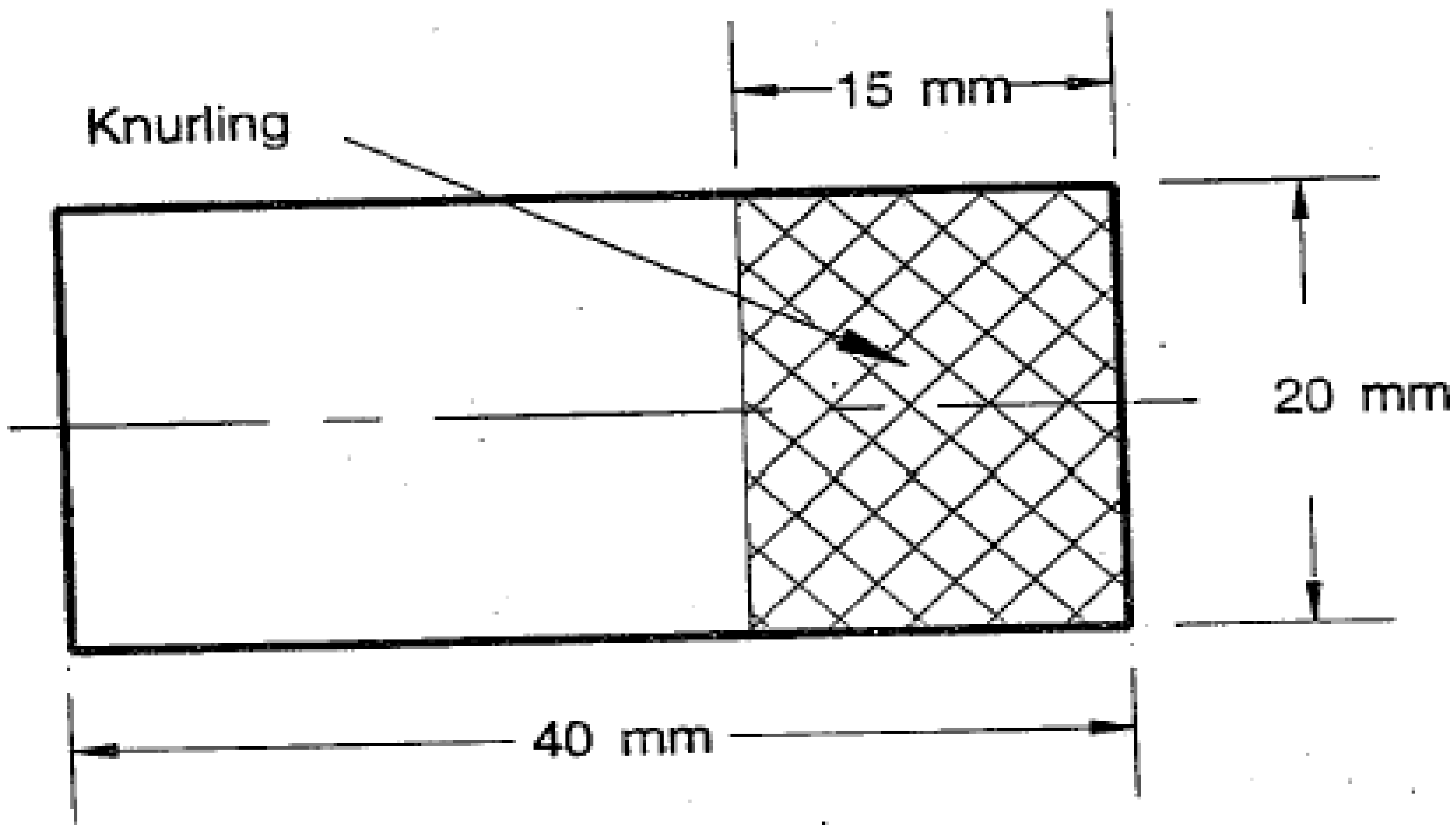


Figure 5.23 Component to be produced.

- A possible sequence for the component could be

1) turning

2) facing

3) Knurling

Machining time

- Time required to machine a component is called machining time

$$t = L_j / f N$$

L_j = length of the job in mm

N = speed of the job in RPM

f = feed in mm/rev

- **Feed rate = f X N in mm/min**

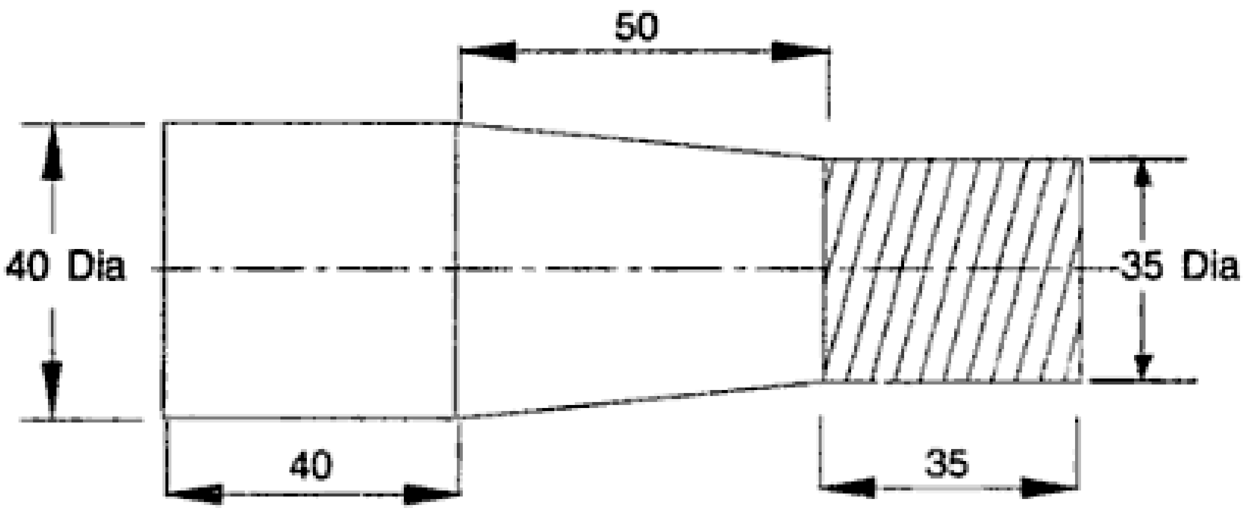
Manufacturing time = Machining time + setup time + moving and waiting time+ Inspection time

Turning Operations

PROBLEMS

Problem 18

18. Write down a possible sequence for manufacturing the component shown in Fig. 5.25 from a raw material having size 135 mm length and 50 mm diameter.

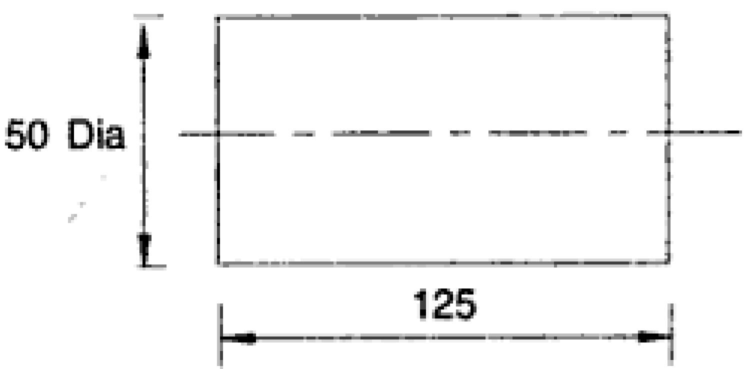


Problem 19

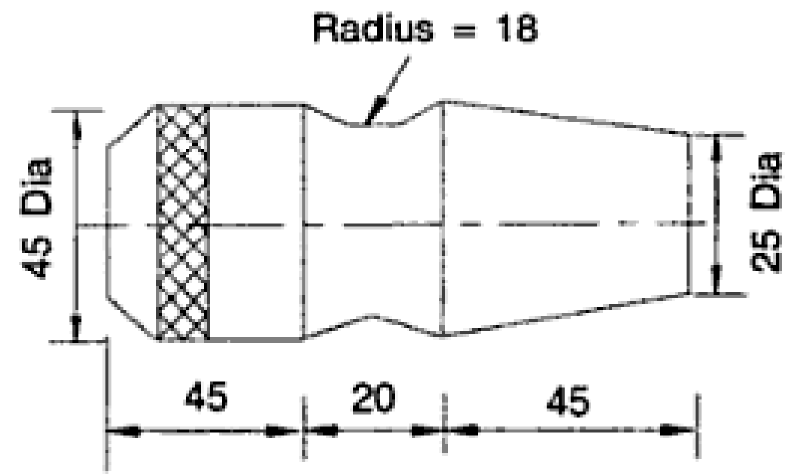
- Find the time required for one complete cut on a piece of work 350mm long and 50 mm diameter. The cutting speed is 35m/min and the feed is 0.5 mm/rev.

Problem 20

20. Write a possible sequence for producing part shown in Fig. 5.26(b) from the raw material shown in Fig. 5.26(a).



(a) Raw material



(b) End product

Problem 21

- A steel shaft of 25 mm diameter is turned at a cutting speed of 50 m/min. find the rpm of the shaft.

Problem 22

- The spindle end of the milling machine arbour has a taper of 7:24. Determine the setting of the compound rest.

Problem 23

- A 100 mm diameter bar is to be reduced to 50 mm diameter. If the depth of cut is 5 mm, how many passes are required?

Problem 24

- A cylinder of 155 mm diameter is to be reduced to 150 mm diameter in one pass with a feed of 0.15 mm/rev and a cutting speed of 150 m/min on a lathe. Determine:
- a) Spindle speed
- b) Depth of cut and
- c) Material removal rate.