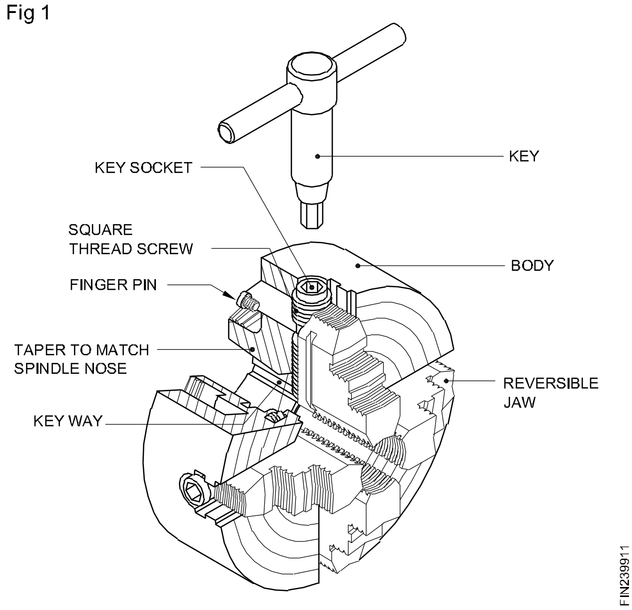
Chucks and chucking - the independent 4 jaw chuck

Objectives: At the end of this lesson you shall be able to
- **state the constructional features of a 4 jaw chuck**
- **name the parts of a 4 jaw chuck.**

4 Jaw chuck (Fig 1)

Fig 1



The four jaw chuck is also called as independent chuck, since each jaw can be adjusted independently; work can be trued to within 0.001" or 0.02mm accuracy, using this chuck.

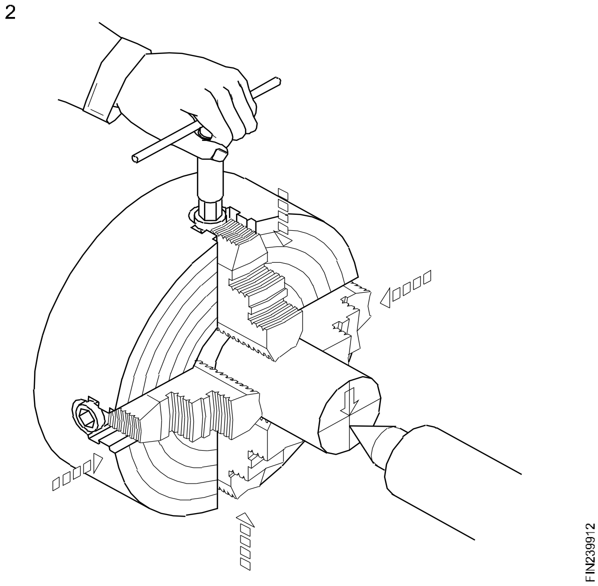
This type of chuck is much more heavily constructed than the self-centering chuck, and has much greater holding power. Each jaw is moved independently by a square thread screw. The jaws are reversible for holding large diameter jobs. The independent 4 jaw chuck has four jaws, each working independently of the others in its own slot in the chuck body and actuated by its own separate square threaded screw. By suitable adjustment of the jaws, a workpiece can be set to run either true or eccentric as required.

To set the job for the second time, it can be trued with the help of a dial test indicator.

The check on the workpiece should be carried out near the chuck and repeated as far from it as the workpiece permits, to ensure that the work is not held in the chuck at an angle to the axis of rotation.

The independent adjustment also provides the facility of deliberately setting the work off-centre to produce an eccentric workpiece. (Fig 2)

Fig 2



The parts of a 4 jaw chuck are:

- Back plate
- Body
- Jaws
- Square threaded screw shaft.

Back plate

The back plate is fastened to the back of the body by means of Allen screws. It is made out of cast iron/steel. Its bore is tapered to suit the taper of the spindle nose. It has a key way which fits into the key provided on the spindle nose. There is a step in front and on which the thread is cut. A threaded collar, which is mounted on the spindle, locks the chuck by means of the thread, and locates by means of the taper and key. Some chucks do not have back plates.

Body (Fig 1)

The body is made out of cast iron/cast steel and the face is flame-hardened. It has four openings at 90° apart to assemble the jaws and operate them. Four screw shafts are fixed on the periphery of the body by means of finger pins. The screw is rotated by means of a chuck key. The body, hollow in the cross-section, has equi-spaced circular rings provided on the face, which are marked by numerical numbers. Number 1 starts in the middle, and increases towards the periphery.

Jaws (Fig 1)

Jaws are made out of high carbon steel. hardened and tempered, which slide on the openings of the body. These jaws are reversible for holding hollow work.

The back side of the jaws are square-threaded which help in fixing the jaws with the operating screws.

Screw shaft (Fig 1)

The screw shaft is made out of high carbon steel, hardened, tempered and ground. The top portion of the screw shaft is provided with a square slot to accommodate the chuck key. On the body portion, a left hand square thread is cut. In the middle of the screw shaft, a narrow step is made and held by means of finger pins. The finger pins permit the screws to rotate but not to advance.

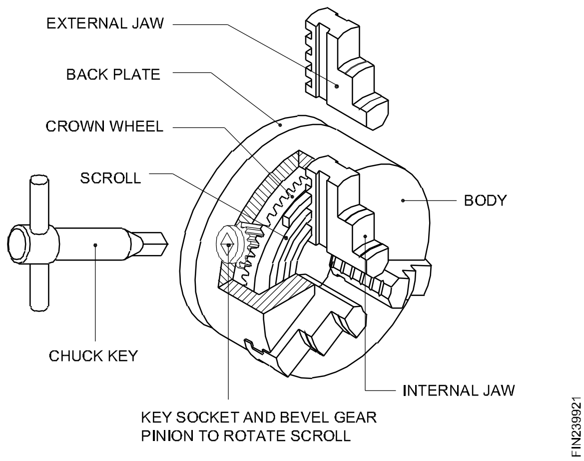
3 jaw chuck

Objectives: At the end of this lesson you shall be able to

- **identify the parts of a 3 jaw chuck**
- **state the constructional features of a 3 jaw chuck**
- **distinguish between a 3 jaw chuck and a 4 jaw chuck**
- **state the merits and demerits of a 4 jaw chuck over a 3 jaw chuck**
- **specify a chuck.**

3 Jaw chuck (Fig 1)

Fig 1



The 3 jaw chuck is also known as a self-centering chuck. The majority of the chucks have two sets of jaws for holding internal and external diameters. Only perfect round work with equally spaced flats divisible by three should be held in a 3 jaw chuck.

From the construction of a 3 jaw chuck it is seen that the scroll not only clamps a component in place, it also locates the component. This is fundamentally a bad practice, since any wear in the scroll and/or the jaws impairs the accuracy of location. Further there is no means of adjustment possible to compensate for this wear.

The jaws of this type of chuck are not reversible, and separate internal and external jaws have to be used.

The parts of a 3 jaw chuck are:

- Back plate
- Body
- Jaws
- Crown wheel and
- Pinion.

Back plate (Fig 1)

The back plate is fastened at the back of the body by means of allen screws. It is made out of cast iron. Its bore is tapered to suit the taper of the spindle nose. It has a key- way which fits into the key provided on the spindle nose. There is a step in the front on which the thread is cut. The threaded collar, which is mounted on the spindle, locks the chuck by means of the thread and locates by mean of the taper and the key.

Body (Fig 1)

The body is made out of cast steel, and the face is hardened. It has three openings 120° apart to assemble the jaws and operate them. Three pinions are fixed on the periphery of the body to operate the jaws by means of a chuck key. It is hollow in its cross-section. A crown wheel is housed inside the body.

Jaws (Fig 1)

The jaws are made out of high carbon steel, hardened and tempered, which slide on the openings of the body. Generally there are two sets of jaws viz. external jaws and internal jaws. External jaws are used for holding solid works. Internal jaws are used for holding hollow works. Steps on the jaws increase the clamping range. The back side of the jaws is cut with scroll thread. Each jaw is numbered in a sequential manner, which helps in fixing the jaws in the corresponding numbered slots.

Crown wheel (Fig 1)

The crown wheel is made out of alloy steel, hardened and tempered. On one side of the crown wheel, a scroll thread is cut to operate the jaws, and the other side is tapered on which bevel gear teeth are cut to mesh with the pinion. When the pinion is rotated by means of a chuck key, the crown wheel rotates, thus causing the jaws to move inward or outward, depending upon the rotation .

Pinion (Fig 1)

Pinion is made out of high carbon steel, hardened and tempered. It is fitted on the periphery of the body. On the top of the pinion a square slot is provided to accommodate the chuck key. It has a tapered portion on which bevel gear teeth are cut, which match with the crown wheel.

Comparison between 3 jaw chuck and 4 jaw chuck

3 Jaw chuck	4 Jaw chuck
Only cylindrical, hexagonal work can be held.	A wide range of regular and irregular shapes can be held.
Internal and external jaws are available.	Jaws are reversible for external and internal holding.
Setting up of work is easy.	Setting up of work is difficult.
Less gripping power.	More gripping power.
Depth of cut is comparatively less.	More depth of cut can be given.
Heavier jobs cannot be turned.	Heavier jobs can be turned.
Workpieces cannot be set for eccentric turning.	Workpieces can be set for eccentric turning.
Concentric circles are not provided on the face.	Concentric circles are provided which help for approximate setting of jaws.
Accuracy decreases as the chuck gets worn out.	There is no loss of accuracy as the chuck gets worn out.

Merits of a 4 jaw chuck

A wide range of regular and irregular shapes can be held.

Work can be set to run concentrically or eccentrically at will.

Has considerable gripping power, and hence heavy cuts can be given.

The jaws are reversible for internal and external work.

Work can be readily performed on the end face of the job.

There is no loss of accuracy as the chuck gets wornout.

De-merits of a 4 jaw chuck

Workpieces must be individually set.

The gripping power is so great that fine work can be easily damaged during setting.

Merits of a 3 jaw chuck

Work can be set with ease.

A wide range of cylindrical and hexagonal work can be held.

Internal and external jaws are available.

De-merits of a 3 jaw chuck

Accuracy decreases as chuck becomes worn out.

Run out cannot be corrected.

Only round and hexagonal components can be held.

When accurate setting or concentricity with an existing diameter is required, a self-centering chuck is not used.

Specification of chuck

To specify a chuck, it is essential to provide :

Type of chuck.

Capacity of chuck.

Diameter of the body.

Width of the body.

The method of mounting to the spindle nose.

Example

3 Jaw self-centering chuck.

Gripping capacity 450 mm.

Diameter of the body 500 mm.

Width of the body 125 mm.

Tapered or threaded method of mounting.

Method of cleaning the thread of the chuck mounting

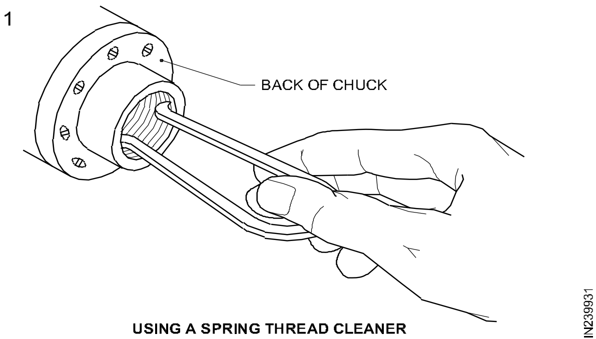
Objective: At the end of this lesson you shall be able to
- **state the uses of thread cleaner.**

Thread cleaners are used to clean all the mating parts of the chuck and spindle as, otherwise, the dirt on these surfaces could result in the following.

Cause the chuck to run out of true.

Damage the threads or taper on the spindle or chuck. (Fig 1)

Fig 1



USING A SPRING THREAD CLEANER

Mounting and dismounting of chucks

Objective: At the end of this lesson you shall be able to
- **explain the method of mounting and dismounting chucks from spindle noses.**

To perform lathe operations on work materials, it may not be always possible to have only one type work-holding device fitted to the spindle. Hence it becomes an absolute necessity for dismounting the work-holding device already assembled to the spindle and mount that work-holding device which is needed for the work in hand.

For an easy understanding of different spindle noses and their applications, the mounting of different work-holding devices are illustrated.

When mounting a chuck on the headstock spindle, exercise care to prevent damage occurring to the chuck or spindle.

Damage may reduce the accuracy of the lathe. The points set out below are important and should be followed.

Before mounting

Before attempting to mount a chuck, ensure that it is the correct one for the lathe and for the job in hand.

> **Do not use power to mount a chuck on spindle noses.**

To prevent such damage from occuring, take the following steps.

Place a wooden board on the lathe bed when mounting light chucks to prevent damage to the slideways. (Fig 1)

For large chucks place a wooden cradle between the chucks and the lathe bed. (Fig 2)

In addition to protecting the bed slideways it makes fitting the chuck easier and safer.

Fig 1

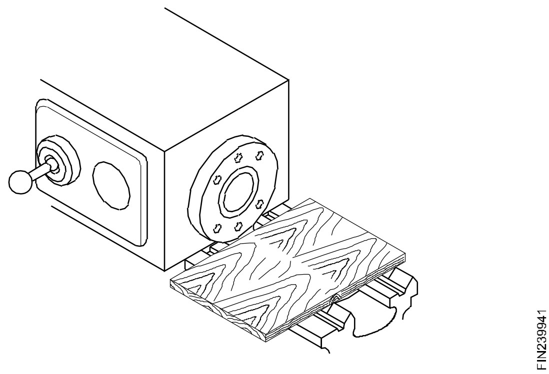
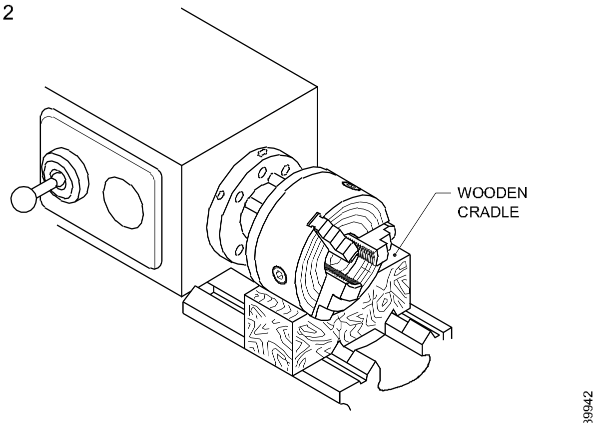


Fig 2



CHUCK SUPPORTED ON WOODEN CRADLE

Always seek assistance when mounting large and heavy chucks.

Lubricate the mating surfaces with a light film of oil.

After mounting

Set the speed-change lever to the slowest speed.

Turn on the power to the motor.

Switch on the motor.

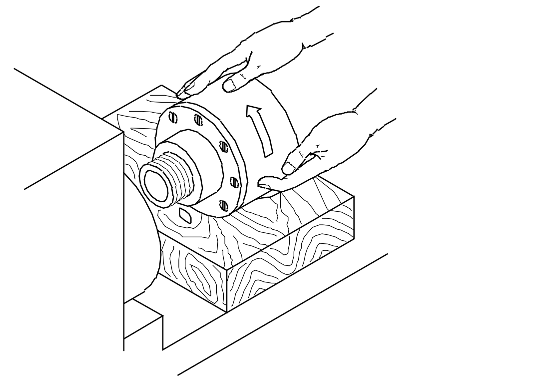
Engage the clutch lever.

The chuck would now begin revolving.

Check that the diameter and face of the chuck are running true by observing the surfaces.

Mounting chuck on to the threaded spindle (Fig 3)

Fig 3



MOUNTING THREADED CHUCK

Switch off the motor.

Place the chuck on the wooden plank or cradle and slide it close to the spindle nose.

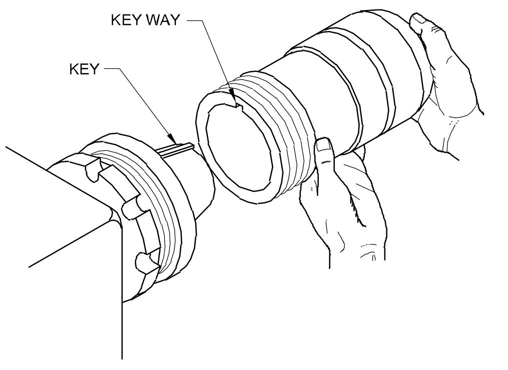
Turn the spindle anticlockwise by hand and engage the chuck on the spindle threads. (Fig 3)

Set the speed-change lever to the slowest speed. Screw the chuck in until it fits firmly on the spindle.

The chuck should easily screw into the spindle. If any resistance is felt, remove the chuck and check that the threads are clean and not damaged.

Mounting on tapered spindle (Fig 4)

Fig 4



MOUNTING THREADED CHUCK

Switch off the motor.

Hence the chuck on the wooden board or cradle and slide it close to the spindle nose.

Turn the spindle by hand until the key on the spindle nose lines up with the keyway in the chuck.

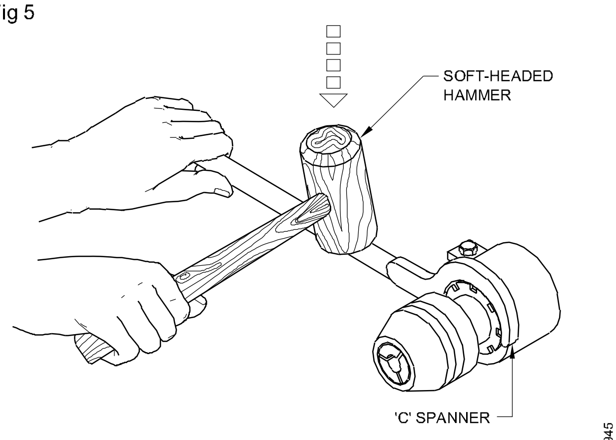
Set the speed-change lever to the slowest speed.

Push the chuck on to the spindle and turn the locking ring anticlockwise. (Fig 4)

The figure given here illustrates a small chuck held with both hands and being mounted. Engage the special ‘C’ spanner on the locking ring.

The spanner should fit around the top of the locking ring with the handle pointing downwards. Grip the end of the handle with one hand and firmly strike the other end with the other hand in an anticlockwise direction. This would securely tighten the locking ring. (Fig 5)

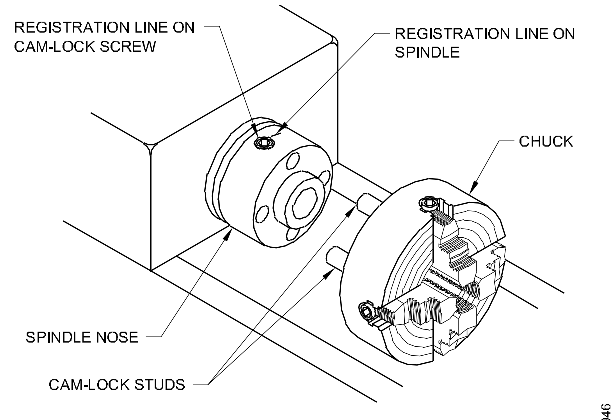
Fig 5



LOCK CHUCK ON SPINDLE

Mounting on a cam-lock spindle (Fig 6)

Fig 6



MOUNTING CHUCK ON CAM-LOCK SPINDLE

Switch off the motor.

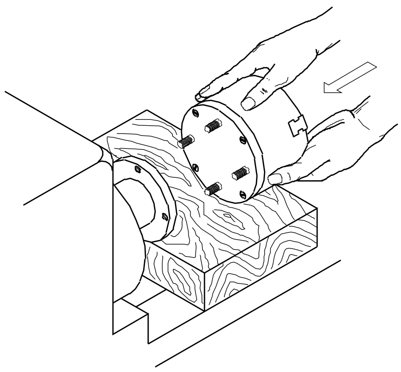
Place the chuck on a wooden board or cradle and slide it close to the spindle nose. Disengage the clutch to permit free rotation of the spindle. Insert the correct chuck key into a cam-locking screw on the spindle.

Turn each cam-locking screw so that the registration line is vertical or aligns with the corresponding line on the spindle. Turn the spindle by hand until the clearance holes on the spindle align with the cam-lock studs on the chuck.

Set the speed. Change lever to the slowest speed. Push the chuck on to the spindle. Tighten each cam-lock screw in a clockwise direction.

Mounting on to a bolted spindle (Figs 7 and 8)

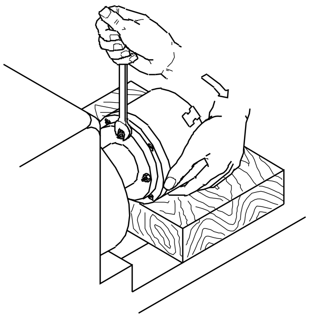
Fig 7



MOUNTING CHUCK TO BOLTED SPINDLE

FIN239947

Fig 8



TIGHTEN NUTS FIRMLY

FIN239948

Switch off the motor.

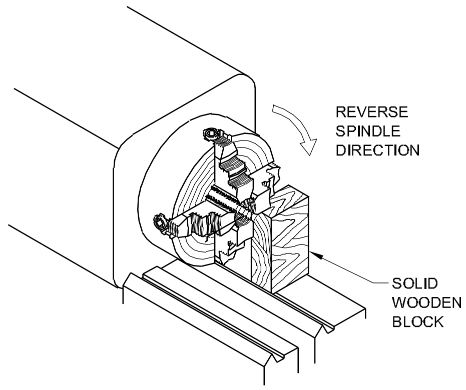
Place the chuck on a wooden board or cradle. Remove nuts and washers from the studs on the chuck. Disengage the clutch to permit free rotation of the spindle. Turn the spindle by hand until the key in the spindle lines up with the slot in the chuck. Set the speed- change lever to the slowest speed. Push the chuck on to the spindle. Fit washers and nuts to the studs.

Hold the chuck in position when fitting nuts.

Tighten the nuts in an anticlockwise direction using a spanner on the opposite nuts.

Dismounting chucks from a threaded spindie (Fig 9)

Fig 9



REMOVING SCREWED CHUCK FROM SPINDLE

FIN239949

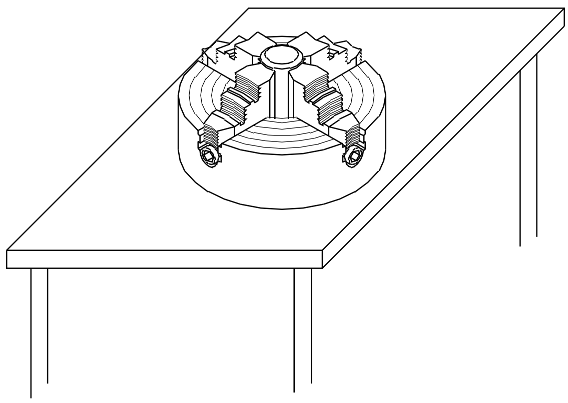
Switch off the motor. Set the speed change lever to the slowest speed. Place a solid wooden block between one of the chuck jaws and the rear of the lathe-bed.

The length of the wooden block should be slightly less than the centre height of the lathe.

Turn the lathe spindle clockwise by hand to loosen the chuck from the spindle nose.

Remove the wooden block. Place the wooden board or cradle on the lathe-bed. Unscrew the chuck from the spindle. Clean and store the chuck (Fig 10)

Fig 10



STORE ALL CHUCKS CAREFULLY AFTER USE

FIN23994A

— — — — — —

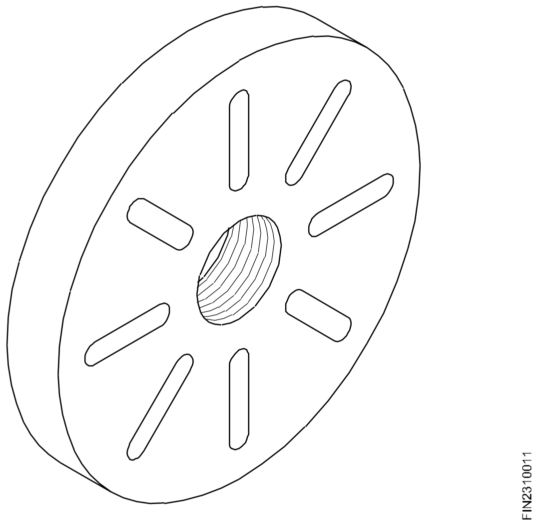
Face plate

Objectives: At the end of this lesson you shall be able to
- **state the types of face plate**
- **state the uses of face plates**

The different types of face plates are:

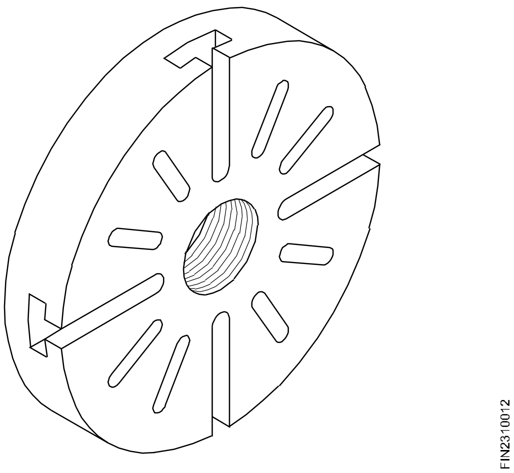
- Face plates with only elongated radial slots (Fig 1)

Fig 1



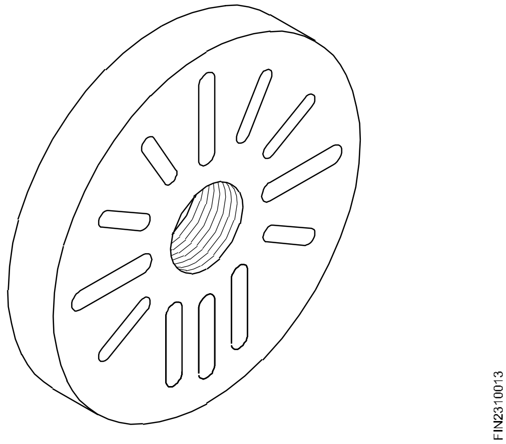
- Face plates with elongated slots 'T' slots. (Fig 2)

Fig 2



- Face plates with elongated radial slots and additional parallel slots. (Fig 3)

Fig 3



Face plates are used along with the following accessories.

Clamps, 'T' bolts, Angle plate, Parallels, counterweight, Stepped block, 'V' Block etc.

Large, flat, irregular shaped workpieces, castings, jigs and fixtures may be firmly clamped to a face plate for various turning operations.

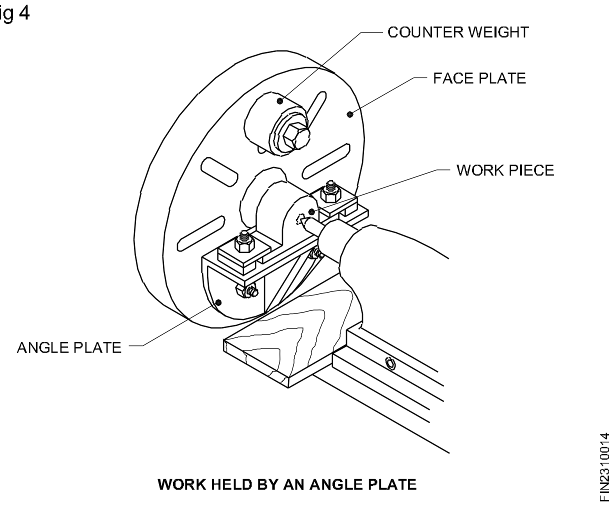
A work can be mounted on a face plate while the face plate is on the lathe spindle or on the workbench. If the workpiece is heavy or awkward to hold, the workpiece is mounted while the face plate is on the workbench. Before mounting the face plate set up to the spindle, it is advantageous to locate the workpiece on the face plate and centre the workpiece. Centre a punch mark or hole approximately on the face plate. This makes it easier to true the work after the face plate is mounted on to the spindle.

The poisition of the bolts and clamps is very important, if a workpiece is to be clamped effectively.

If a number of duplicate pieces are to be machined, the face plate itself can be set up as a fixture, using parallel strips and stop blocks.

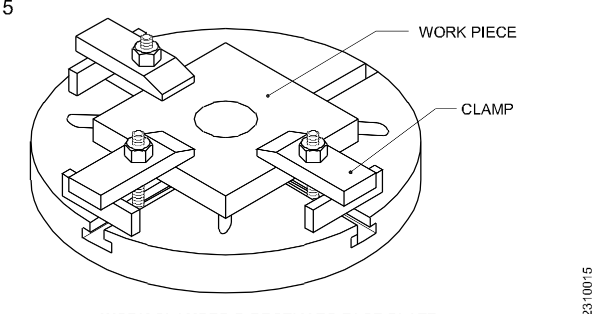
The application of the face plate with accessories in different set ups is shown in the sketches below. (Figs 4, 5 & 6)

Fig 4



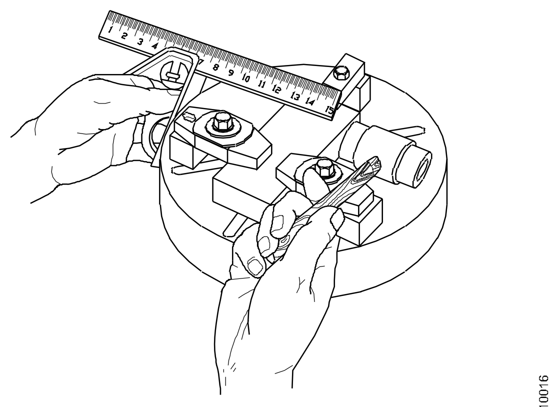
WORK HELD BY AN ANGLE PLATE

Fig 5



WORK CLAMPED DIRECTLY TO FACE PLATE

Fig 6



LOCATING WORK ON A FACE PLATE

— — — — — —

Drilling

Objectives: At the end of this lesson you shall be able to
- **state the drilling process done in a lathe**
- **state the methods of holding the drill in the tail stock.**

Lathe can be used for drilling

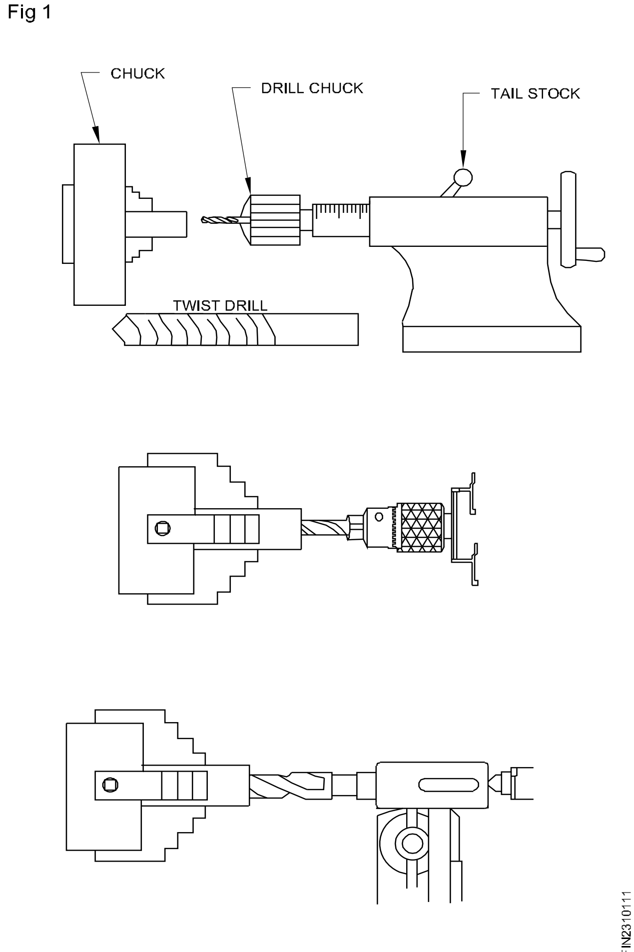
Before doing internal operation like boring, reaming and tapping. Although lathe is not a drilling machine time and effort are saved by using the lathe for drilling operations instead of changing the work to the other machines. Prior to drilling the end of the work piece on the lathe, the end face to be drilled must be spotted (center punched) and then centre drilled so that the drill will start properly

The head stock and tail stock spindle should be alingned for all drilling, reaming and tapping in order to produce a true hole.

Straight shank and taper shank drills can be held in the tailstock spindle as held in the drilling machine spindle using drill chuck sleeve and sockets. Since the tail stock spindle has the morse taper. (Fig 1)

Methods of holding drills in a tail stock (Fig 1)

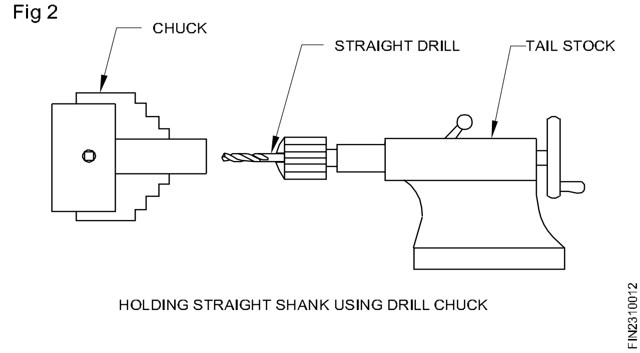
Fig 1



The different methods of holding drill in the tailshock are

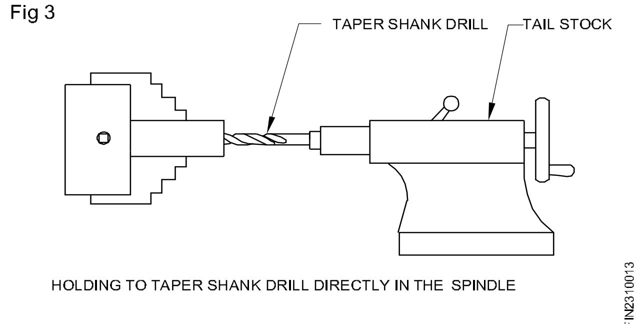
- By using drill chuck (Fig 2)

Fig 2



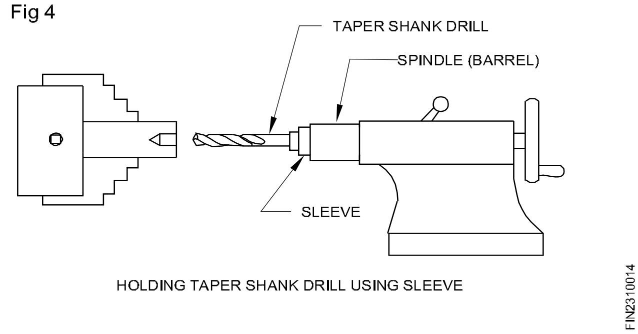
- By directly fitting in the tailstock spindle (Fig 3)

Fig 3



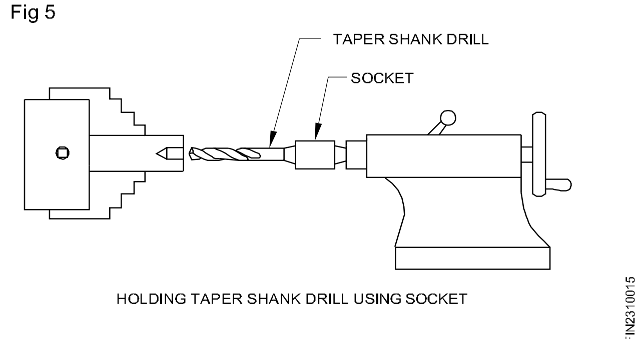
- By using drill sleeve (Fig 4)

Fig 4



- By using drill socket (Fig 5)

Fig 5



— — — — — —

Boring & boring tools

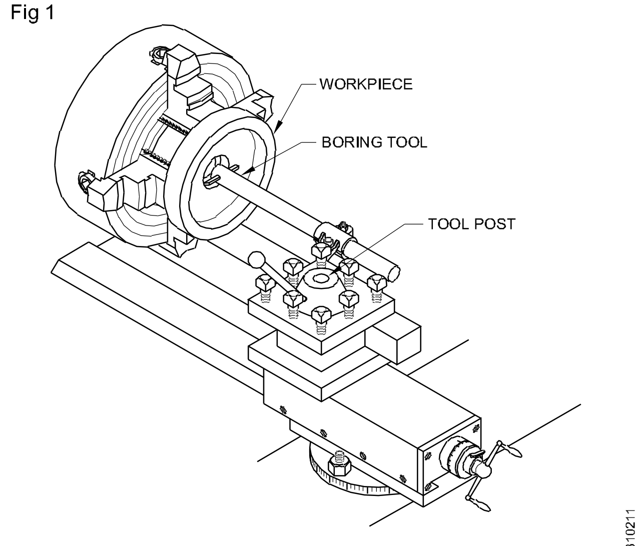
Objectives: At the end of this lesson you shall be able to
- **state the operation boring**
- **state the different types of boring tools.**

Boring

Boring is the operation of enlarging and truing a hole produced by drilling, punching, casting or forging. Boring cannot originate a hole. Boring is similar to the external turning operation and can be performed in a lathe by the following two methods.

The work is revolved in a chuck or a face plate and the tool which is fitted to the tool post is fed into the work. This method is adopted for boring small sized works. A solid forged tool is used for boring small holes, whereas a boring bar with a tool bit attached to it is suitable for machining a large hole. The depth of cut is given by the cross-slide screw and the feed is effected by the longitudinal travel of the carriage. (Fig 1)

Fig 1



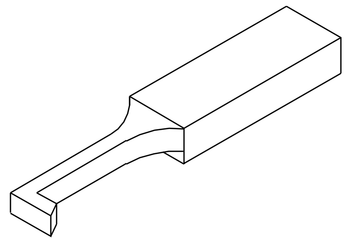
BORING OPERATION

Types of boring tools

Solid forged tools

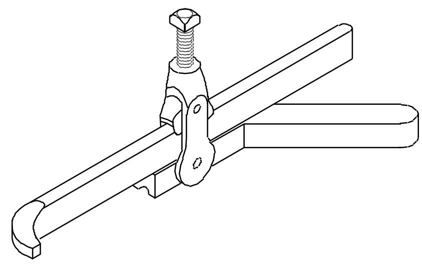
Solid forged boring tool is made from HSS with the end forged and ground. It resembles a left hand turning tool and the operation is performed from right to left. There are two types, solid boring tool (Fig 2) and solid forged bar in a tool-holder (Fig 3). They are used for light duty and on small diameter holes.

Fig 2



SOLID BORING TOOL

Fig 3



A SOLID FORGED BAR IN A TOOL HOLDER

Advantages

Regrinding is easy.

Alignment is easy.

Mounting and removal is easy.

Boring bars with inserted bits

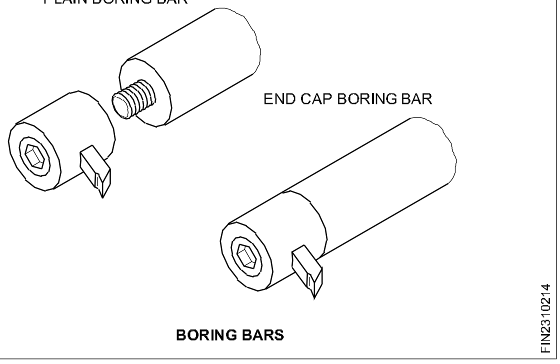
Square and round tool bits made from HSS are inserted and fixed in the boring bar. The inserts can be set at an angle of 30°, 45° or 90° in the bar. It is used for heavier cuts than those made by the solid boring tool.

For plain boring, the inserts are set square to the axis of the bar. For facing the shoulder, or threading up to the shoulder, the inserts are set at an angle.

Boring bars used are of two types. (Fig 4)

- Plain boring bar
- End cap boring bar

Fig 4



BORING BARS

Advantages

Used for heavy duty boring operations.

Tool changing is faster.

Low cost

Boring tools can either be set square or at an angle quickly.

— — — — — —