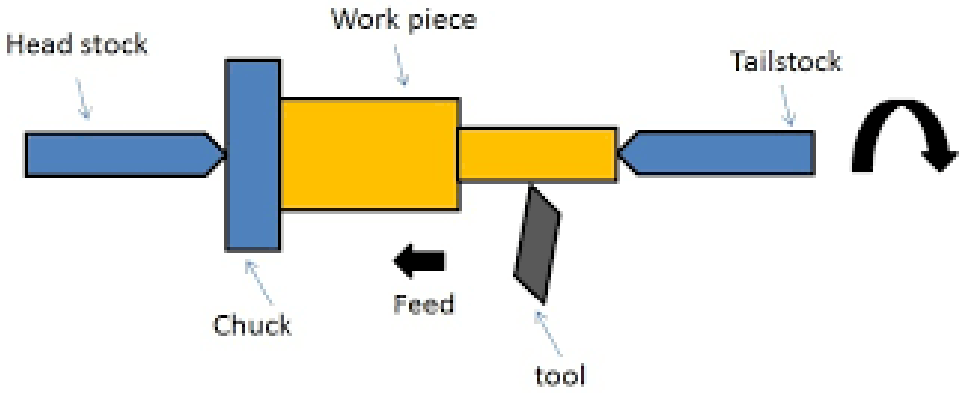
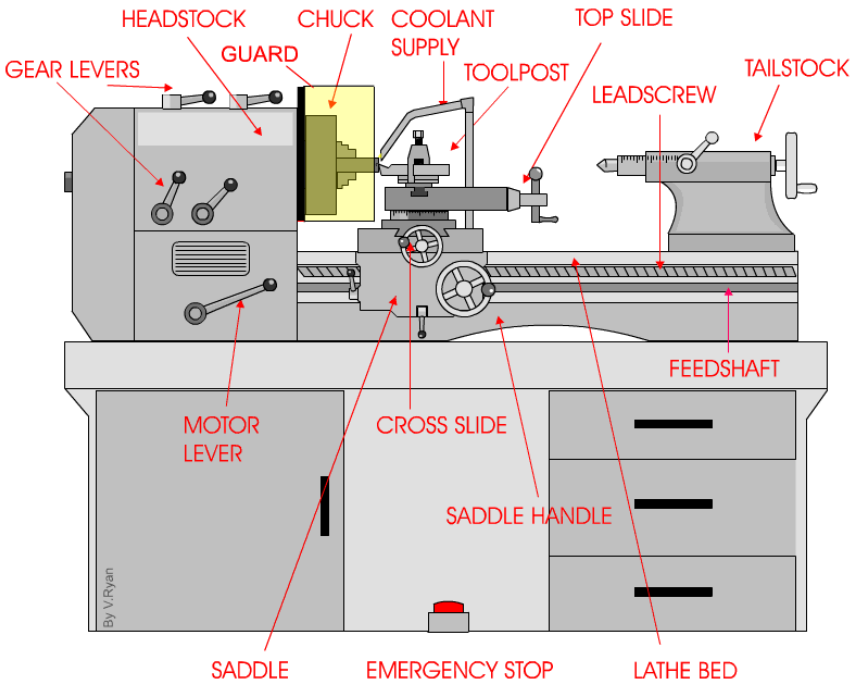
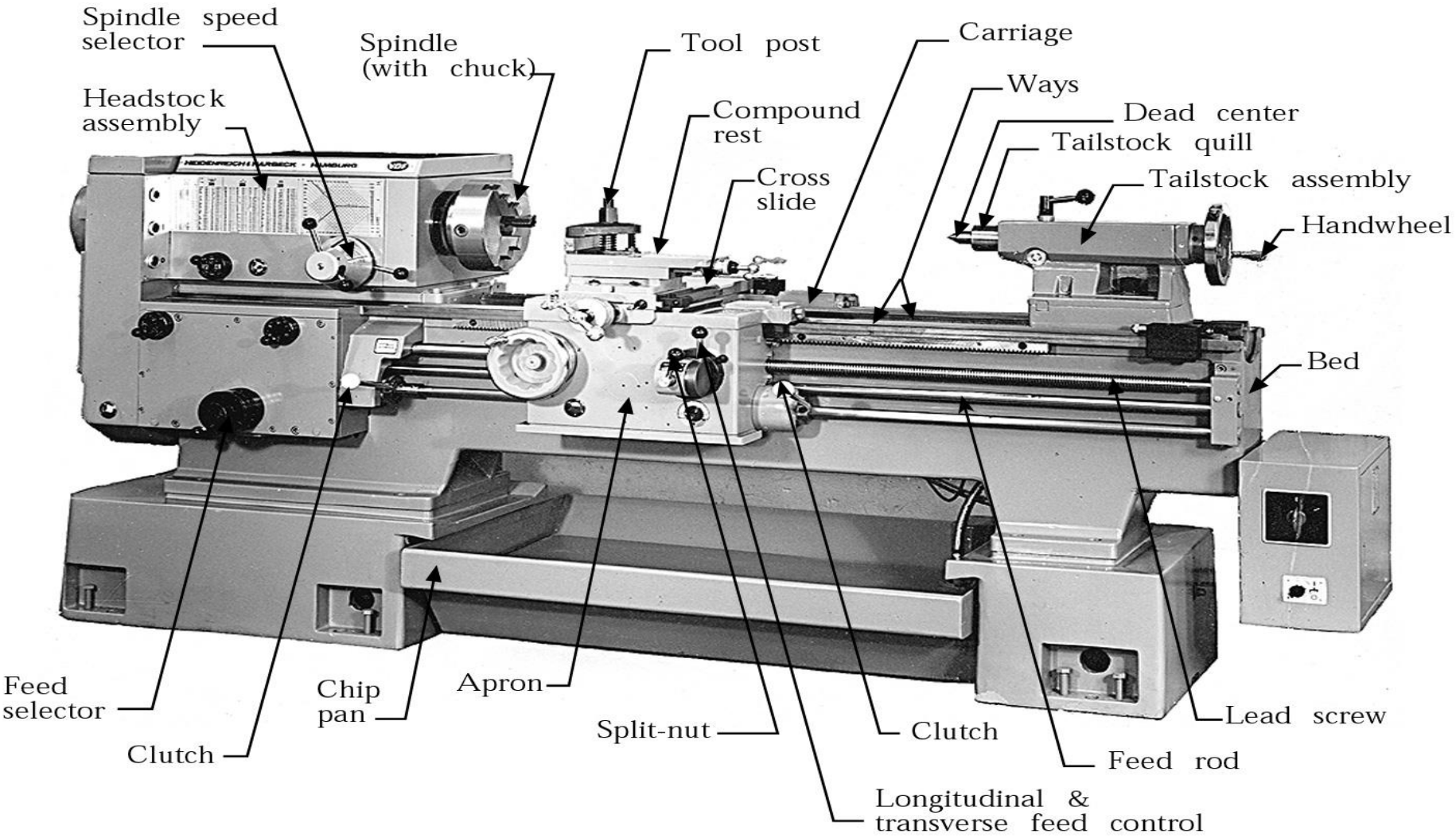
Working Principle of Lathe





Component of Lathe



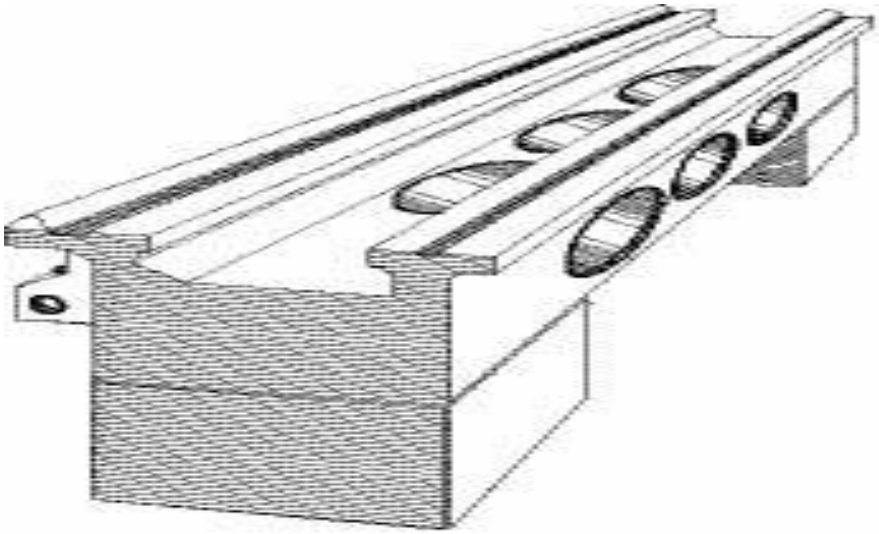
Main parts of Lathe

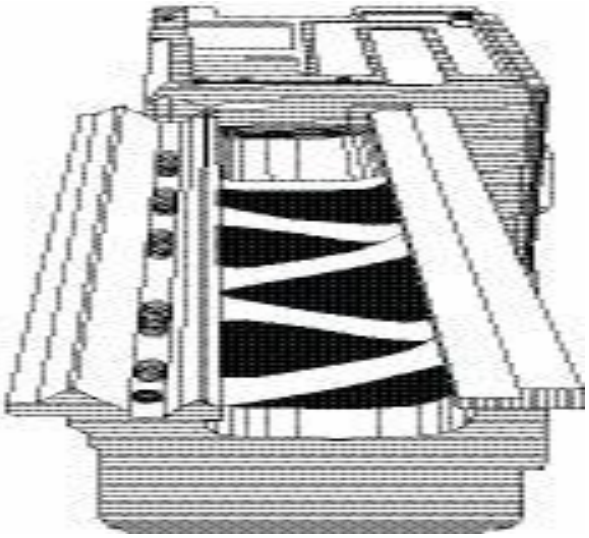
1) **Bed**
2) **Head stock**
3) **Tailstock**
4) **Carriage**
5) **Feed mechanism**
6) **Screw cutting mechanism**

Main parts of Lathe

1) Lathe Bed

- Heavy, casted
- Three major units mounted on bed are – Headstock, carriage, tailstock
    1. Headstock is permanently fixed to bed
    2. Tailstock is adjustable for position to accommodate workpiece of different length
    3. The carriage can be traversed to between the headstock and tailstock
- Top section is machined





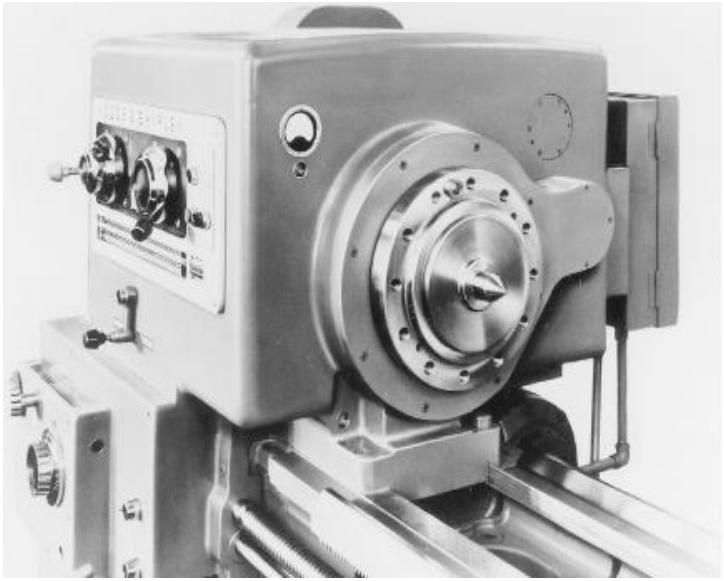
Main parts of Lathe

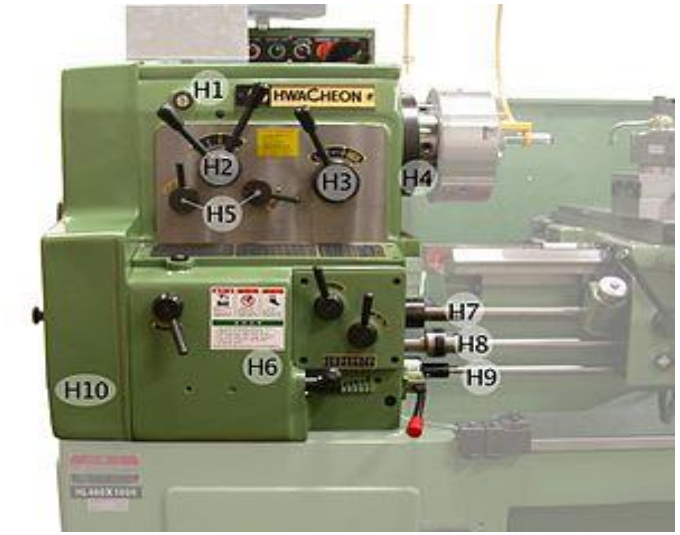
2) Head Stock

- Clamped on left-hand end of bed

It also houses necessary transmission mechanism with speed changing lever to obtain different speed.

Cone pulley or gear or combination of both can be used to change the speed





Main parts of Lathe

Head Stock Spindle

Hollow cylindrical shaft supported by bearing

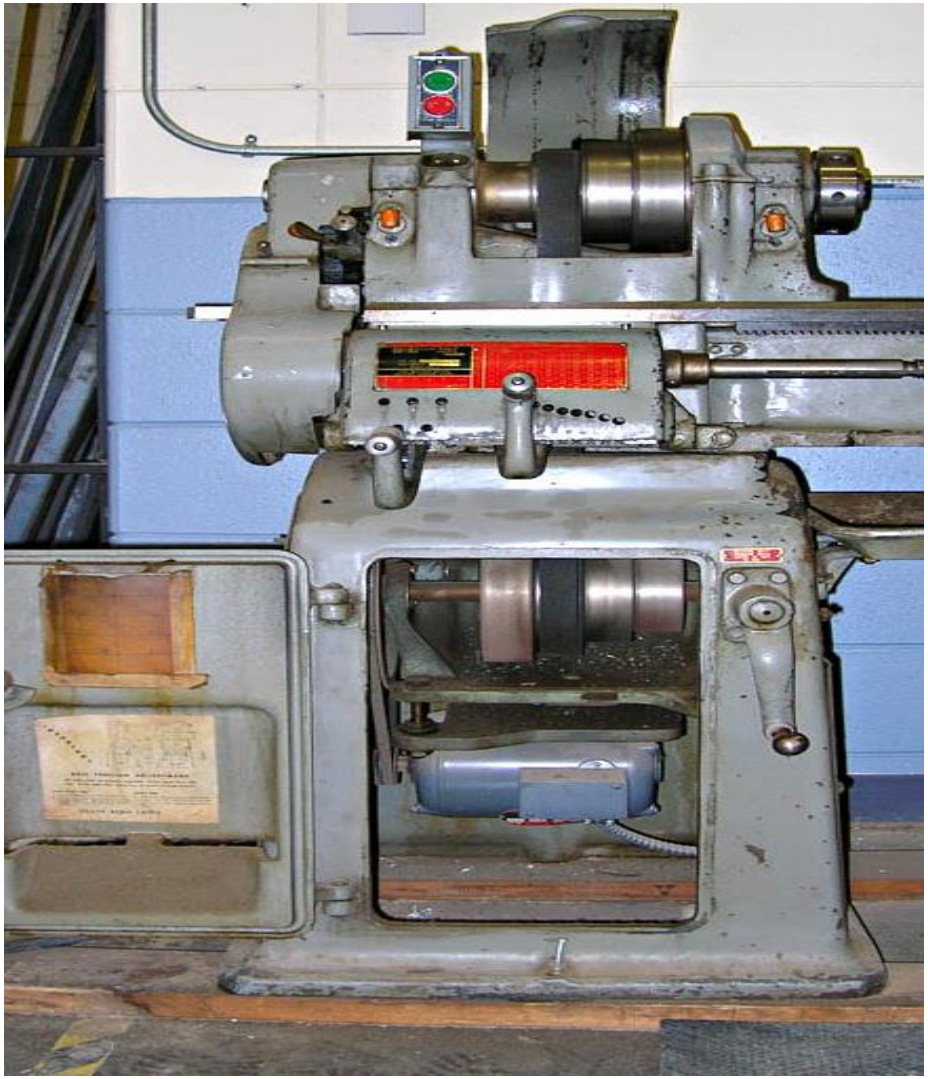
Provides drive through gears to work

Accessories mounted on head stock spindle are – Workpiece holding devices

1. Three jaw chuck
2. Lathe centre
3. Collet chuck
4. Face plate
5. Magnetic Chuck



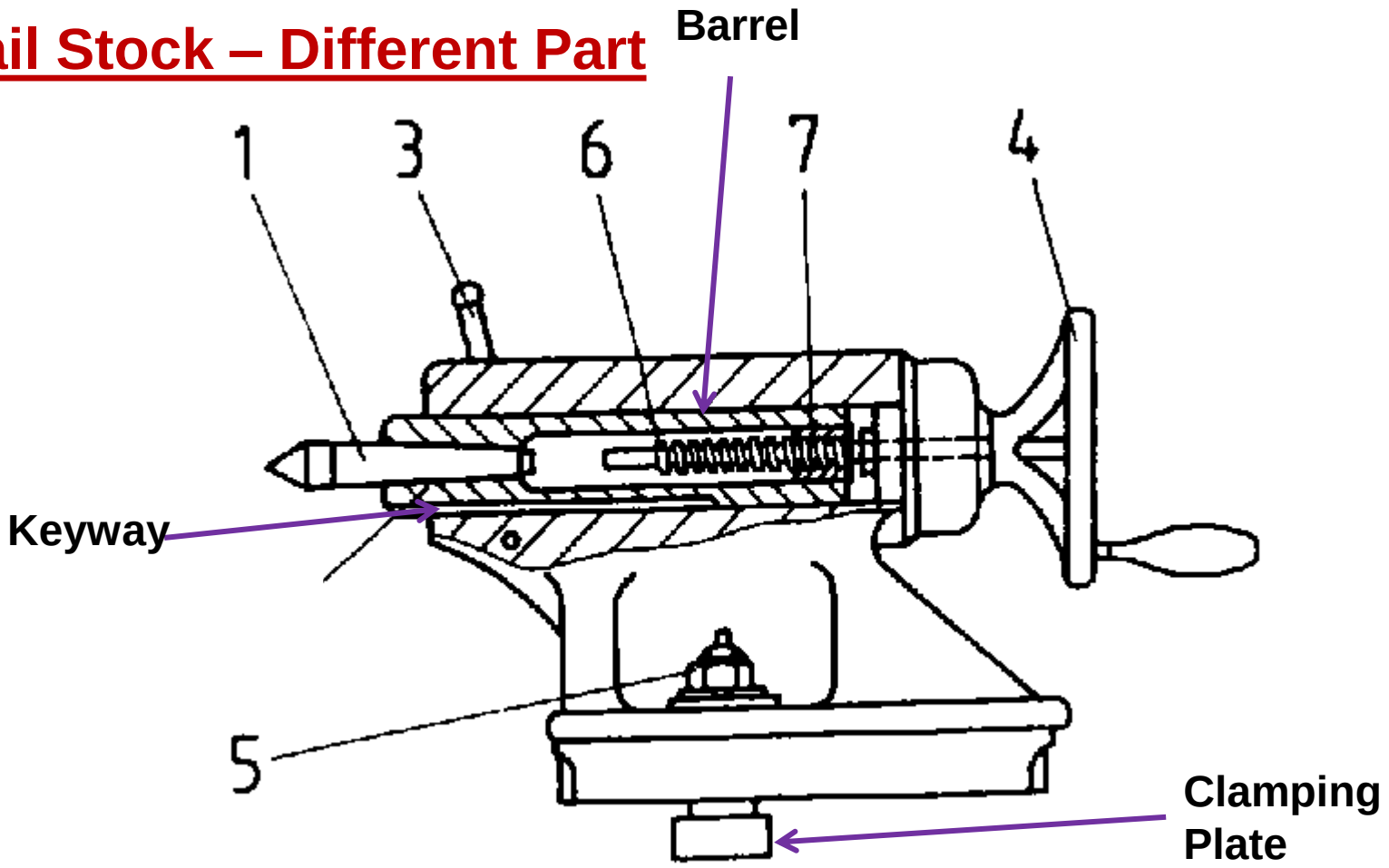
Stepped pulley



Stepped cone pulley

Main parts of Lathe

3) Tail Stock – Different Part



1 tailstock centre (replaceable),
3 clamping lever of the clamping nut,
4 hand wheel
5 tailstock clamping nut,
6, 7 Square threaded Screw

Main parts of Lathe

The body of the tailstock is adjustable on the base which is mounted on the guideways of the bed and can be moved to and fro

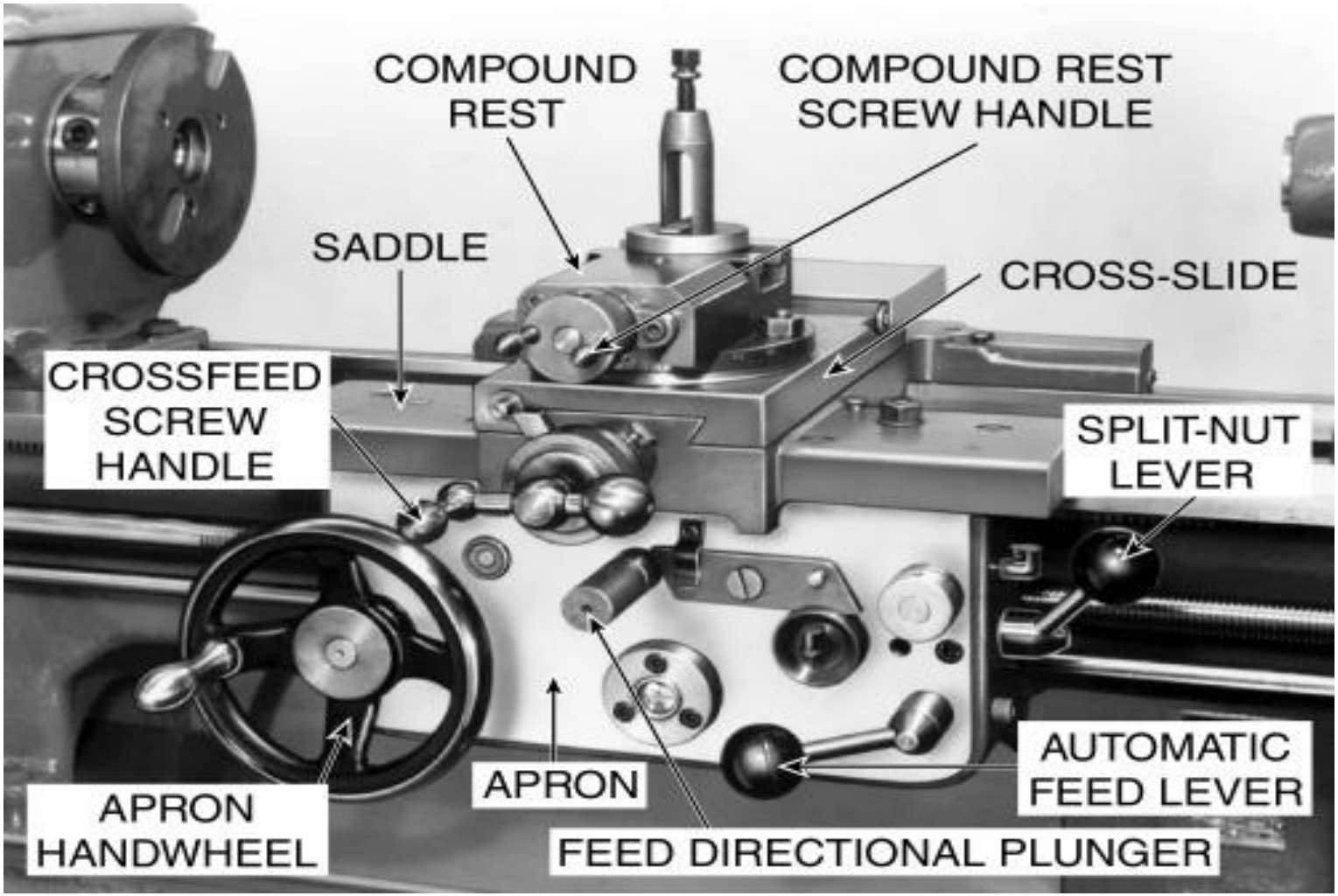
3) Tail Stock - use

- Supports the other end of the work when it is being machined between centers.
- It holds a tool for performing operations such as drilling, reaming, tapping etc.

Main parts of Lathe

B. S. Raghuvanshi

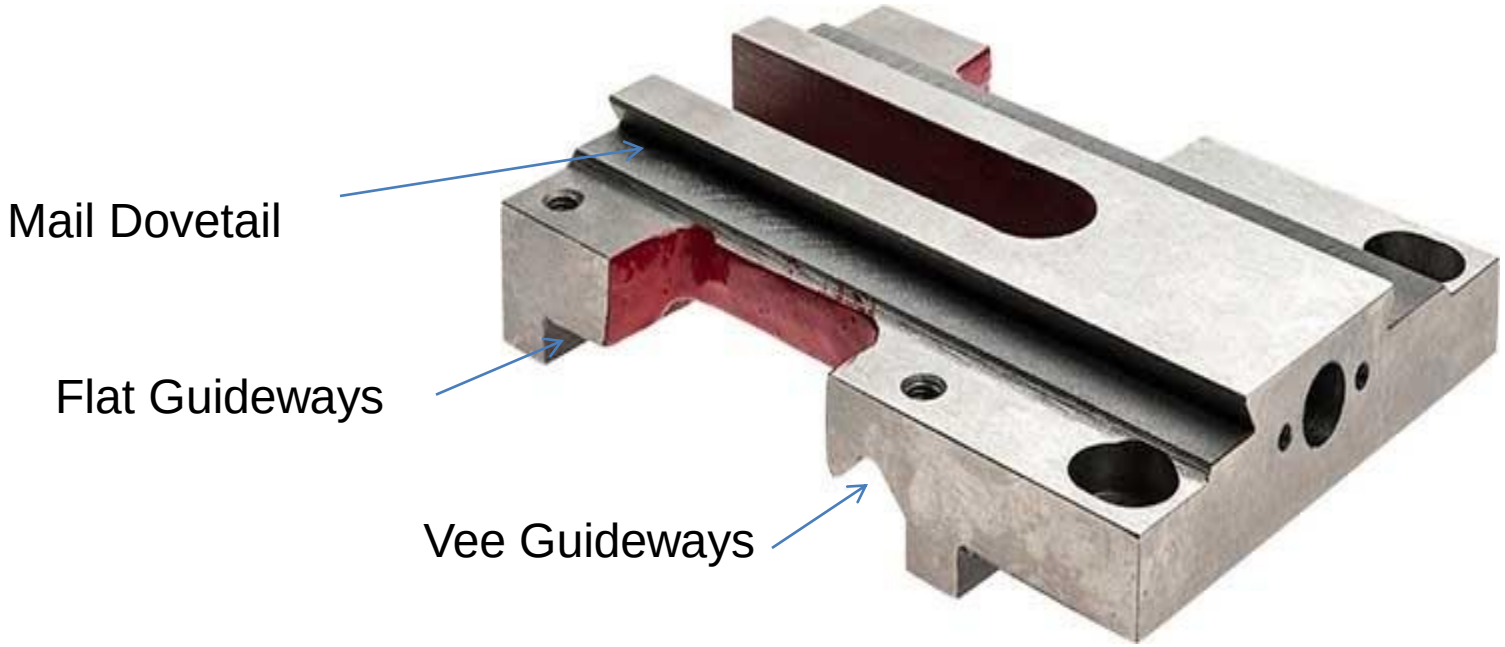
4) Lathe carriage



4) Lathe carriage

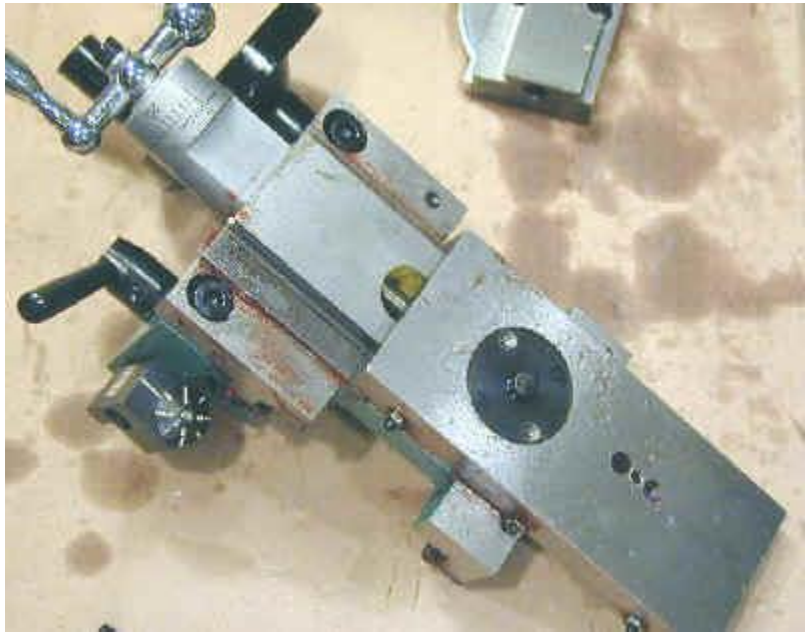
4-A-Saddle:

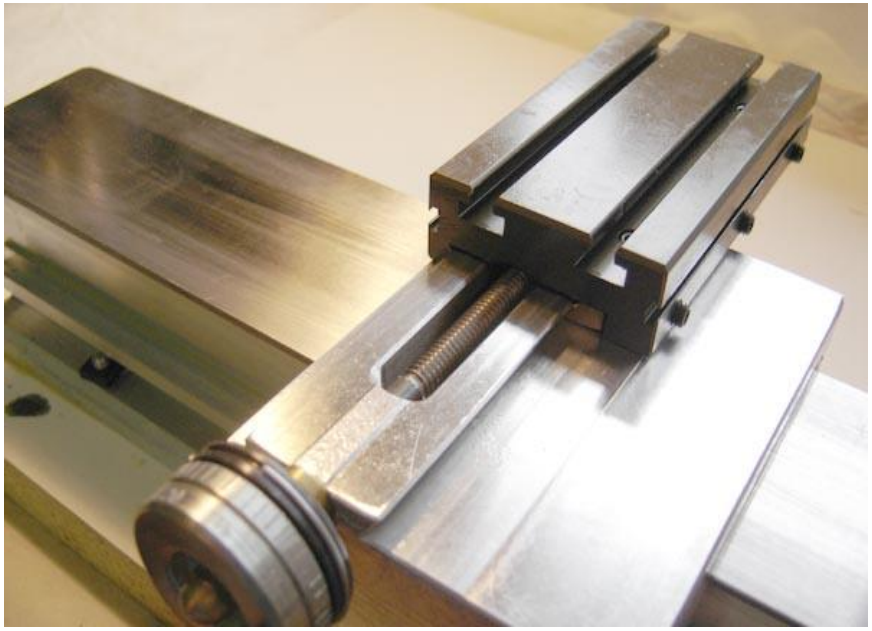
- H Shaped Casted part fitted over the bed and Slides along the ways.
- Carries the cross slide, compound rest and tool post
- It has a vee guide and flat guide for mounting it on lathe bed guideways.
- The other side of the saddle is provided with a mail dovetail to accommodate the cross slide



4-B-Cross Slide:-

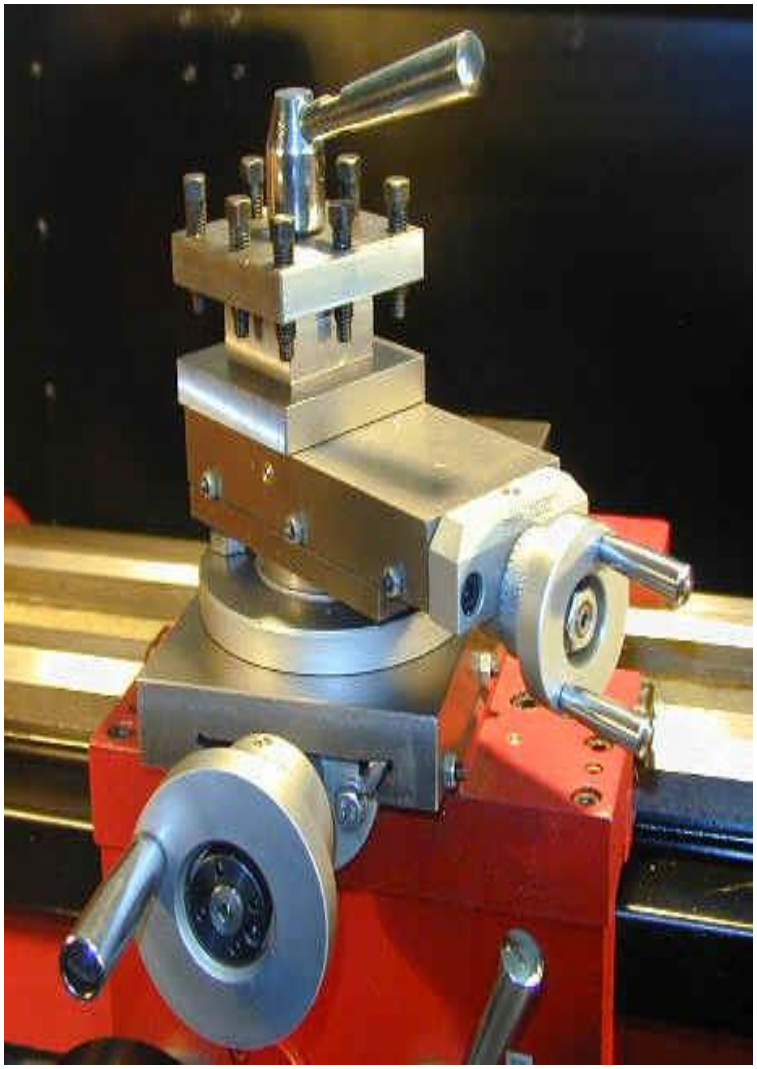
- It is provided with female dovetail on one side and mounted on top of the saddle
- It always moves in a direction normal to the axis of the main spindle.





4-C-The Compound Rest:

- Mounted on the top of the cross slide and has a circular base graduated in degrees.
- Used for obtaining angular cuts and short tapers as well as convenient positioning of the tool to the work.
- There is no any power feed to the compound rest and it is hand operated.
- Equipped with micrometer dial to assist in determining the depth of the cut.



4-d-Tool Post

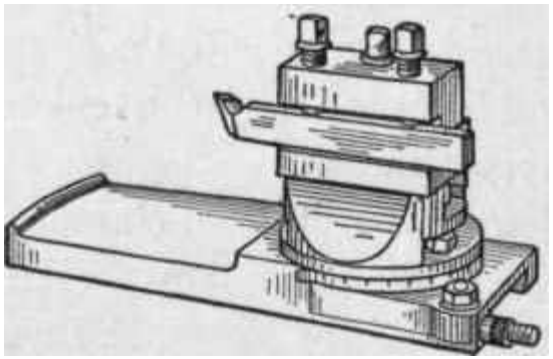
- This is located on top of the compound slide.
- It is used to hold the tools rigidly.



- There are different types of tool posts
  - Single screw tool post
  - Four way tool post
  - Four bolt tool post
  - Open side tool post







Four way tool post

- This type of tool post can accommodate four tools at a time.
- The tools are held in position by separate screws and a locking bolt is located at the centre.
- The required tool may be set for machining by unlocking centre bolt.
- Machining can be completed in a shorter time because the required tools are pre-set.
- Used for heavy lathe and is suitable for repetition work.



Figure: Four way tool post

4) Lathe carriage

4-E- Apron

- Mounted on the front of the saddle and Fastened to saddle
- Consists of Carriage and Cross slide mechanisms
- In-house gears and mechanism required to move carriage or cross-slide automatically
- Apron handwheel turned manually to move carriage along lathe bed

- **Apron mechanism is used for transferring rotary motion of the *feed-rod* and the *lead-screw* into feed motion of the carriage.**

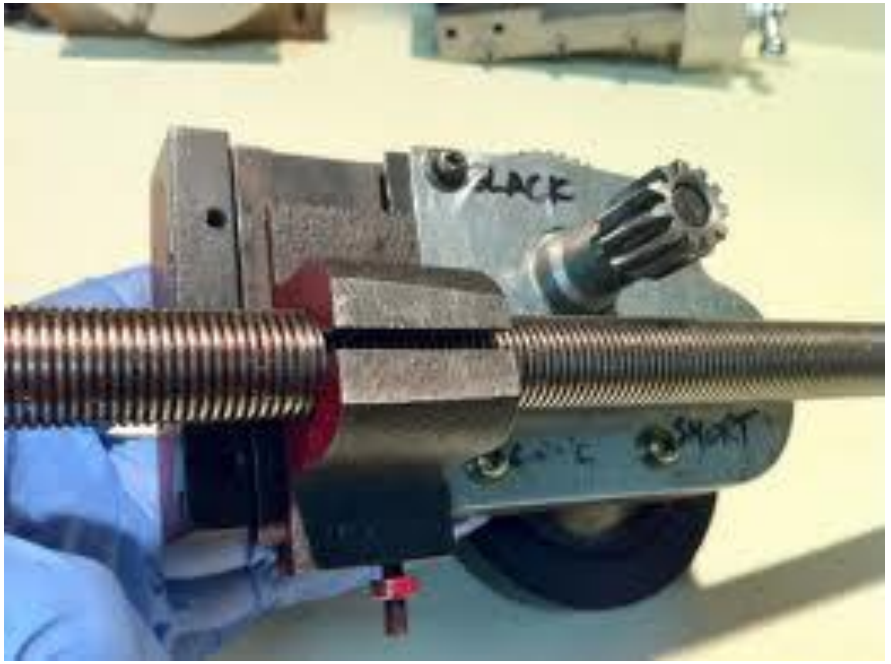
- **Both automatic *longitudinal* and *cross-feed* can be provided to the carriage by gears engagements.**

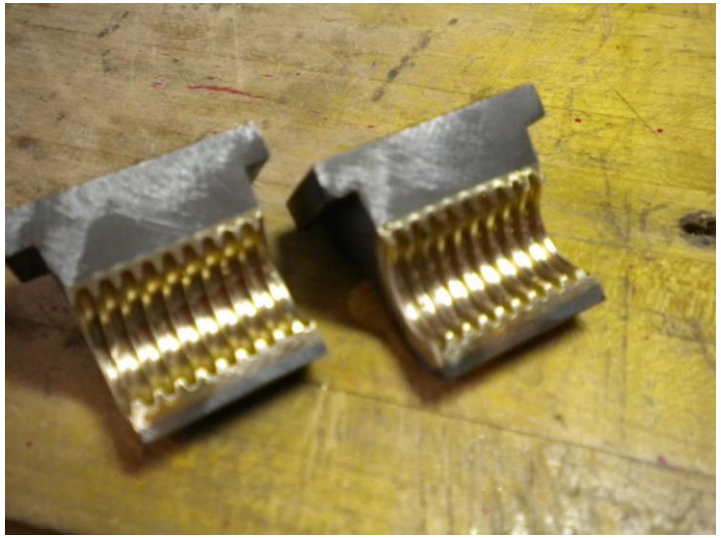
- **The mechanism is so designed that when the *half-nut* is engaged with the *lead-screw*, the automatic feed motion from the *feed- rod* is disconnected.**

- **There is an interlocking device which prevents simultaneous engagement of the *carriage* with the *feed-shaft* and *lead-screw* and saves the machine from any probable damage.**

The Half Nut or Split Nut Mechanism



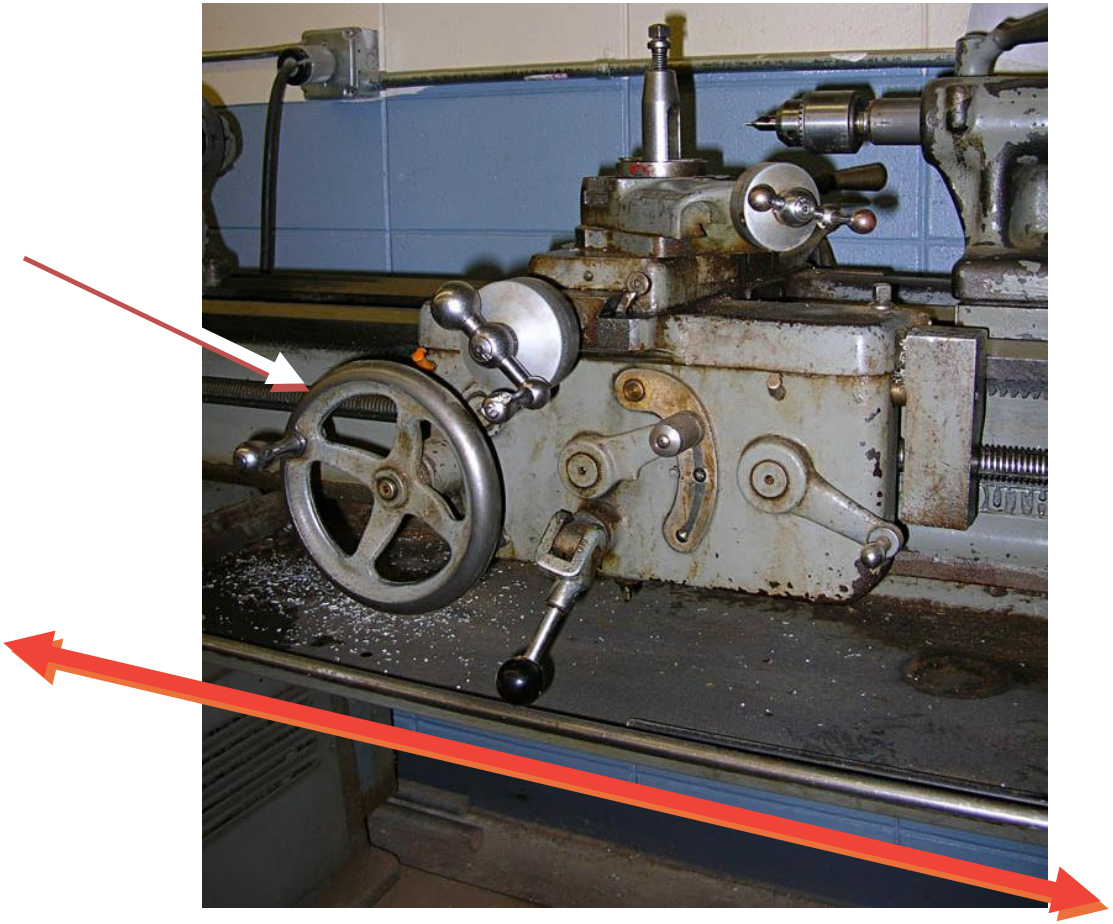




Apron Hand Wheel

Used to move tool along the work - for Turning (Longitudinal Feed)

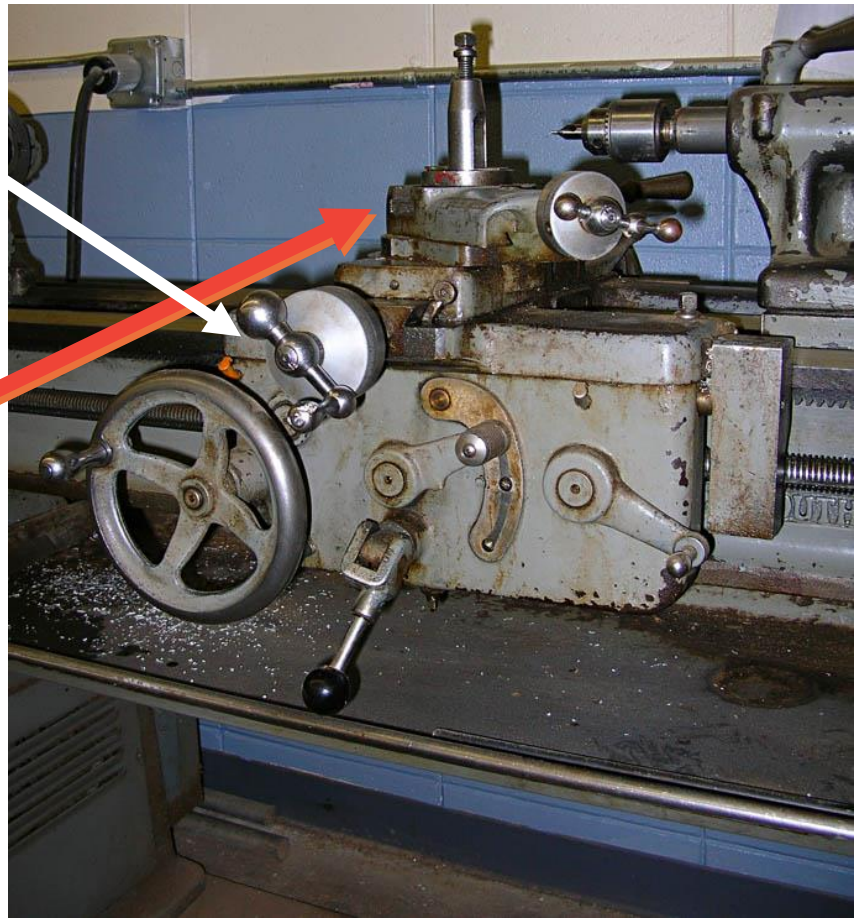
Apron Hand Wheel



Cross Feed Knob

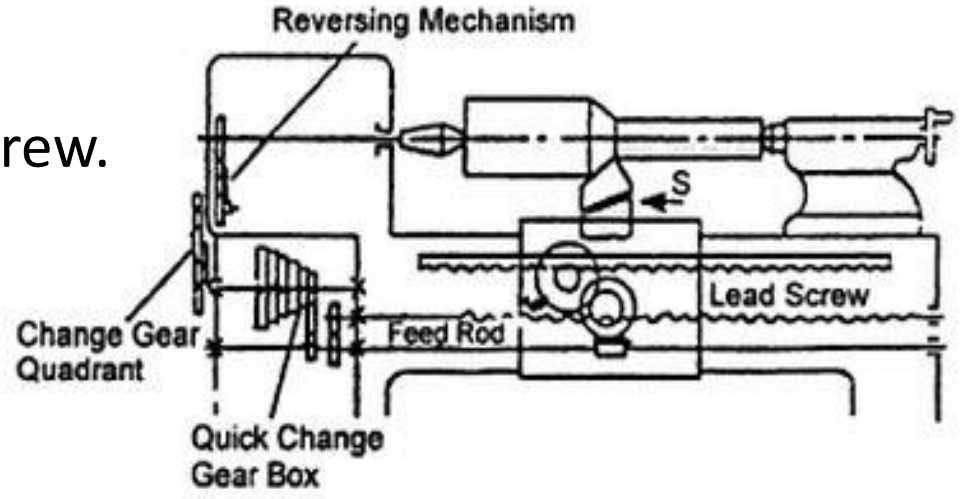
Used to move cutting tool across the end of the stock
- Facing (Cross Feed)

Cross Feed Knob



FEED MECHANISM

- **The movement of the tool relative to the work is termed as feed.**
- A lathe tool may have three types of feed – **longitudinal, cross and angular.**
- The feed mechanism has different units through which motion is transmitted from the head stock spindle to the carriage.
- **Following are the unit:**
  - Feed gear box .
  - Feed rod and lead screw.
  - Apron mechanism.



Feed-rod

- **The feed-rod is a long shaft that has a keyway.**
- **The power is transmitted from the lathe spindle to the apron gears through a feed-rod via a large number of gears.**
- **The feed-rod is used to move the *carriage or cross-slide for turning, facing and all other operations except thread cutting.***

Lead-screw

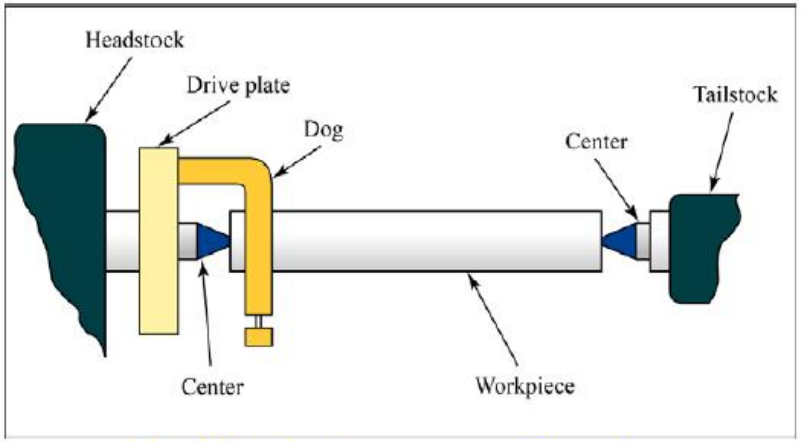
- **The lead-screw is powered by gears from the head stock and is used for providing specific accurate mechanized movement to the *carriage* *for cutting threads on the workpiece.***
- **The lead-screw has a definite pitch.**
- **A split nut *is used to engage the* lead-screw *with the carriage.***
- **In some lathes, the lead-screw performs the functions of feed rod and there is no separate feed rod.**

Work Holding Devices

The most common work holding methods in the lathe are:



3- or 4- Jaw Chucks



Held between Centers



Magnetic chuck



Collets



Faceplates

B] Chuck

Types of Chucks

- There are different kinds of chucks:
  - i. Three jaw self centering chuck
  - ii. Four jaw independent chuck
  - iii. Combination chuck
    - i. It is a combination of self centering and independent chuck.
  - ii. Magnetic chuck
    - i. The workpieces are held in this chuck by means of powerful electro- magnets.
  - iii. Air or hydraulic operated chuck
    - i. The workpieces are held in this chuck by means of fluid pressure.
  - iv. Collet chuck

B] i. Three Jaw Universal Chuck

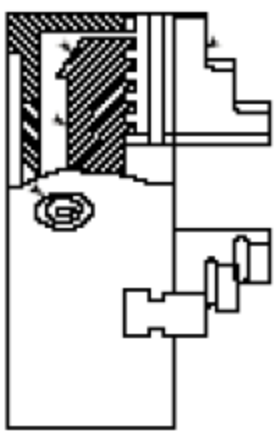
- Holds round and hexagonal work
- Self centered Chuck

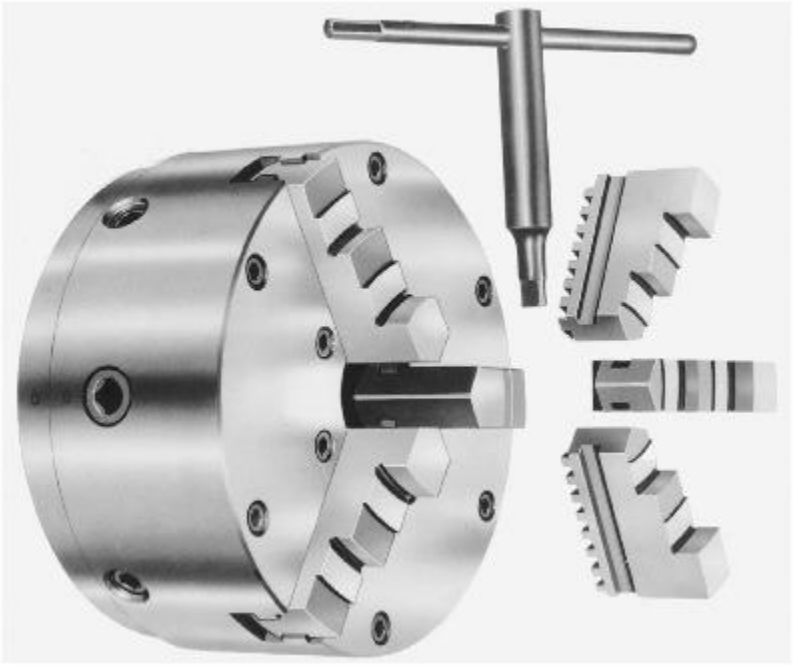


- Three jaws move simultaneously when adjusted by chuck wrench
  - Caused by scroll plate into which all three jaws fit
- Since the jaws maintain an equal distance from the chuck axis, cylindrical workpieces are automatically centered when gripped.
- Less Griping capacity as only three jaws are used

Three-jaw Universal Chuck

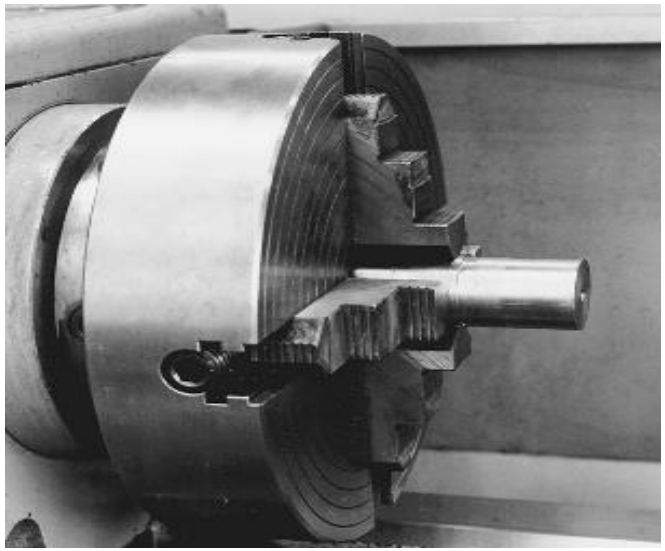


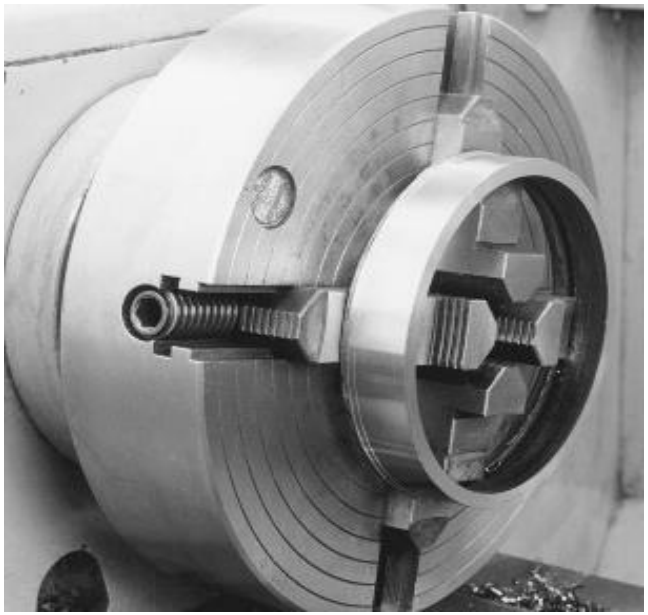




B] ii. Four Jaw Independant Chuck

- Used to hold round, square, hexagonal, and irregularly shaped work pieces
- Has four jaws Each can be adjusted independently by chuck wrench
- Jaws can be reversed to hold work by inside diameter
- Concentric circles inscribed on the face of the chuck facilitate quick centering of the workpiece.





LATHE OPERATION

- Operations which are performed in a lathe either by holding the work piece between **centers or by a chuck** are:

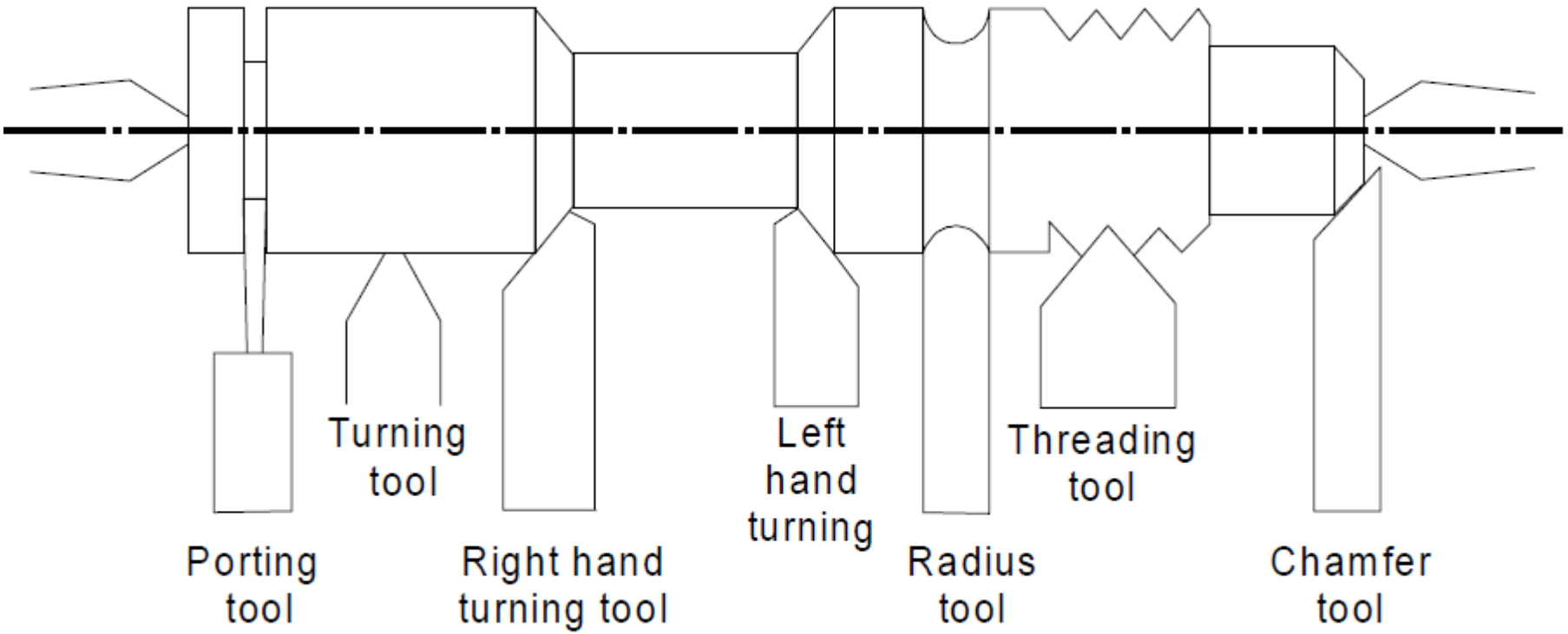
- **Straight turning**
- **Facing**
- **Knurling**
- **Thread cutting**
- Polishing
- Forming
- Drilling
- Reaming
- Boring
- **Taper turning**
- Eccentric turning
- **Chamfering**
- **Grooving**
- Spring Winding
- Filing
- Internal Thread Cutting
- Tapping

- Operations which are performed by using special attachments are:

Grinding **Milling**

LATHE OPERATION

DIFFERENT OPERATION ON A JOB



Cutting Speed, Feed, and Depth of Cut

Cutting Speed

- Rate at which point on workpiece circumference travels past cutting tool
- Always expressed in feet per minute (ft/min) or meters per minute (m/min)
- Important to use correct speed for material
  - Too high: cutting-tool breaks down rapidly
  - Too low: time lost, low production rates

LATHE OPERATION

1. Turning

Cut Types: Roughing & Finishing

Cut Type	*Number of Passes*	*Speed*	*Feed /rev*	*Depth of Cut*
Roughing: removes large amounts to get close to shape	1 +	**Low**	**High** 0.4 - 1.25 mm/	**High** 2.5 - 20 mm
Finishing: achieves final dimensions, tolerances, and finish	1 - 2	**High**	**Low** 0.125 - 0.4 mm/ 0.005 - 0.015 in/	**Low** 0.75 - 2.0 mm 0.030 - 0.075 in

Lathe Cutting Speeds

Using High-Speed Steel Toolbit

	Turning and Boring					
	Rough Cut		Finish Cut		Threading	
Material	**ft/min**	**m/min**	**ft/min**	**m/min**	**ft/min**	**m/min**
Tool steel	70	21	90	27	30	9
Cast iron	60	18	80	24	25	8
Bronze 90	27	100	30	25	8	
Aluminum	200	61	300	93	60	18

Main factors influence the selection of proper speed

- Material of the cutting tool
- Hardness and machinability of the material
- Depth of cut
- Feed to be given

Cutting speed formula

$$V = \frac{\pi D \times N}{1000} mpm$$

V- Cutting speed in meter per min.

D- Diameter of workpiece surface in mm

N- Speed of Workpiece in rpm

Problems

1. Calculate the required rpm of a work of 100 mm dia. To provide a cutting speed of 50 mpm.

2. A workpiece of 1.75 inch dia. is to be turned on a lathe. Find the cutting speed when the work revolves at 150 rpm

Lathe Feed

- Distance cutting tool advances along length of work for every revolution of the spindle
- Three types
  - Longitudinal Feed
  - Cross Feed
  - Angular Feed

Lathe Feed – Rough and Finish

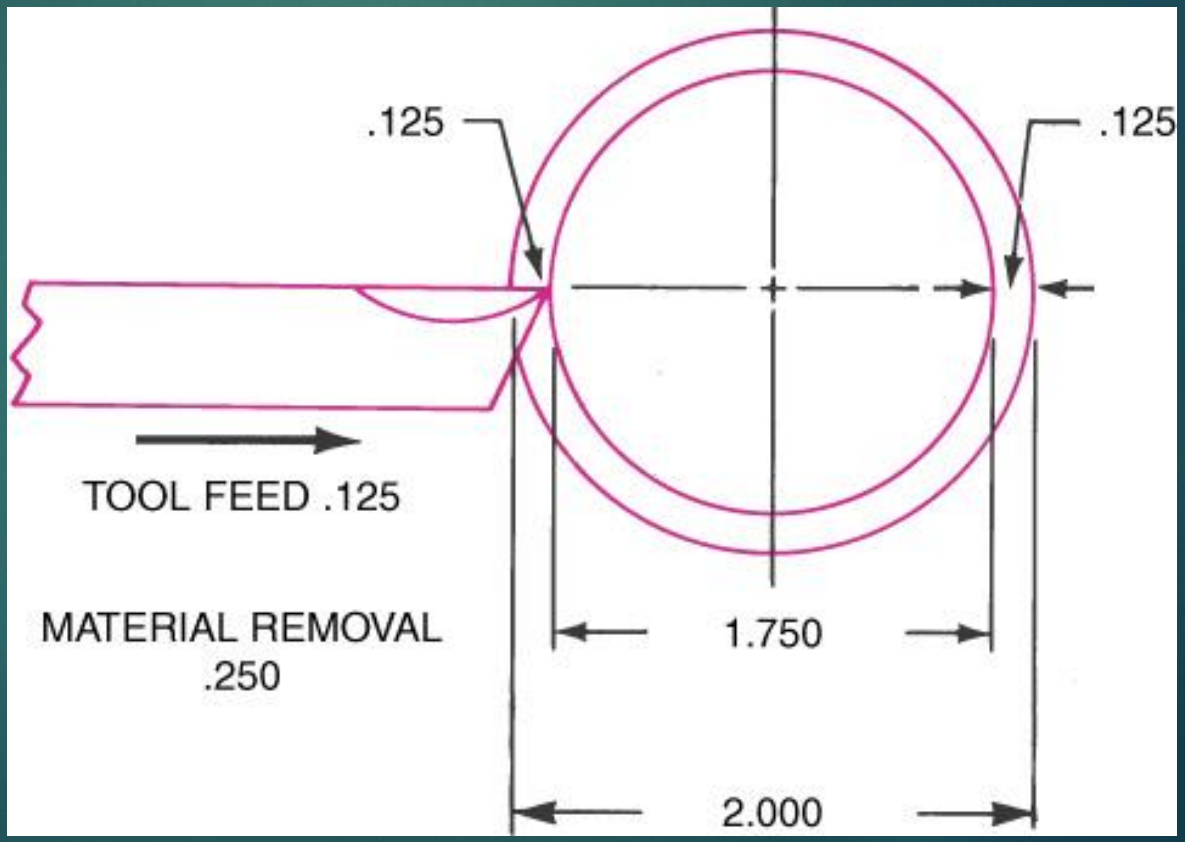
High-speed steel cutting tool feed per revolution of spindle

	Rough Cuts		Finish Cuts	
Material	in.	mm	in.	mm
Tool steel	.010–.020	0.25–0.5	.003–.010	0.07–0.25
Cast iron	.015–.025	0.4–0.65	.005–.012	0.13–0.3
Bronze .	015–.025	0.4–0.65	.003–.010	0.07–0.25
Aluminum	.015–.030	0.4–0.75	.005–.010	0.13–0.25

Feed rate= Feed x RPM

Depth of Cut

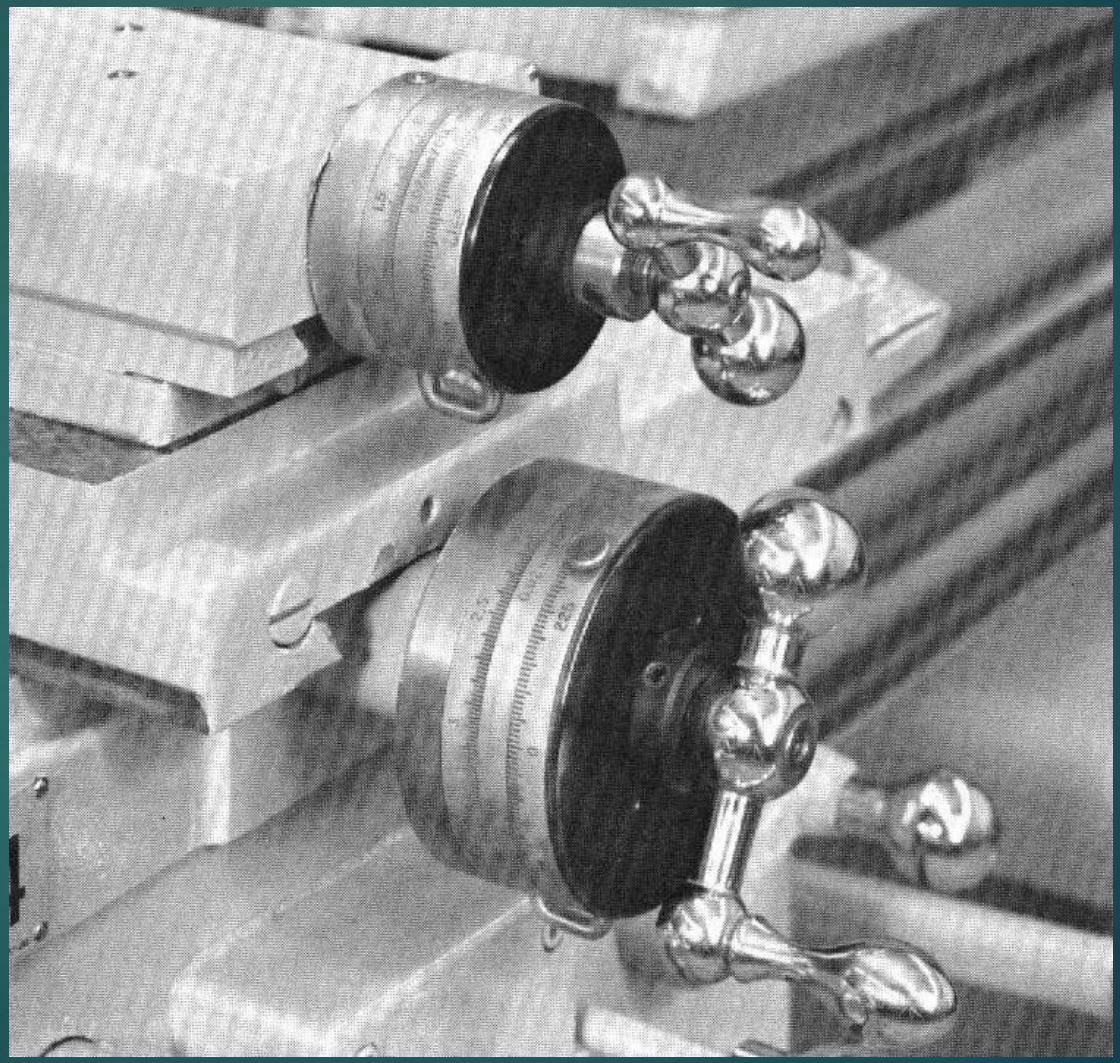
- Depth of chip taken by cutting tool and one-half total amount removed from workpiece in one cut



Graduated Micrometer Collars

- Used when diameter of work must be turned to accurate size
- Bush mounted on compound rest and cross feed screws
- Measurement
  - Inch system graduated in .001 inch
  - Metric system usually in steps of 0.02 mm

Graduated Micrometer Collars



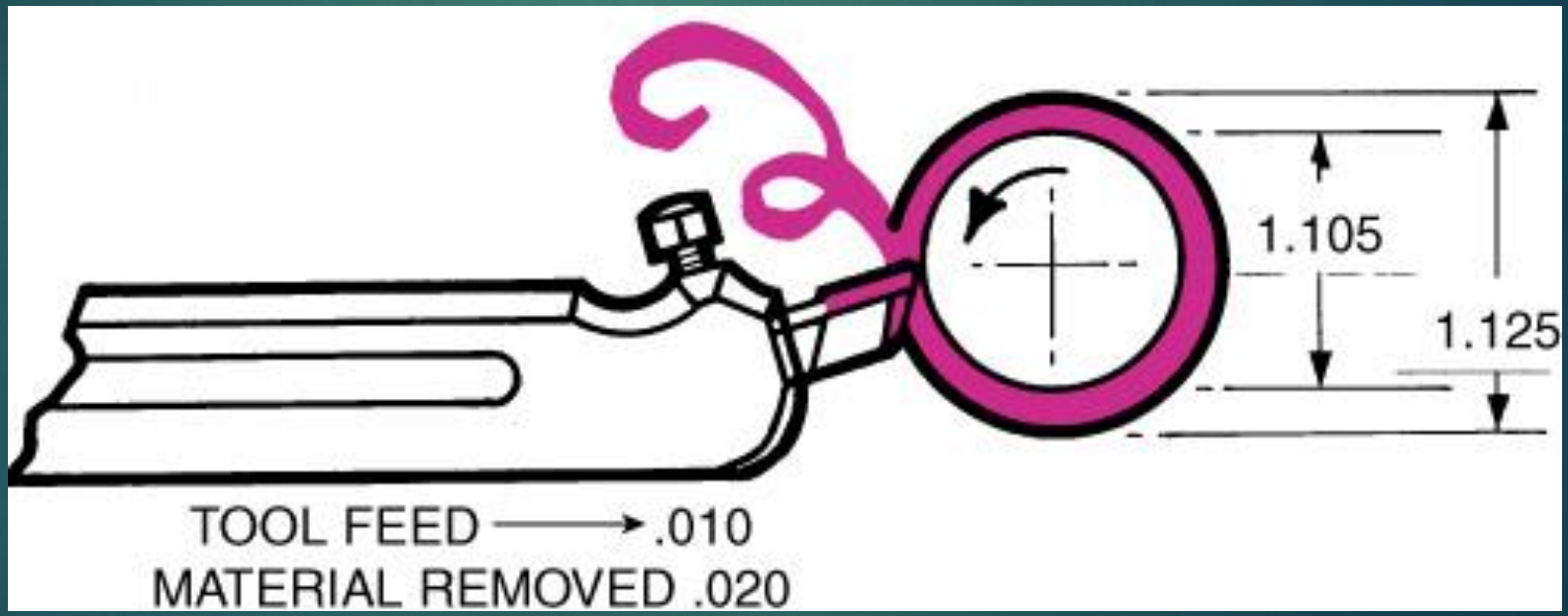
Inch System

- Circumference of cross feed and compound rest screw collars divided into 100-125 equal divisions
  - Each has value of .001 inch
    - Turn cross feed screw clockwise 10 graduations, cutting tool moved .010 inch toward work
    - Lathe revolves, so .010 depth of cut taken from entire work circumference reducing diameter .020 inch

Metric System

- Circumference of cross feed and compound rest screw collars divided into 100-125 equal divisions
  - Each has value of .02 mm
    - Turn cross feed screw clockwise 10 graduations, cutting tool moved .2 mm toward work
    - Lathe revolves, so .2 mm depth of cut taken from entire work circumference reducing diameter .4 mm

On machines where the workpiece revolves, the cutting tool should be set in for only half the amount to be removed from the diameter.



Calculating Machining Time

- Total time taken to machine

$$\text{Time} = \frac{\text{distance}}{\text{rate}}$$

Where distance = length of cut

rate = feed x RPM

Turning Equations

Rotational Speed: N (RPM's)

$$N = \frac{v}{\pi D_O}$$

N = Rotational Speed (RPM's)
v = Cutting Speed (SFPM)
D_O = Original Diameter

Feed Rate: f_r ($^{Dist}/_{Min}$)

$$f_r = N f$$

f_r = Feed Rate ($^{Dist}/_{Min}$)
N = Rotational Speed (RPM's)
f = Feed ($^{Dist}/_{Rev}$)

Turning Equations

***Machining Time* (Min.)**

$$T_m = \frac{L}{f_r}$$

T_m = Machining Time (Min.)
L = Length of Cut
f_r = Feed Rate ($^{In.}/_{Min.}$)