
GrimScythe2001

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INTRODUCTION:

The lathe is one of the oldest machine and into existance from the early tree lathe, which was then a noble device for rotating and machining a piece of work-heals between the two adjacent trees. A rope is wounded around the work which is on one end, attached to a flexible branch of a tree and other end pulled by a man causing the job to rotate. With its further development, a strip of word called 'lath' was used to support lathe machine. This device continued to develop through centuries and in the year 1797, Henry Maudslay and other englishmen designed the first screw altering lathe, which the four turner of the present day high speed heavy duty production lathe, a machine tool which has partially given shape to our present day civilisation by building machines and industries.

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SAFETY PRECAUTION IN MACHINE SHOP:

Before entering the maching shop, all are bound to adopt the safety precautions strictly to avoid any possible accident. Many of the accidents occur due to carelessness, since they fail to follow the safety rules.

The following points are simple but they are the main cause of accidents:

1. Improper dress
2. Poor Judgement
3. Lack of Interest
4. Ignorance
5. Fear
6. Fatigue
7. Over confidence
8. Worries
9. Dullness
10. Insufficient space
11. Poor physical fitness
12. Improper handling of tools, machines and electricity

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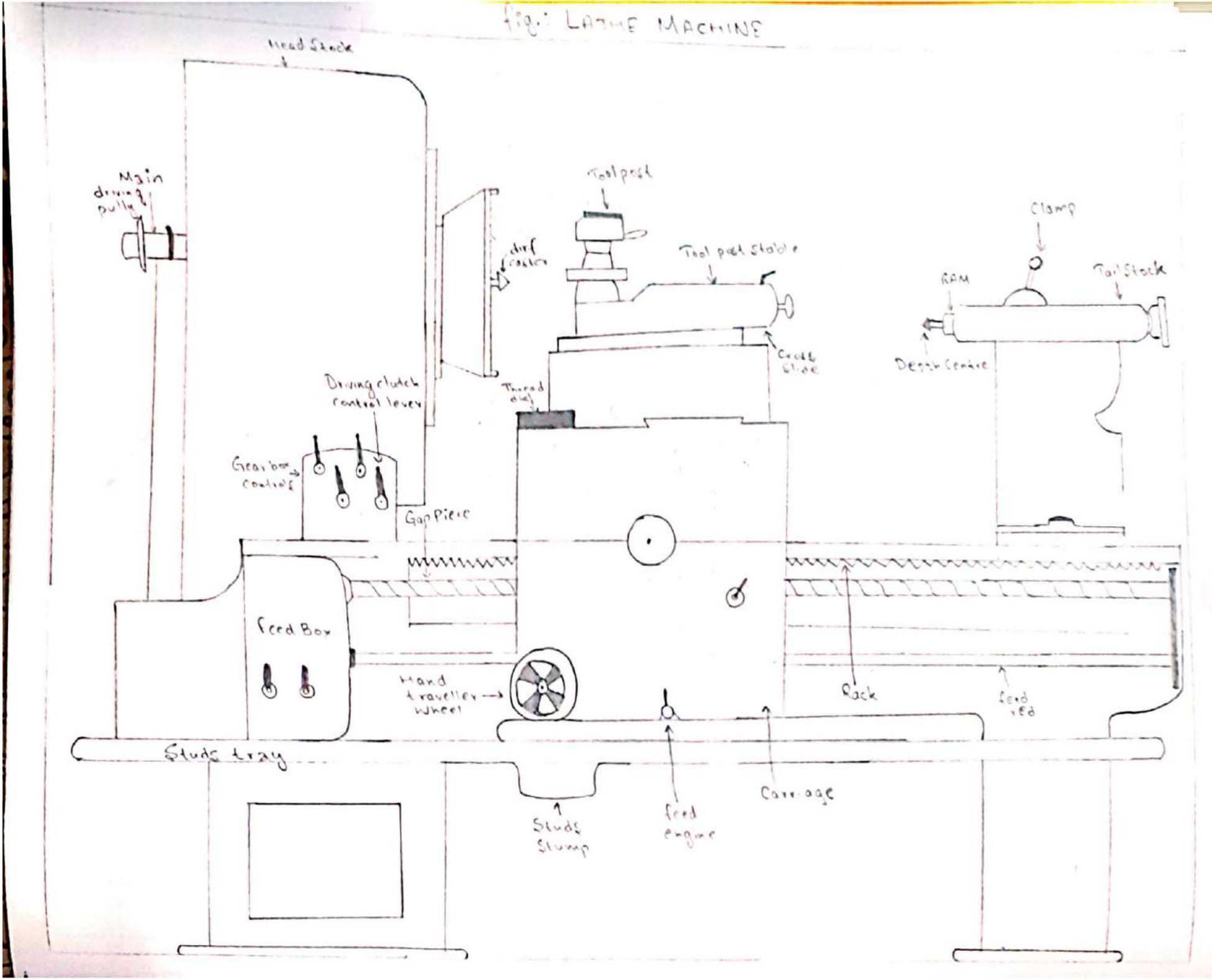
fig: LATHE MACHINE



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PERSONAL SAFETY AND MACHINE SAFETY:

1. PERSONAL SAFETY:

(i) Protect self first and never fail to give protection to the machine immediately
(ii) Wear tight dress and insert the shirt.
(iii) Never use rubber chappals.
(iv) Do not wear a ring or a watch while working.
(v) Wear goggles while on chipping or grinding.
(vi) Never clean the chips by hands; use brush.

2. MACHINE SAFETY:

(i) Do not start machine before getting instructions or permission to do so.
(ii) Never operate a machine, unless you know throughly of its mechanism and working condition.
(iii) Never work on an unguarded machines.

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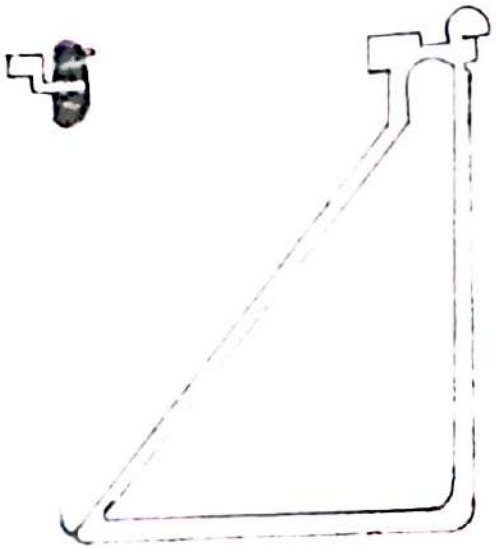

fig: Box Section Lathe Bed

fig: Bed Diagonal Rib

LATHE AND ITS DIFFERENT PARTS:

1. **THE BED**: The lathe bed forms the base of the machine. The head stock and the tail stock are located at its either ends of the bed and carriage rests over the lathe bed and slides on it. The lathe bed being the main guiding members of the tools, for accurate machining work, it must satisfy the following conditions:

(i) It should be sufficiently rigid to prevent deflection under tremendous cutting, pressure transmitted through the tool-post and carriage to the lathe bed.

(ii) It must be massive with ~~different~~ sufficient depth and width variations to absorb vibrations.

(iii) It must resist the twisting stress set up due to the resultant of two forces - the downward cutting force on the tool and the force trending to move the tool away from the work in a horizontal direction

(iv) The bed should be seasoned naturally to avoid distortion or warp that may develop when it is cooled after the bed is cast. On the top of the bed, there are two sets of guide ways or slides namely outerways and innerways.

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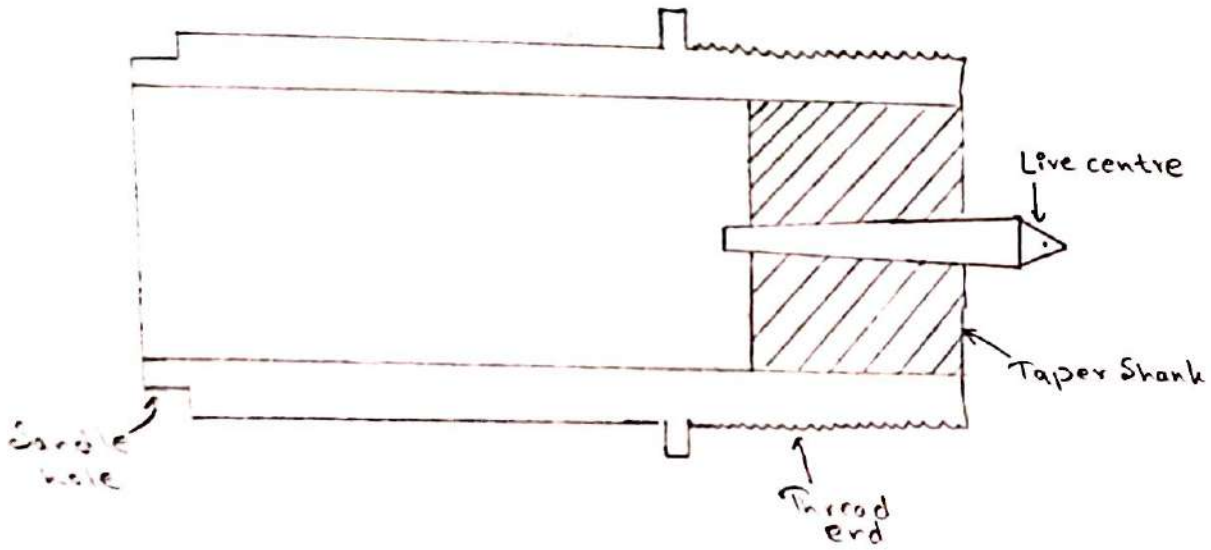

fig Headstock Spindle

2. **THE HEADSTOCK:** The headstock is secured permanently on the inerways at the left hand end of the lathe bed and it provides mechanical mean of rotating the work at multiple speeds. It comprises essentially of a hollow spindle and a mechanism for driving and altering the spindle speed. All parts are allowed within the headstock casting.

Figure shows the spindle of the headstock which is made up of carbon or mild chrome steel. This usually consists of a larger diameter to resist bonding and it should be perfectly aligned with the lathe axis accurately machined for producing true work surface. A hole extends through the spindle so that a long bar may be passed through the core. The front end of the standard morse taper shank. A taper fits into the taper hole and a line centre which supports the work and brush. There are two types of spindle noses- The threaded designs which carries the chuck, driving plate and face plate; the flaged nose which enables them to be directly attached. The lathe most commonly used has a threaded spindle nose.

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3. BELT DRIVEN HEADSTOCK: In a belt driven lathe, fit with back gear, there are usually two different methods of obtaining multiple speed of the lathe spindle, the most common method being the direct speed

DIRECT SPEEDS: All belt driven lathes are provided with countershaft. The countershaft receives its powers from the main shaft having a set of fast and loose pully and a stepped cone pulley for each machine. The figure illustrates a typical countershaft drive. The step cone pulley on the headstock spindle by a belt. A number of speeds can be obtained when the position of driving belt on the step pulley is changed. The spindle speed increases when the belt is shifted from a larger to a smaller step of the cone pulley. To stop the machine, the belt is to be shifted from the fast to the loose pulley and the countershaft by means of a belt fork attached to a striking bar which is operated through a lever by simply pulling a cord.

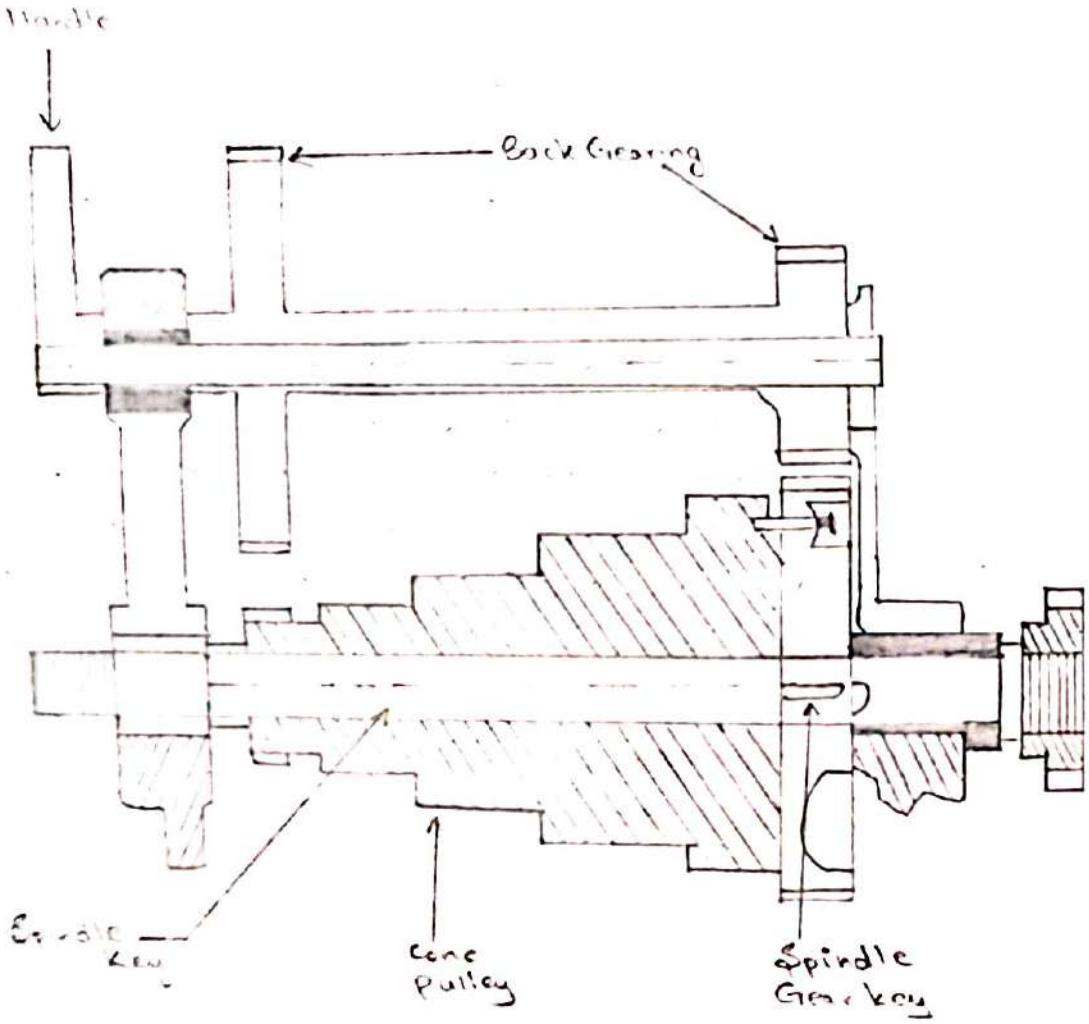

fig. Back Geared Headstock

4. THE BACK GEAR: The back gear is an additional feature of a belt driven lathe and this is used to obtain wider range of spindle speeds. For the number of speeds obtained from "direct speeds" is limited to the number of steps only. When the backgear is engaged, the spindle speed reduces considerably. So, it is also used when it is necessary to have a slower speed of the spindle that cannot otherwise be obtained by direct speed. A slow speed is necessary in the following cases.

(i) In turning jobs of large diameter within the available cutting speed of the material.

(ii) In turning jobs of tough or hard materials. When the material is hard, it becomes necessary to apply greater cutting force by the tool to shear out the metal. This increase in cutting force will require greater turning torque necessitating slower spindle speed.

(iii) In operations like thread cutting, reaming etc.

(iv) In taking deep cut as in rough turning.

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5. TAIL STOCK OR LOOSE HEADSTOCK:

The tail stock is located on the right hand of the bed. This has two main issues:

(i) It supports the other end of the work when it is being supported at the centres

(ii) It holds a tool for performing operations such as drilling, tapping etc.

To accomodate different lengths of work, the body of the tailstock can be adjusted along the ways chiefly by sliding it to the desired position where it can be clamped by plates. The upper casting of the body can be moved towards or away from the operator by means of adjusting screws to offset the tail stock centre for straight turning. The body is bored to act as the barrel which carries the tailstock spindle that moves in and out of the barrel by means of a screw. When the tailstock hand wheel is turned, the front of the spindle has a taper hole into which the dead centre or the other tools fit.

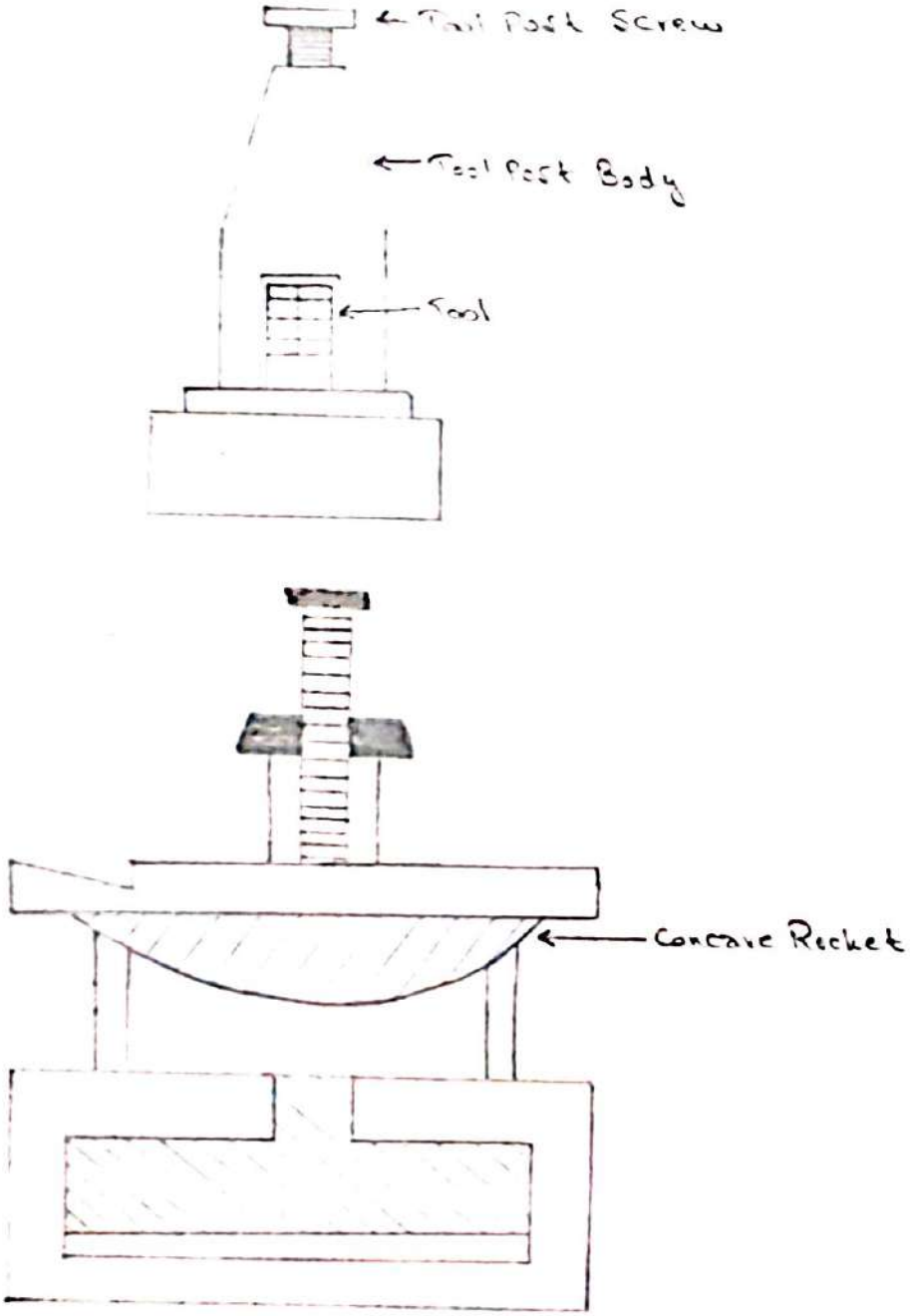

fig: Cross Screw Tool Post

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6. The Tool Post and Types of Tool Post:

This is located on the top of the compound rest to hold the tool and to enable it to be adjusted to a convenient working position. The type and mounting of the tool post depends upon the class of work for which it is to be used. The rigidity of the tool holder and effective method of securing are the essential factors in designing a toolpost. Following are the common types of tool post:

(i) Single Screw Tool Post: This consists of a round bar with a slotted hole in the centre for fixing the tool by means of a set screw. The tool post with concave ring and convex rocker slides in a T-slot on the top of the compound rest. The height of the tool point can be adjusted by tilting the rocker and clamping it in position by the set screw. The tool post can be swivelled about its verticle axis.

(ii) Four Bolt Tool Post: The four bolt tool post is held in position by two straps and four bolts. Loose coil springs are fit to each bolt to keep the straps in place and greatly facilitate the setting up of the tools. Adjustment for tools height can be made by using parallel packing strips under the tools. This type forms a very firm support for either a single

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or double tool set up. This is, therefore, often fit to heavy duty lathes.

(iii) OPEN SIDE TOOL POST: The open side tool post is held quite independent of the main fixing bolt and clamped in position by two set screws. The height of the cutting point can be adjusted by using parallel packing strips and the tool post slide can be swivelled to any desired position after loosening the central bolt which slides in a T-slot. This arrangement ensures quick replacement of the tool.

(iv) FOUR WAY TOOL POST: In this type of tool post, four slides ~~are~~ often ~~open~~ accommodate four tools at a time. The tool is held in position by separate screws and a locking bolt is located at the centre. The tools are fit in proper sequence of operation and by indexing the tool post through 90°, any one of the tools may be fed into the work. This type of tool post is used in moderately heavy lathes and is suitable for repetition work.

THE APRON: It is fastened to the saddle and hangs over the front of the bed. It contains gears, clutches and levers for operating the carriage by hand and power feeds. The apron also contains friction clutches for automatic feeds. In addition, there is a split nut which engages, when required, with the lead screw, when cutting either internal or external threads.

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FEED MECHANISM:

The movement of the tool relative to the work is termed as 'feed'. A lathe tool may have three types of feed - longitudinal, cross and angular. When the tool moves parallel to the lathe axis, the movement is termed as 'longitudinal feed' and is effected by the movement of the carriage. When the tool moves at right angle to the lathe axis with the help of the cross slide, the movement is termed as 'cross feed', while the movement of the tool by compound slide when it is swivelled at an angle to the lathe axis is termed as 'angular feed'. Cross and longitudinal feed are both hand and power operated, but angular feed is only hand operated.

The feed mechanism has different units through which motion is transmitted from the headstock spindle to the carriage. Following are the units:

i) <u>End of bed gearing</u>: This gearing serves the purpose of transmitting the drive to the lead screw and feed shaft, either directly or through a gear box. In modern lathes, tumbler gear mechanism or bevel gear feed reversing mechanism is incorporated to reverse the direction of feed.

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(ii) Feed gear box: The feed gear box or quick change gear box is fit directly below the headstock assembly power from the lathe spindle is transmitted through gears to the quick change gear box, which contains a number of different sizes of gears which provides a means to change the rate of feed, the ratio between revolutions of the headstock spindle and the movement of the carriage for thread cutting by altering the speed of rotation of the feed rod or lead screw.

(iii) Feed rod and lead screw: The feed rod is a long shaft that has the keyway extending from the feed box across and infront of the bed. The lead screw is a long threaded shaft used as a master screw and is brought into operation only when threads have to be cut.

(iv) Apron mechanism: Different designs of apron mechanism for transforming rotatry motion of the feed rod and the lead screw into feed motion of the carriage and constructed by different makes of the lathe.

TYPES of LATHE:

lathes are of various design, and constructions have been developed to suit the various conditions of metal machinery. Speed lathe, center/engine lathe, tool-room lathe and special purpose lathe such as gap bed lathe, capstan and turrent lathe are some types of lathe. Despite its many types, all of them employ the same fundamental principle of operation and perform the same functions.

The general types of lathe are:

i) The speed lathe:

The speed lathe, in construction operations, is the simplest of all types of lathes. It consists of a bed, a head stock, a tail stock and a tool post on an adjustable slide. There is no feed box, lead screw or conventional type of carriage. The tool is mounted on the adjustable shoe and is fed into work purely by hands' control. This character enables it to give desired high speed which usually changes from 1200 to 3600 rpm. As the tool is controlled by hand, the depth of cut and the thickness of the chip is very small.

The head stock construction is very simple and only two or three spindle speeds are

accessible. Light cuts and high speed initiate the use of these types of machine when cutting force is minimised. Such as in wood working spinning, centering, polishing etc because of its high speed of the head stock spindle.

(ii) The engine lathe or centre lathe:
This lathe is the most important member of the lathe family and is most widely used. The term engine is associated with the lathe owing to the similar speed lathe, which was driven by the steam engines. Similar to the speed lathe, the engine lathe has got all the three basic parts of bed, head stock and tail stock. But the headstock of an engine in additional mechanism for driving the lathe spindle at multiple speeds.

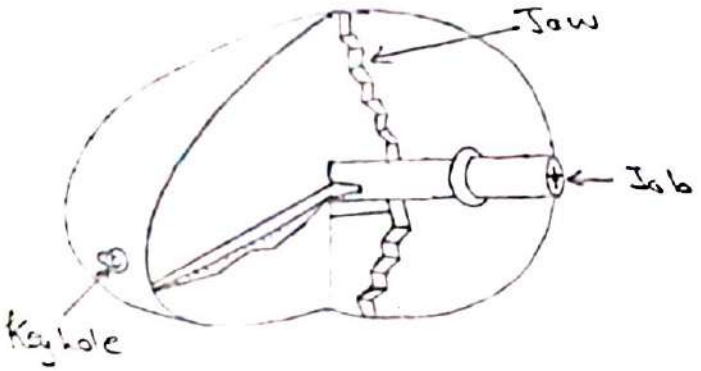

fig four-jaw chuck

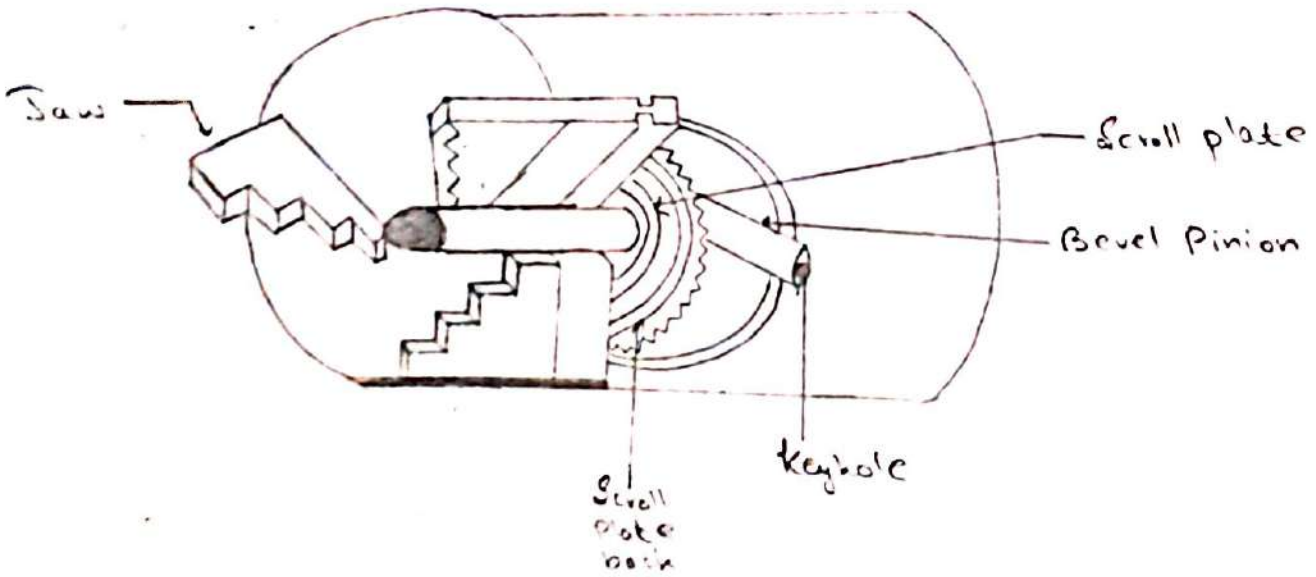

fig Three-jaw chuck

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LATHE ACCESSORIES:

Lathe accessories include centre, catch plates and carriers, chucks, collector, face plates, angle plates, mandrels and rest. They are used either for holding and supporting the work or for holding the tool.

1. Chucks: A chuck is one of the most important device for holding a rotating piece of work in the lathe. It is attached to the spindle by means of belts with the back plate, screwed on the spindle nox. Types of chuck are:

(i) Three jaw chuck: In this type, all the three jaws may be made to slide, simultaneously by an equal amount within the slots provided in the body. This chuck is suitable for holding round or hexagonal piece with defined centre.

(ii) Four jaw chuck: In this type, each jaw may be moved independently by rotating the screw. This type of chuck is particularly used in setting up heavy and irregular shapes.

2. Mandrel: It is a device for holding and rotating a hollow place of work that has been previously drilled and bored. The work revolves with the mandrel which is mounted between two centres. The mandrel is rotated by lathe dog and the catch plate and it drives the work lay fraction. Different types of mandrel are - plain mandrel, step mandrel, collar mandrel, screwed mandrel, cone mandrel and gang mandrel.

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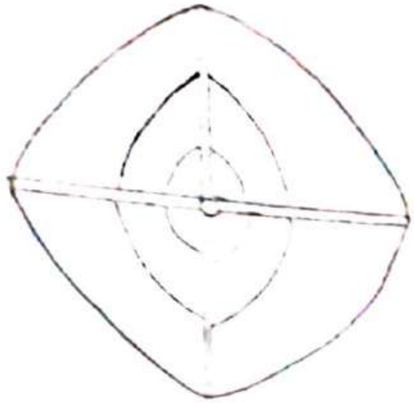

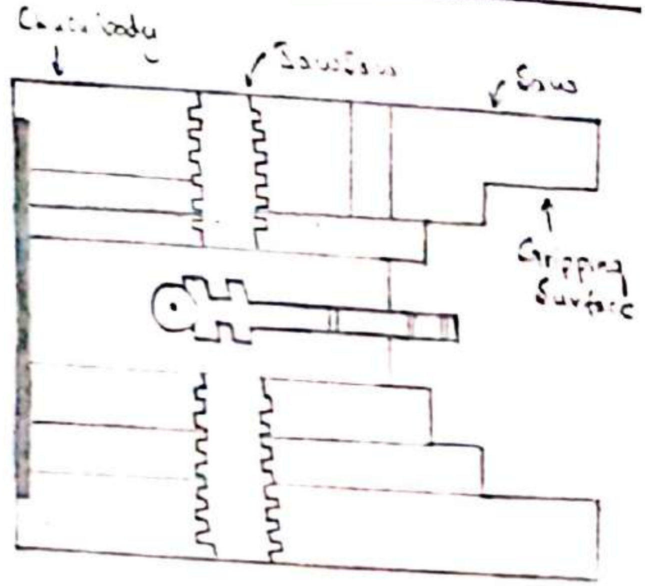

fig: Plain Mandrel

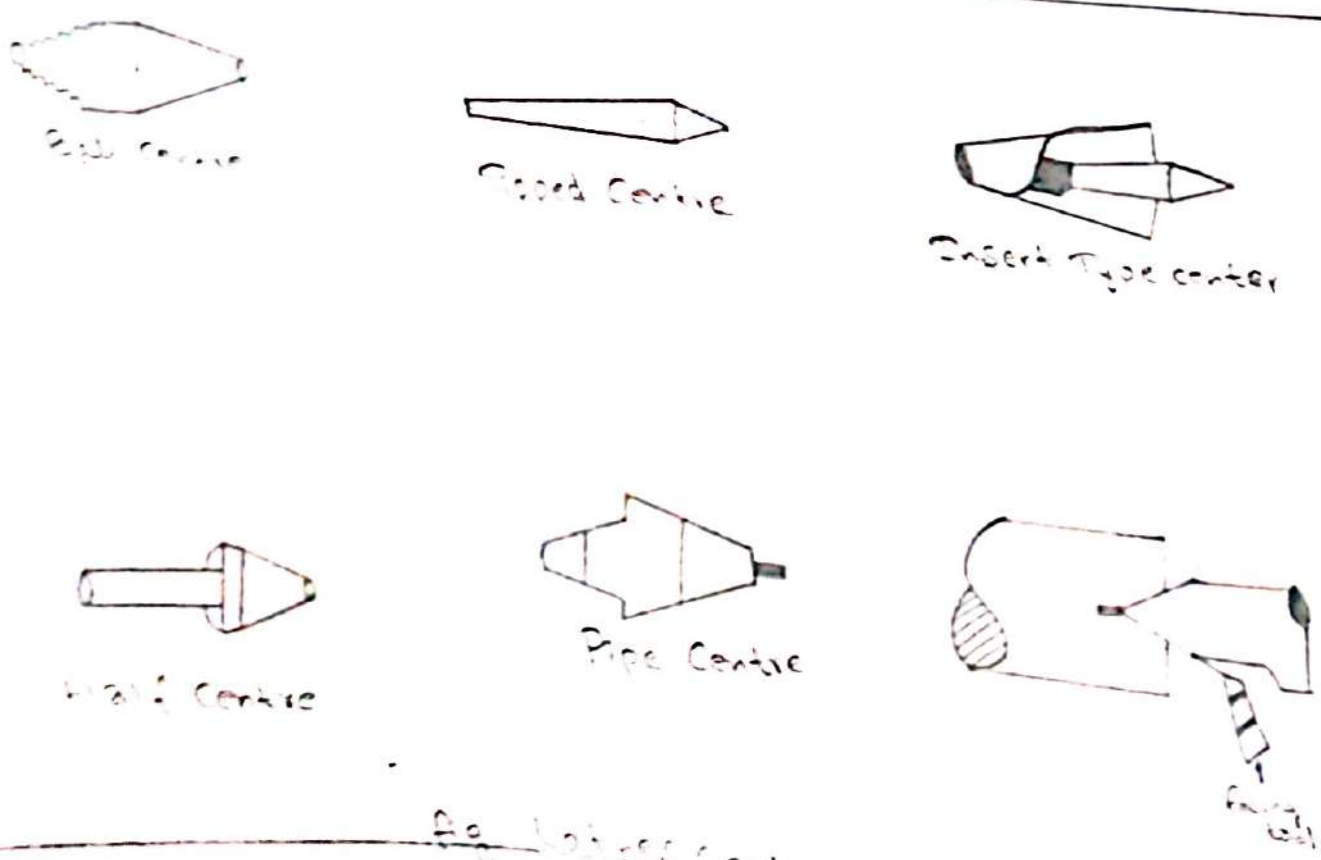

fig Lathe centre

3. Lathe Centres: The most common method of holding the work in lathe is between the two centres – live centres and dead centre. These two centres take up the thrust due to mental cutting and the entire load of the work piece on small bearing surface so that they are made of very hard materials to resist.

4. Face Plates: A face plate consists of a circular disc bored out and threaded to fit the nose of the lathe spindle. This has the radial plain and T-slots for holding work by bolts and clamps. Face plates are used for holding work piece which cannot be continuously held between centres or by chucks.

5. Rests: A rest is a mechanical device which supports a long slender work piece which is turned between centres or by a clutch, at some intermediate points to prevent bending of the work piece due to over weight and vibrations set up due to the cutting forces that acts on it.

6. Steady Rest: A steady rest consists of an iron base, which may be made to slide on the lathe seed ways and clamped at any desired position where support is necessary.

7. Follower Rest: A follower rest consists of 'C' like casting having two adjustable jaws which supports the work piece. The rest is bolted to the back end of the carriage and moves it.

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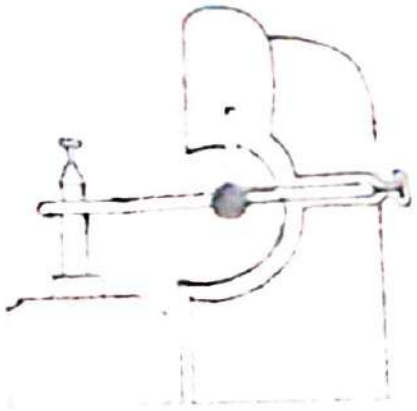


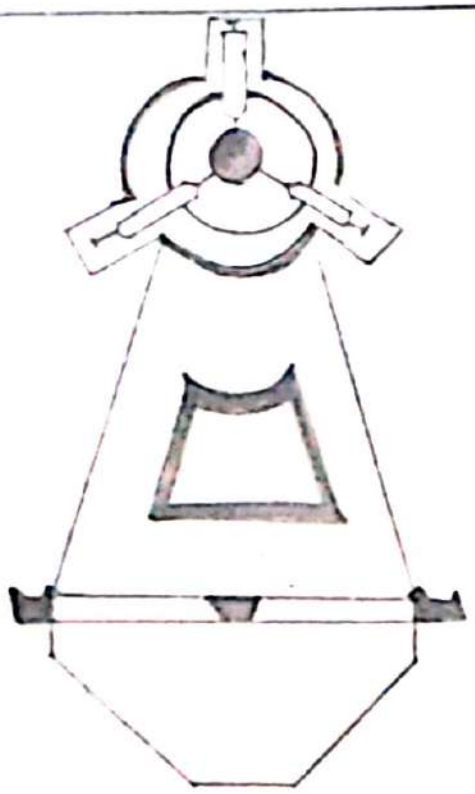
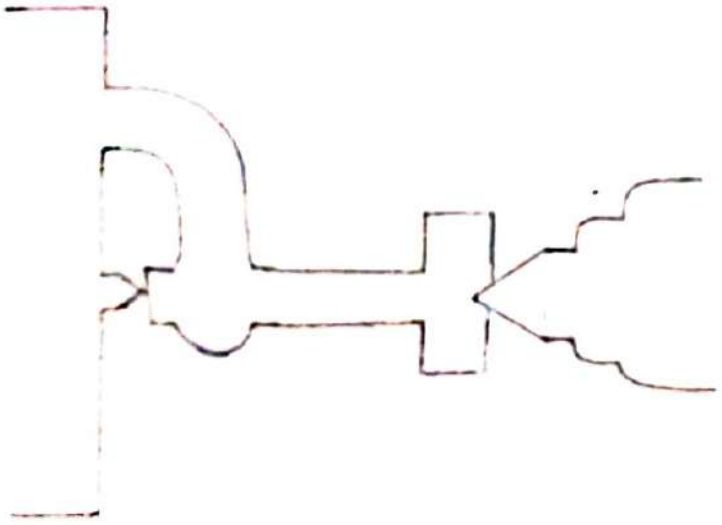


fig: Steady Rest



LATHE OPERATIONS:

Operations that can be performed using a lathe machine:

1. Centering: When work is required to be turned between centre or between a chuck, a centre conical shapeholes must be provided at the end of work piece to prevent heating surfaces. For lathe centres. centering is the generation of providing and producing conical holes in work pieces. It is necessary to locate the central hole at first. The centre holes are produced by using a combined drill and counter sink tool.

The centre can be located by using any one of the following instruments:
(i) Using centre head and steel rule of combination set
(ii) Using a hermaphrodite calliper.
(iii) Using surface gauge.
(iv) Using a ball centre punch.

2. Turning: The turning in a lathe machine is to remove excess material from work piece to produce a cone shaped or a cylindrical surface. The various types of turning are:

(i) Straight Turning: The work is turned straight when it is made to rotate about the lathe axis and tools is fed parallel to the lathe axis. The straight turning produces a cylindrical surface by removing excess metal from the work piece. It is also called plain turning.

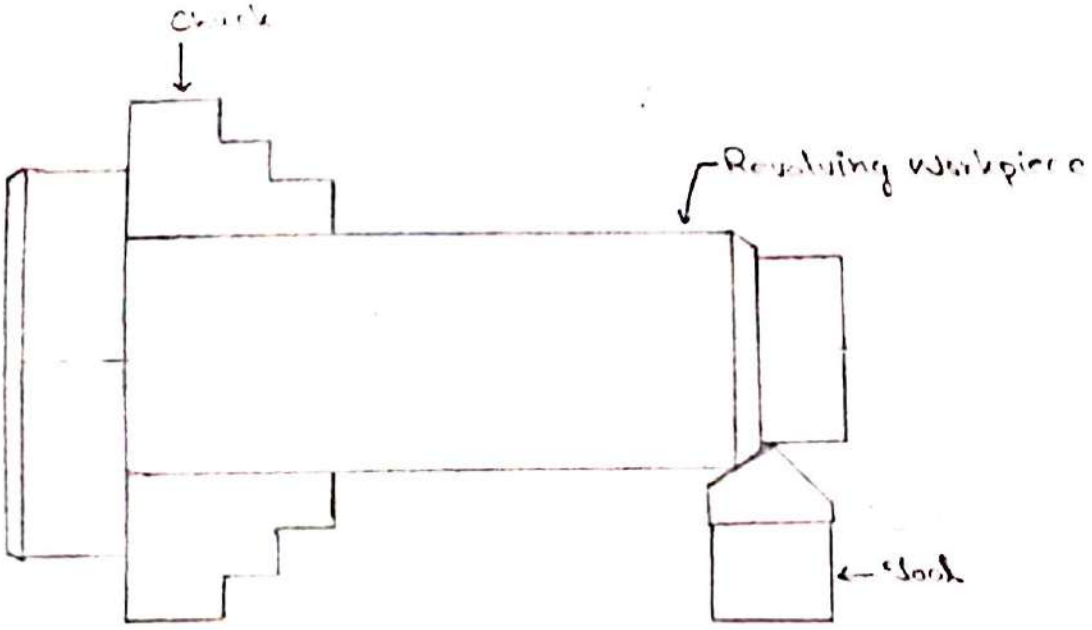


Fig: Straight Turning

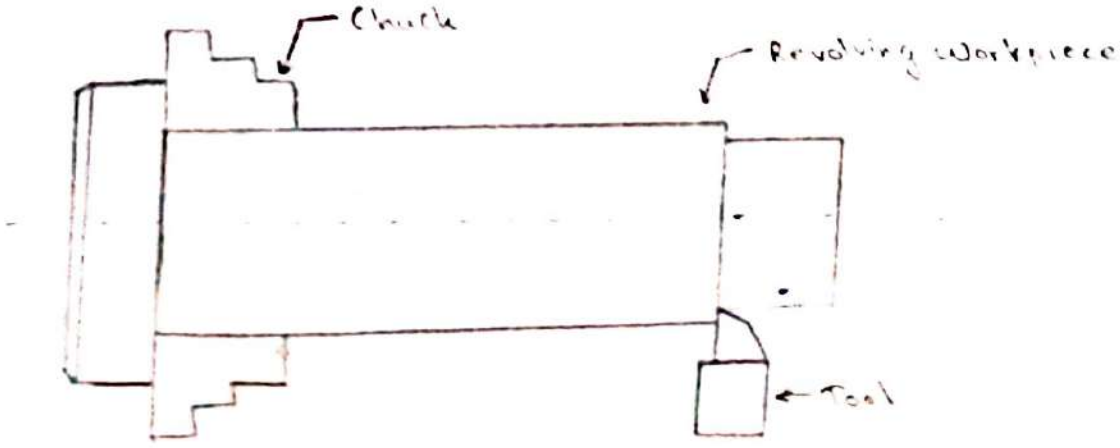


Fig: Straight Turning

(ii) Rough Turning: The rough turning is the process of removal of excess material from the work piece in a limited time by applying high rate of feed and heavy depth cut.

(iii) Finish Turning: The operation requires high cutting speed, several feeds and a very small depth of cut to generate a smooth surface. A finished turning tool having sharp cutting edge is held securely on the tool post for this purpose.

(iv) Shoulder Turning: When a work piece having different diameters is turned, the surface forms the steps from the diameter to the other is called a 'Should' and machining this part of the work piece is called shoulder turning or step turning.

3. Facing: It is the operation of machining the ends of a work piece to produce a flat surface square to the required length. The operations involve feeding the tools perpendicular to the axis of a rotation of the work piece. A properly ground facing tool is mounted in a tool holder in the tool post. A longer turning tool may also be used for facing a large work piece.

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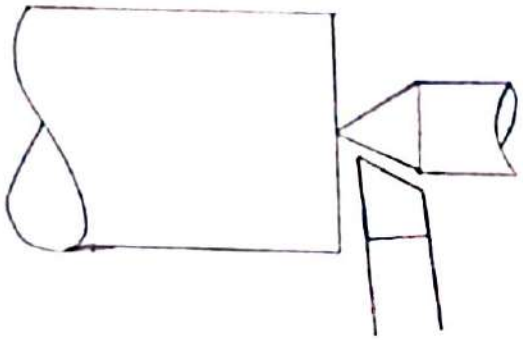

fig: facing operation

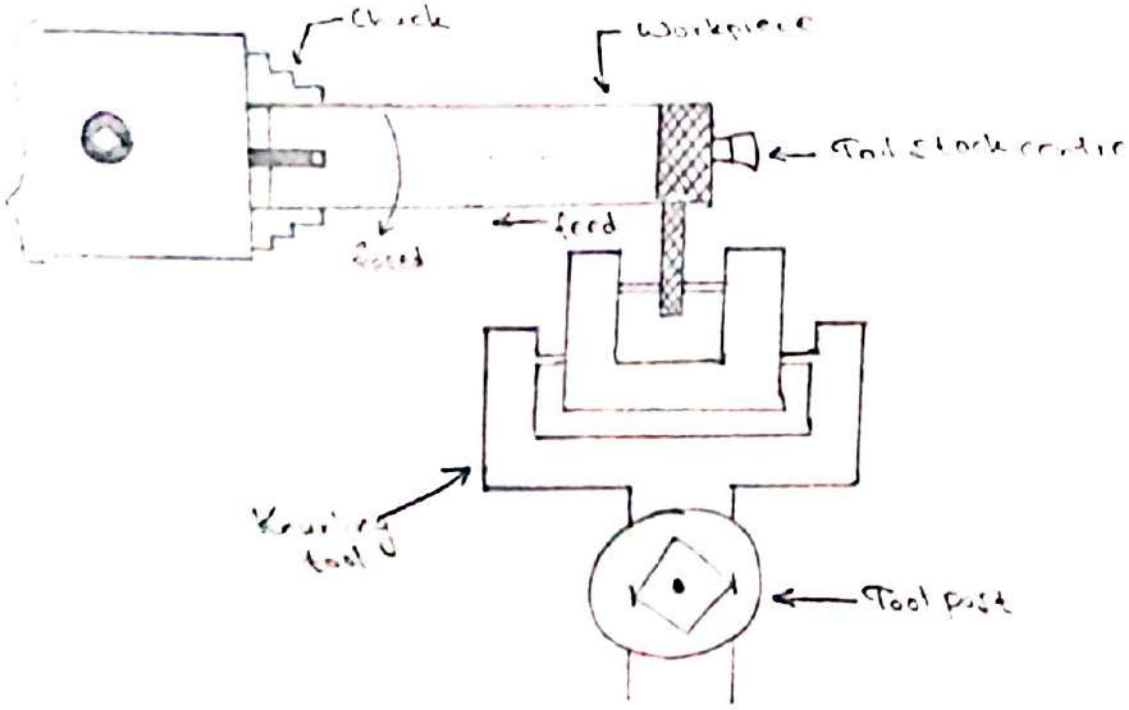

fig: knurling

4. Knurling: It is the process of empassing a diameter shaped pattern on the surface of a work piece to prevent it from slipping when operated by hand. In some press fit work, knurling is done to increase the diameter of the shaft. The operations are performed by ~~spherical~~ special knurling tool which consists of one set of hardened steel roller in a holder while the teeth cut on their surface on a defined pattern.

5. Grooving: It is the process of removing the diameter of a work piece over a narrow surface. It is often done at the end of the thread or adjusted to a shoulder to lend a small margine.

6. Chamfering: It is the operation of bevelling the extreme ends of a work piece. This is done to remove the burns to protect the end of a work piece from being damaged and to have a better look. It is an essential operation after thread cutting.

7. Drilling: It is the procedure of producing a hole in the metal work piece by rotating the cutting edge of a cutter known as the drill.

8. Tapered turning: It produces a cylindrical shape that gradually decreases in diameter from one end to the other.

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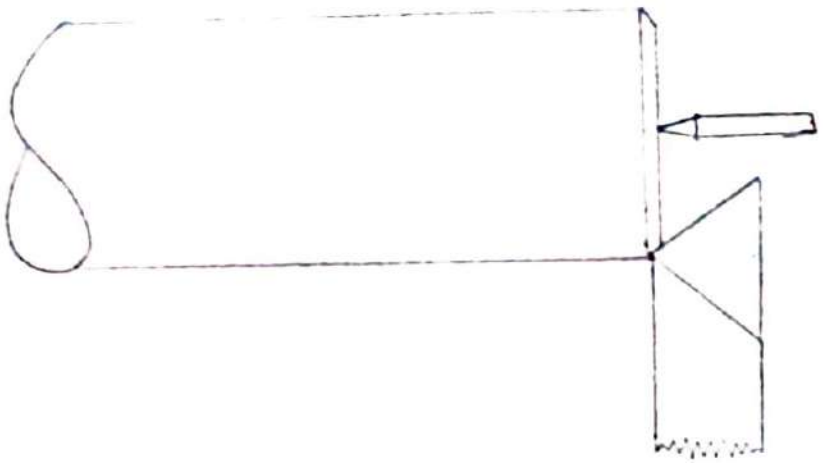

fig: Chamfering Operation

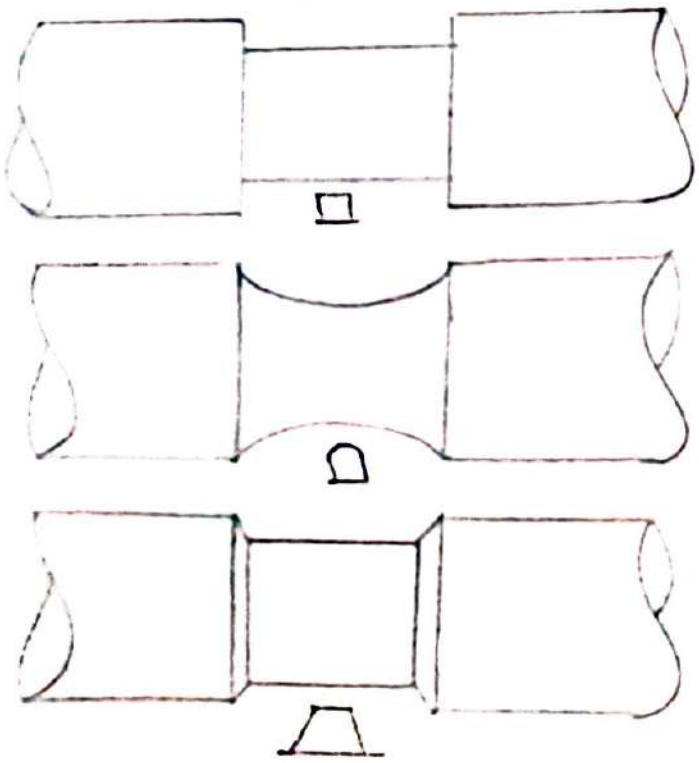

fig: Grooving Operation

9. Parting: This process, also called parting off or cutoff. is used to create deep groves which will remove a completed or part-complete component from its parent stock.

10. Threading: Both standard and non-standard screw threads can be turned on a lathe using an appropriate cutting tool, usually having a 60° or 55° nose angle.

11. Filing: It is the finishing operation performed after turning. This is done in a lathe to remove burns, sharp corners and feed marks on a work piece. And also. to bring a workpiece to the size by removing very small amount of metals, filing is done.

12. Polishing: It is performed after filing to improve the surface quality of the work piece. Polishing with sufficiently finer grade of emery cloth after filing results in very smooth and bright surface.

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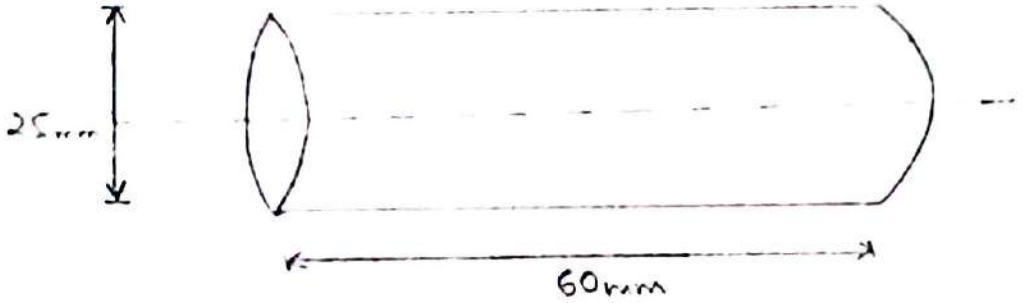
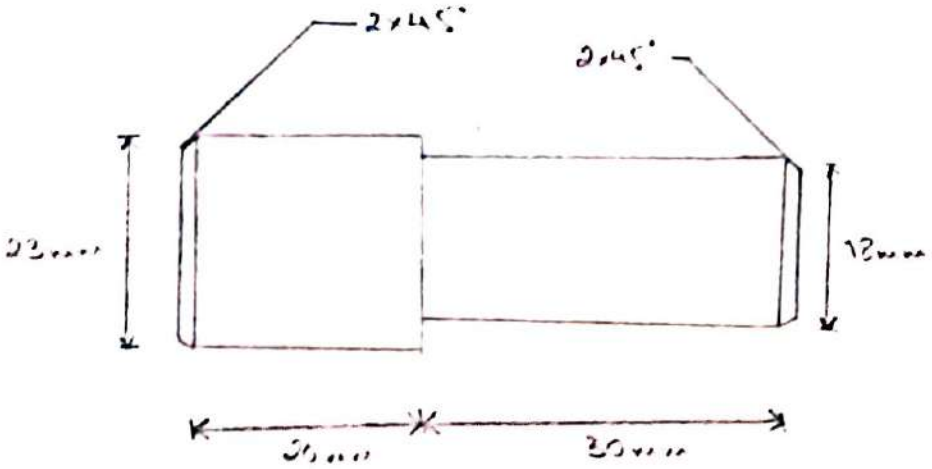
AIM TO PERFORM STEP TURNING OPERATION





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JOB DIARY:

S.No.	Title of Job	Materials Used	Measuring Tools	Cutting Tools	Machine Used	Time Alloted	Time Taken	Remarks
1.	Step Turning	Mild Steel (MIS) Rod	Vernier Calliper	(i) High Speed Steel 'V' Shaped (ii) File	(i) Chop Saw (ii) Lathe	2 hrs	2 hrs	

PROCEDURE:

1. A MIS rod was cut with the help of a chop saw.
2. The dimensions of the specimen were made according to the drawing.
3. It was then held in self-centering chuck of the lathe machine
4. Facing operation was done with the help of cross slide.
5. The markings were done as per the drawing.
6. Turning operation was done with the help of carriage moving hand wheel.
7. Chamfering operation was performed with the help of compound slide
8. The dimensions of the job were checked with the vernier calliper.
9. The same operations were performed on the other side as per the drawing.
10. Finally the job was checked by vernier callipers.

Teacher's Signature: _____

Date

Expt. No.

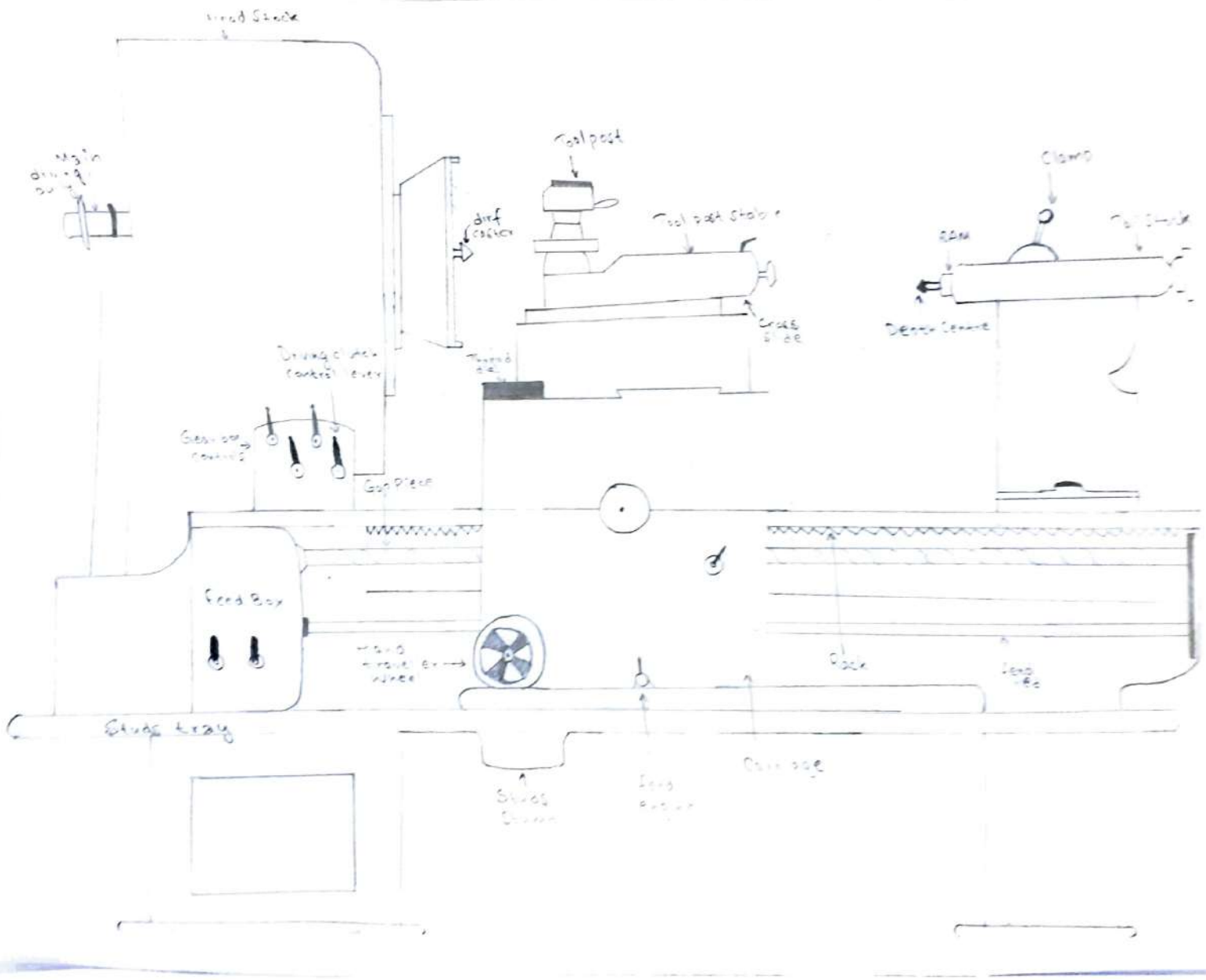
Page No. 22

Student's Signature	Incharge's Signature

BAIT

Teacher's Signature :

Fig.: LATHE MACHINE



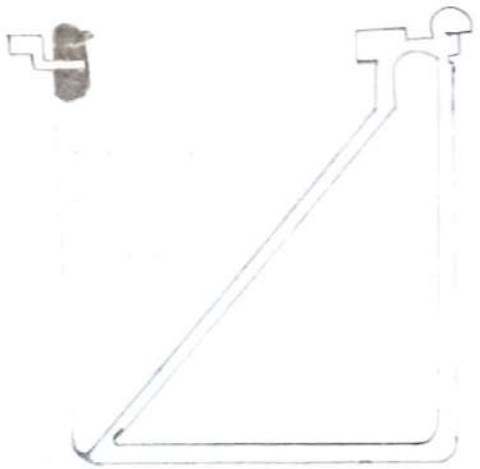


fig Box Section Lathe Bed

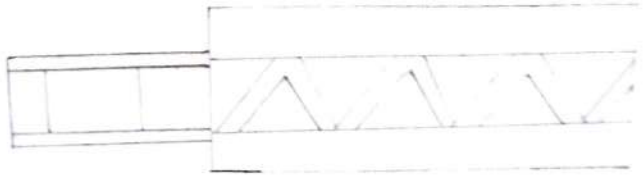


fig Bed Diagonal Rib

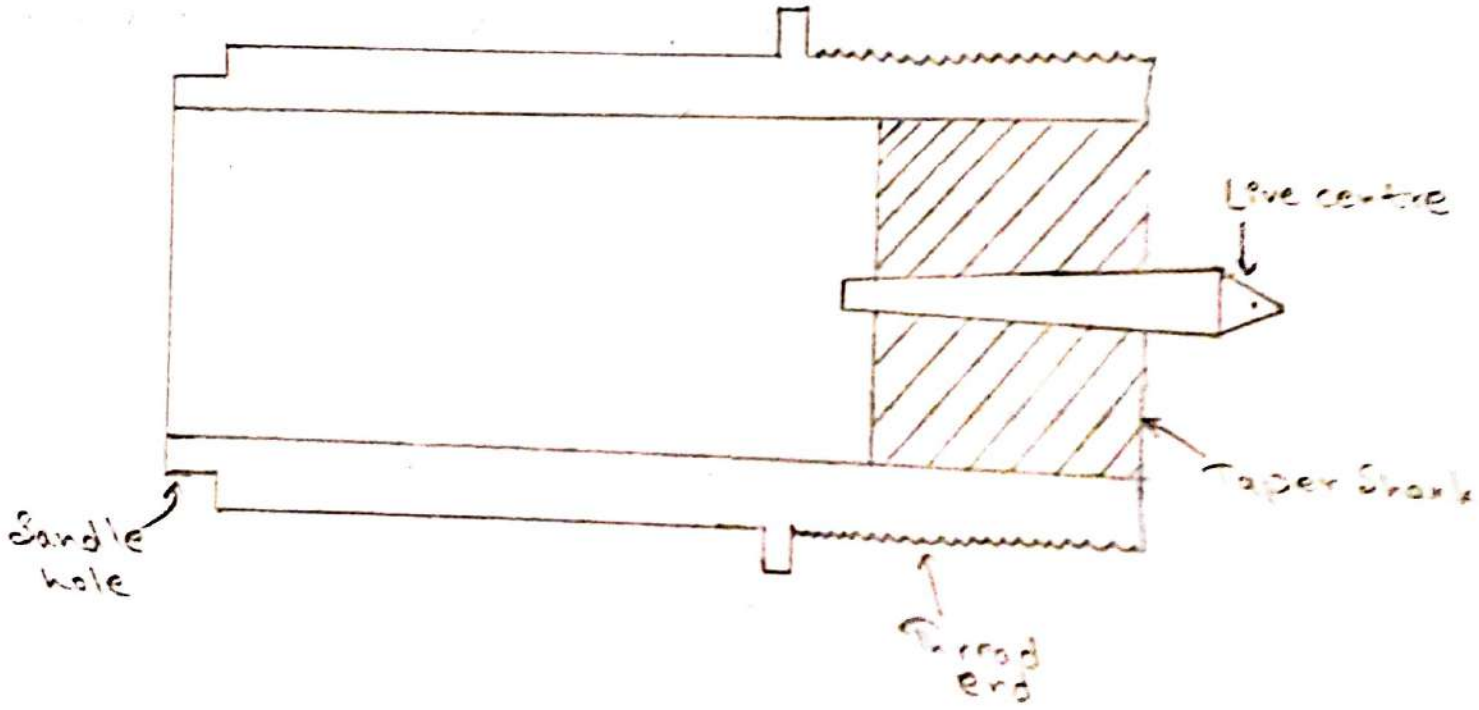


fig: Headstock Spindle

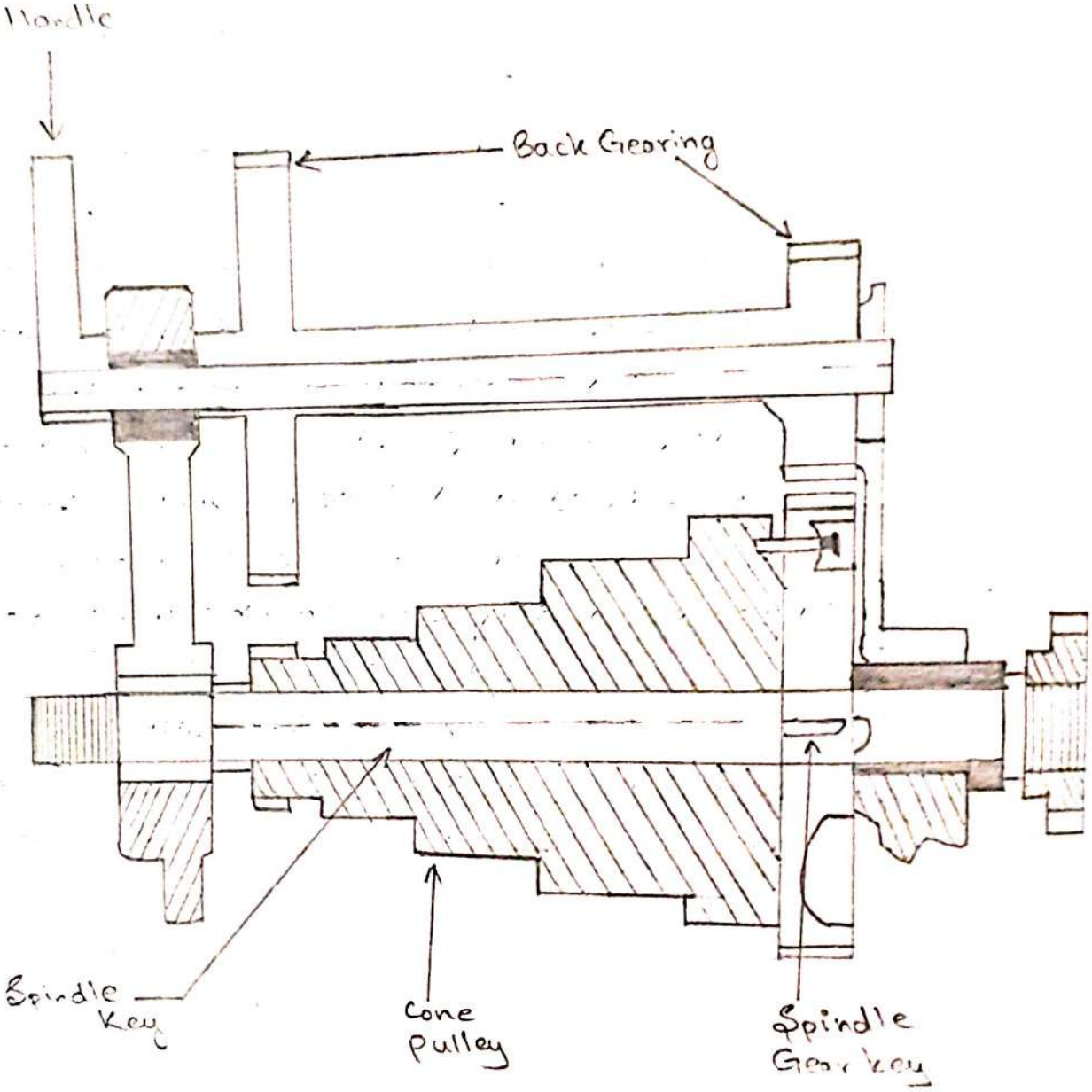


fig: Back Geared Headstock

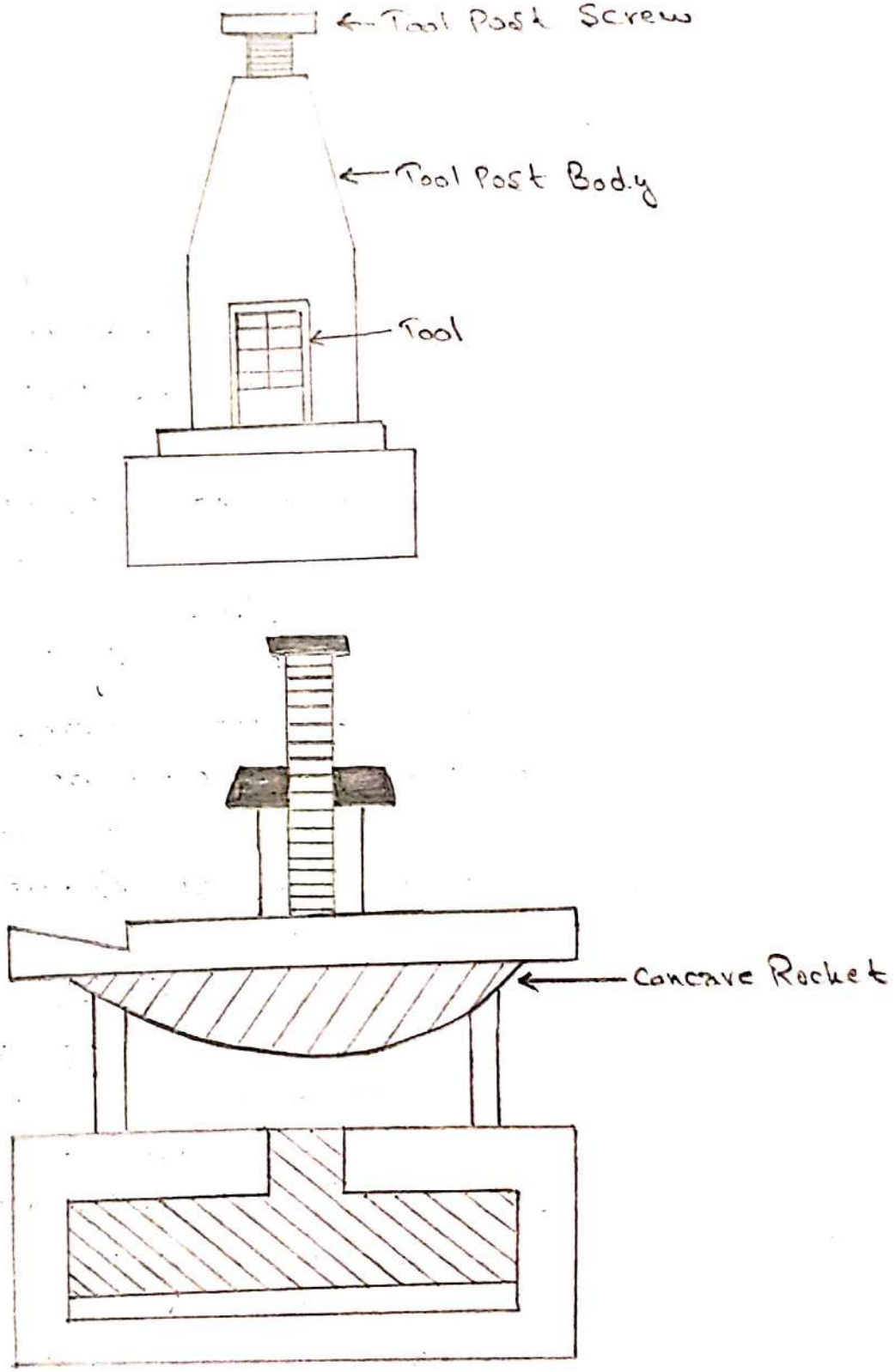


fig: Single Screw Toolpost

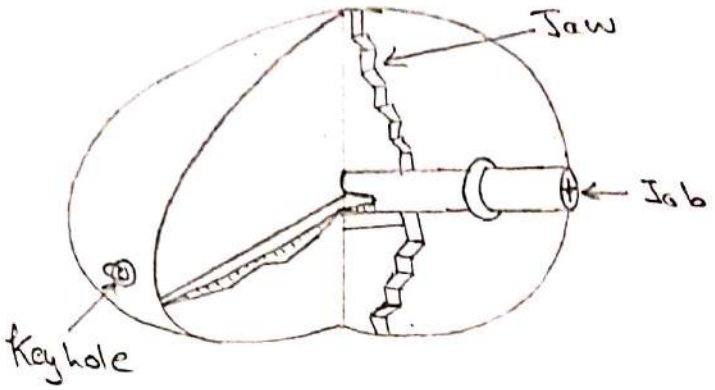


fig: four-jaw chuck.

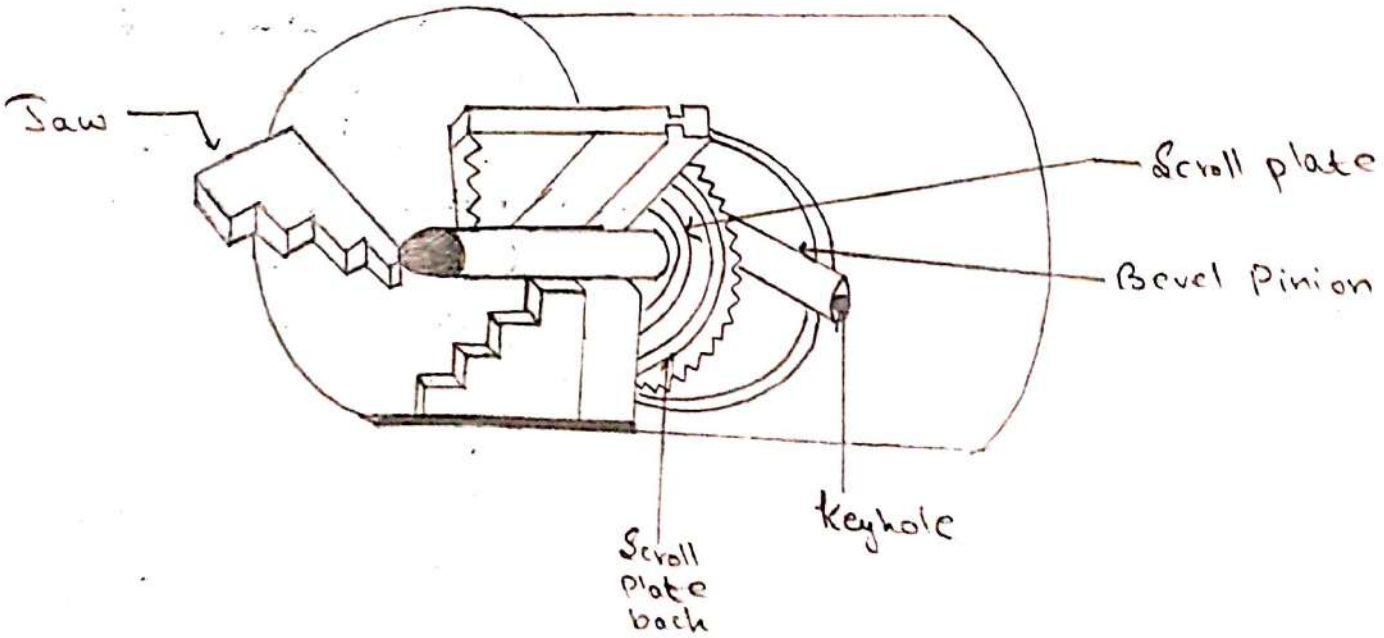
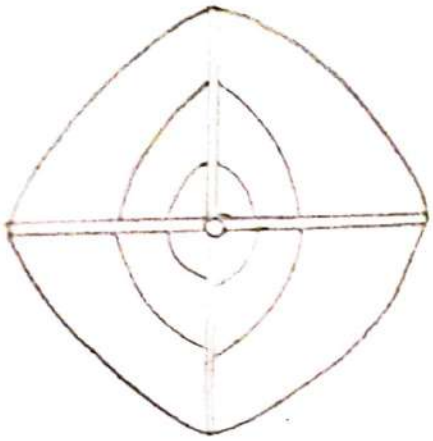


fig: Three-jaw Chuck



Recess for back plate

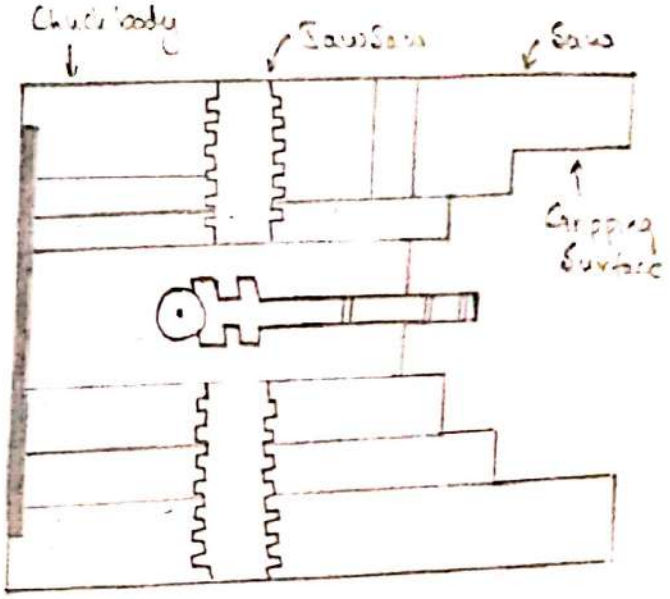
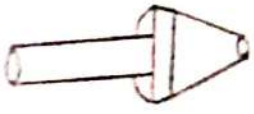


fig: Plain Mandrel

Ball centre

Tipped Centre

Insert Type center



Half Centre

Pipe Centre

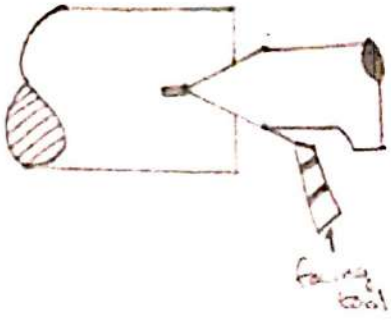


fig Lathes Centre

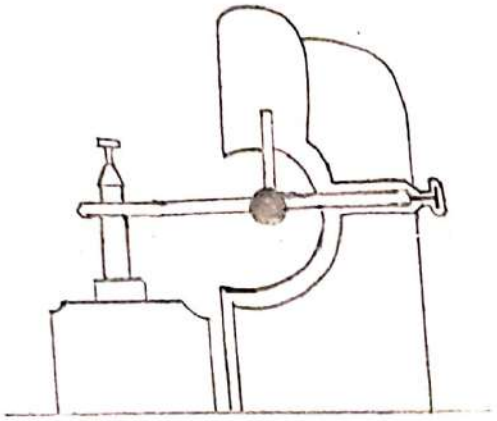


fig:- follower rest

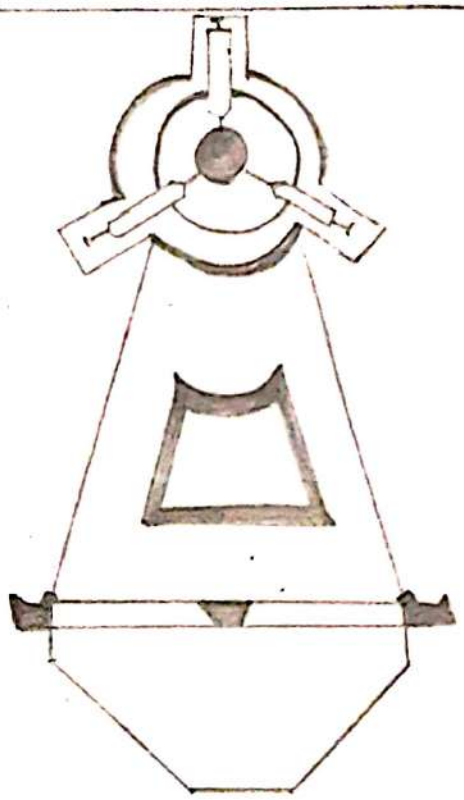


fig:- Steady Rest

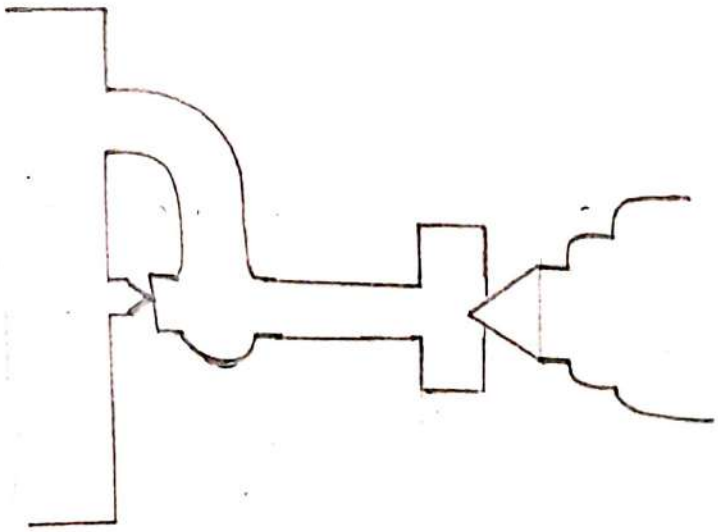


fig:- Centering

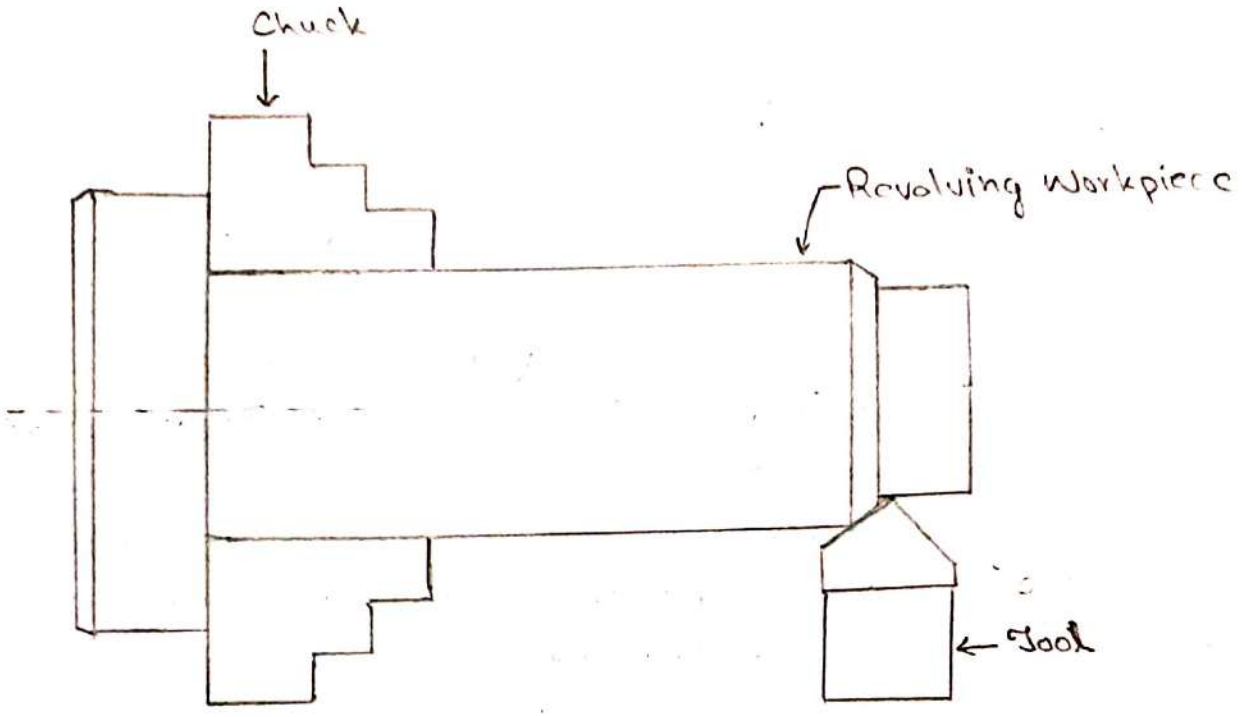


fig.: Straight Turning

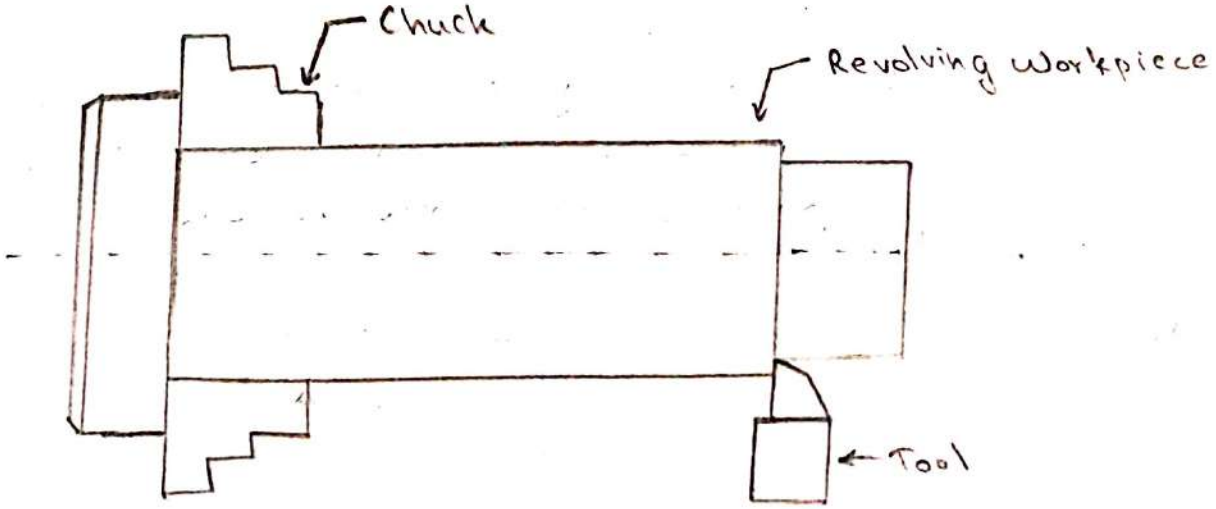


fig.: Shoulder Turning

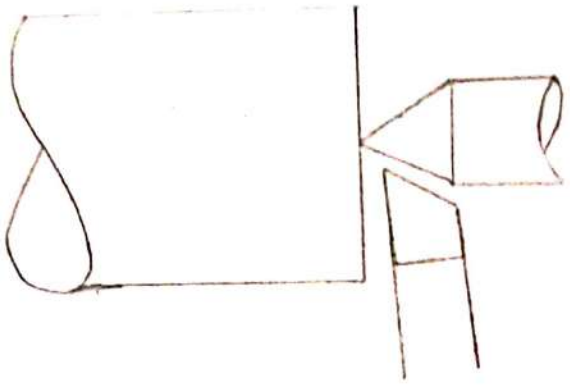


fig.: facing operation

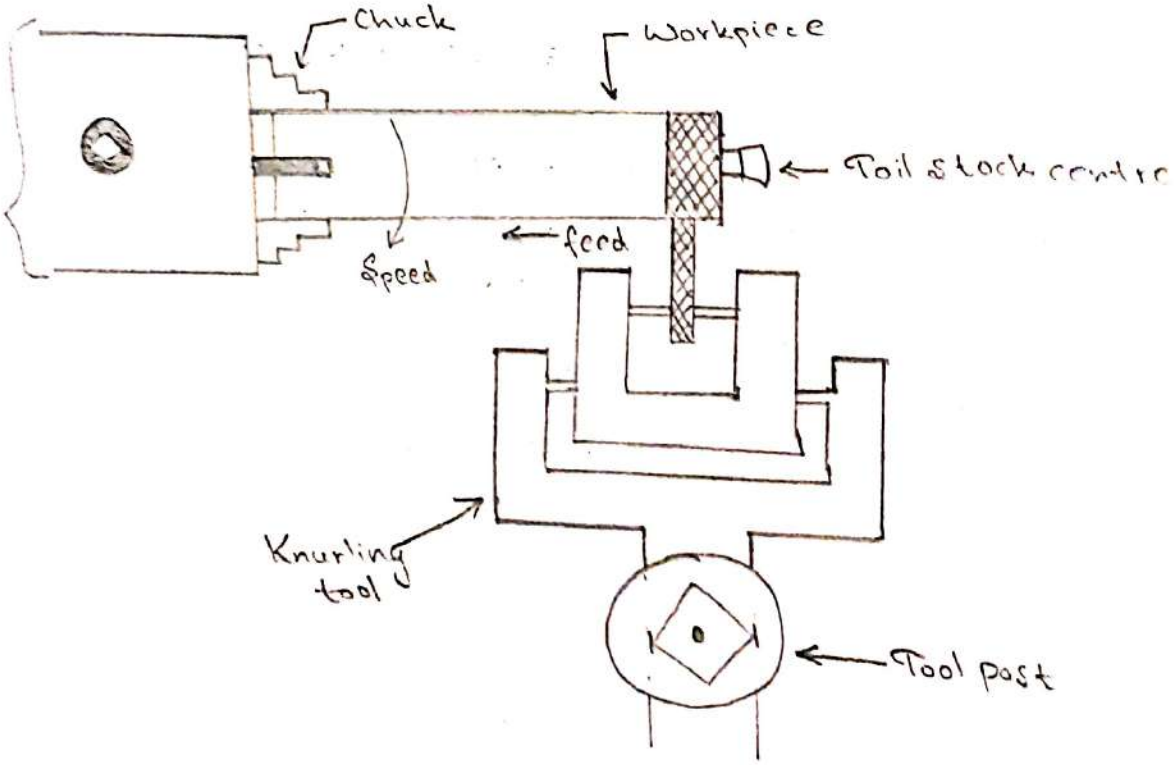


fig.: Knurling

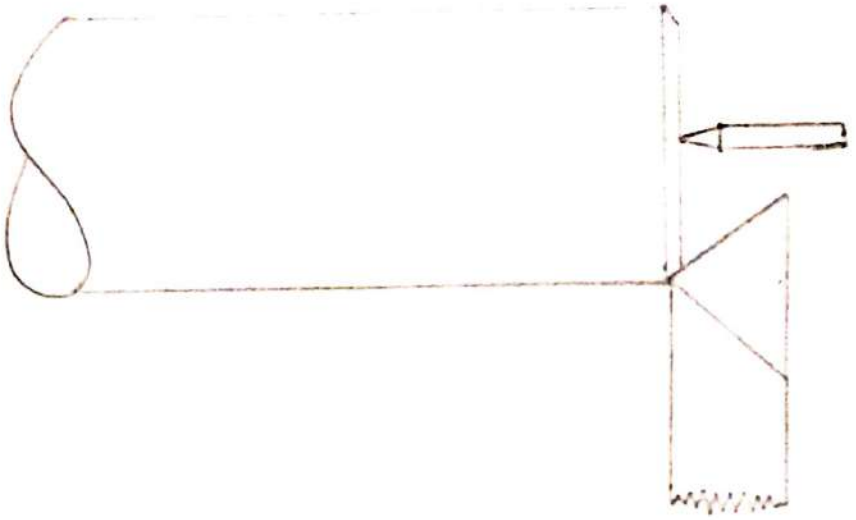


fig: Chamfering Operation

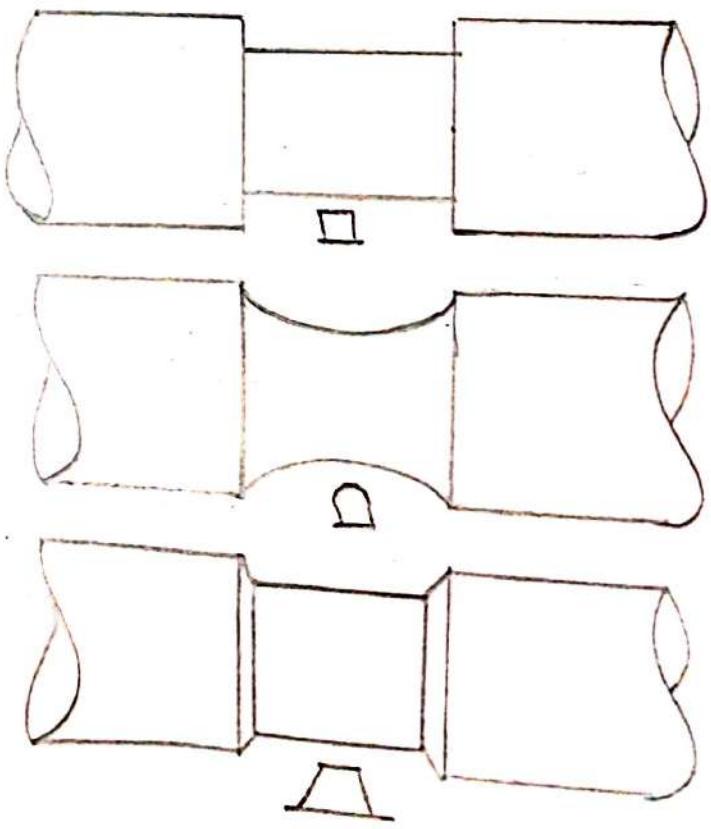


fig: Grooving Operation

AIM: TO PERFORM STEP TURNING OPERATIONS