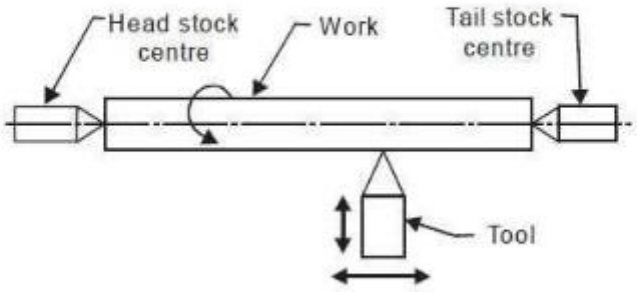
UNIT II TURNING MACHINES

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi automatic – single spindle: Swiss type, automatic screw type – multi spindle

Centre Lathe

A lathe is a machine tool that rotates the work piece against a tool whose position it controls. The spindle is the part of the lathe that rotates. Various work holding attachments such as three jaw chucks, collets, and centres can be held in the spindle. The spindle is driven by an electric motor through a system of belt drives and gear trains. Spindle rotational speed is controlled by varying the geometry of the drive train. Lathe is one of the most versatile and widely used machine tools all over the world. It is commonly known as the mother of all other machine tool. The main function of a lathe is to remove metal from a job to give it the required shape and size. The job is secure1y and rigid1y held in the chuck or in between centers on the lathe machine and then turn it against a single point cutting tool which wi11 remove meta1 from the job in the form of chips. An engine lathe is the most basic and simplest form of the lathe. It derives its name from the early lathes, which obtained their power from engines. Besides the simple turning operation as described above, lathe can be used to carry out other operations also, such as drilling, reaming, boring, taper turning, knurling, screw thread cutting, grinding etc.



The tailstock can be used to support the end of the workpiece with a centre, or to hold tools for drilling, reaming, threading, or cutting tapers. It can be adjusted in position along the ways to accommodate different length workpiece. The tailstock barrel can be fed along the axis of rotation with the tailstock hand wheel.

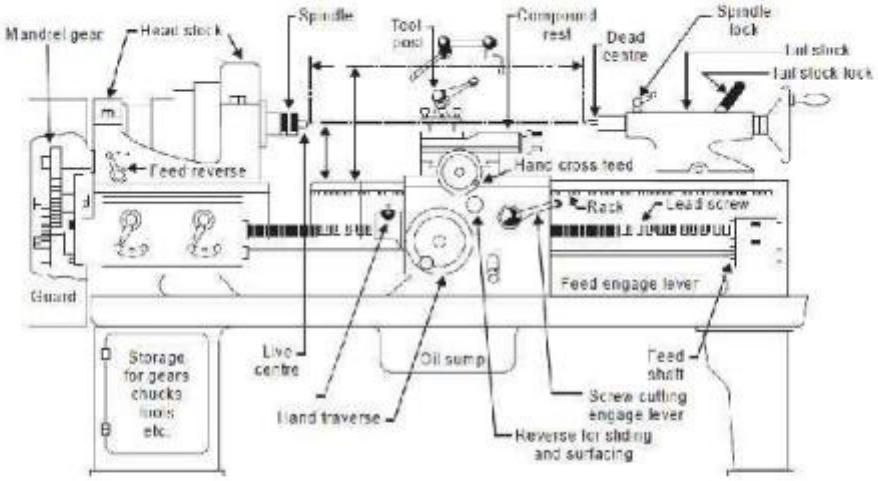
The carriage controls and supports the cutting tool. It consists of:

A saddle that slides along the ways;

- An apron that controls the feed mechanisms;
- A cross slide that controls transverse motion of the tool (toward or away from the operator);
- A tool compound that adjusts to permit angular tool movement; v a tool post that holds the cutting tools.

Construction of Lathe Machine

A simple lathe comprises of a bed made of grey cast iron on which headstock, tailstock, carriage and other components of lathe are mounted. The major parts of lathe machine are given as under:



Bed

The bed of a lathe machine is the base on which all other parts of lathe are mounted. It is massive and rigid single piece casting made to support other active parts of lathe. On left end of the bed, headstock of lathe machine is located while on right side tailstock is located. The carriage of the machine rests over the bed and slides on it. On the top of the bed there are two sets of guideways-innerways and outer ways. The inner ways provide sliding surfaces for the tailstock and the outerways for the carriage. The guideways of the lathe bed may be flat and inverted V shape. Generally cast iron alloyed with nickel and chromium material is used for manufacturing of the lathe bed.

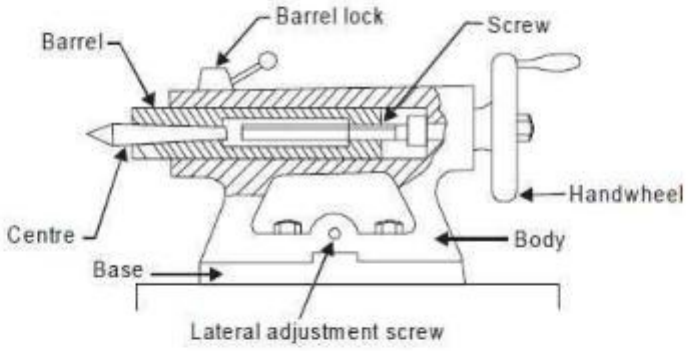
Head Stock

The main function of headstock is to transmit power to the different parts of a lathe. It comprises of the headstock casting to accommodate all the parts within it including gear train arrangement. The main spindle is adjusted in it, which possesses live centre to which the work can be attached. It supports the work and

revolves with the work, fitted into the main spindle of the headstock. The cone pulley is also attached with this arrangement, which is used to get various spindle speed through electric motor. The back gear arrangement is used for obtaining a wide range of slower speeds. Some gears called change wheels are used to produce different velocity ratio required for thread cutting.

Tail Stock

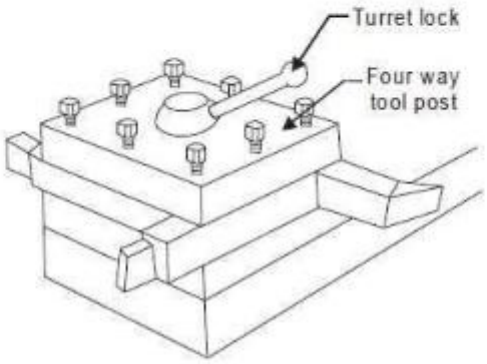
The tail stock of central lathe, which is commonly used for the objective of primarily giving an outer bearing and support the circular job being turned on centers. Tail stock can be easily set or adjusted for alignment or non-alignment with respect to the spindle centre and carries a centre called dead centre for supporting one end of the work. Both live and dead centers have 60° conical points to fit centre holes in the circular job, the other end tapering to allow for good fitting into the spindles. The dead centre can be mounted in ball bearing so that it rotates with the job avoiding friction of the job with dead centre as it important to hold heavy jobs.



Tail stock of central lathe.

Carriage

Carriage is mounted on the outer guide ways of lathe bed and it can move in a direction parallel to the spindle axis. It comprises of important parts such as apron, cross-slide, saddle, compound rest, and tool post. The lower part of the carriage is termed the apron in which there are gears to constitute apron mechanism for adjusting the direction of the feed using clutch mechanism and the split half nut for automatic feed. The cross-slide is basically mounted on the carriage, which generally travels at right angles to the spindle axis. On the cross-slide, a saddle is mounted in which the compound rest is adjusted which can rotate and fix to any desired angle. The compound rest slide is actuated by a screw, which rotates in a nut fixed to the saddle. The tool post is an important part of carriage, which fits in a tee-slot in the compound rest and holds the tool holder in place by the tool post screw



Tool post of centre lathe

Feed Mechanism

Feed mechanism is the combination of different units through which motion of headstock spindle is transmitted to the carriage of lathe machine. Following units play role in feed mechanism of a lathe machine-

1. End of bed gearing

2. Feed gear box
3. Lead screw and feed rod
4. Apron mechanism

The gearing at the end of bed transmits the rotary motion of headstock spindle to the feed gear box. Through the feed gear box the motion is further transmitted either to the feed shaft or lead screw, depending on whether the lathe machine is being used for plain turning or screw cutting. The feed gear box contains a number of different sizes of gears. The feed gear box provides a means to alter the rate of feed, and the ration between revolutions of the headstock spindle and the movement of carriage for thread cutting by changing the speed of rotation of the feed rod or lead screw. The apron is fitted to the saddle. It contains gears and clutches to transmit motion from the feed rod to the carriage, and the half nut which engages with the lead screw during cutting threads.

Thread Cutting Mechanism

The half nut or split nut is used for thread cutting in a lathe. It engages or disengages the carriage with the lead screw so that the rotation of the leadscrew is used to traverse the tool along the workpiece to cut screw threads. The direction in which the carriage moves depends upon the position of the feed reverse lever on the headstock.

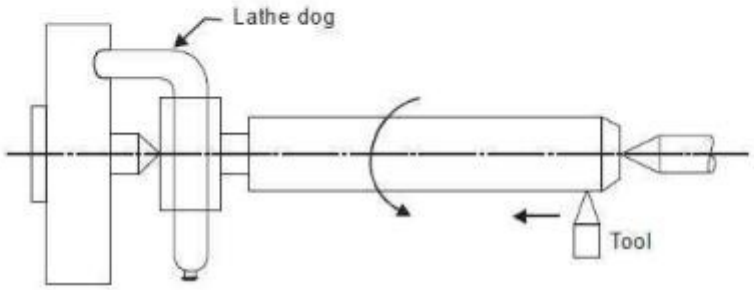
Accessories and Attachments of Lathe

There are many lathe accessories provided by the lathe manufacturer along with the lathe, which support the lathe operations. The important lathe accessories include centers, catch plates and carriers, chucks, collets, face plates, angle plates, mandrels, and rests. These are used either for holding and supporting the work or for holding the tool. Attachments are additional equipments provided by the lathe

manufacturer along with the lathe, which can be used for specific operations. The lathe attachment include stops, ball turning rests, thread chasing dials, milling attachment, grinding attachment, gear cutting attachment, turret attachment and crank pin turning attachments and taper turning attachment.

Lathe centers

The most common method of holding the job in a lathe is between the two centers generally known as live centre (head stock centre) and dead centre (tailstock centre). They are made of very hard materials to resist deflection and wear and they are used to hold and support the cylindrical jobs. Carriers or driving dog and catch plates These are used to drive a job when it is held between two centers. Carriers or driving dogs are attached to the end of the job by a setscrew. A use of lathe dog for holding and supporting the job as shown.



Lathe dog

Catch plates are either screwed or bolted to the nose of the headstock spindle. A projecting pin from the catch plate or carrier fits into the slot provided in either of them. This imparts a positive drive between the lathe spindle and job.

Chucks

Chuck is one of the most important devices for holding and rotating a job in a lathe. It is basically attached to the headstock spindle of the lathe. The internal threads in the chuck fit on to the external threads on the spindle nose. Short, cylindrical, hollow objects or those of irregular shapes, which cannot be conveniently mounted between centers, are easily and rigidly held in a chuck. Jobs of short length and large diameter or of irregular shape, which cannot be conveniently mounted between centers, are held quickly and rigidly in a chuck.

There are a number of types of lathe chucks, e.g.

(1) Three jaws or universal
(2) Four jaw independent chuck
(3) Magnetic chuck
(4) Collet chuck
(5) Air or hydraulic chuck operated chuck
(6) Combination chuck
(7) Drill chuck.

Face plates

Face plates are employed for holding jobs, which cannot be conveniently held between centers or by chucks. A face plate possesses the radial, plain and T slots for holding jobs or work-pieces by bolts and clamps. Face plates consist of a circular disc bored out and threaded to fit the nose of the lathe spindle. They are heavily constructed and have strong thick ribs on the back. They have slots cut into them, therefore nuts, bolts, clamps and angles are used to hold the jobs on the face plate. They are accurately machined and ground.

Angle plates

Angle plate is a cast iron plate having two faces machined to make them absolutely at right angles to each other. Holes and slots are provided on both faces so that it may be clamped on a faceplate and can hold the job or workpiece on the other face by bolts and clamps. The plates are used in conjunction with a face plate when the holding surface of the job should be kept horizontal.

Mandrels

A mandrel is a device used for holding and rotating a hollow job that has been previously drilled or bored. The job revolves with the mandrel, which is mounted between two centers It is rotated by the lathe dog and the catch plate and it drives the work by friction. Different types of mandrels are employed according to specific requirements. It is hardened and tempered steel shaft or bar with 60° centers, so that it can be mounted between centers. It holds and

locates a part from its center hole. The mandrel is always rotated with the help of a lathe dog; it is never placed in a chuck for turning the job. A mandrel unlike an arbor is a job holding device rather than a cutting tool holder. A bush can be faced and turned by holding the same on a mandrel between centers. It is generally used in order to machine the entire length of a hollow job.

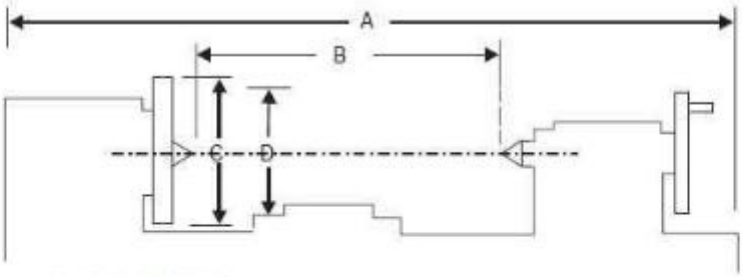
Rests

A rest is a lathe device, which supports a long slender job, when it is turned between centers or by a chuck, at some intermediate point to prevent bending of the job due to its own weight and vibration set up due to the cutting force that acts on it. The two types of rests commonly used for supporting a long job in an engine lathe are the steady or centre rest and the follower rest.

Specification of Lathe

The size of a lathe is generally specified by the following means:

- Swing or maximum diameter that can be rotated over the bed ways
- Maximum length of the job that can be held between head stock and tail stock centres
- Bed length, which may include head stock length also
- Maximum diameter of the bar that can pass through spindle or collect chuck of capstan lathe.



A - Length of bed.
B - Distance between centres.
C - Diameter of the work that can be turned over the ways.
D - Diameter of the work that can be turned over the cross slide.

Specifications of a lathe

(i) Maximum swing over bed

(ii) Maximum swing over carriage

(iii) Height of centers over bed

(iv) Maximum distance between centers

(v) Length of bed

(vi) Width of bed

(vii) Morse taper of center

(viii) Diameter of hole through spindle

(ix) Face plate diameter