Safety to be observed while working on lathes

Objective: At the end of this lesson you shall be able to
- **state the precautions to be observed before starting work on a lathe, during work and after.**

Before starting the work

Ensure that the lubricating system is functioning.

The mating gears should be in proper mesh and the power feed levers are in neutral position.

The work area should be clean and tidy.

The safety guards should be in place.

During work

Never try to stop a rotating chuck with your hand. A rotating chuck is dangerous.

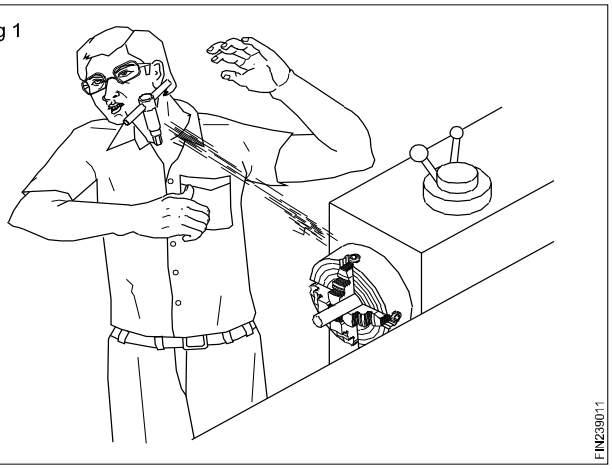
Switch off the machine before making any adjustment on the lathe.

It is dangerous to leave the chuck key in the chuck. Remove it immediately after use. (Fig 1)

Single point tools are sharp and dangerous. Be extra careful when using them.

Chips are sharp and dangerous. Never remove them with your bare hands. Use a chip rake or brush.

Fig 1



You must always know where the emergency stop switch is.

After work

Clean the lathe with a brush and wipe with cotton waste.

Oil the bedways and lubricating points.

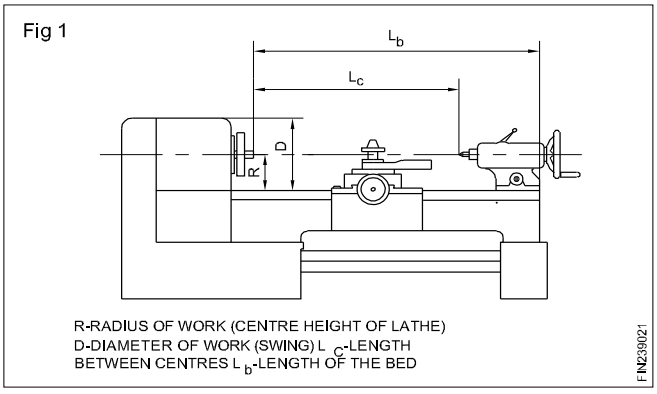
Clean the surroundings of the lathe, wipe the dirt and coolant and remove the swarf.

Specification of a centre lathe

Objective: At the end of this lesson you shall be able to
- **specify a centre lathe.**

Specification of a lathe (Fig 1)

Fig 1



A lathe is to be specified by the following.

The maximum diameter of a work that can be held.

The swing over bed. This is the perpendicular distance from the lathe axis to the top of the bed.

The length of the bed. The length of the bed-ways.

The maximum length of work that can be turned between centres.

The range of threads that can be cut. The capacity of the lathe. The swing over carriage.

The value of each division on the graduated collars of the cross-slide and compound slide.

Range of spindle speeds.

Range of feeds.

Size of the spindle bore.

Type of spindle nose.

The specifications help in communication between the seller and the buyer of the lathe.

It helps the operator of the lathe to decide whether the work in hand can be accommodated for performing the operations.

Constructional features of lathe

Objectives: At the end of this lesson you shall be able to
- **name the main parts of a lathe**
- **state the constructional features of lathe**
- **explain the principle of a lathe.**

Centre lathe is a machine which is used to bring the raw material to the required shape and size by metal removal. This is done by feeding a cutting tool against the direction of rotation of the work.

The machine tool on which turning is carried out is known as a lathe.

Lathe is a machine tool which holds the job in between the centre and rotates the job on its own axis. Due to this quality of holding the job from the centre and rotating the job, it is called centre lathe. Work can be held on a chuck and face plate. Chuck and face plate are mounted on the front of spindle. Cutting tool is fed against work after holding it in the tool post firmly. The work rotates on it own axis and tool is moved parallel to work. When tool moves parallel to axis it produces cylindrical surface and when it rotates at some angle, it produces taper surface.

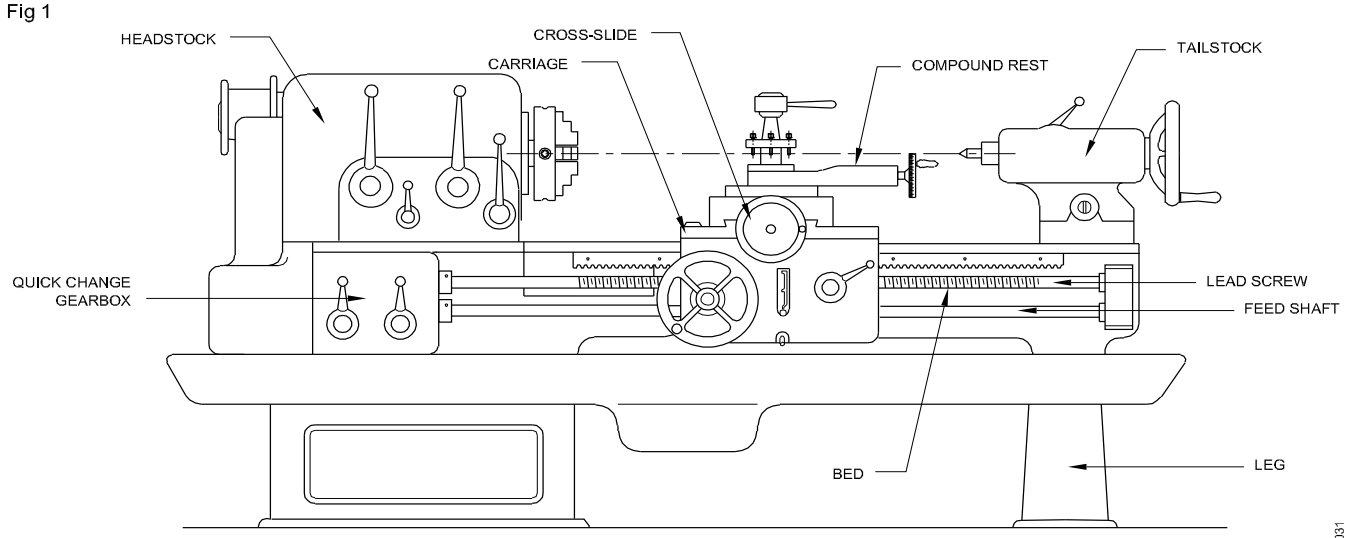
Constructional features of a lathe

A lathe should have provision :

- To hold the cutting tool, and feed it against the direction of rotation.
- To have parts, fixed and sliding, to get a relative movement of the cutting tool with respect to the rotation of the work.
- To have accessories and attachments for performing different operations.

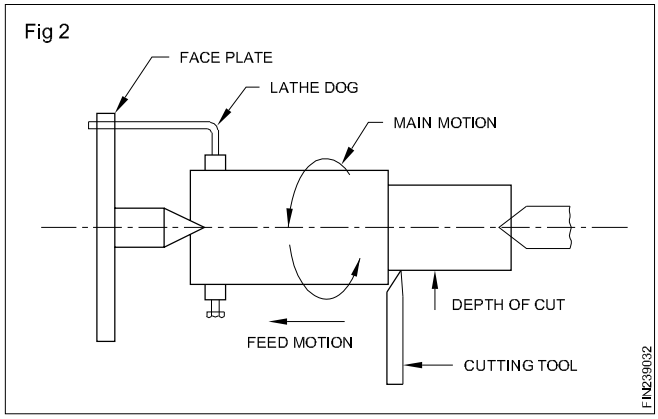
The following are the main parts of a lathe. (Fig 1)

Fig 1



- Headstock
- Tailstock
- Carriage
- Cross-slide
- Compound slide
- Bed
- Quick change gearbox
- Legs
- Feed shaft
- Lead screw

Fig 2



Working principle of Lathe (Fig 2)

Lathe main parts

Objectives: At the end of this lesson you shall be able to
- **name the parts**
- **state the functions of the parts**

Lathe bed

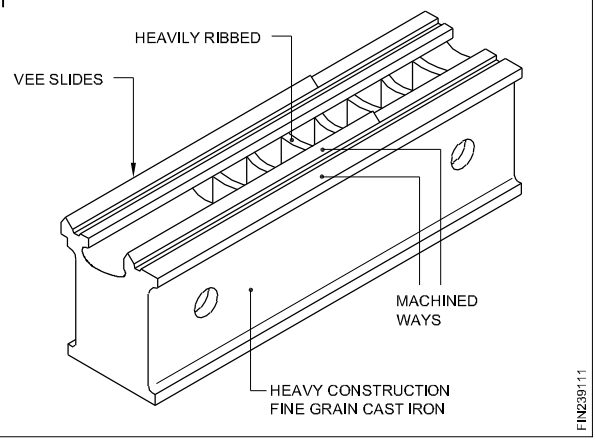
Functions of a lathe bed

The functions of a lathe bed are:

- To locate the fixed units in accurate relationship to each other.
- To provide slide-ways upon which the operating units can be moved.

Constructional features of a lathe bed (Fig 1)

Fig 1



The lathe bed generally consists of a single casting. In larger machines, the bed may be in two or more sections accurately assembled together. Web bracings are employed to increase the rigidity. For absorbing shock and vibration,the beds are made heavy.

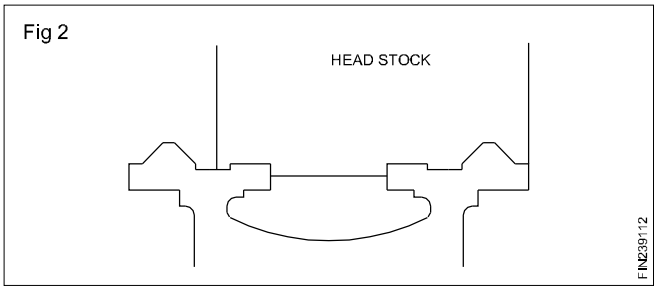
A combined swarf and coolant tray is provided on lathes. This may be an integral part with the lathe bed.

The bed is generally made by cast iron or welded sheet metal legs of box section. This provides the necessary working height for the lathe. Very often the electrical switch gear unit and the coolant pump assembly are housed in the box section of the legs at the headstock end.

Bed-ways (Fig 2)

The bed-ways or slideways assist in accurate location and sliding of the accessories/parts mounted on this.

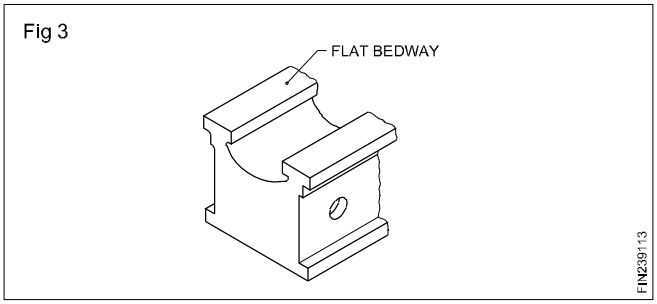
Fig 2



The bed-ways are of three types.

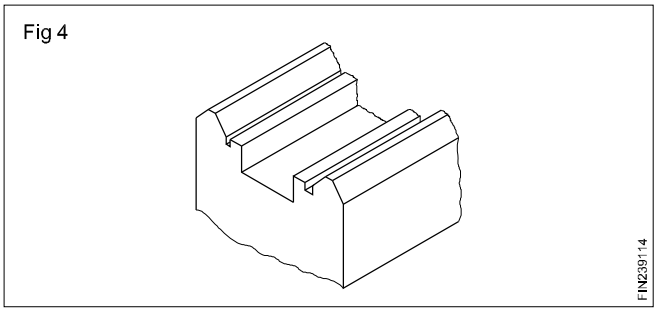
Flat bed-way (Fig 3)

Fig 3



'V' bed way (Fig 4)

Fig 4



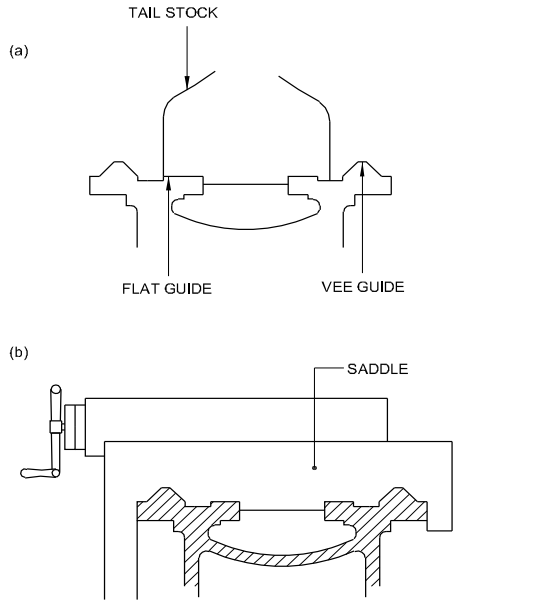
Combination bed way (Figs 5a & 5b)

Normally the bed-ways stop at a distance away from the headstock with a gap at this point. This enables to mount larger diameters of the work.

Some lathes have a detachable section of the bed, which can be fitted when desired, to enable the saddle to operate close to the headstock.

The bed-ways are highly finished by grinding. Some lathes have their bed-ways hand scraped. Some have their bed-ways hardened and ground. The wear-resisting qualities of bearing surfaces are improved by employing chilled iron castings.

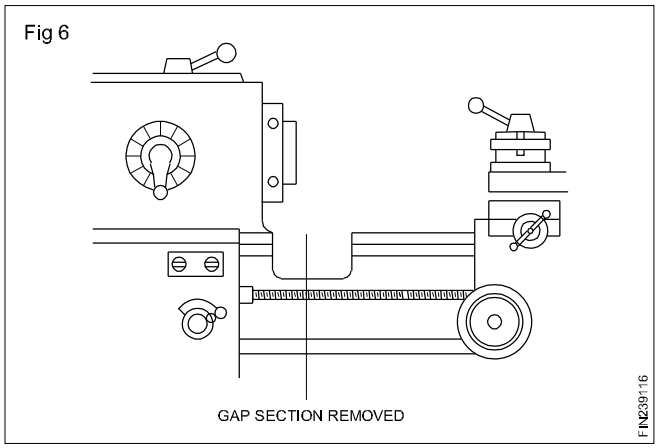
Fig 5



The beds are mostly made up of closely ground, grey cast iron.

Gap bedway (Fig 6)

Fig 6

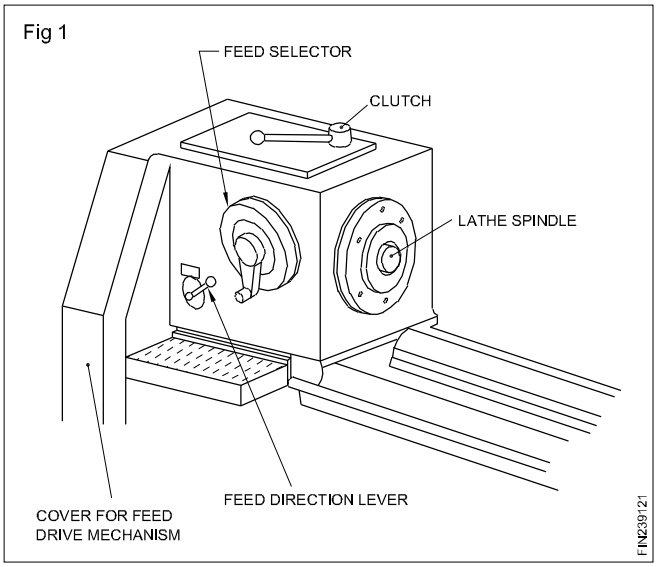


Headstock

Objectives: At the end of this lesson you shall be able to
- **state the function of the headstock**
- **differentiate between cone pulley headstock and all geared headstock.**

Functions (Fig 1)

Fig 1



To provide a means to assemble the work-holding devices. Transmit the drive from the main motor to the work.

To accommodate shafts, gears and levers for a wide range of varying work speeds.

To ensure arrangement for lubricating the gears, shafts and bearings.

Types of headstocks

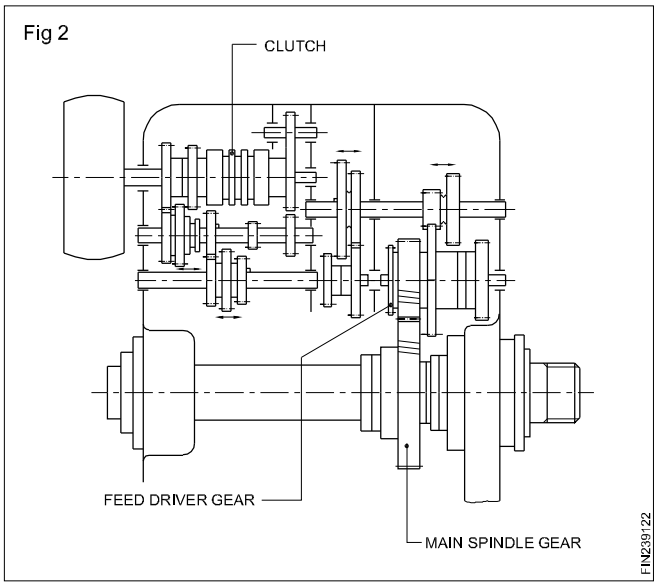
The following are the two types of headstocks.

1 All geared headstock.

2 Cone pulley headstock.

All geared headstock (Fig 2)

Fig 2



It is a box section casting having a removable top cover. It has internal webs for stiffening, and to take shaft bearings. It has an input shaft which is connected by means of 'V' belts to the main motor, and it runs at a constant speed. It is equipped with clutches and a brake.

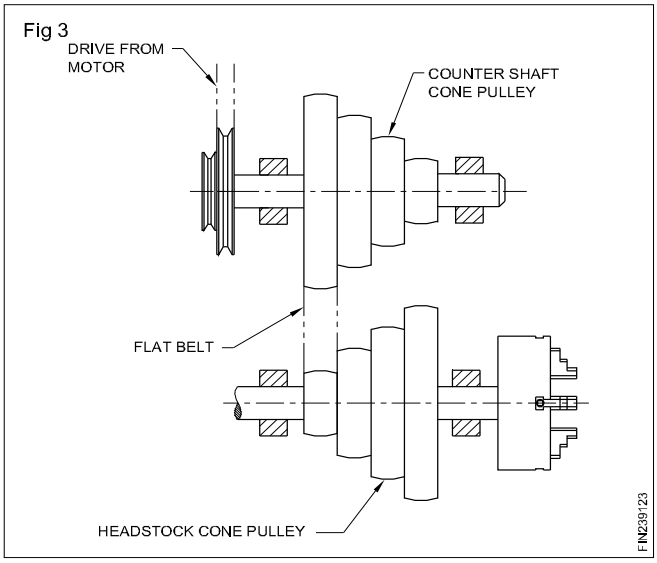
There may be two or more intermediate shafts on which sliding gears are mounted. The main spindle is the last driven shaft in the headstock assembly. The nose of the spindle is outside the headstock casting, and is designed to accommodate the work-holding devices.

The levers operating the forks for the sliding gears are situated outside in front of the headstock casting.

In the all-geared headstock, lubricating oil is filled for splash lubrication of the internal gears. A sight glass with an oil level mark is provided to see the oil level.

Cone pulley headstock (Fig 3)

Fig 3

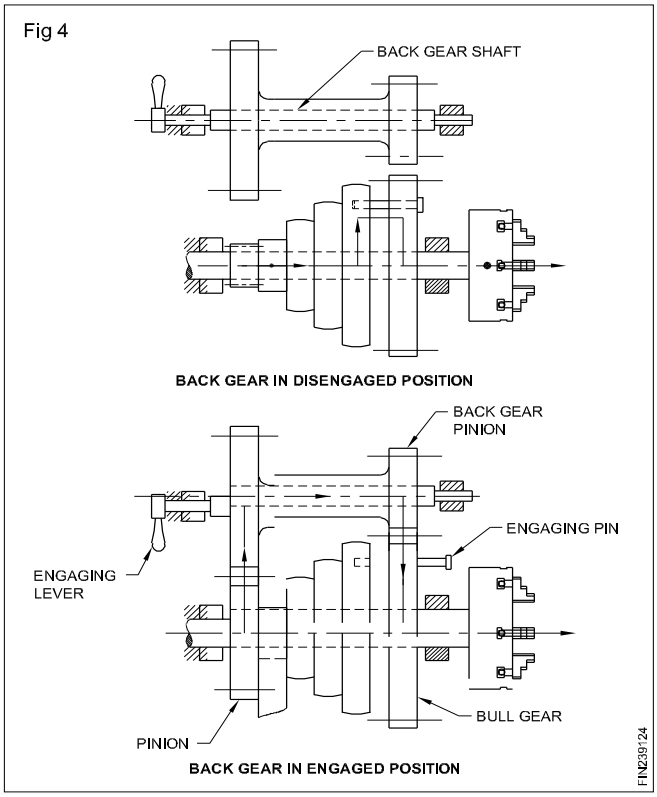


It has a stepped cone pulley mounted on the main spindle, and it is free to revolve. It is connected by means of a flat belt to a similar cone pulley, with steps arranged in the reverse order. This cone pulley gets the drive from the main motor.

The spindle is mounted on the bearing on the headstock casting and has a gear wheel called 'bull gear' keyed to it. A pinion is coupled to the cone pulley.

The back gear unit has a shaft which carries a gear and a pinion. The number of teeth of the gear and pinion on the back gear shaft corresponds to the number of teeth on the bull gear and pinion on the cone pulley. The axis of the back gear shaft is parallel to the axis of the main spindle. The back gear is engaged or disengaged with the cone pulley system by means of a lever. The back gear unit is engaged for reducing the spindle speeds. (Fig 4)

Fig 4



A three-stepped cone pulley headstock provides 3 direct ranges of speeds through a belt connection. With the back gear in engagement, 3 further ranges of reduced speeds can be obtained.

Advantages

Can take up heavy load.

Less noise during working.

Easy to maintain.

Disadvantages

The number of spindle speeds is limited to the number of steps in the cone pulley.

It takes time to change the spindle speeds.

Carriage

Objectives: At the end of this lesson you shall be able to
- **state the functions of a carriage**
- **name the parts of a carriage.**

Carriage is the feature of a lathe that provides the method of holding and moving the cutting tool. (Fig 1) It can be locked at any desired position on the lathe bed. It consists of two major parts namely, apron and saddle.

Apron (Fig 2)

The apron is bolted to the front of the saddle. It contains mechanism for moving and controlling the carriage. The main parts of an apron are :

Fig 1

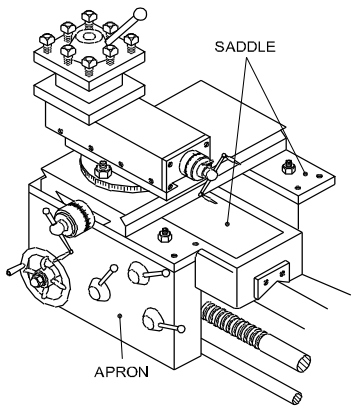
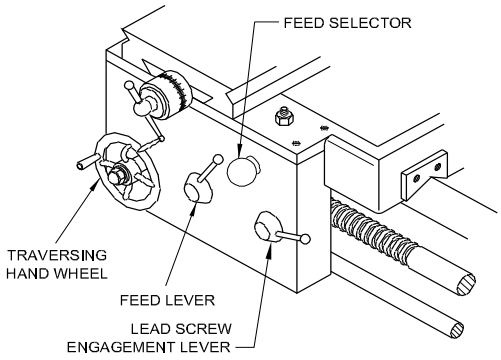


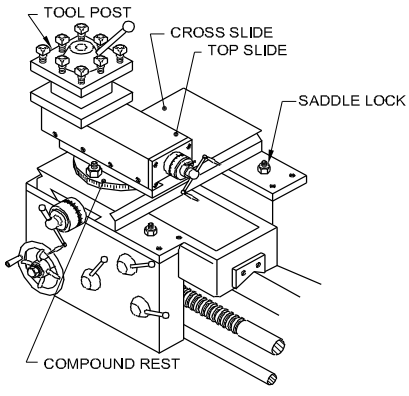
Fig 2



- Traversing hand wheel
- Feed lever
- Feed selector
- Lead screw engagement lever.

Saddle (Fig 3)

Fig 3



It is a 'H' shaped casting having 'V' guide grooves at the bottom face, corresponding to the lathe bed-ways for mounting on the lathe bed and for sliding.

Parts of a saddle

Cross-slide

The cross-slide is mounted on the top of the saddle, and it provides cross movement for the tool. This is fitted at right angles to the bed and is moved by means of a screwed spindle, fitted with a handle. A graduated collar, mounted on the screw rod along with the hand wheel, helps to set the fine movements of the cross- slide.

Compound rest

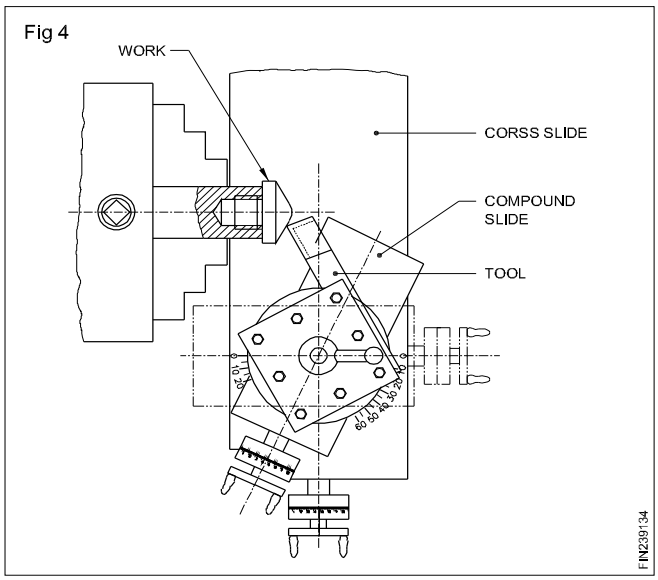
The compound rest is fitted on the top and to the front of the cross-slide. The compound rest can be swivelled horizontally through 360°.

Top slide

The top slide is fitted on the top of the compound rest. It supports the tool post which holds the cutting tool. The top slide provides a limited horizontal movement for the cutting tool.

By swivelling the compound rest, the top slide can be set at an angle to the cross-slide (Fig 4). Usually the compound rest is set in such a way that the top slide is at right angles to the cross-slide.

Fig 4



Tailstock

Objectives: At the end of this lesson you shall be able to
- **list the parts of a tailstock**
- **state the uses of a tailstock**
- **explain the function of a tailstock.**

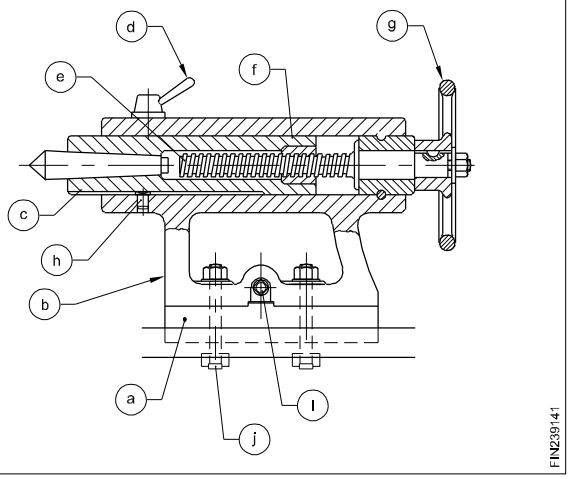
Tailstock

It is a sliding unit on the bed-ways of the lathe bed. It is situated on the right hand side of the lathe. It is made in two parts namely the `base' and the `body'. The base bottom is machined accurately and has `V' grooves corresponding to the bed-ways. It can slide over the bed and can be clamped at any position on the bed by means of the clamping unit. The body of the tailstock is assembled to the base. Graduations are marked on the rear end of the base and a zero line is marked on the body.

When both zero lines coincide,the axis of the tailstock is in line with the axis of headstock.

The body and base are made out of cast iron. The parts of a tailstock are: (Fig 1)

Fig 1



a Base

b Body

c Spindle (barrel)

d Spindle locking lever

e Operating screw rod

f Operating nut

g Tailstock hand wheel

h Key

i Set screw/set overscrew

j Clamping bolt

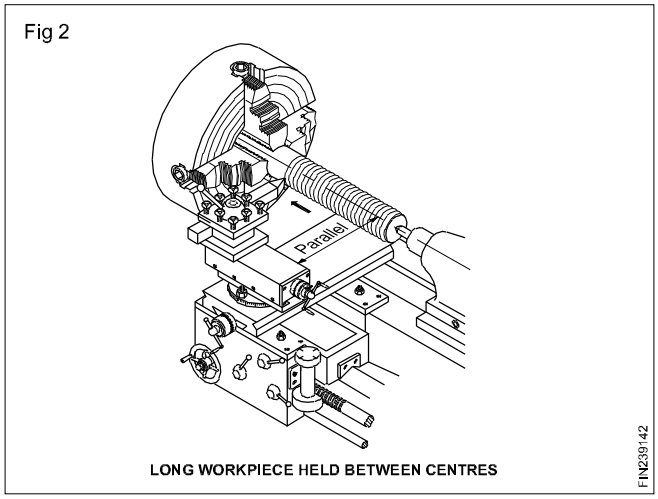
Functioning of a tailstock

By rotating the hand wheel, the barrel can be moved forward or backward. The barrel can be locked in any required position. The hollow end of the barrel at the front is provided with a Morse taper to accommodate the cutting tools with a taper shank. Graduations are sometimes marked on the barrel to indicate the movement of the barrel. With the help of the adjusting screws, the body can be moved over the base laterally, and the amount of movement may be read approximately refering to the graduations marked. This arrangement is to offset the centre of the tailstock as required for taper turning.

Purpose of the tailstock

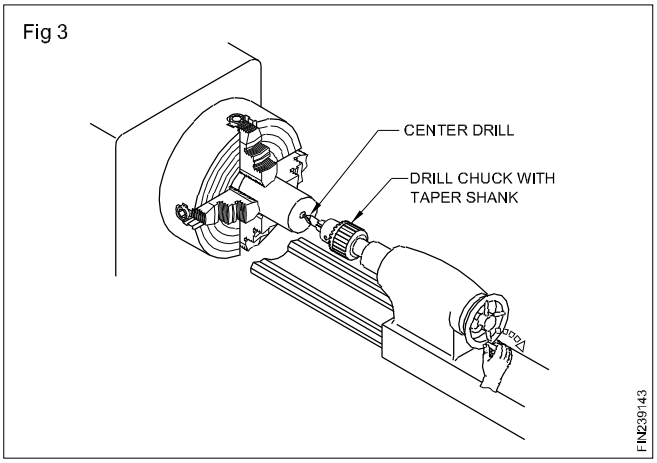
To accommodate the dead center to support lengthy work to carry out lathe operations. (Fig 2)

Fig 2



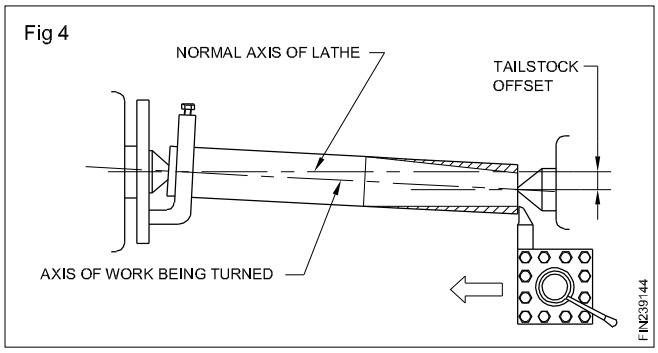
To hold cutting tools like drills, reamers, drill chucks provided with taper shank. (Fig 3)

Fig 3



To turn external taper by offsetting the body of the tailstock with respect to the base. (Fig 4)

Fig 4



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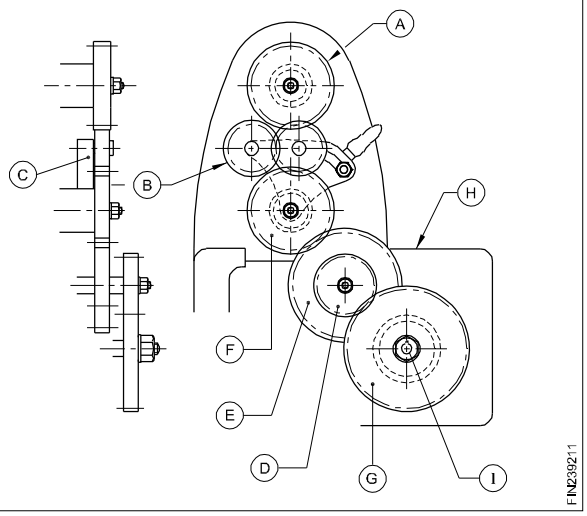
Feeding & thread cutting mechanism

Objectives: At the end of this lesson you shall be able to
- **name the parts of the feeding mechanism**
- **state the functional features of the feeding mechanism.**

Feed mechanism (Fig 1)

Fig 1



The feed mechanism of a lathe enables automatic feeding for the tool longitudinally and transversely as needed. By automatic feeding the finish on the work will be better, the feeding of the tool will be at a uniform continuous rate and it takes less time to finish the operation while manual labour is avoided.

The feed mechanism comprises the following.

- Spindle gear (A)
- Tumbler gear unit (B)
- Fixed stud gear (C)
- Change gear unit (DEFG)
- Quick change gear box (H)
- Feed shaft / Lead screw (I)
- Apron mechanism (Fig 5)

The proportionate tool movement for each revolution of work is achieved through all the above units of the feed mechanism.

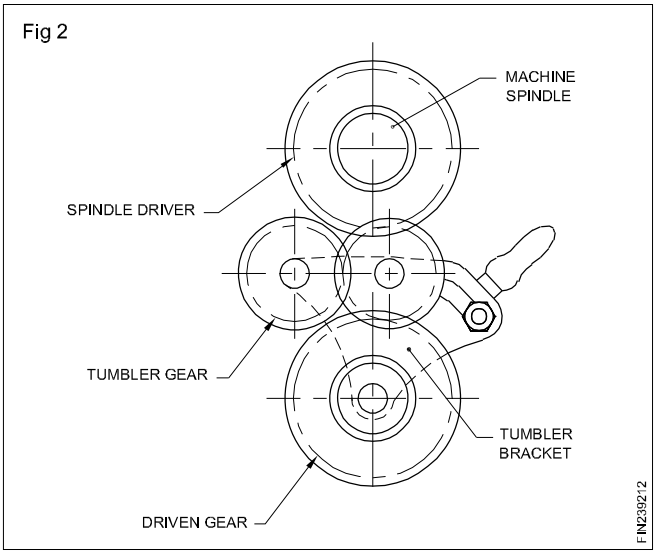
Spindle gear

The spindle gear is fitted to the main spindle, and it is outside the headstock casting. It revolves along with the main spindle.

Tumber gear unit

The tumbler gear unit set of three gears, having the same number of teeth and it connects the spindle gear to the fixed gear. It is also called the reversing gear unit as it is used to change the direction of feed of the tool for the same direction of rotation of the spindle.It can be engaged and disengaged with the fixed stud gear by the operation of the hand lever provided in the unit. (Fig 2)

Fig 2



The fixed stud gear

The fixed stud gear gets the drive from the main spindle gear through the tumbler gear unit and runs at the same number of revolutions per minute as the spindle gear on most lathes.

Change gear unit

The fixed stud gear transmits its drive through a change gear unit to the quick change gear box. The change gear unit has provision for changing the driver, the driven and the idler gears from the set of change gears available for the purpose of feed changing as an additional unit. (Fig 3)

Quick change gear box

The quick change gear box is provided with levers outside the box casting, and by shifting the levers, different gears are brought in mesh so that different feed rates can be given to the tool. A chart listing the different feed rates for the different positions of the levers is fixed to the casting, and by referring to the table, the levers may be engaged in position for the required feed rate. (Fig 4)

Fig 3

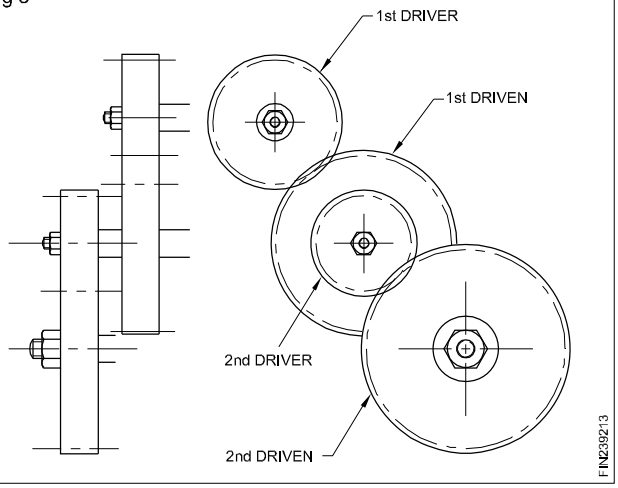
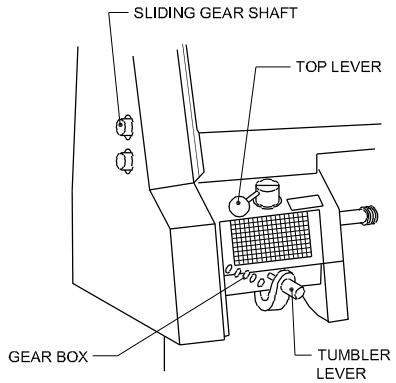


Fig 4



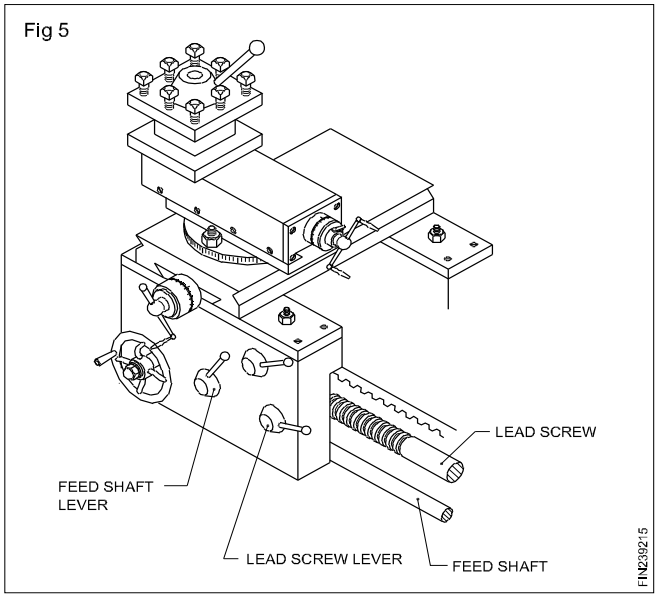
The feed shaft

The feed shaft gets its drive from the quick change gear box, and through the apron mechanism, the rotary movement of the feed shaft is converted into the linear movement of the tool.

The apron mechanism

The apron mechanism has the arrangement for transmitting the drive from the feed shaft to the saddle for longitudinal movement of the tool or to the cross-slide for the transverse movement of the tool. (Fig 5)

Fig 5



Thread cutting with simple and compound gear trains

Objective: At the end of this lesson you shall be able to
- **thread cutting with simple and compound gear trains.**

Change gear train

Change gear train is a train of gears serving the purpose of connecting the fixed stud gear to the quick change gearbox. The lathe is generally supplied with a set of gears which can be utilized to have a different ratio of motion between the spindle and the lead screw during thread cutting. The gears which are utilized for this purpose comprise the change gear train.

The change gear tran consists of driver and driven gears and idler gears.

Simple gear train

A simple gear train is a change gear train having only one driver and one driven wheel. Between the driver and the driven wheel, there may be an idler gear which does not affect the gear ratio. Its purpose is just to link the driver and the driven gears, as well as to get the desired direction to the driven wheel.

Fig 1 shows an arrangement of a simple gear train.

Fig 1

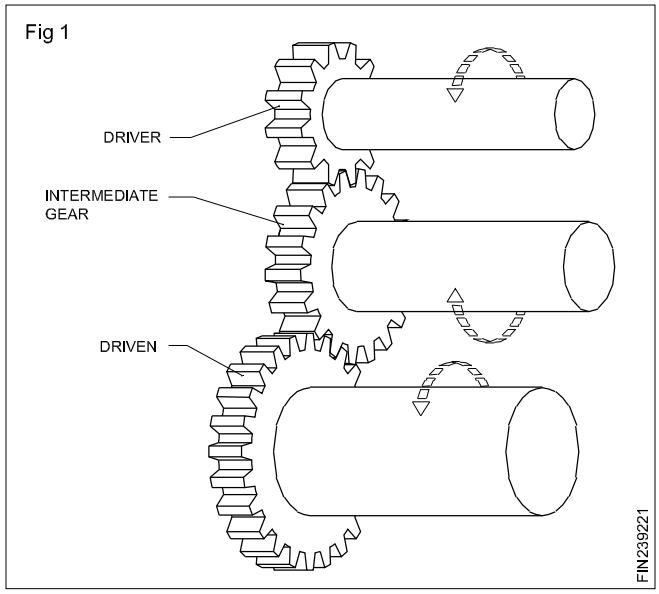
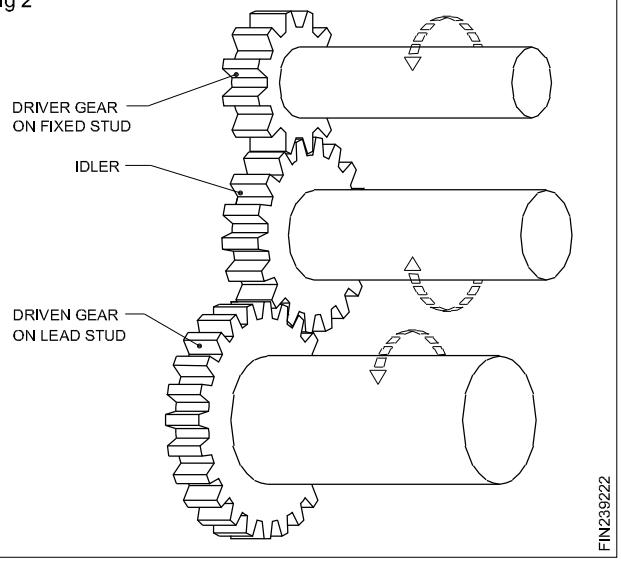


Fig 2 shows mountings of the driver and driven gears in a lathe.

Fig 2



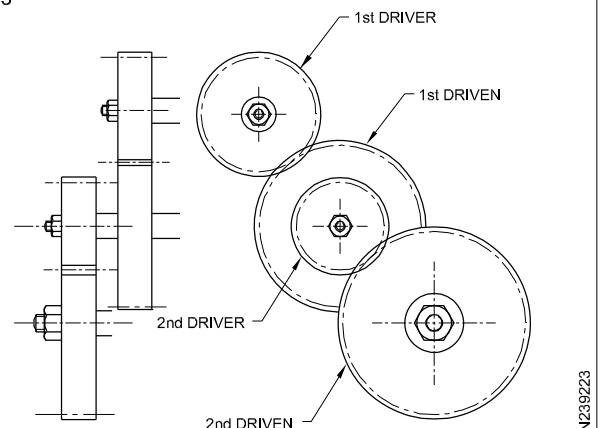
The driver gear and the driven gear are changed according to the pitch of the thread to be cut on the job.

Compound gear train

Sometimes, for the required ratio of motion between the spindle and the lead screw, it is not possible to obtain one driver and one driven wheel. The ratio is split up and then the change gears are obtained from the available set of gears which will result in having more than one driver and one driven wheel. Such a change gear tain is called a compound gear train.

Fig 3 shows the arrangment of a compound gear train.

Fig 3



Holding the job between centre and work with catch plate and dog

Objectives: At the end of this lesson you shall be able to
- **preparing work for turning between centre**
- **to set the catch plate**
- **working with catch plate and dog**

Turning work in-between centres avoids the need for truing the work. The work turned will be parallel through-out. But it requires great skill to perform operations especially like knurling, thread cutting, undercutting. It is limited to external operations only. The work needs the following preparations to be carried out before the actual operations are to be performed.

Face both sides of the work, and maintain the total length accurately within limits.

Choose the correct size and type of centre drill and do centre drilling at both ends.

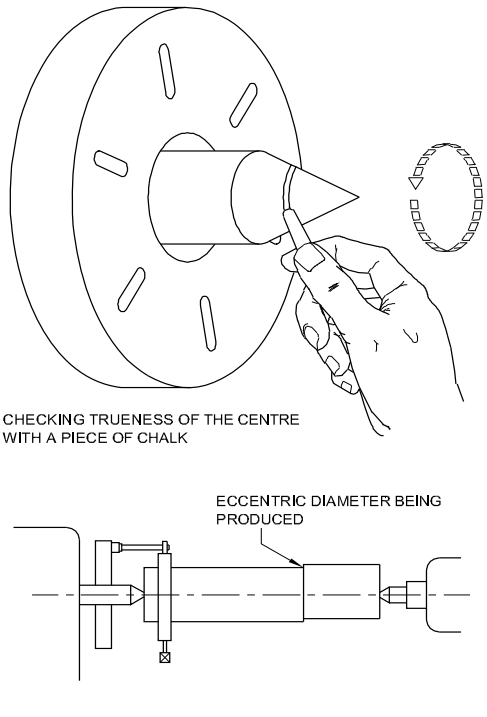
Diamantle the chuck from the spindle nose and assemble the driving plate or catch plate.

Assemble the spindle sleeve to the spindle nose and fix live centre to the sleeve.

Ensure that the spindle sleeve and live centre are free from damages, burrs and are thoroughly cleaned before assembly.

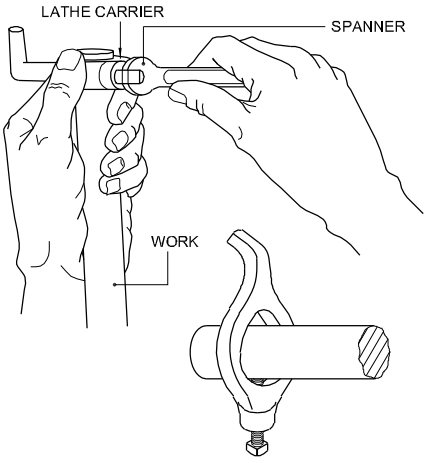
Check for the true running of the live centre. (Fig 1)

Fig 1



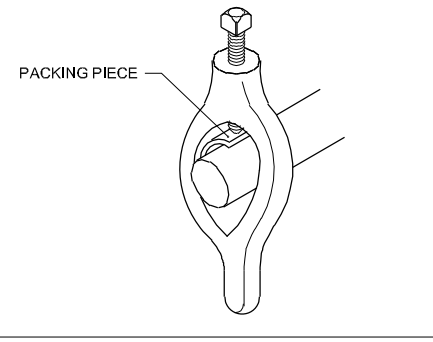
Select a suitable lathe carrier according to the diameter of the work and fasten it on one end of the work with the bent tail pointing outwards. (Fig 2)

Fig 2



Work that has a finished surface should be protected by inserting a small sheet of copper or brass between the end of the screw in the carrier and the work. (Fig 3)

Fig 3



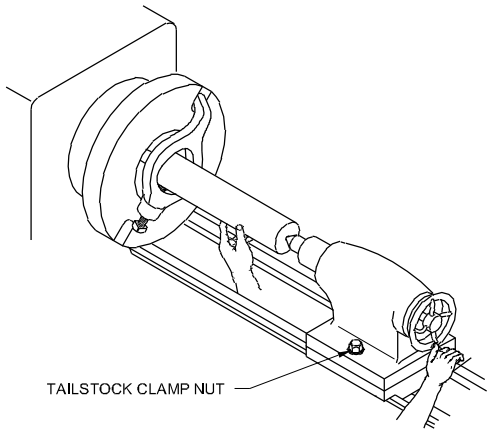
Apply a suitable lubricant (soft grease) to the centre hole of the workpiece to be engaged by the tailstock dead centre.

Move the tailstock to a position on the bed to suit the length of the workpiece. The tailstock spindle should extend approximately 60 to 100 mm beyond the tailstock.

Ensure there is sufficient space for the saddle to operate before clamping the tailstock to the bed.

Clamp the tailstock in position by tightening the tailstock clamp nut. (Fig 4)

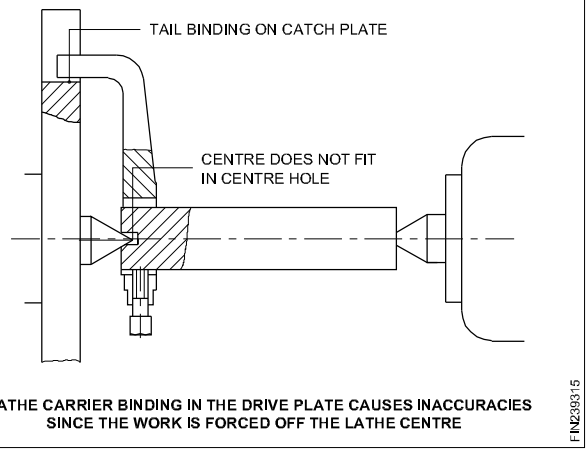
Fig 4



Engage the work-centre hole with the point of live centre and with the tail of the lathe carrier in the slot in the catch plate. Hold the work in this position with hand.

Ensure that the tail of the lathe carrier does not rest on the bottom of the slot in the driving plate. This will not permit the centre entering the centre hole of the work for proper seating. (Fig 5)

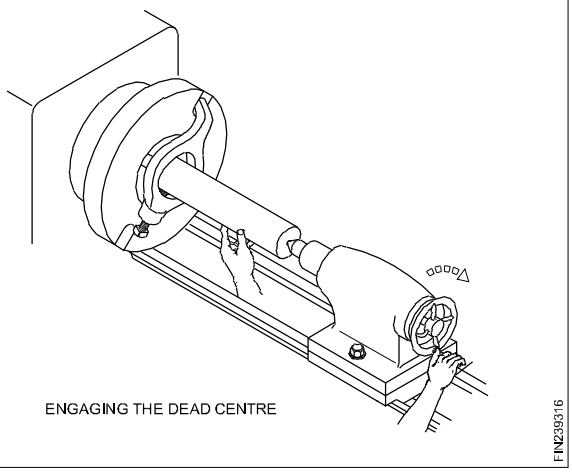
Fig 5



A LATHE CARRIER BINDING IN THE DRIVE PLATE CAUSES INACCURACIES SINCE THE WORK IS FORCED OFF THE LATHE CENTRE

Advance the tailstock spindle by the hand wheel rotation until the point of dead centre enters the centre hole of the work with proper seating eliminating all endwise movement. (Fig 6)

Fig 6



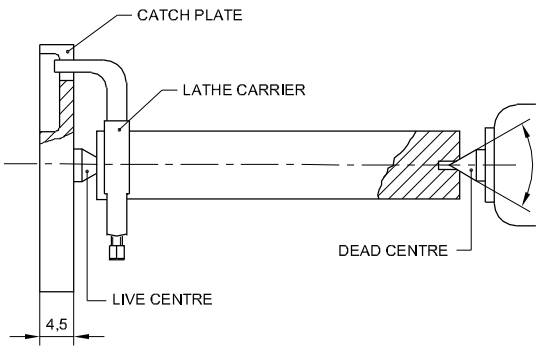
Move the tail of the carrier back and forth. At the same time adjust the hand wheel until only a slight resistance is felt.

Tighten the tailstock spindle clamp at this position and check that the resistance does not change. Set the machine for about 250 r.p.m. and allow the work to run for a few seconds.

Check once again for the resistance and adjust the tailstock spindle, if needed.

Work is now ready for operations. (Fig 7)

Fig 7



WORK HELD BETWEEN CENTRES

Before holding the work in between centres ensure that the centres are aligned.

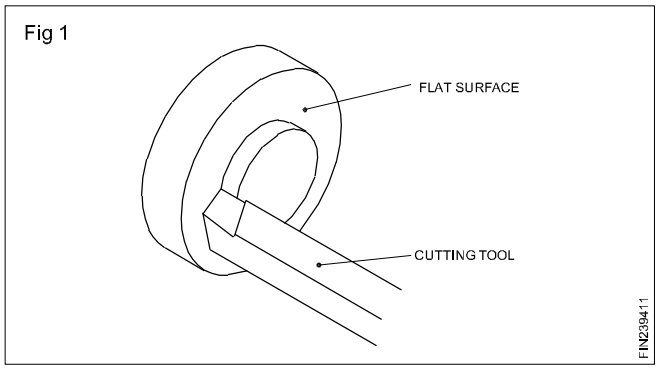
Simple description of facing and roughing tool

Objectives: At the end of this lesson you shall be able to
- **state the purpose of facing**
- **setting the rough facing tool**
- **state the reasons for the defects**
- **state the remedies to overcome the defects in facing**

Facing

This is an operation of removing metal from the work-face by feeding the tool at right angles to the axis of the work. (Fig 1)

Fig 1



Purpose of facing

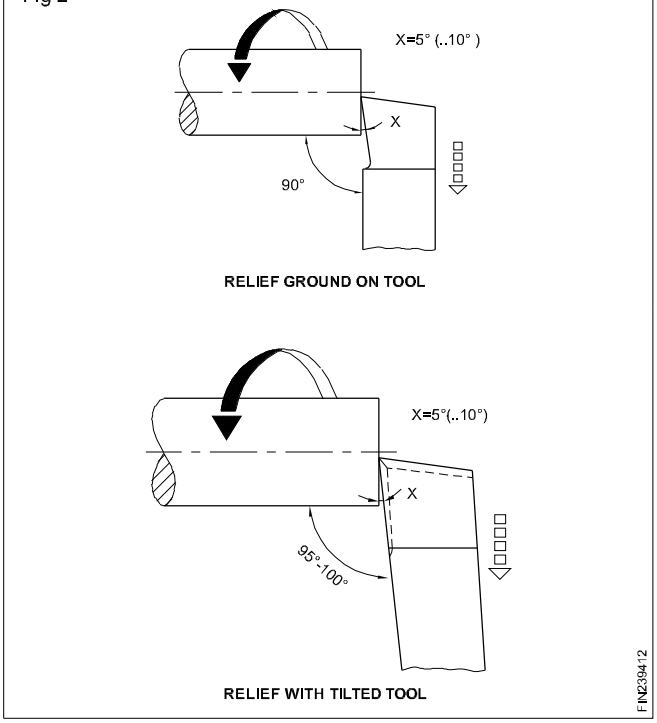
- To have a reference plane to mark and measure the step lengths of the work.
- To have a face at right angle to the axis of the work.
- To remove the rough surface on the faces of the work and have finished faces instead.
- To maintain the total length of the work.

Facing may be rough or finish facing. Rough facing is done to remove the excess metal on the face of the work by coarse feeding with more depth of cut, leaving sufficient metal for finishing. Rough facing is done by feeding the tool from the periphery of work towards the centre of the work. Finish facing is the operation to have a smooth face by removing the rough surface produced by the rough facing.

Finish facing is done by feeding the tool from the centre of the work towards the periphery. (Figs 2a and 2b)

Rough facing is done by choosing a spindle RPM according to the average diameter of the work, the recommended cutting speed, with a coarse feed and more depth of cut.

Fig 2



Finish facing is done by choosing a cutting speed about twice that of the cutting speed for roughing, with a fine feed rate of 0.05 mm approximately and with a depth of cut of not more than 0.1 mm.

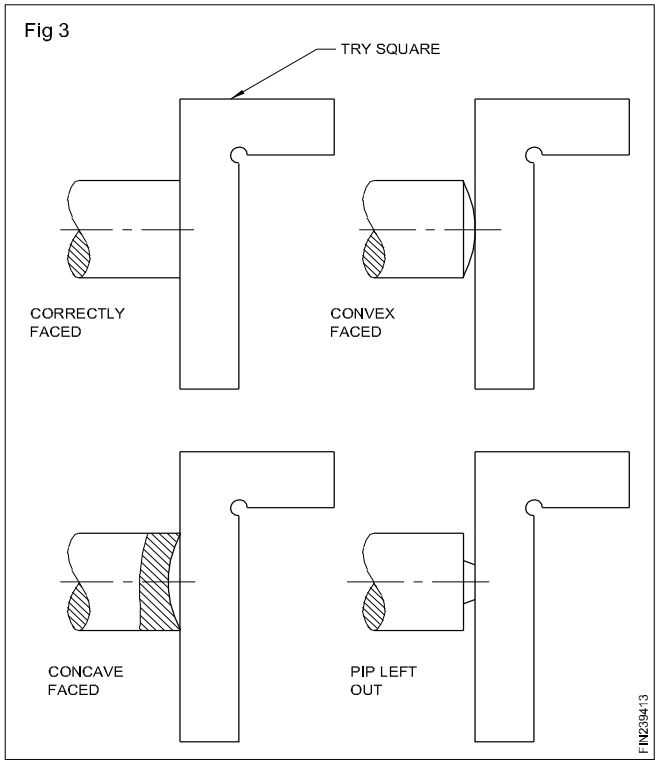
The following are the defects found in facing work (Fig 3)

A concave face

This is caused by the tool digging into the work during the feeding as the tool is not clamped rigidly. By clamping the tool rigidly with minimum overhang, this defect can be avoided.

A convex face

This is caused by the blunt cutting edge of the tool and the carriage not being locked. To avoid this defect, re-sharpen the tool and use it; Also lock the carriage to the bed of the lathe.



A pip left in the centre

This is due to the tool not being set to the correct centre height. By placing the tool to the centre height, this defect can be avoided.