2019 JANUARY

Week 01 002-363

LATHE MACHINE

Wednesday 02

DEFINATION

Lathe machine is a machine which is used to remove metal from the work-piece in the form of metal chips to get the required shape and size by rotating the work piece against a stationary single point or multi-point cutting tool.

It is generally used for making cylindrical jobs. Usually a single point cutting tool is used to perform the operation.

FEED

The direction of movement of the cutting tool (tool bit) towards the work-piece is called as Feed. The cutting tool may be moved in the following 3 ways as per the requirement :—

PARALLEL FEED

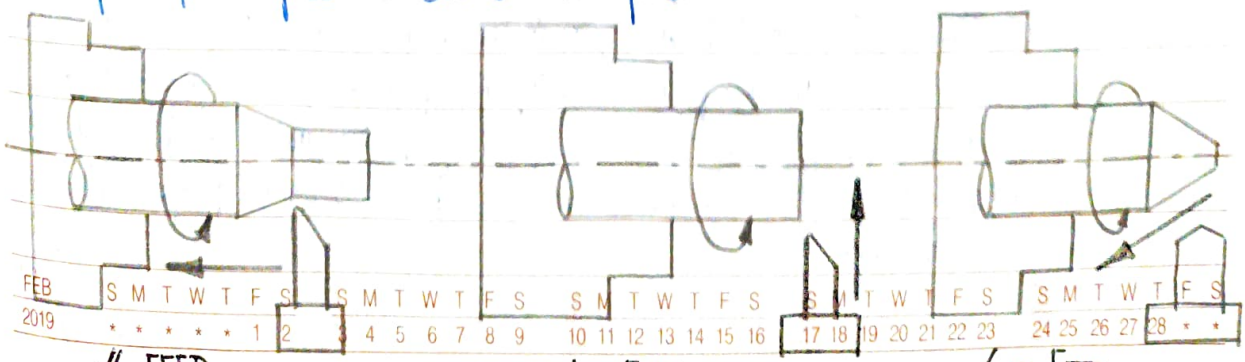
Parallel feed to the axis of rotation of the work-piece, to produce cylindrical surface and also to reduce the diameter of the job.

PERPENDICULAR FEED

Perpendicular feed to the axis of rotation of the work piece, to produce flat surface and also to reduce the length of the job.

ANGULAR FEED

Angular feed to the axis of rotation of the work piece, to produce tapered surface or conical surface.



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S.S AND S.C LATHE MACHINE

S.S stands for Surface Slicting.
S.C stands for Screw Cutting
In a S.S and S.C Lathe machine both surface slicting and screw cutting operation can be performed. It is the conventional name of the lathe machine, which is sometimes Also known as Centre Lathe Machine.

MAIN PARTS OF SS & SC LATHE / CENTRE LATHE MACHINE

A SS and S.C lathe machine, has the following main parts, Such as—

(01) Head-Stock.
(02) Tail-Stock.
(03) Bed-Stock.
(04) Carriage
(05) Quick Change gear box.
(06) Feed shaft
(07) Lead screw.

- Tool post
- Compound Rest
- Cross slide
- Saddle
- Apron

HEAD STOCK

(I) It is mounted on the left end of the bed.
(II) It is a fixed unit of lathe.
(III) It carries a hollow spindle through which long bar and tubes can pass.
(IV) The spindle nose is threaded.
(V) Chuck or face plate can be attached to the nose of the spindle.
(VI) The chuck can hold the job or work-piece and rotates it at different speeds as per the requirement of the operation to be performed.
(VII) The head stock can transmit power from the spindle to the lead screw and feed shaft for automatic threading and feeding respectively.

(VIII) The head stock may be of two types according to the types of gears —
(A) All geared type head stock
(B) Cone pulley type of head stock.

TAIL STOCK

(I) It is mounted on the bed at the right hand.
(II) It is a slicting or movable unit.
(III) It is made up of two parts :- (A) Base (B) Body.
(IV) The main functions of tail stock are :—
(A) To provide support at the right end of a long job, when machined in between centres (live centre and dead centre) and thus minimizes Sagging or bending of the job.
(B) To hold tools like drill bit, boring tool, reamer for drilling, boring, reaming operations.
(C) To make extend taper by setting the body of the tail-stock with respect to the base.
(V) To support different lengths of the work, the body of the tail stock can be move through the guideways of the bed clamped at any position.
(VI) The tail stock body is bored through which the tail-stock spindle come move axially by the help of a hand wheel.
(VII) A dead centre is attached at the spindle tip to give support to the right end of the job.

BED STOCK

(I) It is the base of the lathe machine.
(II) The headstock is mounted on the left hand side, tailstock on the right side and carriage in the middle of the bed stock.
(III) The bed has two guideways on its top surface. The guideways may be flat or inverted V- type.
(IV) The carriage and the tail stock move over the bed through guideways.

(V)- The bed is very strong to resist the cutting forces and vibrations produced during the machining operation.
(VI)- It is usually made up of Cast Iron with Chromium [Cr] and Nickel [Ni]
(VII)- Main functions of bed stock are :—
(A)- To support the total weight of the machine.
(B)- To locate the fixed units in their accurate positions.
(C)- To provide guideways upon which the movable units can move.

CARRIAGE

(I)- It is a slicing unit of the lathe machine mounted in between headstock and tail stock.
(II)- It is used to give various movements to the cutting tool either manually or by power feed.
(III)- The carriage can be locked on the bed at any desired position by tightening the carriage lock screw.
(IV)- The cutting tool can be provided with the following 3 movements by the carriage — Longitudinal / Parallel feeding, Cross-feed / Perpendicular feed and Angular feed.
(V)- The carriage consists of the following parts such as — Toolpost, Compound rest, Cross-slide, Saddle and Apron.

TOOL POST

It is mounted over the compound rest. It holds the tool/tools on it. It is fitted to the top slide of the compound rest. There are commonly 3 types of toolpost used in Centre Lathe Machine — Single way toolpost, Indexing toolpost / Square toolpost / American type toolpost, Quick change toolpost / Universal toolpost.

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COMPOUND REST

It is mounted over the cross-slide. It has two parts — Swivel base and top slide. The swivel base is assembled into the top of the crossslide and may be clamped at any required position between 0° to 360° by tightening the T-bolts. The swivel base is provided with a dovetail projection while the top slide has a dovetail groove. The sliding of the top slide on the swivel base is done by a screw rod fitted with a hand wheel and graduated collar. It can be used during taper turning operation to set the tool for angular feeds. There is no power feed to the compound rest.

CROSS-SLIDE

The cross slide is mounted over the saddle. A dovetail groove is made on its bottom surface, which is assembled with the saddle. It carries the compound rest and tool post over it. The X-slide can move perpendicular to the lathe axis either by hand or automatic power feed. There is a micrometer dial on the cross-slide hand wheel with an accuracy of 0·05 mm.

SADDLE

It is a H-shaped casting having V grooves fitted over the guideways of the bed. It carries the X-slide, compound rest and tool post. It can move over the guideways to the requirement position and locked to the bed. A dovetail projection is made on the top surface of the saddle.

APRON

It is the hand outer covering of the carriage, covered to protect the various mechanisms of carriage.

QUICK CHANGE GEAR BOX

(I)- For obtaining automatic feed and thread cutting a quick change gearbox is placed below the headstock.
(II)- The gearbox contains a number of different size of gears.
(III)- A feed shaft and a lead screw extends from the gearbox to tailstock end.

(IV)- When the automatic feed lever is engaged, the feed shaft advances the carriage slowly especially for turning operation.
(V)- When the leadscrew lever / half nut lever is engaged, the lead screw advances the carriage for the thread cutting operation.
(VI)- The gearbox is getting power from the motor fitted on the headstock.

LEAD SCREW

(I)- It is a threaded shaft; extends from the headstock end to the tailstock end and is placed slightly below the guideways and parallel to it.
(II)- It may be rotated clockwise or anti-clockwise direction at various speeds as per the requirement through the quick change gear box.
(III)- It is engaged to or disengaged from the carriage assembly by the half nut lever.
(IV)- It is used during thread cutting operation only and rest of the time remains stationary.

FEED SHAFT

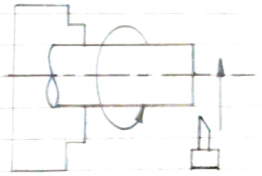
(I)- The feed shaft is a plain rod extending from the headstock to the tailstock end.
(II)- It remains below the leadscrew and parallel to it.
(III)- It is used for giving automatic feed or longitudinal movement to the carriage for plain turning (except thread cutting operation).
(IV)- It also gets power through the quick change gear box.
(V)- It has a keyway extending throughout its length which provides mechanism inside the apron and transmit motion to the carriage.

OPERATIONS PERFORMED ON A LATHE MACHINE

In a lathe machine, the following machining operations are performed such as :-

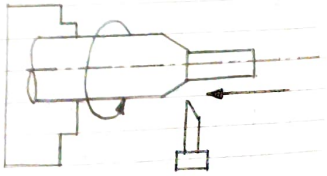
Facing operation, Plain turning operation, Grooving operation, Knurling operation, Taper turning operation, Thread cutting operation (Internal + External), Chamfering operation, Shoulder turning operation, Forming operation, Parting off operation, Boring operation, Reaming operation, Drilling operation, Spinning operation, Eccentric turning operation, Step turning operation etc.

FACING OPERATION



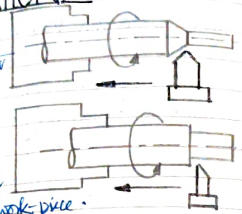
(I)- In facing operation, the end of the work-piece is made flat.
(II)- Here, the work-piece is rotating about the lathe axis, while the facing tool is fed ⊥ar to the lathe axis.
(III)- The tool is slightly inclined towards the work-piece, so as to prevent the end of the work-piece from getting damaged.
(IV)- Sometimes, this operation is known as Squaring Operation.

PLAIN TURNING OPERATION



(I)- In plain turning / straight turning operation, a cylindrical surface is produced.
(II)- Here the workpiece is rotated about the lathe axis while the turning tool is fed ‖el to the lathe axis throughout the length of the job.

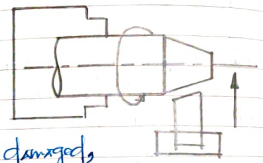
SHOULDER TURNING OPERATION



(I) In shoulder turning process, the diameter of the job is different which looks like step.

(II) Here, work piece is rotating about the lathe axis, while the tool is fed parallel to the lathe axis to certain length of the work piece.

CHAMFERING OPERATION



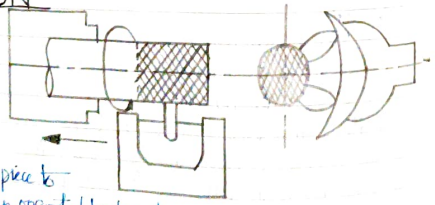
(I) It is the bevelling or turning a slope at the end of the work piece.

(II) This is done so as to remove burns to protect the end of the work piece from being damaged, to make bolts for easy passing into the nut and to have a better look.

(III) This operation may be performed after thread cutting, knurling operation and turning etc.

(IV) In this operation, the work piece is rotating about the lathe axis while the tool is fed perpendicular to the lathe axis.

KNURLING OPERATION



(I) It is a machining operation in which a rough impression is made in the work surface.

(II) It is done to give a good gripping surface on the work piece to prevent it from slipping when operated by hand.

(III) The knurling tool have two hardened steel rollers having teeth on its surface.

(IV) The teeth may be fine, medium or coarse.

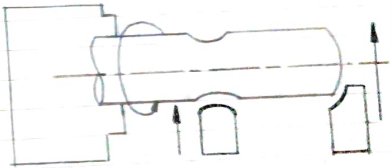
(V) The knurling tool is held in the toolpost against the rotating work piece at the headstock.

(VI) The tool is fed parallel to the spindle lathe axis.

(VII) A very low cutting speed is used in this operation.

(VIII) The knurling tool doesn't cut the work piece but produce an rough impression on its surface.

FORMING OPERATION

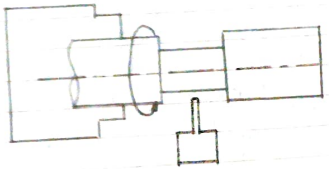


(I) It is a turning operation in which a concave, convex, radial or any irregular shape is made on the work piece by the help of form tools.

(II) The cutting edge of the tool is grooved to the required form.

(III) The form tool is cross-fed against the rotating work piece.

GROOVING OPERATION



(I) Grooving is also known as recessing, necking or undercutting operation.

(II) It is generally done at the edge of the shoulder end at the end of the threaded portion.

(III) It is the turning operation in which a work piece is cut to the required depth.

(IV) Here the grooving tool is cross-fed against the rotating work piece.

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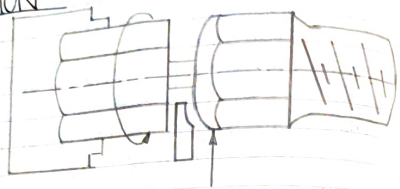
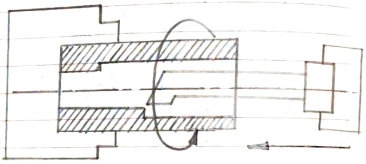
PARTING OFF OPERATION



(I) It is a turning operation in which a finished component can be cut off from the workpiece.
(II) The parting tool is cross-feed against the rotating work piece.
(III) The feed rate is slow (during this operation [0.08 mm to 0.16 mm/revolution].
(IV) If the feed rate will become high the parting off tool may be broken.

BORING OPERATION



(I) Boring is an operation in which enlargement of an existed drilled, punched or cast hole is done.
(II) It is similar to the external plain turning operation but the turning should be done inside the job.
(III) The job is held on the chuck, while the boring tool is held on the tailstock spindle.
(IV) Feed is given to the tool axially by moving the tailstock over the guideways of the lathe bed.
(V) If the boring operation is done through certain length of the jobs, then it is called Counter Boring.

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DRILLING OPERATION

(I) It is the operation of making a hole in the job, where not existed previously.
(II) Here the job is held on the chuck and drill bit on tailstock spindle.

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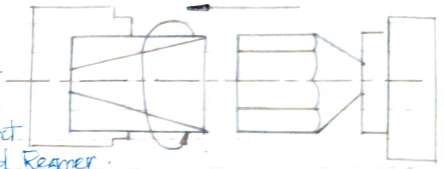
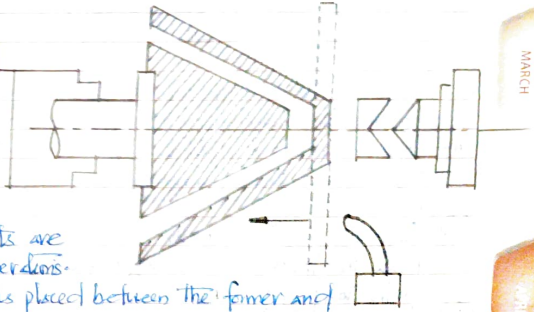
(III) Feed is given to the tool axially.
(IV) In drilling operation, the job remains stationary while the drill bit rotates but in case of lathe machine, the job rotates while the drill bit remains stationary.

REAMING OPERATION



(I) Reaming is the operation of sizing & finishing a drilled hole or bored hole to its correct size by means of a tool called Reamer.
(II) In reaming operation, job is held on the head stock spindle while the reamer on the tail stock spindle.
(III) Axial feed is given to the reamer.
(IV) By reaming operation, rectification of defects in drilled or bored holes can also be done.

SPINNING OPERATION



(I) Spinning is an operation in which thin sheet of metal can be formed to the required shape.
(II) Generally cup shaped parts are produced by spinning operations.
(III) At first the sheet metal is placed between the former and tail stock centre.
(IV) The sheet metal is rotated at a high speed, then a long round nose forming tool is pressed slowly against the rotating sheet ex pressure cooker vessel, cup shape metal containers etc.

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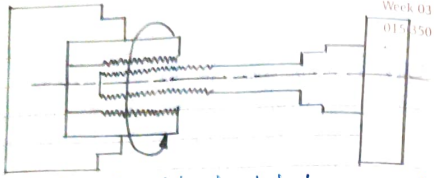
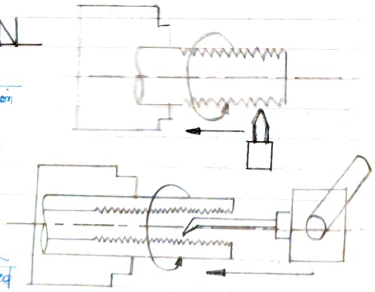
TAPPING OPERATION



(I) It is the operation of forming internal thread inside a hole by means of a sets of tools called taps.
(II) Here the job is held in the chuck while the tap is held in the tool stock spindle.
(III) Axial feed will be given to the tap against the rotating work-piece.
(IV) During tapping operation, the speed and rotation of the job will be very slow, otherwise the tap may be damaged.
(V) A set of 3 nos of taps are used to perform the operations.
1st TAP = It is used to make the path of the threads on the job.
2nd TAP = It performs the actual cutting operation.
3rd TAP = It is used to finish the threads.

THREAD CUTTING OPERATION



(I) It is one of the most important operation performed in a lathe machine.
(II) It is the operation in which both external and internal threads can be cut on the job.
(III) Here the job is held on the chuck while the thread cutting bit is fitted on the tool post.
(IV) Longitudinal feed is given to the bit against the rotating job.
(V) During thread cutting, the lead screw is engaged for automatic movement of the carriage.
(VI) The cutting speed or rotation of the job or work-piece will be very slow.

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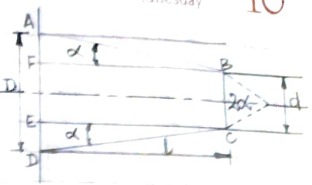
TAPER TURNING OPERATION



(I) It is the operation in which an uniform change in diameter of the job takes place.
(II) In this operation a conical surface on the work piece is formed.
(III) A taper can be expressed in the following ways :-

TAPER ANGLE

It is expressed in degree of half the included angle/reduced angle/inclined angle.

CONICITY

It is defined as the ratio of the gradual increase or decrease in diameter of the job per unit length.

(IV) Here, D = big / large diameter
d = small diameter.
l = length of the taper.
α = half inclined angle.
2α = full inclined angle.

$$\therefore \tan\alpha = \frac{p}{b} = \frac{\left(\frac{D-d}{2}\right)}{l} = \frac{D-d}{2l}.$$

From ΔABF,

$$\alpha = \tan^{-1}\left(\frac{D-d}{2l}\right)$$ where, α = half inclined angle / taper angle.

$$\text{Conicity}(K) = \frac{\text{Increase or Decrease in diameter}}{\text{Unit length}}$$

$$\Rightarrow K = \frac{D-d}{l}.$$

(V) Taper turning operation can be performed by the following methods :-
By swivelling the compound rest by taper turning attachment, by combination feed, by off-setting the tail stock & by using a form tool.

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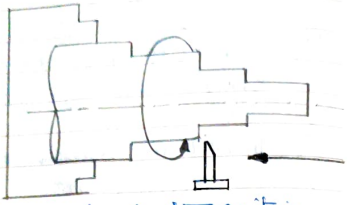
STEP TURNING OPERATION



(I)- It is a type of turning operation in which the job or work piece will be held in the chuck and the feed is given parallel to the lathe axis.

(II)- This turning operation is carried out by a number of steps, so it is known as Step Turning Operation.

SPECIFICATION OF A CENTRE LATHE MACHINE

To specify a General purpose Centre Lathe Machine completely, the following details are given which are as follows:—

(01)- Bed Size = 3'11"
(02)- V-belt cone pulley drive.
(03)- 2HP motor.
(04)- 3 phase supply motor.
(05)- RPM (Revolution per minute) = 1440.
(06)- 3 jaw/4 jaw chuck.

SAFETY PRECAUTIONS ADOPTED/TAKEN/NEEDED FOR WORKING ON A LATHE MACHINE

Following are the personal, workshop as well as machine safety precautions adopted during operation on a lathe machine:—

(I)- Before operating the machine, one should completely understand its operations and controls.
(II)- All the safety guards should be in proper positions.
(III)- Wearing of loose garments, rings, wrist watches, bracelets etc should be avoided as it may lead to accident.
(IV)- Safety goggles are preferred to protect the eyes from hot metal chips.
(V)- For cleaning, oiling and setting the machine, it should be stopped first.
(VI)- The work area should be clean and tidy i.e. away from oil and chips to avoid accidents.
(VII)- One should not under the working area be bare-footed.
(VIII)- Before starting the machine it should be ensured that the chuck or face plate is mounted securely.
(IX)- Chuck key should be removed after tightening the job in the chuck.
(X)- Revolving the chuck should not be stopped by hand.
(XI)- Tools and other instruments should be placed on the tray provided below the bed, should not be placed over the bedek.

LIMITATIONS OF CENTRE LATHE MACHINE

We have so far discussed about a Centre Lathe Machine. The centre lathe machine is capable of producing a large varieties of cylindrical jobs. But there are certain limitations of Centre Lathe Machine which are as follows:—

(I)- A complete component can't be produced with a single setting tools, we have to change the tools everytime a new operation is to be performed.
(II)- It is difficult to perform operation on the end face of the job.
(III)- A no. of different operations can't be performed simultaneously on the job.
(IV)- High skill is required to perform the operations on the work piece.
(V)- Rate of production is less, since a long time is spent on changing and setting of tools for new operations. So, it is not economical.
(VI)- It is not suitable for mass production of identical components.

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CAPSTAN AND TURRET LATHE

For all the mentioned limitations of Centre Lathe, it can be eliminated by introducing a special type of lathe machine known as Capstan And Turret Lathe Machine. These lathe machines are a modification of Centre Lathe Machine. These machines are introduced in semi-automatic machine as number of operations can be done automatically.

It is used to manufacture any number of identical work pieces in less time. In these types of lathe, the work-piece is held on collet/chuck which are actuated hydraulically or pneumatically. All the needed tools are held in the respective holes on the turret head and according to the sequence of operation, the tool is moved with the help of a turret head.

MAJOR COMPONENTS AND THEIR FUNCTIONS IN A CAPSTAN AND TURRET LATHE

The major components/parts of Capstan And Turret Lathe Machine are:—

(I)- Bed-stock.
(II)- Head-stock.
(III)- Legs.
(IV)- Carriage/Chaser Saddle [X slide and saddle].
(V)- Turret Saddle/Auxiliary Device.

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BED-STOCK

(I)- It is a box type casting provided with parallel guideways over its top.
(II)- The carriage and the turret saddle are placed over them.
(III)- At the same time, it supports the headstock at its one end and the turret saddle on the other end and the carriage is placed in between them.
(IV)- It provides the required rigidity to all the parts mounted over it.

HEAD-STOCK

(I)- It carries a similar type of head stock as compared to centre lathe, but is comparatively larger in size and bigger in construction.
(II)- It is a large casting located at the left end of the lathe bed.
(III)- Due to its large size and heavier construction, it is capable to provide a wider range of speeds i.e. between 30 rpm to 2000 rpm.
(IV)- Generally the following types of head stock are used in a Capstan and Turret Lathe machine — Step Cone Pulley Driven Head Stock, Direct Electric Motor driven Head Stock, All geared type Head Stock And Pre-optive/Pre-selective type of Head stock.

LEGS

(I)- It possesses two legs, one below each end of the bed.
(II)- These legs are hollow casting which bear the entire load of the bed and all the stationary as well as movable parts over the bed.
(III)- The left leg may house several mechanisms such as electric drives, oil pumps etc, that's why it is larger than the right leg.

CARRIAGE/CHASER SADDLE

(I)- The carriage or chaser saddle of Capstan and Turret Lathe machine mounted on the bed is not much different from the carriage of a Centre Lathe Machine.
(II)- It carries a cross-slide over which two tool posts are mounted, one tool post at the front and the other tool post at the rear end.
(III)- It doesn't carry a compound rest as that of Centre Lathe machine.
(IV)- Both the front and rear tool post are usually square tool post in which each can hold four tools on it.
(V)- By means of a handle provided at the top of the tool post, the tools can be indexed equally each time to bring one tool after the other in required position.

(vi) In the front tool post, four tools can be mounted while in the rear tool post normally a single tool (parting off tool) is mounted because less number of operations is to be performed from the rear side.

(vii) Both hand feeding and power feeding can be used to the saddle as well as the cross-slide.

(viii) The commonly used types of carriage can be classified as follows:—
(A) Conventional Type / Reach Over Type Carriage.
(B) Side Hung Type Carriage.

(A) CONVENTIONAL / REACH OVER TYPE CARRIAGE

It is a conventional carriage known as Bridge Type Carriage as it bridges over the front and rear way of the bed. The swing over the cross-slide is limited hence used for machining smaller jobs. So, it is preferred for Capstan Lathe Machine.

(B) SIDE HUNG TYPE CARRIAGE

This type of carriage doesn't bridges over the bedways of the bed. It is supported on the front bedway only. Because of this feature, the space between the longitudinal bedways provided on the top of the bed remains wide open. Therefore a much larger swing is available which can carry larger diameter of the job. It is therefore preferred in Turret Lathe Machine.

TURRET SADDLE AND AUXILIARY DEVICE / SLIDE

In Capstan lathe, the turret saddle bridges the gap between two bedways and the top face is accurately machined to provide a bearing surface for the auxiliary slide. The saddle is adjusted on the lathe bedways and clamped at desired position. The hexagonal turret is mounted on the auxiliary slide.

In turret, it is directly mounted on the top of the saddle

and any movement of the turret is affected by the movement of saddle. The movement of turret may be effected by hand or by power. The turret is a hexagonally shaped tool holder intended for holding six or more tools.

Each face of the turret is accurately machined. On each face accurately bored holes are provided for accomodating shanks of different tool holders. The centre line of each hole coincides with the axis of the lathe when aligned with the headstock spindle. In addition to these holes, there are four tapped holes on each face of the turret for securing different tool holding attachments. At the centre of the turret on the top of it, there is a clamping lever which locks the turret on the saddle.

MULTIPLE TOOL HOLDER

(i) As we know that in Capstan and Turret lathe, a wide variety of operations can be performed for mass production. On this purpose, a necessity of designing different types of tool holder for holding different tools. A multiple tool holder is one such device which can serve the above purpose.

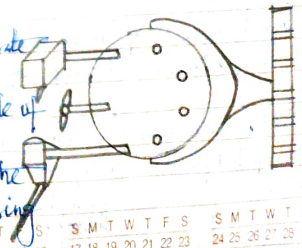
(ii) It is used for holding straight, angular, multiple cutting holders, boring bars etc for various turning and boring operations so that it may be possible to undertake a number of operations simultaneously.

(iii) The tools are set at different positions on the work surface by inserting the shank of the tool holder in different holes of the multiple head body.

(iv) Each tool holder is tightened by separate set of screws.

(v) The boring bar is held at the centre hole of the body's head.

(vi) The multiple head is supported on the turret face by tightening the bolts passing through the holes of the flange.



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DIFFERENCE BETWEEN CENTRE LATHE MACHINE & CAPSTAN AND TURRET LATHE MACHINE

FEATURES	S.S AND S.C LATHE/ CENTRE LATHE M/C	CAPSTAN AND TURRET LATHE M/C
(I) Direction of spindle rotation	Anti-clockwise direction of the spindle.	Both clockwise and anti-clockwise direction of the spindle
(II) Motor Power	Requires less power, as only one operation is done at a time when the m/c operates.	Requires about 5 times the power of centre lathe machine, as two or more than two operations are done at a time.
(III) Spindle speed	Less number of spindle speed are available.	More number of spindle speed are available.
(IV) Tool setting and machining time	High	Less.
(V) Skill required	High skilled operators are required for setting and machining.	Skilled operators are required for setting the tool layout but semi-skilled operators are required for machining operation.
(VI) Arrangement of lead screw.	There is a long screw for thread cutting operation.	No such lead screw is required.
(VII) Arrangement of tool post	Usually a single tool post is used but sometimes a square tool post may also be used.	There are 3 types of tool post used: (A) Front/Square tool post (4 nos) (B) Rear tool post (1 no) (C) Hexagonal tool post (6 nos).

(VIII) Head stock size and rigidity	Smaller size and good rigidity.	Larger size and more rigidity since a number of operations at greater depth of cut and higher speed feedings are done at a time.
(IX) No. of tools mounted on tool post	Usually one tool can be mounted at a time but sometimes 4 nos of tool can be mounted in square tool post.	Eleven or more tools can be mounted at a time ie 4 tools in front/square tool post, 1 tool in rear tool post and 6 tools in hexagonal or circular turret head.
(X) Arrangement of automatic movement	No such arrangement	Automatic movement of cutting tools to a pre-determined length is possible by feed stops and trip dogs.
(XI) Role of production	Lower	Higher.
(XII) Arrangement of Tail stock	Tail stock exists.	There is no such tail stock instead of which a hexagonal or circular turret head is provided.
(XIII) Overhead charges.	Comparatively less than other two machines.	High overhead charges.
(XIV) Applications	More versatile and is suitable for jobbing work and also can handle smaller jobs.	Used for mass production on identical jobs and can handle bigger size of jobs.

SRL NO.	S.S & S.C LATHE MACHINE/ CENTRE LATHE MACHINE	CAPSTAN AND TURRET LATHE MACHINE
01.	It is manually operated type of lathe machine.	It is semi-automatic type of lathe machine.
02.	It has only one tool post, tool changing time is more	Front and rear tool post are available, tool changing time is less.
03.	It has tail-stock	It has turret head instead of tail-stock.
04.	Only one tool can be fitted in the tail stock	Six different tools can be fitted in the turret head.
05.	No of speeds is less	No. of speeds is more.
06.	Tool changing time is more	Tool changing time is less.
07.	The machine should be stopped for changing the tool.	Tool can be changed without stopping the machine.
08.	It is not suitable for mass production.	It is suitable for mass production.
09.	No feed stops to control the tool.	The tools are controlled by feed stops
10.	The tool is control manually after changing the tool	The tool is control automatically.
11.	Only one operation is done at a time.	More than one operation is done or can be done at a times

DIFFERENCE BETWEEN CAPSTAN AND TURRET LATHE

SRL NO	CAPSTAN LATHE	TURRET LATHE
01.	It is a light weight machine.	It is a heavy weight machine.
02.	In Capstan Lathe, the turret tool head is mounted over the ram and that is mounted over the saddle	In Turret Lathe, the turret tool head is mounted over the saddle like a single unit.
03.	For providing feed to the tool, the ram is moved.	For providing feed to the tool, the saddle is moved.
04.	Because of no saddle displacement movement of turret head over the longitudinal direction of bed is small along with the ram.	Turret tool head moves alongwith the saddle over the entire bed in the longitudinal direction.
05.	Used for shorter work-piece because of limited ram movement.	Used for longer work piece because of saddle movement along the bed.
06.	Its working operations are fast because of lighter in constructions	Its working operations are slower because of heavier in constructions.
07.	Heavy cuts on the work piece cannot be given because of non-rigid construction.	Heavy cuts on the work piece can be given because of the rigid construction of the machine.
08.	For releasing turret tool head, the hand wheel of the ram is reversed and turret tool index automatically.	For indexing turret tool head, the turret is rotated manually after releasing the clamping lever.

09.	The turret head cannot be moved in the lateral direction of the bed.	The turret head can be moved crosswise direction i.e. in the lateral direction of bed in some turret lathe.
10.	In Capstan lathe, collet is used to grip the job.	In Turret lathe, power jaw chuck is used to grip the job.
11.	Used for machining work-piece upto 60mm diameter.	Used for machining work-piece upto 120 diameter.
12.	These are usually horizontal lathes	Turret lathes are available in horizontal and vertical lathes.

COLLET CHUCK

(i) Collet chuck are used for gripping small bars in Capstan and Turret lathe for mass production and work.
(ii) Different size of collets are necessary for holding bars of different sections.
(iii) The split jaws of the collet grip the job by espranging action.
(iv) In operation, when the key is rotated the sleeve also rotates.
(v) In doing so, it either draws in or draws out, the collet depending upon its direction of rotation.
(vi) When the collet is drawn in, its splitted body is processed against the tapered inside surface of the chuck, which makes a firm grip over the bar.
(vii) When the collet is pushed out, the pressure on its body is released and it opens out releasing the grip on the bar which can be then fed forward for the next operation to be performed.

A collet is a subtype of chuck that forms a collar around an object to be held and exerts a strong clamping force on the object when it is tightened usually by means of a tapered outer collar. It may be used to hold a workpiece or a tool.

An external collet is a sleeve with a normally cylindrical inner surface and a conical outer surface. The collet can be squeezed against a matching taper such that its inner surface contracts to a slightly smaller diameter, squeezing the tool or work-piece to hold it securely. Most often it is achieved with a spring collet, made of spring steel with one or more kerf cuts along its length to allow it to expand or contract.

An internal collet can be used to lock two telescoping tubes together. In this case, the collet is in the form of truncated cone drilled and threaded down the centre-line. The collet diameter matches the bore of the inner-tube, having the larger end slightly greater than the bore while the smaller diameter is slightly less than the bore. A threaded stud, anchored at its other end to the tube, is then pushed to pull the collet into the tube. The increasing diameter of the collet forces the inner tube to expand and be pushed against the inner wall of the outer-tube thus locking the two tubes together. The inner-tube is often slotted to facilitate the expansion.

TURRET HEAD INDEXING MECHANISM

The carriage, cross slide, turret slide and the saddle feeding the turret may be fed into the work by hand or by power feed, separate feed rods transmit power to the carriage and turret saddle for this purpose. In addition to the apron mechanism and complicated geared head stock A Capstan and Turret Lathe uses a robot device by virtue of which the turret indexes automatically when it is brought back away from the spindle nose the first operation is completed and this mechanism is known as Turret Indexing Mechanism.

2019 FEBRUARY

SHAPER MACHINE

Saturday 02

DEFINATION

The shaper machine is a reciprocating type of machine primarily intended for producing flat surfaces. These surfaces may be horizontal, vertical or inclined. A single point cutting tool is used to perform the machining operations. Here the job remains stationary while the cutting tool reciprocates.

Shaping machine is a machine designed for giving desired shapes to the surfaces that may be horizontal, vertical and flat. A shaping tool is used to cut in curves, different angles and many other desired shapes. A disc is responsible for the tool rotation which results in the forward and backward movement. The cutting tool is used to give the shape to the hard surface of the metal or wood by removing the excess material. The metal working shaper machine was developed by an English man "JAMES NASMYTH" in 1836.

WORKING MECHANISM OF SHAPER MACHINE

The shaping machine operates in the reciprocating type of machine function. Here the workpiece is fixed on the machine table and the cutting tool is placed on the workpiece. Reciprocating movements over the workpiece results in forward and backward strokes. Forward stroke is responsible for cutting action over the object and backward movement is responsible for restoring its position without any cutting action.

DESCRIPTION OF PARTS OF SHAPER MACHINE WITH ITS FUNCTIONS

Sunday 03

Working mechanism of shaping machine is very simple but effective. The parts responsible for its working along with its functional importance are listed below:-

Base, Body, Crossways, Stroke Adjuster, Cross rail, Ram, Table, Clapper box etc.

MARCH

MAR 2019

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BASE

The base of shaping machine is a kind of tool to hold the different parts of shaping machine, it is made up of cast iron since the strength of the base is very important. The base bears the vibrations or vibrational shocks of forward and backward movement of stroke responsible for shaping action.

BODY

The body of machine consists of parts named Pillar, Frame and Column. The body of shaping machine is affixed on the base of the shaping machine. The column is also made up of cast iron and it is box shaped part which is placed on the base. Column plays the covering role and supports the reciprocating movement in the operation of the machine.

CROSS WAYS

These are the sideways affixed vertically and horizontally across the table to allow the movement of the table.

STROKE ADJUSTER

It absorbs the vibration shock by controlling the length of the stroke.

CROSS RAIL

It is affixed on the front part of the body which can be moved in an upward and downward direction. It enables to perform shaping operation at different positions.

RAM

It is responsible for the reciprocating action of the column sideways. forward and backward movement of the ram is called as a Stroke.

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TABLE

It is a kind of flat body affixed over the frame to hold the work piece on which the shaping action needs to be performed.

CLAPPER BOX

It is used to carry the shaping tool holder. It is responsible for the smooth and hindrance free movement of backward stroke to prevent the damage in the form of wear and tear.

HOW THE SHAPING TASK IS PERFORMED OVER THE OBJECT

A shaping task is based on the stroke mechanism. Forward stroke performs the action and backward or return stroke brings back the tool to its original position for the next forward stroke. The working of a shaper machine is expressed in below points :—

(I)– First and foremost task is to place the work-piece on the table.
(II)– After that, cutting tool is placed in the tool holder mounted on the ram.
(III)– It is time to supply power by starting the motor for performing a reciprocating action.
(IV)– In the reciprocating action, cutting tool performs the task on the work-piece and removes the extra material from the work piece to get the desired shape.
(V)– Here forward stroke performs the shaping action on the work piece by cutting the extra material and backward / return stroke doesn't perform cutting action, it is a kind of restoring stroke for the next actionable forward stroke.

CLASSIFICATION OF SHAPER MACHINE

Shaping machine types are classified on the basis of its motion type, Ram-travel, Table design and the type of cutting stroke.

(I)- Shaping machine classified under the type of motion are :—
Crank, Geared and Hydraulic.
(II)- Shaping machine classified under the type of Ram travel are:—
Horizontal and Vertical; Inclined And Irregular.
(III)- Shaping machine classified according to the design of the table are:—
Standard and Universal.
(IV)- Shaping machine classified according to the type of stroke are:—
Push and Draw.

STANDARD OR PLAIN SHAPER

In this machine, the table has only two motion: crossrise in the horizontal plane and vertical movement (up and down). The table is not provided with a swivelling motion.

UNIVERSAL SHAPER

This machine is similar to plain shaper except that the table can be tilted at various angles, making it possible to inclined flat surfaces. The table can be swivelled about 360° about a central axis parallel to the cutting stroke direction and also perpendicular to it i.e. around two horizontal axes. The table has a movement in the horizontal plane and vertical direction (up and down) as in plain shaper.

HORIZONTAL CUTTING

Horizontal surfaces are machined by moving the work mounted on the machine table at a cross direction with respect to the ram movement.

The clapper box can be set vertical or slightly inclined towards the uncut surface. This arrangement enables the tool to lift automatically during the return stroke. The tool will not drag on the machined surface.

VERTICAL CUTTING

A vertical cut is made while machining the end of a workpiece, squaring up a block or machining a shoulder. The feed is given to the tool by rotating the down feed screw of the vertical slide. The table is not moved vertically for this purpose. The apron is swivelled away from the vertical surface being machined.

INCLINED CUTTING

An angular cut is done at any angle other than a right angle to the horizontal or to the vertical plane. The work is set on the table and the vertical slide of the toolhead is swivelled to the required angle either towards the left or towards right from the vertical position.

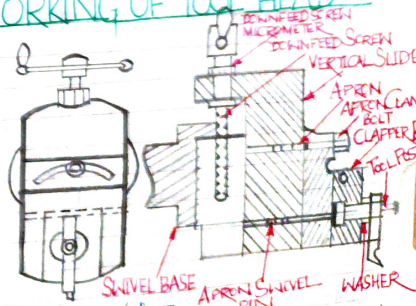
IRREGULAR CUTTING

A round nose tool is used for this operation. For a shallow cut the apron may be set vertical but if the curve is quite sharp, the apron is swivelled towards the right or left away from the surface to be cut.

CONSTRUCTION AND WORKING OF TOOL HEAD

The tool head holds the cutting tool firmly and provides both vertical and angular movement to the tool with the help of a downfeed screw handle.

The head allows the tool to have automatic relief during the return stroke.



The vertical slide of a tool head consists of a swivel base which is graduated in degrees. So, the vertical slide

can set at any angle with the work surface.

The amount of feed or depth of cut may be adjusted by a micrometer dial on the top of the down feed screw. A tool head again consists of :- Apron, Clapper box and clapper block.

Apron consisting of clapper box and tool post is clamped on the vertical slide by the screw. The apron can be swivelled upon the apron swivel pin towards left or right.

The Clapper Box houses the clapper block by means of a hinge pin. The tool post is mounted on the clapper block.

During forwarding cutting stroke the clapper block keeps the rigid support to the tool by fitting securely into clapper box and while returning stroke the tools slide over the work by lifting, the block out of clapper boxes as shown in the figure.

SPECIFICATION OF A SHAPER MACHINE

The specification of shaper machine depends upon the following :-

(I)- The maximum length of stroke ram = 457 mm / 18"
(II)- Types of the drive [Crank, Gear and Hydraulic type].
(III)- Power input of the machine.
(IV)- Floor space required to establish the machine.
(V)- Weight of the machine in tonne.
(VI)- Feed [Horizontal = 610 mm and Vertical = 457 mm
(VII)- Cutting to return stroke ratio.
(VIII)- Angular movement of the table on either side = 60°.
(IX)- Main drive motor = 3HP (x)- RPM = 950 rpm.

ADVANTAGES OF A SHAPER MACHINE

(I)- The single point tool used is inexpensive or we can say low costing tool.
(II)- The cutting stroke having a definite stopping point.
(III)- The work can be held easily in the shaper machine.
(IV)- The set up is very quick and easy and also can be readily changed from one job to another job.

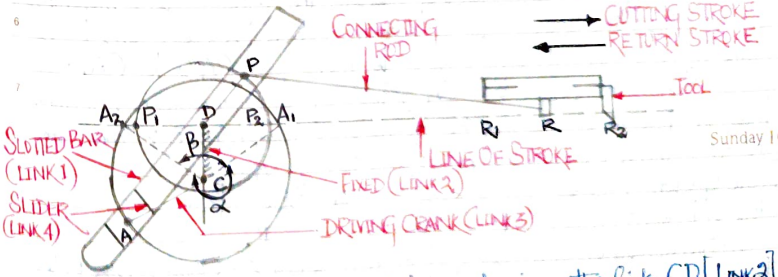
DISADVANTAGES OF A SHAPER MACHINE

(I)- By nature, it is a slow machine because of its straight line forward and return strokes. The single point cutting tool requires several strokes to complete a work. They are slow.
(II)- The cutting speed is not usually very high speeds of reciprocating motion due to high inertia force developed in the motion of the units and components of the machine.

APPLICATIONS OF SHAPER MACHINE

(I)- To generate straight and flat surfaces.
(II)- Smooth rough surfaces.
(III)- Make internal splines.
(IV)- Make gear teeth.
(V)- To make dovetail slides.
(VI)- Make keyways in pulleys or gears.
(VII)- Machining of die, punches, straight and curved slots.

WHITWORTH QUICK RETURN MECHANISM



In this type of shaper machine mechanism, the link CD [Link 2] forming the turning pair is fixed as shown in the above figure. The link 2 matches to a crank in a reciprocating steam engine. The driving crank

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"CA" (LINK 3) rotates at a similar angular speed. The slider (LINK 4) connected to the crank pin at "A" moves along the slotted bar "PA" (LINK 1) which oscillates at a provided point D.

The connecting rod PR carries the ram at R to which the cutting tool is fixed. The movement of the tool is constrained along the line RD produced i.e. along a line passing through D and perpendicular to CD.

WORKING

When the driving crank CA moves from the point CA1 to CA2 (or the link DP from the point DP1 to DP2) through an angle α in the clockwise direction, the tool moves from the left hand end of its stroke to right hand end by a distance 2PD.

Now when the driving crank moves from the point CA2 to CA1 (or the link DP from the point DP2 to DP1) through an angle β in the clockwise direction, the tool moves back from the right hand end of its stroke to the left hand end.

A little consideration will show that the time taken during the right movement of the ram (i.e. during forward stroke) will be equal to the time taken by the driving crank to move from CA1 to CA2.

Similarly, the time needed during the right to left movement of the ram (i.e. during idle or return stroke) will be equal to the time taken by the driving crank to move from CA2 to CA1.

Since, the crank like CA rotates at uniform angular velocity, thus the time taken during the forward cutting stroke is more than the time taken during the backward return stroke.

$$\frac{\text{Time of Cutting Stroke}}{\text{Time of Return Stroke}} = \frac{\alpha}{\beta} = \frac{\alpha}{360^\circ - \alpha} \text{ or } \frac{360^\circ - \beta}{\beta}.$$

In other words, the mean speed of the ram during a cutting stroke is less than the mean speed during the return stroke. The ratio between the time taken during cutting and return stroke is given by the formula shown in the above image.

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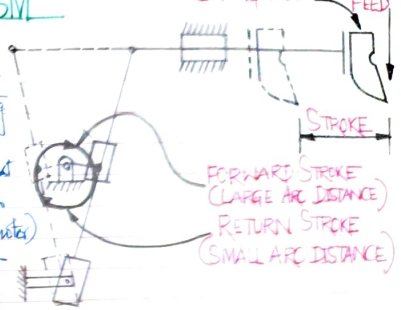
QUICK RETURN MECHANISM



A quick return mechanism is an apparatus to produce a reciprocating motion in which the time taken for travel in return stroke is less than that of forward stroke. It is driven by a circular motion source (typically a motor) and uses a system of links with three turning pairs and a sliding pair.

Quick return is a common feature of tools in which the action is action performed in only one direction of the stroke such as shapers and powered saws, because it allows less time to be spent on returning the tool to its initial position.