Module 4

General Purpose Machine Tools

Version 2 ME, IIT Kharagpur

Lesson 17

Kinematic systems and operations of lathes

Version 2 ME, IIT Kharagpur

Instructional objectives

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

(i) Name the general purpose machine tools of common use
(ii) Classify the different types of lathes
(iii) Illustrate the kinematic system of centre lathe and explain its method of working
(iv) State the different machining operations that are usually done in centre lathes.

(i) General Purpose Machine Tools Of Common Use

The basic machine tools which are commonly used for general purposes, are :

- Lathes
- Drilling machines
- Shaping machines
- Planning machines
- Slotting machines
- Milling machines
- Boring machines
- Hobbing machines
- Gear shaping machines
- Broaching machines
- Grinding machines

Each one of the machine tools, mentioned above, can be further classified into several types depending upon size, shape, automation, etc.

(ii) Classification Of Lathes

Lathes are very versatile of wide use and are classified according to several aspects:

(a) According to configuration

- Horizontal
  - Most common for ergonomic conveniences
- Vertical
  - Occupies less floor space, only some large lathes are of this type.

(b) According to purpose of use

- General purpose
  - Very versatile where almost all possible types of operations are carried out on wide ranges of size, shape and materials of jobs; example : centre lathes
- Single purpose

- Only one (occasionally two) type of operation is done on limited ranges of size and material of jobs; example – facing lathe, roll turning lathe etc.

- Special purpose
  - Where a definite number and type of operations are done repeatedly over long time on a specific type of blank; example: gear blank machining lathe etc.

(c) According to size or capacity

- Small (low duty)
  - In such light duty lathes (upto 1.1 kW), only small and medium size jobs of generally soft and easily machinable materials are machined
- Medium (medium duty)
  - These lathes of power nearly upto 11 kW are most versatile and commonly used
- Large (heavy duty)
- Mini or micro lathe
  - These are tiny table-top lathes used for extremely small size jobs and precision work; example : swiss type automatic lathe

(d) According to degree of automation

- Non-automatic
  - Almost all the handling operations are done manually; example: centre lathes
- Semi-automatic
  - Nearly half of the handling operations, irrespective of the processing operations, are done automatically and rest manually; example : capstan lathe, turret lathe, copying lathe relieving lathe etc.
- Automatic
  - Almost all the handling operations (and obviously all the processing operations) are done automatically; example – single spindle automat (automatic lathe), swiss type automatic lathe, etc.

(e) According to type of automation

- Fixed automation
  - Conventional; example – single spindle automat, swiss type automatic lathe etc.
- Flexible automation
  - Modern; example CNC lathe, turning centre etc.

(f) According to configuration of the jobs being handled

- Bar type
  - Slender rod like jobs being held in collets
- Chucking type
  - Disc type jobs being held in chucks

- Housing type

- Odd shape jobs, being held in face plate

(g) According to precision

- Ordinary
- Precision (lathes)
  - These sophisticated lathes meant for high accuracy and finish and are relatively more expensive.

(h) According to number of spindles

- Single spindle
  - Common
- Multispindle (2, 4, 6 or 8 spindles)
  - Such uncommon lathes are suitably used for fast and mass production of small size and simple shaped jobs.

(iii) Kinematic System And Working Principle Of Lathes

Amongst the various types of lathes, centre lathes are the most versatile and commonly used.

Fig. 4.1.1 schematically shows the typical kinematic system of a 12 speed centre lathe.

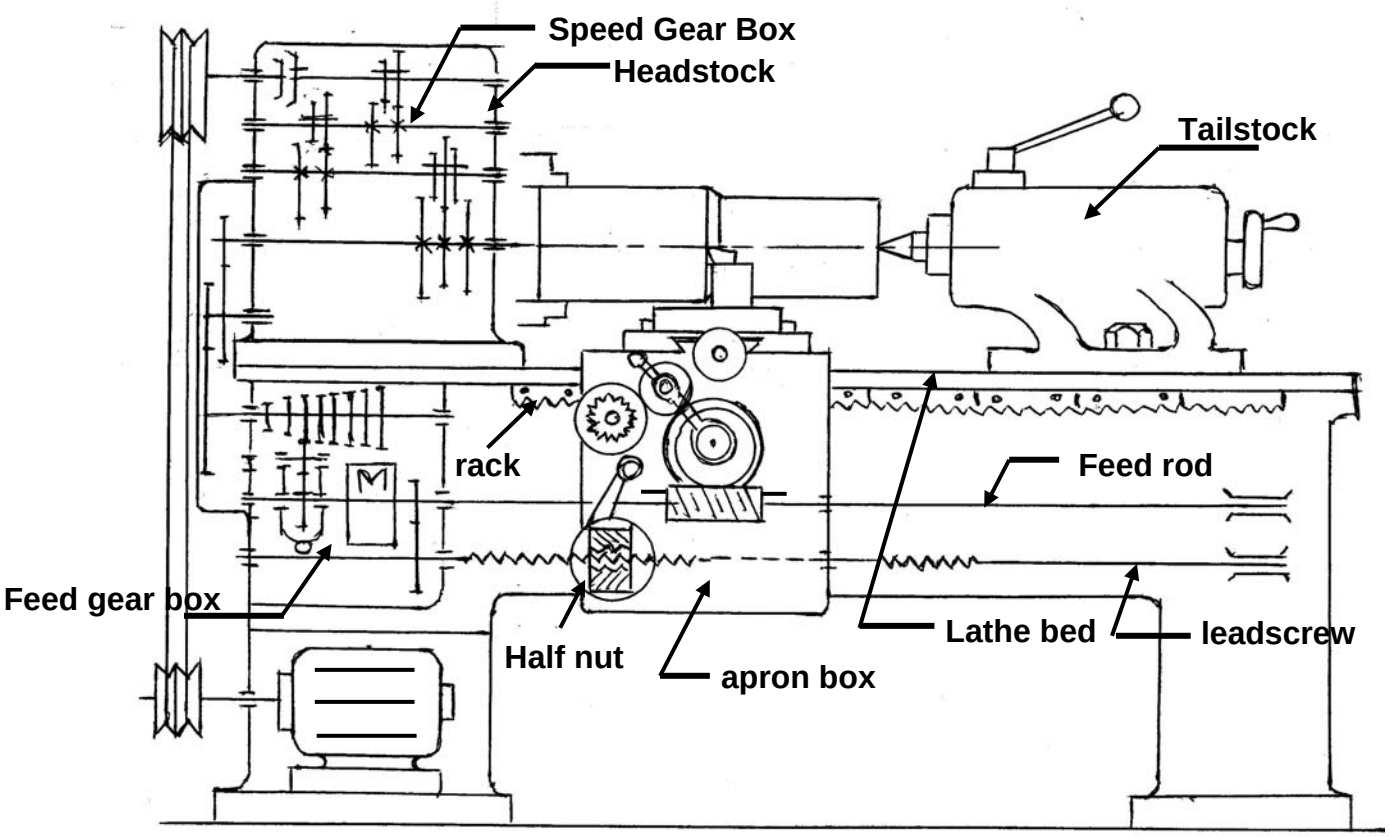

Fig. 4.1.1 *Schematic diagram of a centre lathe.*

For machining in machine tools the job and the cutting tool need to be moved relative to each other.

The tool-work motions are :

- Formative motions : - cutting motion
  - feed motion
- Auxiliary motions : - indexing motion
  - relieving motion etc

In lathes

- Cutting motion is attained by rotating the job
- Feed motion by linear travel of the tool
  - either axially for longitudinal feed
  - or radially for cross feed

It is noted, in general, from Fig. 4.1.1

- The job gets rotation (and power) from the motor through the belt-pulley, clutch and then the speed gear box which splits the input speed into a number (here 12) of speeds by operating the cluster gears.
- The cutting tool derives its automatic feed motion(s) from the rotation of the spindle via the gear quadrant, feed gear box and then the appron mechanism where the rotation of the feed rod is transmitted
  - either to the pinion which being rolled along the rack provides the longitudinal feed
  - or to the screw of the cross slide for cross or transverse feed.
- While cutting screw threads the half nuts are engaged with the rotating leadscrew to positively cause travel of the carriage and hence the tool parallel to the lathe bed i.e., job axis.
- The feed-rate for both turning and threading is varied as needed by operating the Norton gear and the Meander drive systems existing in the feed gear box (FGR). The range of feeds can be augmented by changing the gear ratio in the gear quadrant connecting the FGB with the spindle
- As and when required, the tailstock is shifted along the lathe bed by operating the clamping bolt and the tailstock quil is moved forward or backward or is kept locked in the desired location.
- The versatility or working range of the centre lathes is augmented by using several attachments like
  - Taper turning attachment
  - Thread milling attachment
  - Copying attachment

(iv) Machining Operations Usually Done In Centre Lathes

The machining operations generally carried out in centre lathes are :

- Facing
- Centering
- Rough and finish turning
- Chamfering, shouldering, grooving, recessing etc
- Axial drilling and reaming by holding the cutting tool in the tailstock barrel

- Taper turning by

  - offsetting the tailstock
  - swivelling the compound slide
  - using form tool with taper over short length
  - using taper turning attachment if available
  - combining longitudinal feed and cross feed, if feasible.
- Boring (internal turning); straight and taper
- Forming; external and internal
- Cutting helical threads; external and internal
- Parting off
- Knurling

In addition to the aforesaid regular machining operations, some more operations are also occasionally done, if desired, in centre lathes by mounting suitable attachments available in the market, such as,

- Grinding, both external and internal by mounting a grinding attachment on the saddle
- Copying (profiles) by using hydraulic copying attachment
- Machining long and large threads for leadscrews, power-screws, worms etc. by using thread milling attachment.