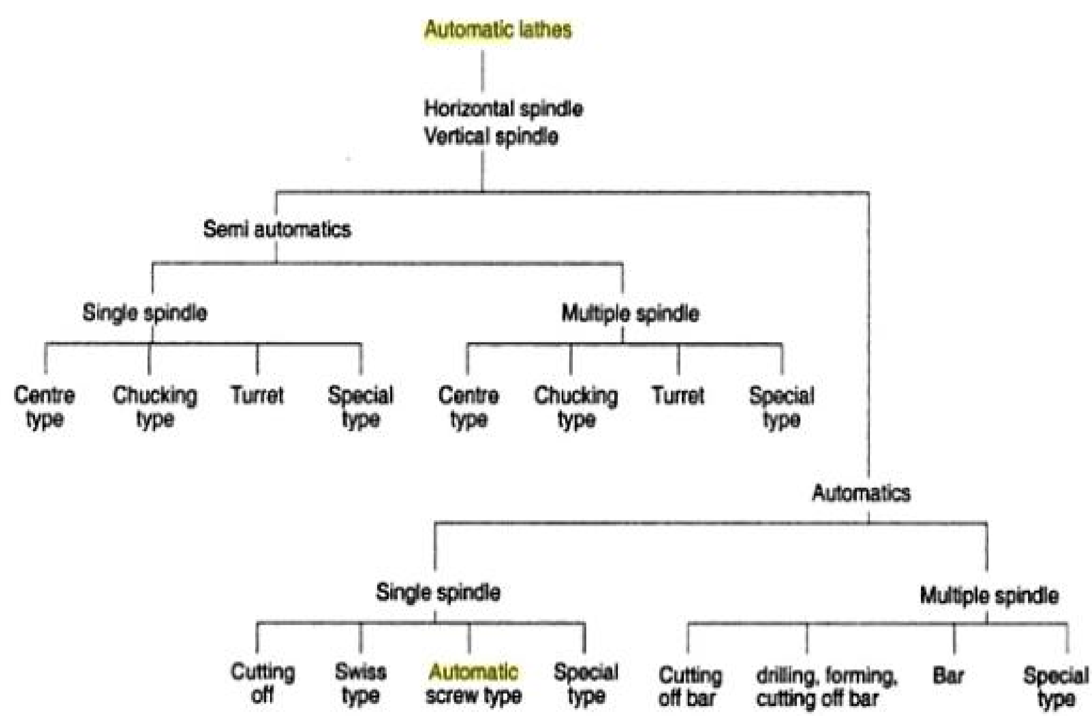
UNIT – II SEMI-AUTOMATIC AND AUTOMATIC MACHINES

Automatic Lathe

Automatic lathes are operated with complete automatic control. They are high speed, mass production lathes. An operator can look after more than one automatic lathe at a time. These are machine tools in which components are machined automatically. The working cycle is fully automatic that is repeated to produce duplicate parts without participation of operator. All movements of cutting tools, their sequence of operations, applications, feeding of raw material, and parting off, unloading of finished parts all are done on machine. All working & idle operations are performed in definite sequence by control system adopted in automatic which is set up to suit a given work. Only operation required to be performed manually is loading of bar stock / individual casting/ forged blanks. These machines are used when production requirements are too high for turret lathes to produce economically.



Classification of Automatic Lathes

General purpose machine tools may have both fixed automation or flexible automation where the latter one is characterized by computer Numerical Control (CNC).
Amongst the machine tools, lathes are most versatile and widely used. Here automation of lathes only have been discussed.
The conventional general purpose automated lathes can be classified as,

(a) Semiautomatic • capstan lathe (ram type turret lathe)
- turret lathe
- multiple spindle turret lathe
- copying (hydraulic) lathe

(b) Automatic :
- Automatic cutting off lathe
- Single spindle automatic lathe
- Swiss type automatic lathe
- multiple spindle automatic lathes

SEMI AUTOMATIC LATHE

a) Semiautomatic lathes

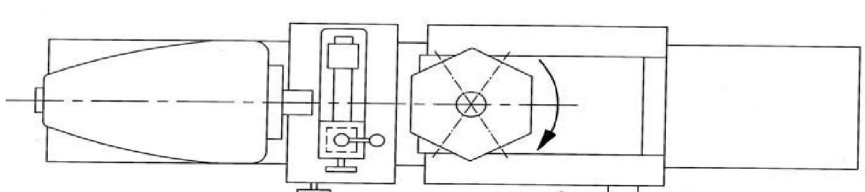
The characteristic features of such lathes are;

- some major auxiliary motions and handling operations like bar feeding, speed change, tool change etc. are done quickly and consistently with lesser human involvement
- the operators need lesser skill and putting lesser effort and attention
- suitable for batch or small lot production
- Costlier than centre lathes of same capacity.

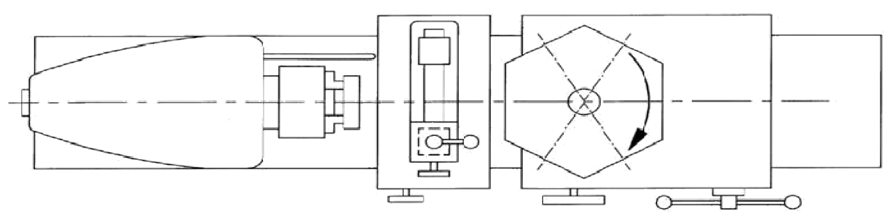
Semi automatic lathe Turret and Capstan lathes are known as semi-automatic lathes. These lathes are used for production work where large quantities of identical work pieces are manufactured. They are called semi-automatic lathes as some of the tasks are performed by the operators and the rest by the machines themselves. A semi skilled operator can do this at low cost and at shorter time. So, the cost of production is reduced. There are two tool posts in the machine namely four way tool post and rear tool post. Four tools can be mounted on the four way tool post and parting tool is mounted on the rear tool post. The tailstock of an engine lathe is replaced by a hexagonal turret. As many tools may be fitted on the six sides of the turret, different types of operations can be performed on a work piece without resetting of tools. The tool heads of a turret lathe and a capstan lathe are illustrated.

Capstan and Turret lathes

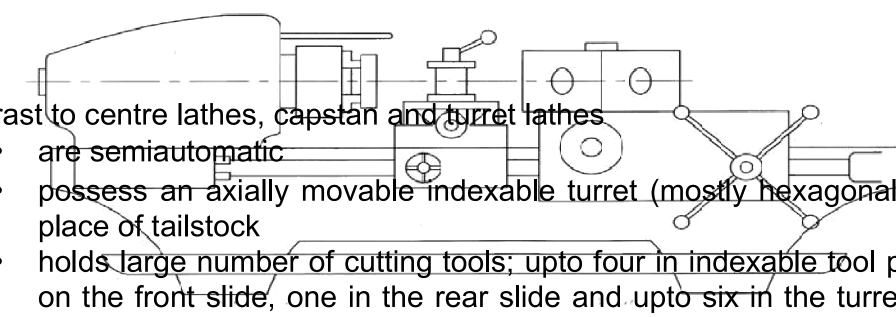
The semiautomatic lathes, capstan lathe and turret lathe are very similar in construction, operation and application. Fig. schematically shows the basic configuration of capstan lathe and Fig. shows that of turret lathe.



Schematic configuration of capstan lathe



Schematic configuration of turret lathe



In contrast to centre lathes, capstan and turret lathes

- are semiautomatic
- possess an axially movable indexable turret (mostly hexagonal) in place of tailstock
- holds large number of cutting tools; upto four in indexable tool post on the front slide, one in the rear slide and upto six in the turret (if hexagonal) as indicated in the schematic diagrams.
- are more productive for quick engagement and overlapped functioning of the tools in addition to faster mounting and feeding of the job and rapid speed change.
- enable repetitive production of same job requiring less involvement, effort and attention of the operator for pre-setting of work–speed and feed rate and length of travel of the cutting tools
- are relatively costlier
- are suitable and economically viable for batch production or small lot production.

There are some differences in between capstan and turret lathes such as,

- Turret lathes are relatively more robust and heavy duty machines
- Capstan lathes generally deal with short or long rod type blanks held in collet, whereas turret lathes mostly work on chucking type jobs held in the quick acting chucks
  In capstan lathe, the turret travels with limited stroke length within a saddle type guide block, called auxiliary bed, which is clamped on the main bed as indicated in Fig., whereas in turret lathe, the heavy turret being mounted on the saddle which directly slides with larger stroke length on the main bed as indicated in Fig.
- One additional guide rod or pilot bar is provided on the headstock of the turret lathes as shown in Fig., to ensure rigid axial travel of the turret head
- External screw threads are cut in capstan lathe, if required, using a self opening die being mounted in one face of the turret, whereas in turret lathes external threads are generally cut, if required, by a single point or multipoint chasing tool being mounted on the front slide and moved by a short lead screw and a swing type half nut.

Ram type turret lathes, i.e., capstan lathes are usually single spindle and horizontal axis type. Turret lathes are also mostly single spindle and horizontal type but it may be also

- Vertical type and
- Multi spindle type

Some more productive turret lathes are provided with preemptive drive which enables on-line presetting and engaging the next work-speed and thus help in reducing the cycle time.

Multiple spindle Vertical Turret lathe

Turret lathes are mostly horizontal axis single spindle type. The multiple spindle vertical turret lathes are characterised by :

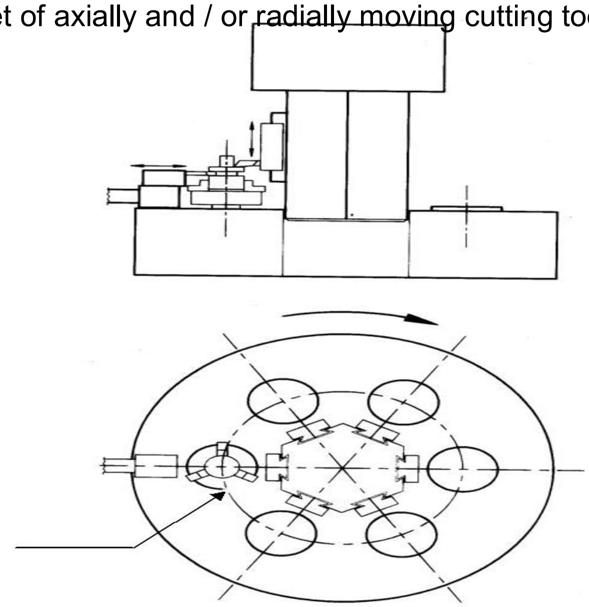
- Suitably used for large lot or mass production of jobs of generally ;
  - chucking type
  - relatively large size
  - requiring limited number of machining operations
- Machine axis – vertical for
  - lesser floor space occupied
  - easy loading and unloading of blanks and finished jobs
  - relieving the spindles of bending loads due to job – weight.
- Number of spindle – four to eight.

the basic configuration of multiple spindle vertical turret lathes which are comprised mainly of a large disc type spindle carrier and a tool holding vertical ram as shown.

Such vertical turret lathes are of three categories :

- **Parallel processing type :**

The spindle carrier remains stationary. Only the tool slides move with cutting tools radially and axially. Identical jobs (say six) are simultaneously mounted and machined in the chucks parallely at all stations each one having same set of axially and / or radially moving cutting tools.



Loading – unloading station

Basic configuration of multi spindle automatic vertical lathe

- **Progressively processing type :**

The spindle carrier with the blanks fitted in the chucks on the rotating spindle is indexed at regular interval by a Geneva mechanism. At each station the job undergoes a few preset machining work by the axially and / or radially fed cutting tools. The blank getting all the different machining operations progressively at the different work stations is unloaded at a particular station where the finished job is replaced by another fresh blank. This type of lathes are suitable for jobs requiring large number of operations.

- **Continuously working type :**

Like in parallel processing type, here also each job is finished in the respective station where it was loaded. The set of cutting tools, mostly fed only axially along a face of the ram continuously work on the same blank throughout its one cycle of rotation along with the spindle carrier. The tool ram having same tool sets on its faces also rotate simultaneously along with the spindle carrier which after each rotation halts for a while for unloading the finished job and loading a fresh blank at a particular location. Such system is also suitable for jobs requiring very few and simple machining operations.

- **Hydraulic copying (tracer controlled) lathes**

Jobs having steps, tapers and / or curved profiles, as typically shown in Fig. 4.7.6, are conveniently and economically produced in batch or lot in semi automatically operated tracer controlled hydraulic copying lathe. The movement of the stylus along the template provided with the same desired job-profile) is hydraulically transmitted to the cutting tool tip which replicates the template profile.

(b) General Purpose Automatic lathes

Automatic lathes are essentially used for large lot or mass production of small rod type of jobs. Automatic lathes are also classified into some distinguished categories based on constructional features, operational characteristics, number of spindles and applications as follows

- Single spindle
    - Automatic cutting off lathes
    - Automatic (screw cutting) lathe
    - Swiss type automatic lathe
- Multispindle automatic lathe

Automatic cutting off lathe

These simple but automatic lathes are used for producing short work pieces of simple form by using few cross feeding tools. In addition to parting some simple operations like short turning, facing, chamfering etc. are also done.

Single spindle automatic lathe

The general purpose single spindle automatic lathes are widely used for quantity or mass production (by machining) of high quality fasteners; bolts, screws, studs etc., bushings, pins, shafts, rollers, handles and similar small metallic parts from long bars or tubes of regular section and also often from separate small blanks. Fig shows a typical single spindle automatic lathe. Unlike the semiautomatic lathes, single spindle automats are :

- preferably and essentially used for larger volume of production i.e., large lot production and mass production
- used always for producing jobs of rod, tubular or ring type and of relatively smaller size.
- run fully automatically, including bar feeding and tool indexing, and continuously over a long duration repeating the same machining cycle for each product
- provided with upto five radial tool slides which are moved by cams mounted on a cam shaft
- of relatively smaller size and power but have higher spindle speeds

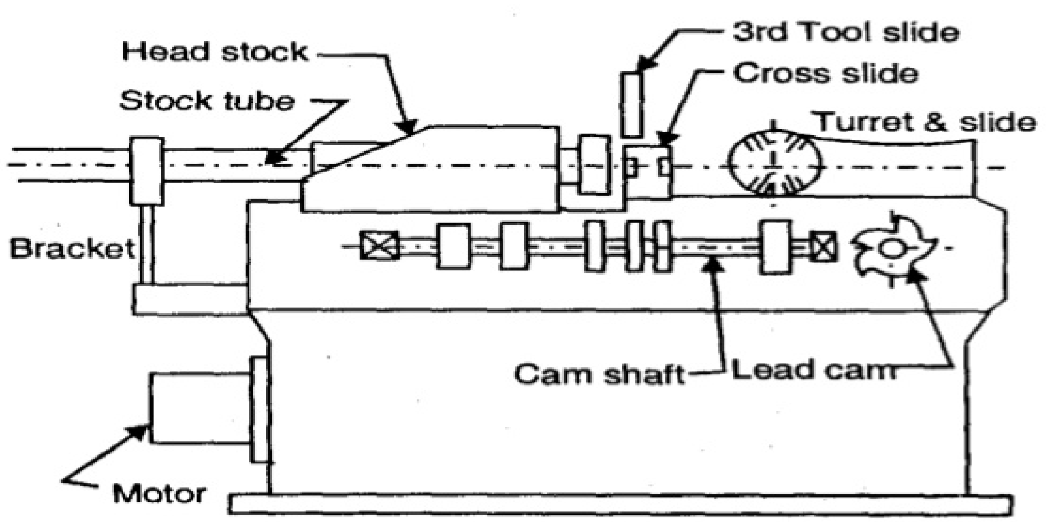
- **Kinematic system and working principle of automatic lathes of common use.**

o **Single spindle automatic lathe**

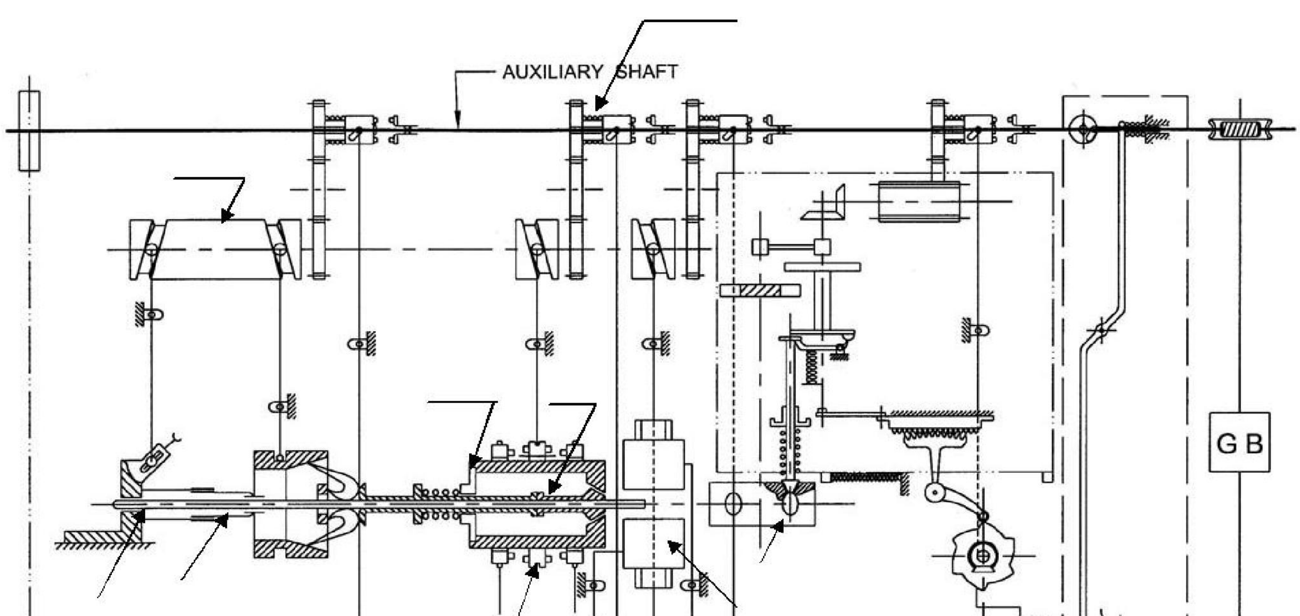
This general purpose and widely used automatic lathe is also known as single

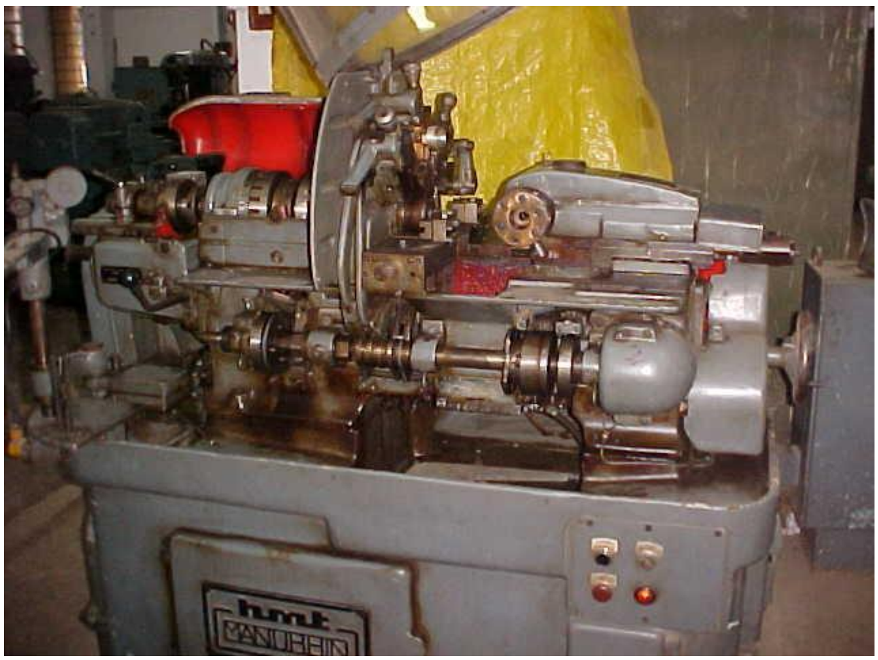
spindle automatic screw cutting lathe (SSASCL) because such lathes were introduced aiming mainly mass production of fasteners having screw threads.
In Fig. schematically shows the typical kinematic system of single spindle automat. The major characteristic functions that are automatically accomplished in sequence and proper synchrony in such lathes are :

- spindle speed change – magnitude and direction of rotation
- bar feeding
- transverse tools – feeding
- turret indexing and travelling



Single Spindle Automatic Screw Lathe





A typical single spindle automatic lathe

SWISS TYPE AUTOMATIC LATHE

Swiss type automatic lathe

The characteristics and applications of these single spindle automatic lathes are :

- In respect of application :
  Used for lot or mass production of thin slender rod or tubular jobs, like components of small clocks and wrist watches, by precision machining;
  - Job size (approximately)
    Diameter range – 2 to 12 mm
    Length range – 3 to 30 mm

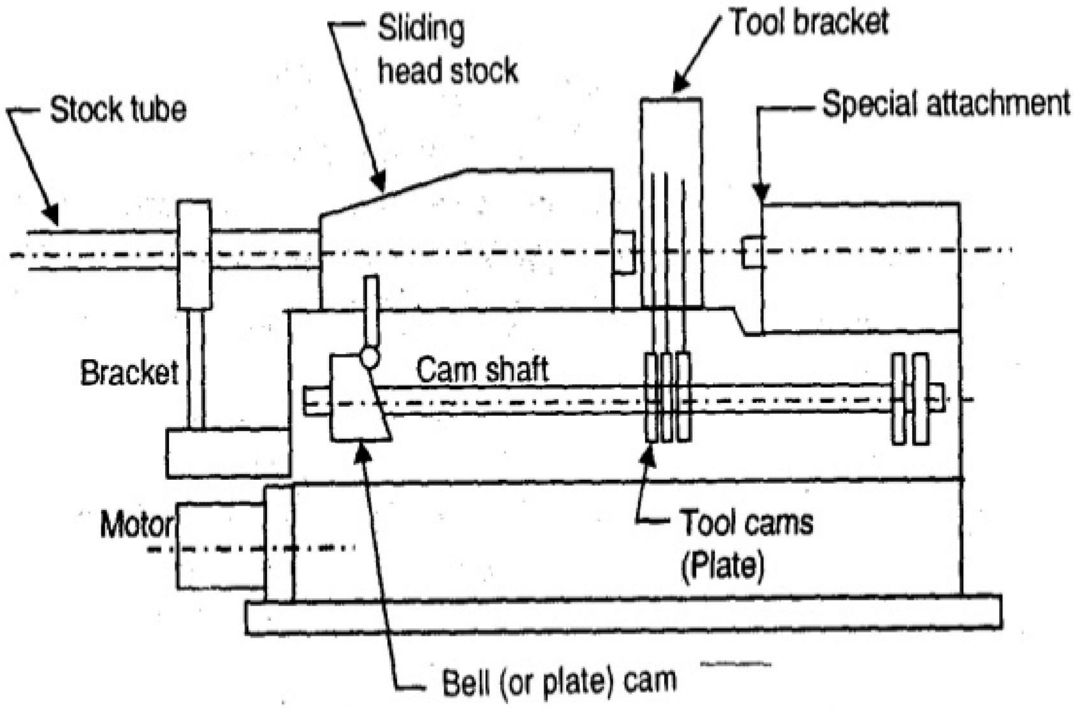
  Dimensional accuracy and surface finish – almost as good as provided by grinding
- In respect of configuration and operation
  The headstock travels enabling axial feed of the bar stock against the cutting tools as indicated in Fig. 4.7.8
  - There is no tailstock or turret
  - High spindle speed (2000 – 10,000 rpm) for small job diameter
  - The cutting tools (upto five in number including two on the rocker arm)

are fed radially

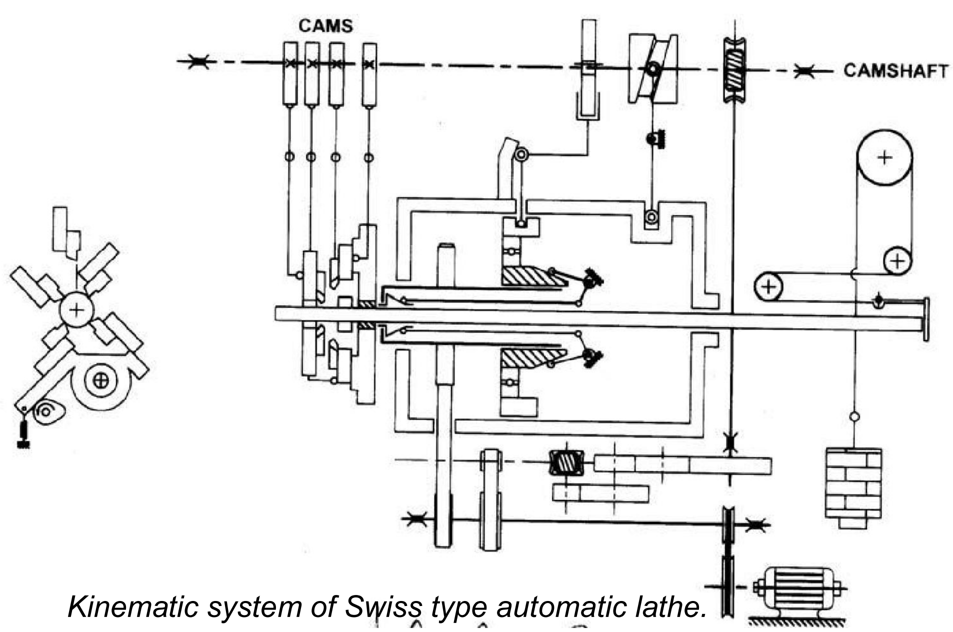
- Drilling and threading tools, if required, are moved axially using swivelling device(s)
- The cylindrical blanks are prefinished by grinding and are moved through a carbide guide bush as shown.

These lathes are very small, very tiny may be say about say only 6 inch may be 2 feet but they are fully automatic and highly precision and quite expensive. Now the characteristics are now the products products are really very small. It is a mass production machine, but the product side is very small, very slender rod like product as you see here are manufactured the diameter may vary from 2 millimeter to say 10 millimeter maximum. Length may vary from 3 millimeter to say 15 millimeter or 20 millimeter. Precision, yes is a highly precision the dimensional accuracy and finish will be in the order of microns, speed see the diameter is very small. The speed should very high configuration which has got very peculiar configuration. We can see that the headstock travels. Now if you want to machine turn a rod like this a long rod, we normally start turning from this side. Now if we take a long rod, thin long rod projected so much, then there will be lot of bending force. To avoid that, there is a tool guide job guide through which the job is passed. This is called job guide, the bush and the cutting tools are mounted along the guide and the job is gradually projected. So the projection length or the bending moment will be always small. So the headstock will gradually move which will be equivalent to the feed motion. So this is the unique characteristics of this. So tool will be almost stationary moving radially just after this tool job guide and the job will moving through that so whatever be the length of the job the over or the bending movement will be very small and there will be 5 radial cutting tools shown over here. One say front slide front slide real slide vertical slide and two inclined and these two slides will be mount tool slide will be mount on a rocker arm and this rocker arm will be oscillating when this will move in this direction this cutting tool will be engaged, when this will rotate in this direction this tool will be engaged into work. So this is the basic configuration of Swiss type automatic. These are 11 basically used for very small tiny components, mechanical components say this small pins used in say wrist watch or similar things.

Now this is Swiss type automatic were this is the bar which is held by a collet here, that is called stationary collet operated by a push tube. Now the power comes from the motor through the shaft and it goes to the spindle. So the spindle rotates along with the collet and the job in this direction and then, this power comes into this cam shaft which rotates very slowly. Now when the cam shaft rotates this cylindrical cam moves this entire headstock along with all these things forward through the tool job guide the bush against the cutting tools all five cutting tools which are actuated by 5 cams or 4cams and then which are mounted on the cam shaft and when the job will be complete, then the collet will open and under gravity the rod will be pushed, it will be arrested by a tool and again this will be and this will be repeated.



Swiss Type Automatic Lathe



Kinematic system of Swiss type automatic lathe.

Multispindle automatic lathes

For further increase in rate of production of jobs usually of smaller size and simpler geometry. Multispindle automatic lathes having four to eight parallel spindles are preferably used. Unlike multispindle turret lathes, multispindle automatic lathes ;

- o are horizontal (for working on long bar stocks)
- o work mostly on long bar type or tubular blanks

Multiple spindle automats also may be parallel action or progressively working type. Machining of the inner and outer races in mass production of ball bearings are, for instance, machined in multispindle automatic lathes.

Tool Layout For Machining a Product In Semi-Automatic And Automatic Lathes.

The procedural steps to be followed in sequence for batch or lot production of a job by machining in semi-automatic and automatic general purpose machine tools are :

(a) Thorough study of the job to be produced: in respect of :

- volume of production, i.e., number of pieces of the specific job to be produced
- material and its properties
- size and shape
- surfaces to be machined
- required dimensions with tolerances and surface finish
- end use of the product

(b) Selection of machine tool (after studying the job): in respect of ;

- type
- size
- precision
- kind and degree of automation

(c) Selection of blank (based on job and machine selected): in respect of;

- bar chucking or housing type
- preformed by; casting, forging, rolling etc.
- if bar type; cross section (circular, tubular, square, hexagon etc.)
- nominal size based on largest dimensions and availability
- preformed by hot working or cold working

(d) Identification and listing of the elementary machining operations required, depending upon the product configuration

(e) Combine elementary machining operations as much as possible for saving time

(f) Sequence the operations (after combining)

(g) Select cutting tools: in respect of;

- type
- material
- size
- geometry
- availability

depending upon the machining operations (after combining) and work material

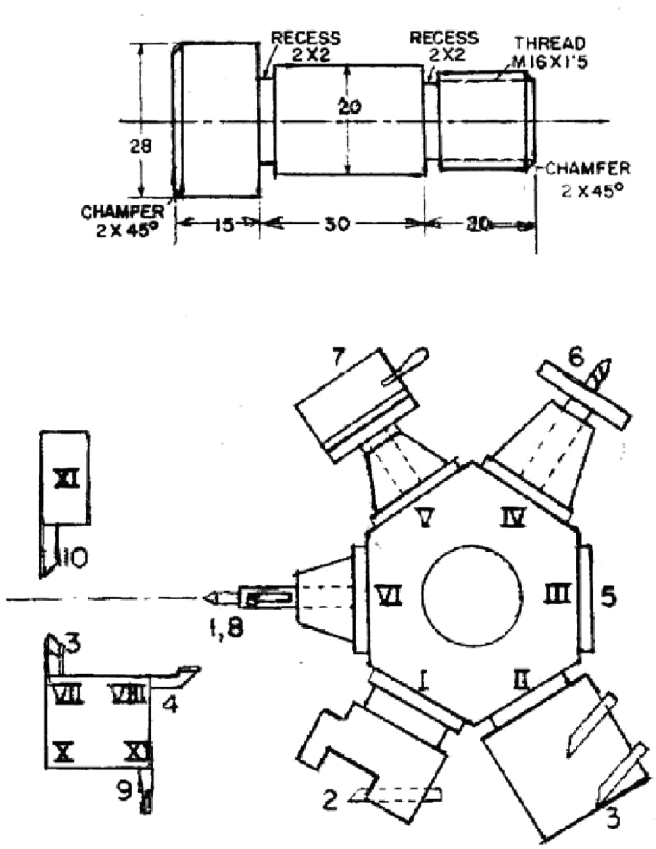
(h) work scheduling or preparation of the instruction sheet or operation chart giving column-wise :

- description of the machining work to be done in sequence
- cutting tools : type and location

- speed and feed for each operation
- length of travel of the tools
- cutting fluid application;
    - o yes or not required
    - o type of cutting fluid

(i) Tool layout : schematically showing the type and configuration of the cutting tools and their location and mounting.

A typical tool layout for a particular job being machined in a single spindle automatic lathe is schematically shown in Fig.



Tool layout for a typical job in single automatic lathe.

Hopper Feeding:

A hopper can be used as a container, as a crafting ingredient, and as a red stone component.

A hopper has an "output" tube at its bottom that can face down or sideways and provides visual feedback of which direction the hopper will output items to if a container is present. To place a hopper, use the Place Block control while aiming at the surface to which its output should face (a hopper will *not* automatically orient itself to point at a container). To place a hopper so that it faces a container (or other block which has a Use Item interaction), sneak while placing the hopper. A hopper placed while aiming at the bottom of a block will re-orient to face down instead. Hoppers won't change their direction after being placed and aren't "attached" to the container they are facing—the container can be removed and the hopper will continue to face in the same direction.

Hoppers cannot be moved by pistons. Despite not appearing as a solid block, attached blocks such as rails, levers, tripwire and red stone dust can be placed on top of hoppers (but not on their side).

A hopper can be used to suck in item entities above it, or to transfer items to or from other containers.

Hoppers are red stone mechanisms and can be activated by:

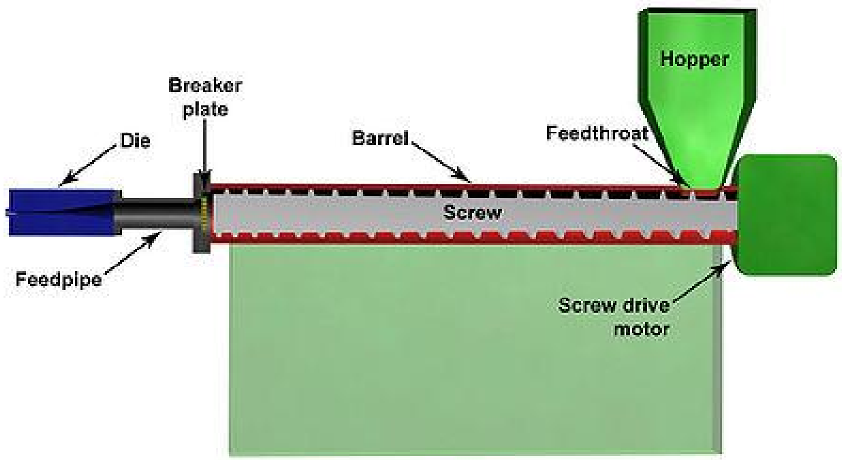
- An adjacent active **power component**: for example, a redstone torch (except that a redstone torch will not activate a hopper it is attached to), a block of redstone, a daylight sensor, etc.
- An adjacent **powered block** (for example, an opaque block with an active redstone torch under it)
- A powered **redstone comparator** or **redstone repeater** facing the hopper
- Adjacent powered **redstone dust** configured to point at the hopper (or on top of it) or directionless; a hopper is *not* activated by adjacent powered redstone dust that is configured to point away from it.

A hopper's behavior is the opposite of most redstone components, in that it performs actions while *not* activated and stops performing actions when activated. Thus, an unactivated hopper is described as **enabled** and an activated hopper is described as **disabled**.

An enabled hopper can do three things (all at once)

- **suck** item entities (free-floating items in the world) into its inventory from the space above it
- **pull** a single item into its inventory from a container above it
- **push** a single item from its own inventory into a container it is facing

example a hopper mechanism comprising a hopper front panel and a back shoe horizontally side able with respect to a hopper base together forming a hopper into which a horizontal deck of document cards may be placed; a belt extending around a pick roll moveable through the front panel for picking an end card in the hopper and driving it downwardly through a throat gap disposed in the hopper base; a relatively large diameter roll supporting the belt and forming a nip with the belt into which the picked document card moves from the throat gap for reversing the direction of movement of the card from vertical to horizontal; a registration arm swing able by the card as it passes out from engagement with the large diameter roll and belt for sensing the position of the card; and a reversely rotating roll coasting with a roller carried by the registration arm for moving the card backwardly, after the card has cleared the registration arm, into contact with a card abutting registration edge of the arm for providing a registered position for the card.



Magazine Feeding

A **magazine** is an ammunition storage and feeding device within or attached to a repeating firearm. Magazines can be removable (detachable) or integral to the firearm. The magazine functions by moving the cartridges stored in the magazine into a position where they may be loaded into the chamber by the action of the firearm. The detachable magazine is often referred to as a **clip**, although this is technically inaccurate.

Magazines come in many shapes and sizes, from those of bolt-action express rifles that hold only a few rounds to drum magazines for self-loading rifles that can hold as many as one hundred rounds. Various jurisdictions ban what they define as "high-capacity magazines".

To fire, the operator inserts a loaded magazine, pulls back and releases the charging handle, and then pulls the trigger. In semi-automatic, the firearm fires only once, requiring the trigger to be released and depressed again for the next shot. In full-automatic, the rifle continues to fire automatically cycling fresh rounds into the chamber, until the magazine is exhausted or pressure is released from the trigger. After ignition of the cartridge primer and propellant, rapidly expanding propellant gases are diverted into the gas cylinder above the barrel through a vent near the muzzle. The build-up of gases inside the gas cylinder drives the long-stroke piston and bolt carrier rearward and a cam guide machined into the underside of the bolt carrier along with an ejector spur on the bolt carrier rail guide, rotates the bolt approximately 35° and unlocks it from the barrel extension via a camming pin on the bolt. The moving assembly has about 5.5 mm (0.2 in) of free travel which creates a delay between the initial recoil impulse of the piston and the bolt unlocking sequence, allowing gas pressures to drop to a safe level before the seal between the chamber and the bolt is broken. The AK-47 does not have a gas valve; excess gases are ventilated through a series of radial ports in the gas cylinder. The Kalashnikov operating system offers no primary extraction upon bolt rotation, but uses an extractor claw to eject the spent cartridge case.

Transfer Machines:

Transfer machines are metal working machine tools with several stations for performing various machining processes. Work pieces are fed into the machine and automatically indexed from station to station. Each station simultaneously performs a different operation on the work piece and they exit the machine as a partially or completely finished unit. Standard transfer machine systems consist of multiple, sequential mechanical components, such as machining heads, transfer devices, indexing tables, and work. Work pieces are held by stationary or traveling fixtures and indexed in a circular or linear path. In the course of a cycle, components pass through each work station undergoing specific machining operations. The indexing table turns either vertically or horizontally and supports both continuous and intermittent movement. When combined with an automated transfer line for part feeding, transfer machines amplify production rate.

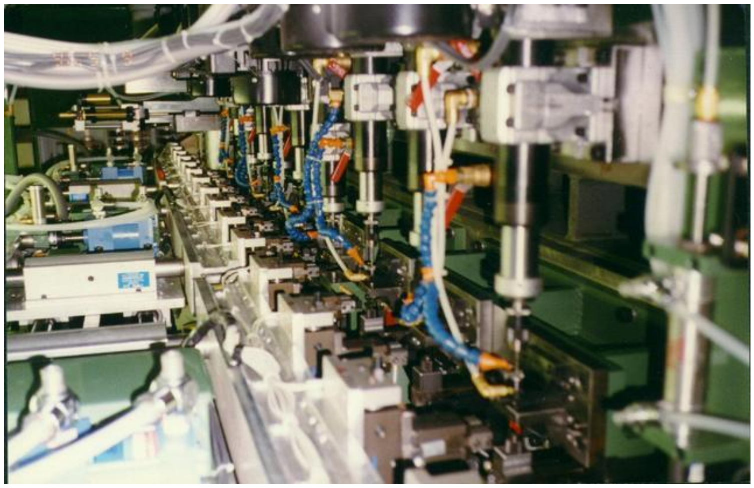
Uses for transfer machines include mass production of metal parts for a variety of industries, such the automotive and industrial machinery industries. Custom systems exist for manufacturing discrete components.

Types of Transfer Machines:

Transfer machines come in three main types, including:

Rotary: These machines move work pieces between stations in a circular path. Mass manufacturing within a small footprint makes these systems an economical solution. Modern CNC-enabled flexible transfer machines of this type gained popularity in European and North American domestic manufacturing facilities given the lower labor costs.

In-line or linear: Work pieces follow a linear path from one workstation to the other. The number of axes a machine operates on, combined with the number of machining stations, determines the quantity and type of parts and processes the machine can perform.

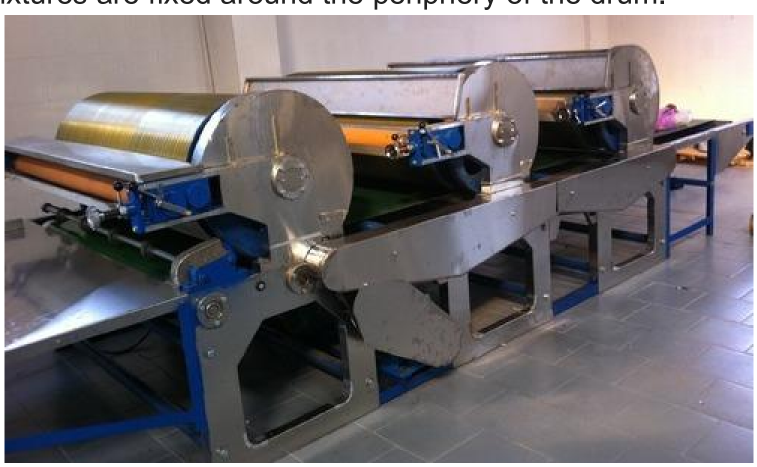


Drum Type Transfer Machines

It is like a rotary type transfer machine, this machine also transfers the components in a circular path to work stations positioned around at equal distances.

This machine instead of having a table has got a drum which rotates about a horizontal axis.

The work fixtures are fixed around the periphery of the drum.



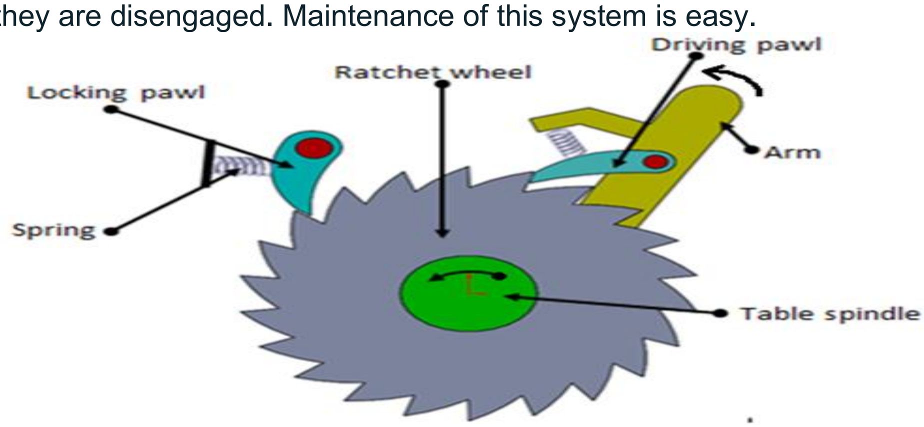
Trunnion: Parts are indexed around a horizontal shaft, known as the trunnion. The rotary movement of the parts is similar to the motion of a Ferris wheel. Cutting tools engage the parts at respective stations at the same time, allowing each index to deliver a completed part. The number of machining units depends on the size of the machine.

CNC-enabled trunnions with the flexibility to adjust their tooling eliminate the need to perform secondary operations, as well as associated tooling and labor. Newer trunnion transfer devices are capable of axially processing a work piece at each end. They can be configured using supplementary tooling units, vertical or angular, resulting in a five-sided contact with the part during the machining process.

Ratchet and Pawl Type Mechanism

Mechanism is a system of rigid elements arranged and connected to transmit motion in a predetermined fashion. Indexing mechanisms generally converts a rotating or oscillatory motion to a series of step movements of the output link or shaft. In machine tools the cutting tool has to be indexed in the tool turret after each operation. Also in production machines the product has to be indexed from station to station and need to be stopped if any operation is being performed in the station. Such motions can be accomplished by indexing mechanisms. Indexing mechanisms are also useful for machine tool feeds. There are several methods used to index but important types are ratchet and pawl, rack and pinion, Geneva mechanism and cam drive.

A ratchet is a device that allows linear or rotary motion in only one direction. In Figure shows a schematic of the same. It is used in rotary machines to index air operated indexing tables. Ratchets consist of a gearwheel and a pivoting spring loaded pawl that engages the teeth. The teeth or the pawl, are at an angle so that when the teeth are moving in one direction the pawl slides in between the teeth. The spring forces the pawl back into the depression between the next teeth. The ratchet and pawl are not mechanically interlocked hence easy to set up. The table may over travel if the table is heavy when they are disengaged. Maintenance of this system is easy.



Applications:

Transfer machines cover a wide range of applications, including:

- Automotive
- Pneumatic fittings
- Hydraulic fittings
- Cast iron
- Aluminum
- Flanges
- Forgings
- Castings
- High volume manufacturing
- Medium volume manufacturing