Bench vice

Objectives : At the end of this lesson you shall be able to
- **name the parts and uses of a bench vice**
- **specify the size of a bench vice**
- **state the uses of vice clamps.**

Vices are used for holding workpieces. They are available in different types. The vice used for bench work is called as bench vice or (Engineer's vice)

A bench vice is made of cast iron or cast steel and it is used to hold work for filling, sawing, threading and other hand operations.

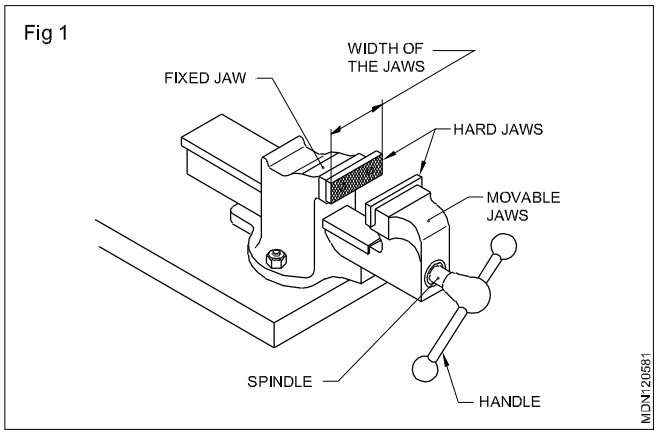
The size of the vice is stated by the width of the jaws.

Parts of a bench vice (Fig.1)

The following are the parts of the vice

The Vice is generally bolted and secured in a wooden work table, and is useful for operations like filing, chipping, hacksawing, bending sheetmetal etc.

Fig 1



Fixed jaw, movable jaw, hard jaws, spindle, handle, box-nut and spring are the parts of vice.

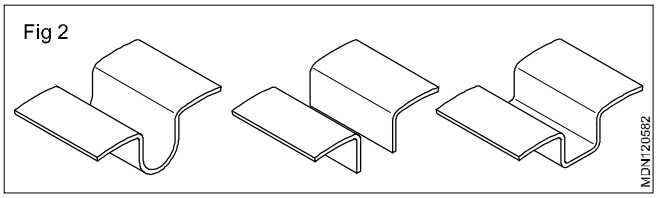
The box-nut and the spring are the internal parts.

Vice clamps or soft jaws (Fig. 2)

The hold a finished work use soft jaws (vice clamps) made of aluminium over the regular jaws. This will protect the work surface from damage.

Do not over-tighten the vice as, the spindle may get damaged.

Fig 2



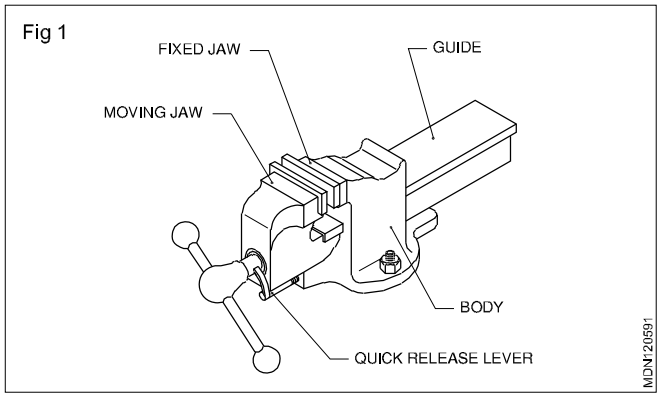
Types of vices

Objectives : At the end of this lesson you shall be able to
- **state the construction and advantages of a quick releasing vice**
- **state the uses of pipe vice, toolmakers vice, hand vice and pin vice.**

There are different types of vices used for holding workpieces. They are quick releasing vice, pipe vice, hand vice pin vice and toolmaker's vice.

Quick releasing vice (Fig 1)

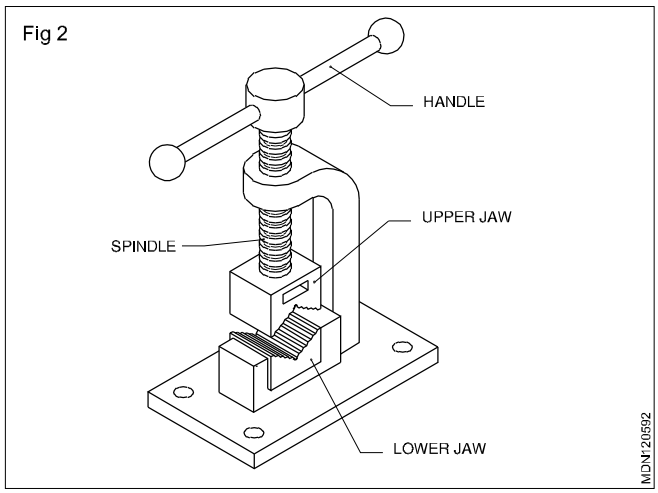
Fig 1



A quick releasing vice is similar to an ordinary bench vice but the opening of the movable jaw is done by using a trigger (lever). If the trigger at the front of the movable jaw is pressed, the nut disengages the screw and the movable jaw can be set in any desired place quickly.

Pipe vice (Fig 2)

Fig 2

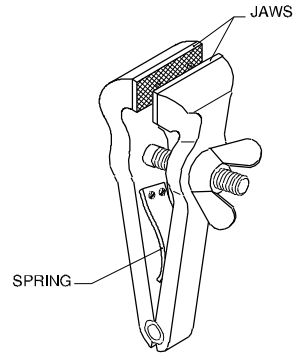


A Pipe vice is used for holding round sections of metal, and pipes. In this vice, the screw is vertical and movable. The jaw works vertically.

The pipe vice grips the work at four points on its surface. The parts of a pipe vice are shown in Fig. 2.

Hand vice (Fig 3)

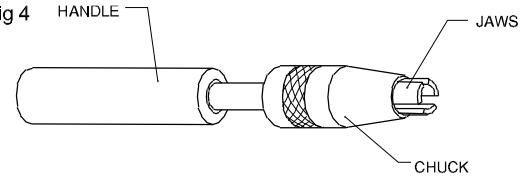
Fig 3



Hand vices are used for gripping screws, rivets, keys, small drills and other similar objects which are too small to be conveniently held in the bench vice. A hand vice is made in various shapes and sizes. The length varies from 125 to 150 mm and the jaw width from 40 to 44 mm. The jaws can be opened and closed using the wing nut on the screw that is fastened to one leg, and passes through the other.

Pin vice (Fig 4)

Fig 4

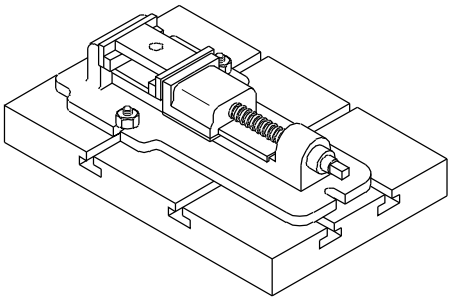


PIN VICE

The pin vice is used for holding small diameter jobs. It consists of a handle and a small collet chuck at one end. The chuck carries a set of jaws which are operated by turning the handle.

Toolmaker's vice (Fig 5)

Fig 5



The toolmaker's vice is used for holding small work which required filing or drilling and for marking of small jobs on the surface plate. This vice is made of mild steel.

Toolmaker's vice is accurately machined.

C- Clamps and toolmaker's clamps

Objectives : At the end of this lesson you shall be able to
- **state the purpose of using clamps**
- **specify the requirements of the clamping devices**
- **state the features and uses of 'C' clamps**
- **state the features of Toolmaker's clamps.**

Purpose of using clamps

Clamps are used for preventing the movement of work, and for holding the job tight.

Requirements of clamping devices

Should be able to manipulate for easy loading.

Should provide the required clamping force.

Should be capable of locking with minimum movement.

Should accommodate a range of sizes of jobs.

(Fig 1) shows a typical clamping device, employing a screw and nut to provide the clamping force.

'C' Clamps

These clamps are in the shape of a 'C'. The 'C' clamp has its body forged or cast. One end of the clamp is machined flat. The other end is drilled and threaded to accommodate a screw-rod which is operated by a handle. The screw-rod carries a swivel pad which is free to revolve. The clamp is hardened and the face is serrated. (Fig 2)

Fig 1

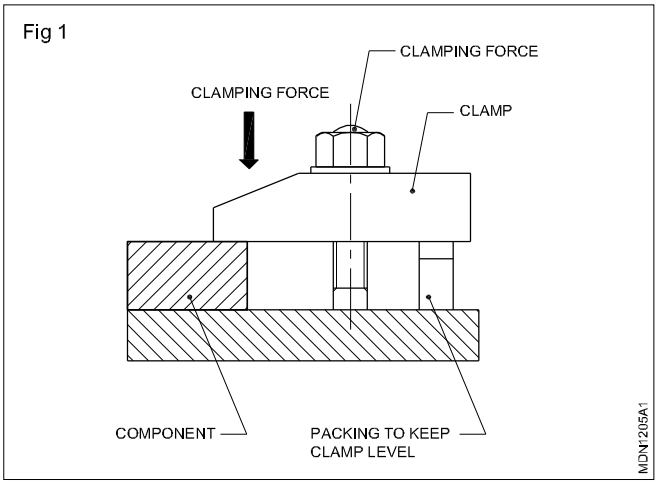
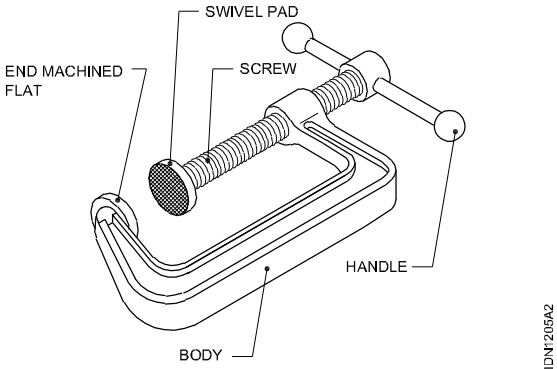


Fig 2



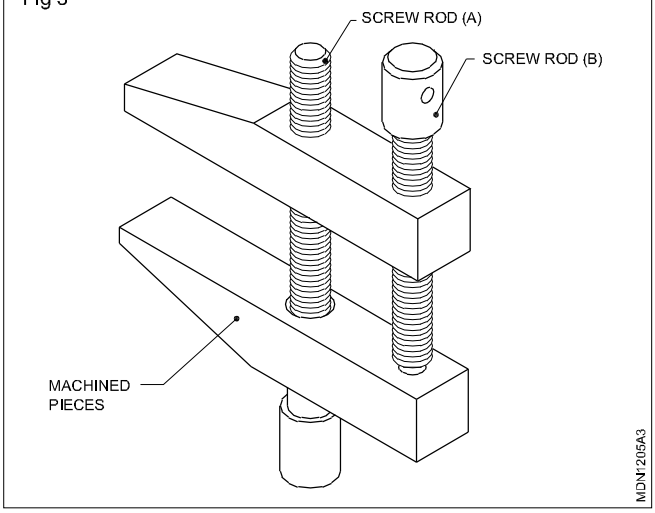
These clamps are used to hold work, on an angle plate or a drill press table, and also, for holding two or more workpieces together.

The swivel pad on the end of the clamping screw helps in clamping surfaces which are not parallel. 'C' clamps are available for light and heavy duty work.

Toolmaker's clamps

This is the type most commonly used by toolmakers for holding small, machined, flat pieces for further operations. They have two rectangular pieces of steel perfectly machined. The inner faces which come in contact with the workpiece are perfectly parallel. They are assembled by means of two threaded rods. The screw-rod (A) is rotated in one direction to adjust the gap between the two holding faces. The other screw (B) when tightened maintains the required pressure. (Fig 3)

Fig 3



The head of the screw-rod (B) is provided with a hole through which a cylindrical pin may be passed for tightening purposes. The toolmaker's clamps are for holding a previously machined work which is flat and parallel.

The toolmaker's clamp is not suitable for doing any heavy operations on the workpiece since the contacting and holding area of the clamp is limited. It is meant for holding light jobs. It is also called as parallel clamp.

'U' Clamps

These are clamps used along with 'V' Blocks as an accessory. These clamps serve the purpose of holding the round work securely in the 'V' groove for layout operations as well as for machining operations.

Spanners and their uses

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

- **state the necessity of spanners**
- **identify the different types of spanners**
- **specify the spanners**
- **list out the parts of adjustable spanners**
- **state the features of 'C' spanners and their uses.**

Spanners are used for operating threaded fasteners, bolts and nuts. They are made with jaws or opening that fit square on hexagonal nuts and bolts and screw heads. They are made of high tensile or alloy steel. They are drop-forged and heat-treated for strength. Finally they are given a smooth surface finish for ease of gripping.

Spanners are considerably in shape to provide ease of operation under different conditions.

The basic types of spanners are : (Fig. 1)

- Open end spanners (1)
- tube or tubular box spanners (2)
- Socket spanners (3)
- Ring spanners (4)

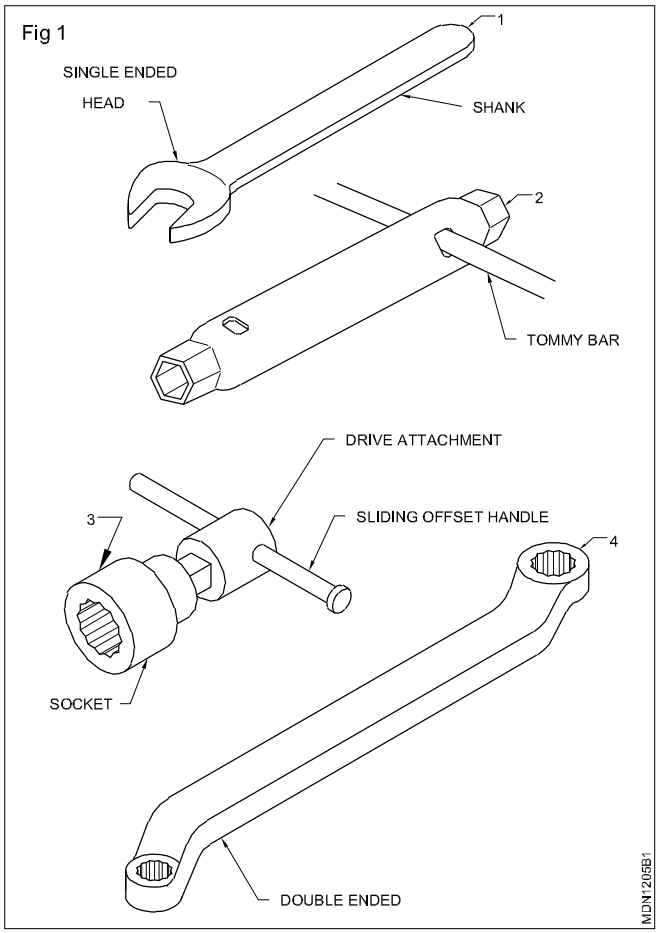
The correct spanner fits exactly and allows room for use. They should also permit the job to be done in a shorter time.

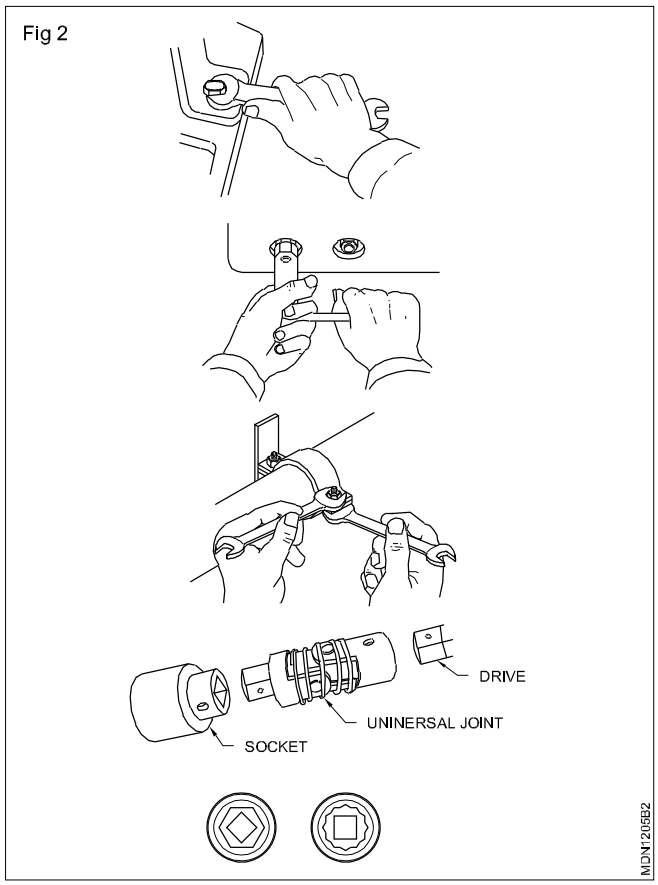
The following are the points to be noted for using spaners in a safe way. (Fig. 2)

Use open end and ring spanners by pulling on the shank. It is safest to pull as there is less chance of hitting your knuckles if the spanner or nut slips suddenly. If you are forced to push the spanner, use the base of your hand and keep your hand open.

Use both hands for large spanners.

Keep yourself balanced and firm to avoid slipping yourself, if the spanner slips suddenly, Hold on to some support, if there is any chance of falling.





Use both hands as shown in the figure, when using tubular box spanners. (Fig. 2)

Use two spanners as shown in the figure to stop the head of the bolt rotating as the nut is operated. (Fig. 2)

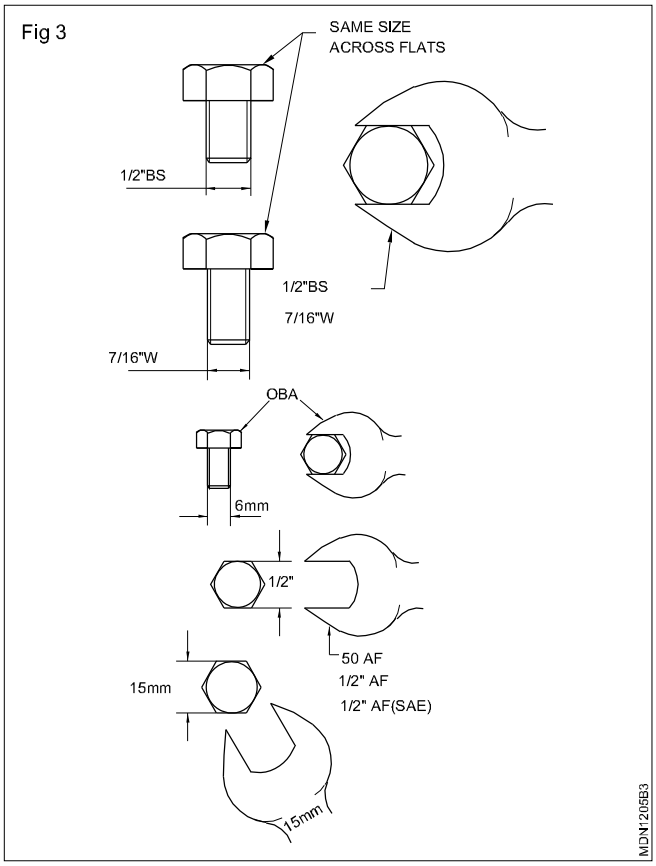
Socket spanners may be turned by accessories which have square driving ends. (Fig. 2)

Size and identification of spanners

The size of a spanner is determined by the nut or bolt it fits. The distance across the flats of a nut or bolt varies both with the size and the thread system. (Fig 4)

In the British system the nominal size of the bolt is used to identify the spanner. (Fig. 3)

In the unified standard system (Fig. 3), the spanners are marked with a number based on the gas requirement decimal equivalent of the nominal fractional size across the flats of the hexagon, following the sign A/F or with the fractional size across the flats following the sign A/F. In the metric system, spanners are marked with the size across the jaw opening followed by the abbreviation 'mm'.



To fit exactly, a spanner must be :

- of the correct size
- placed correctly on the nut
- in good condition.

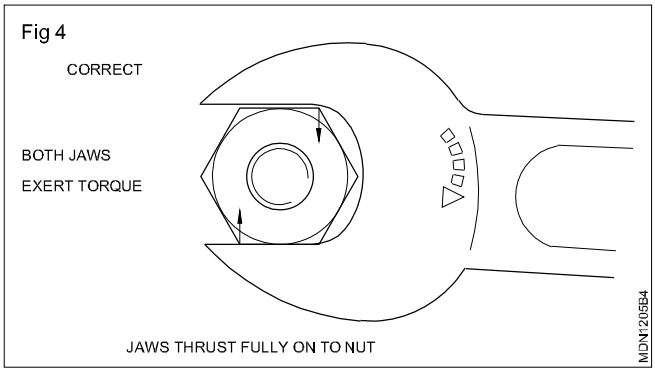
Spanners have their jaws slightly wider than the width of the nut so that they can be placed into position easily. Any excess more than a few hundredths of a millimeter clearance could cause the spanner to slip under pressure.

Place the spanner so that its jaws bearfully on the flats of the nut.

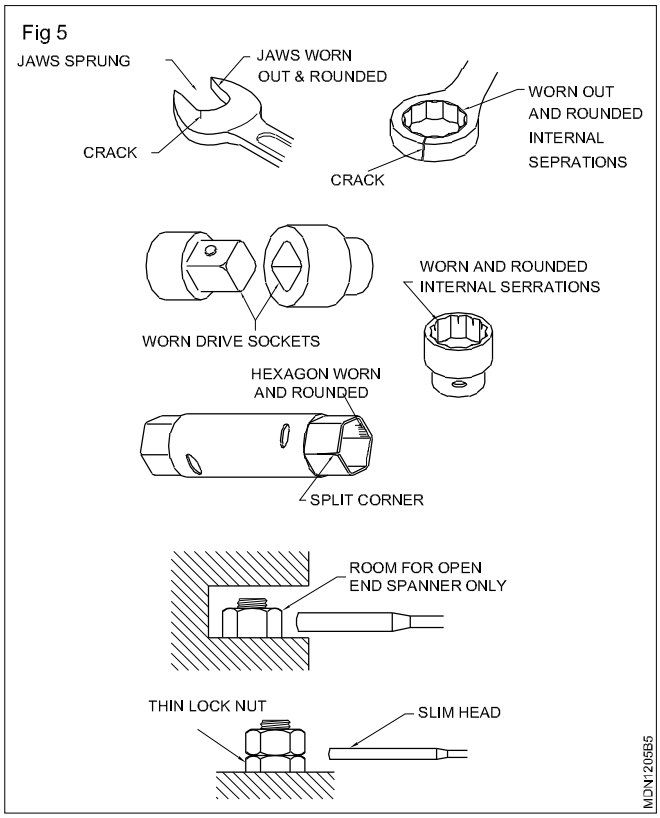
Incorrect use damages the spanners & the nuts too.

Discard any defective spanners. The spanners illustrated here are dangerous for use.

Choose spanners that allow room for use.



Nuts in inaccessible positions may be reached with socket spanners, with special drawing accessories. (Flg 5)



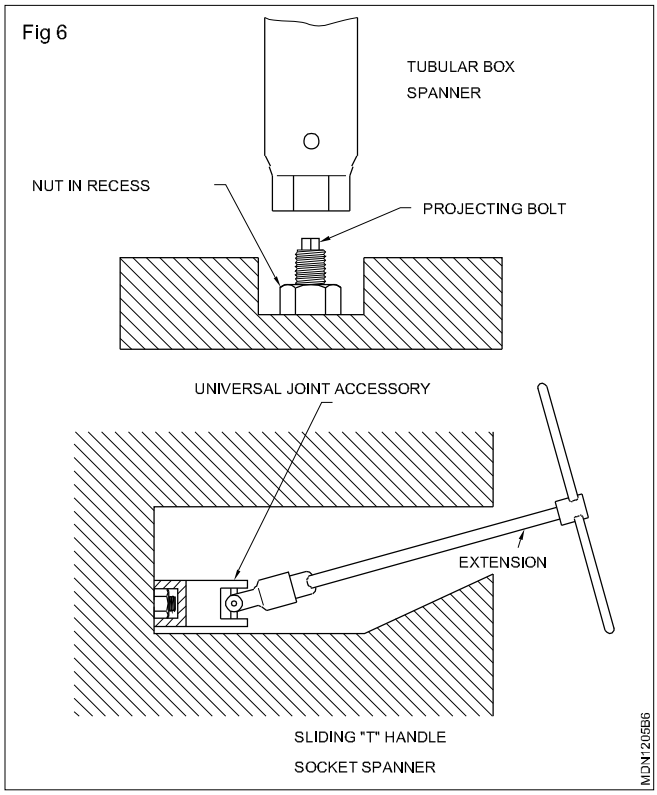
Length of spanners (Fig. 6)

Normally spanners have a length that is about ten times the width of the jaw opening.

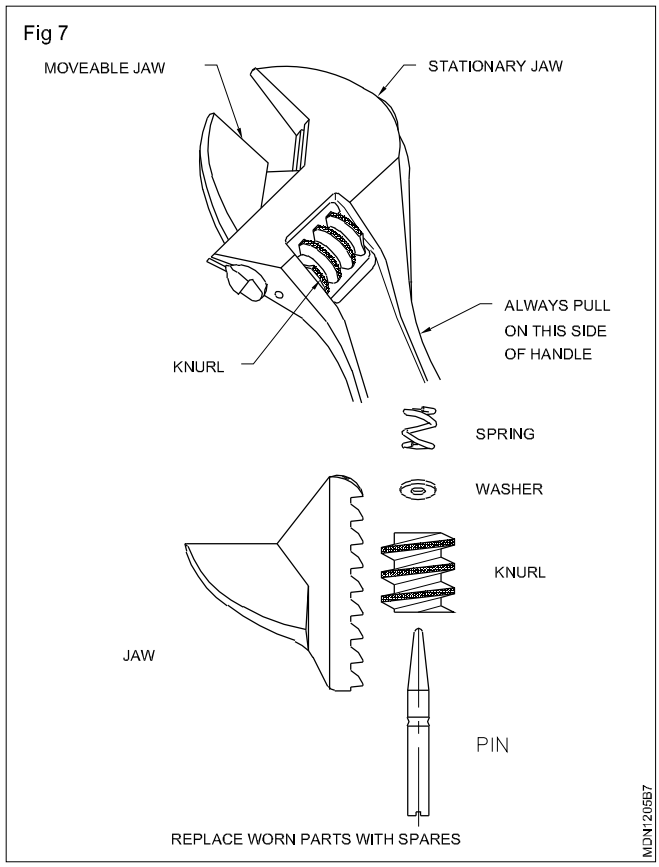
Never exert excessive pull on a spanner, particularly by using a pipe to extend the length of a spanner.

Excess turning effect of the spanner could result in :

- striping the thread
- shearing the bolt
- straining the jaws of the spanner
- making the spanner slip and cause an accident.

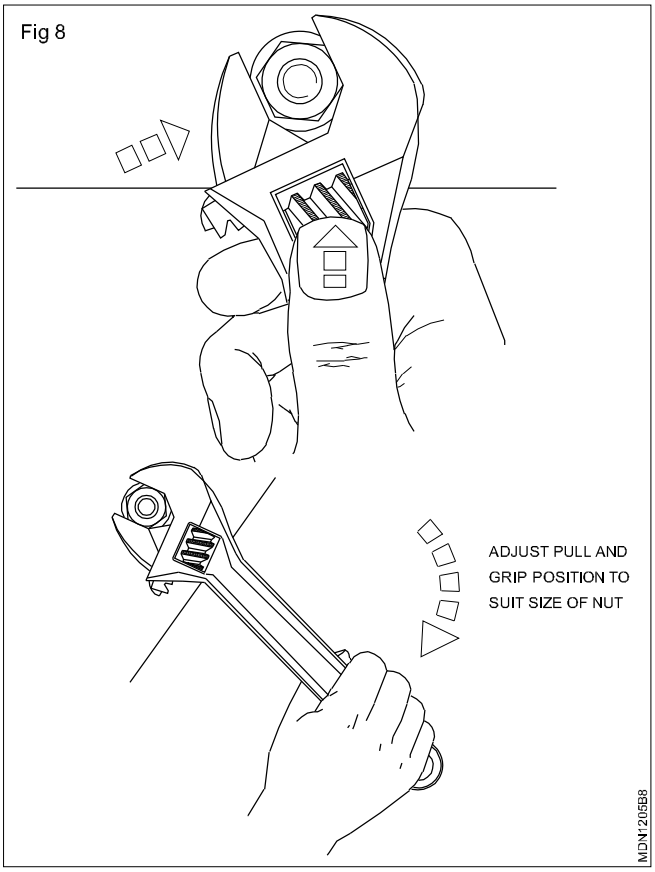


Adjustable spanners (Figs 7 & 8)



Most common types of adjustable spanners are similar to open and spanners, but they have one movable jaw. The opening between the jaws of a typical 250 mm spanner can be adjusted from zero to 28.5 mm. Adjustable spanners may range in length from 100 mm to 760 mm. the type illustrated has its jaws set an angle of 22 1/2^0 to the handle. Adjustable spanners are convenient for use where a full kit of spanners cannot be carried about. They are not intended to replace fixed spanners which are more suitable for heavy service. If the movable jaw or knurled screw is cracked or worn out, replace them with spare ones.

Fig 8



When using the adjustable spanner follow the steps given below.

Place it on the nut so that the jaw opening points in the same general direction the handle is to be pulled. In this position the spanners are less liable to slip and the required turning force can be exerted without damage to the moving jaw and knurl.

Push the jaws into full contact with the nut.

Use the thumb to tighten the adjusting knurl so that the jaws fit the nut strongly.

Pull continuously. The length of the handle is designed to suit the maximum opening of the jaws. With small nuts, a very small pull on the handle will produce the required torque.

'C' spanners (Hook spanners) (Fig. 9)

It has a lug that fits in a notch, cut in the outer edge of a round nut. The 'C' section is placed around around the nut in the direction in which it is to be turned. In adjustable hook wrenches, part of the 'C' section pivots to fit nuts with a range of diameters. A set of three spanners is needed to cover diameters from 19 mm to 120 mm.

The applications of 'C' spanners are shown in the figure.

C' Spanners are also used for zero - selfing of micrometer.

With socket spanners (Fig. 10), use the reversible ratchet handle for doing fast work, where turning space is restricted.

Fig 9

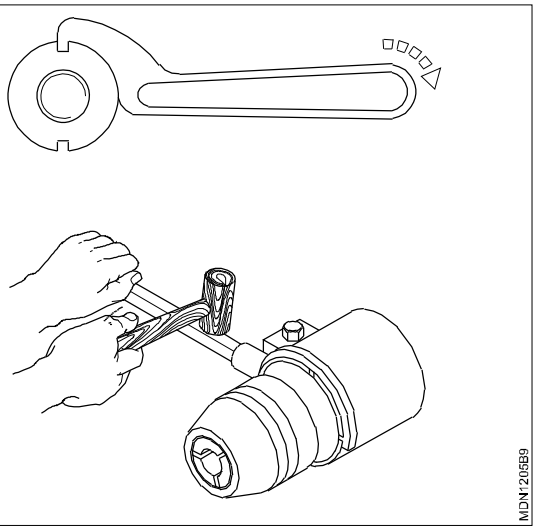
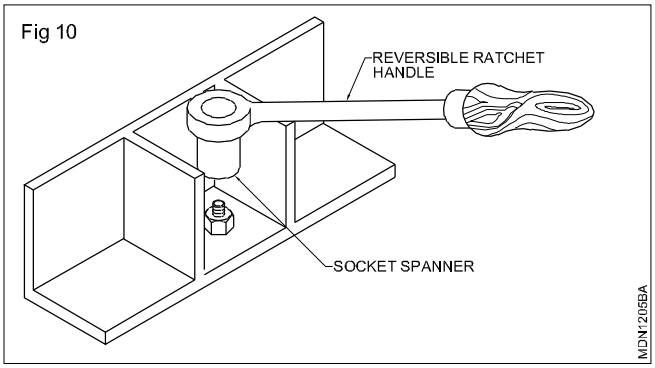
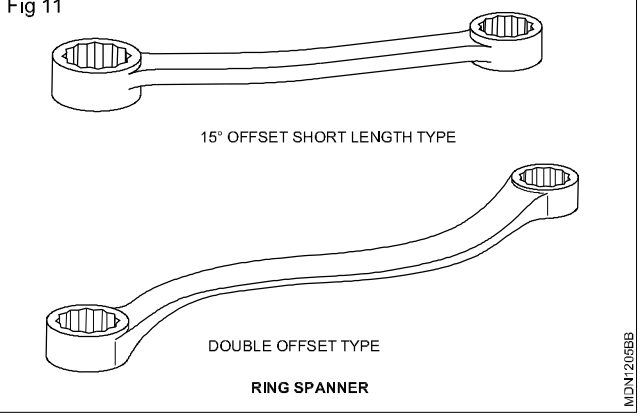


Fig 10



Ring or box spanner (Fig 11)**:** For critical tighting and loosening of nuts. For multi contact on bolts and nuts.

Fig 11



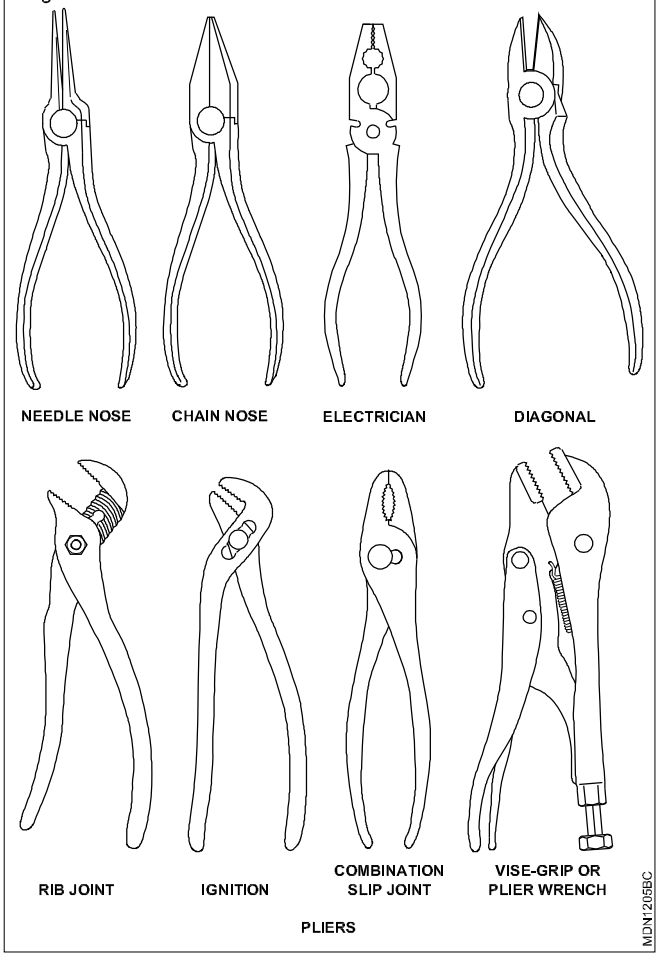
Pliers (Fig 12)**:** Pliers are commonly used for cutting wires, holding parts, crimping electrical connections and bending cotter pins.

Safety:

1 Avoid cutting hardened objects.

2 Never use pliers to turn nuts, bolts or tubing fitting.

Fig 12



Combination of ring and open end spanner (Fig 13)**:** This tool has a box end on one end and an open end on the other. Both ends are of the same size.

Fig 13

Socket spanners (Fig 14)**:** The socket is one of the fastest and most convenient of all the spanners. Sockets come in two sizes; standard and deep.

Standard sockets will handle the most of the works, while the extra reach of the deep socket is occasionally needed.

Swivel socket (Fig 15)**:** The swivel socket allows the user to turn fasterners at an angle.

Socket handles: Several different drive handles are used. The speed handle (Fig 16 & 17) is used whenever possible as it can be turned rapidly.

Fig 14

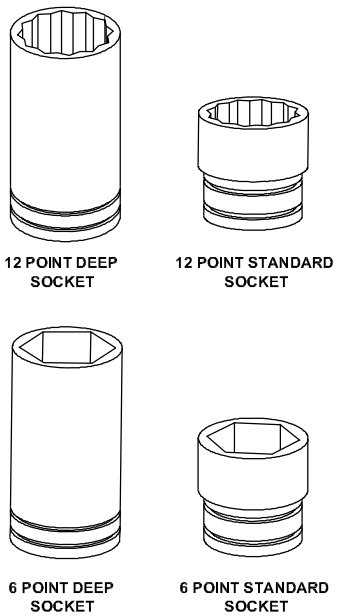


Fig 15

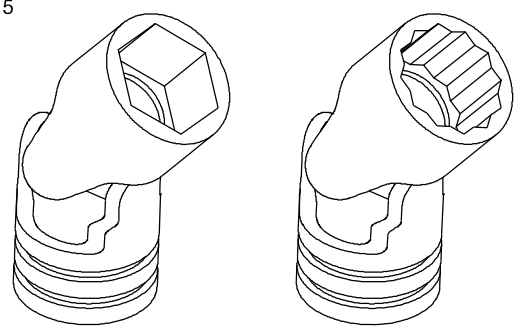


Fig 16

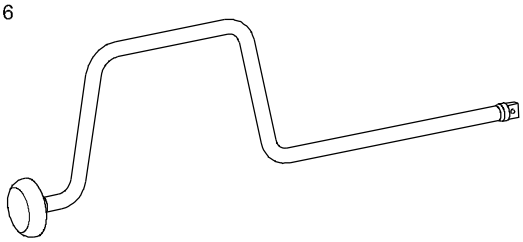
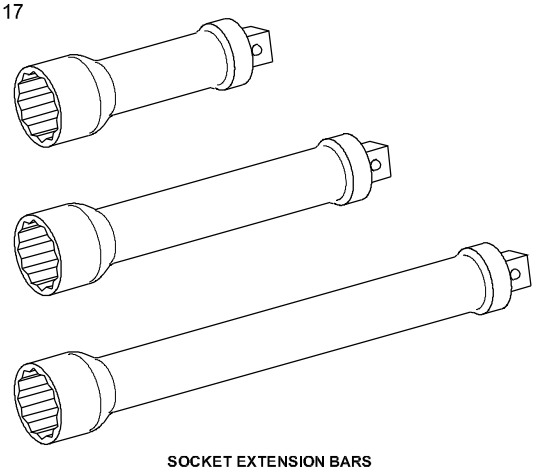


Fig 17



Pliers

Objectives : At the end of this lesson you shall be able to
- **state the features of pliers**
- **state the uses of pliers.**

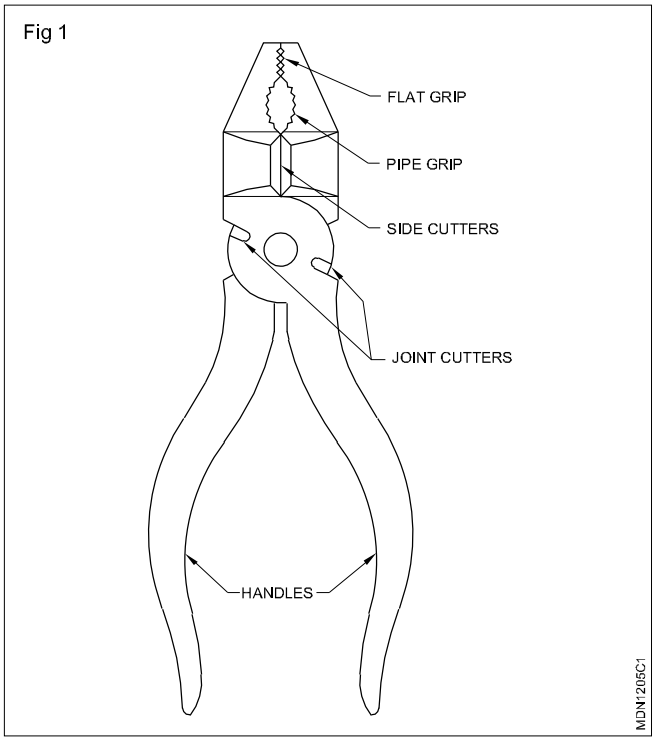
Features

Pliers have a pair of legs joined by a pivot, hinge or fulcrum pin. Each leg consists of a long handle and a short jaw.

Elements of pliers with two joint cutters (Fig. 1) **(Combination pliers)**

- Flat jaw
- Pipe grip
- Side Cutters

Fig 1



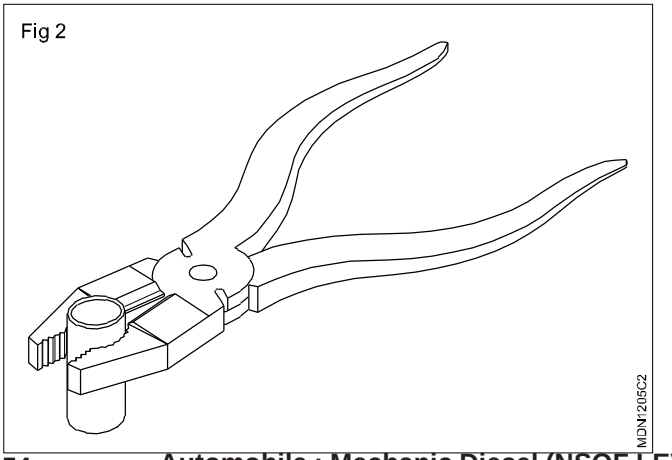
- Joint cutters
- Handles

Features

Flat jaw tips are serrated for general gripping.

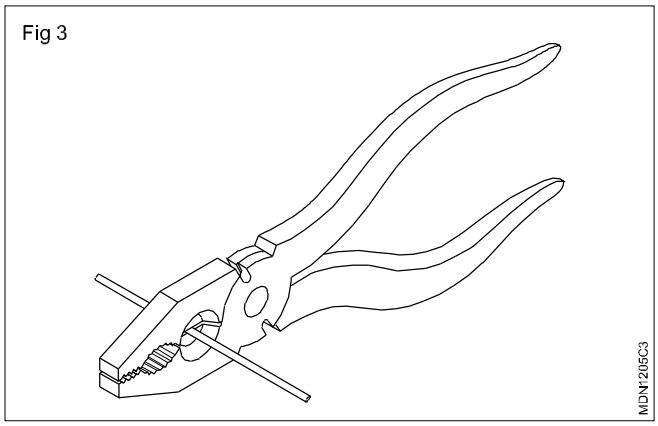
Pipe grip is serrated for gripping cylindrical objects. (Fig 2)

Fig 2



Cutters are provided for cutting off soft wires. (Fig 3)

Fig 3

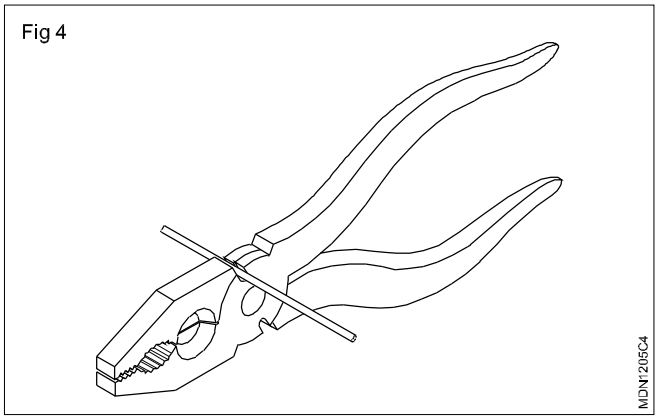


Two joint cutters are provided for cutting or shearing off steel wires (Fig 4)

Handles are used for applying pressure by hand.

Pliers are available in sizes from 150 mm to 230 mm. (Size = Overall length)

Fig 4

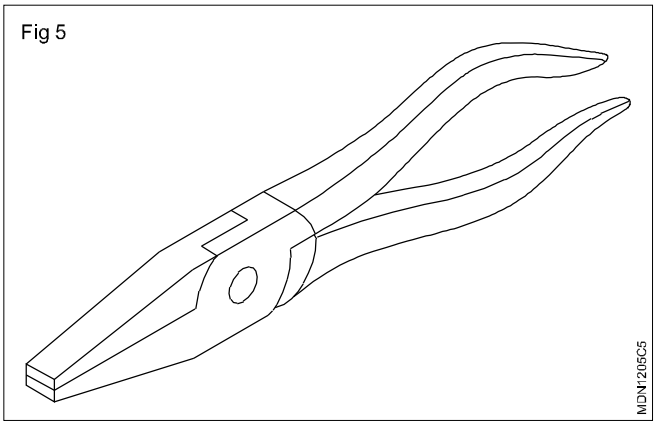


Other types of pliers

Flat nose pliers

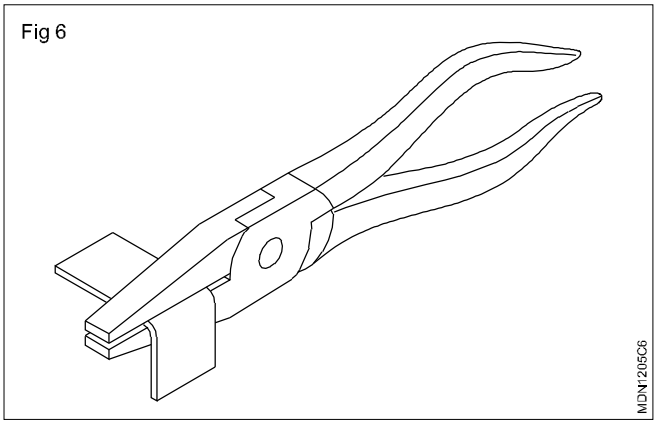
It has tapered wedge jaws with flat gripping surfaces which may be either smooth or serrated. (Fig 5)

Fig 5



It is used for bending and folding narrow strips of thin (Fig.6)

Fig 6



Roundnose Pliers

This type of pliers is made with tapered round shaped (Fig.7) They are used to shape loops in wires and the form curves in light metal strips (Fig.8)

Fig 7

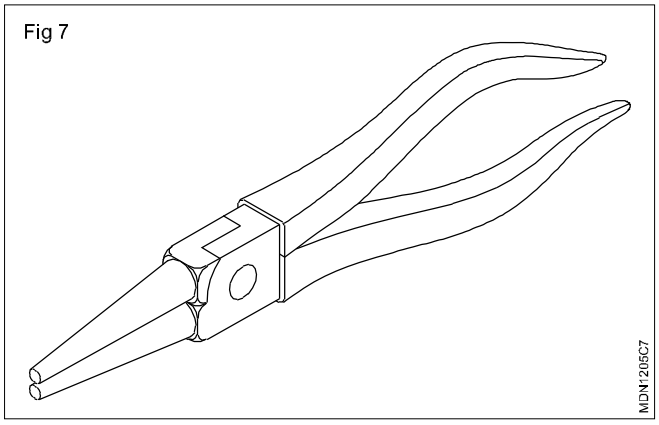
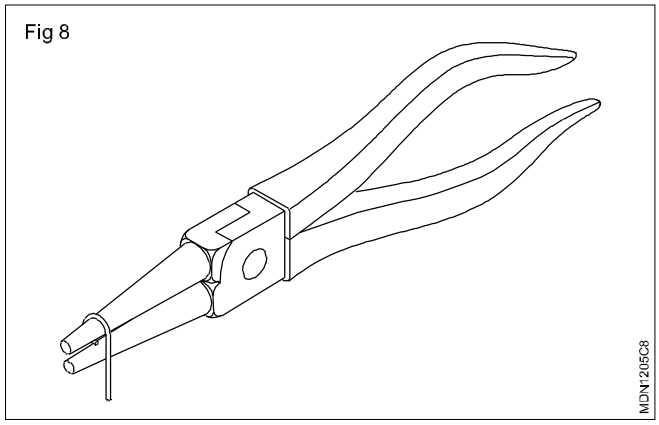


Fig 8

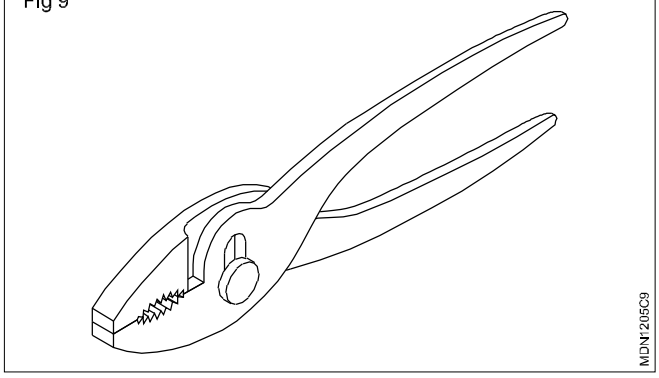


Slip-joint pliers

These pliers are available in various ranges of positions with different shapes of pivot pins so that they have various ranges of jaw opening.

Mainly used for gripping. (Fig 9)

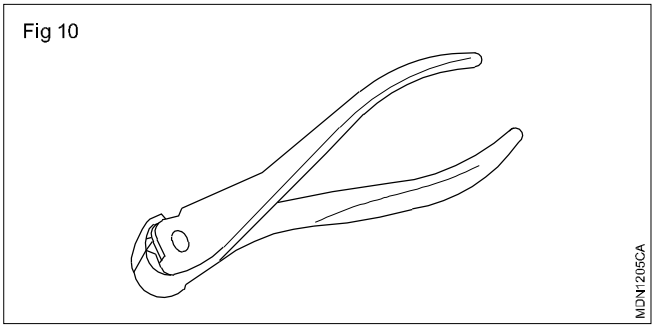
Fig 9



End cutting pliers

These pliers have the same uses as the side cutting pliers. (Fig 10)

Fig 10



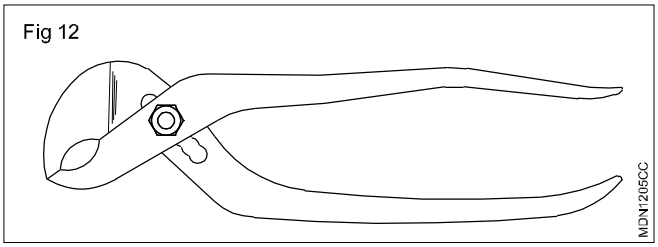
Circlip pliers

Circlip pliers are used for fitting and removing circlips in assembly works.

Internal circlip plier

It is used to fit and remove the internal circlip in the groove of the bore. (Fig 11)

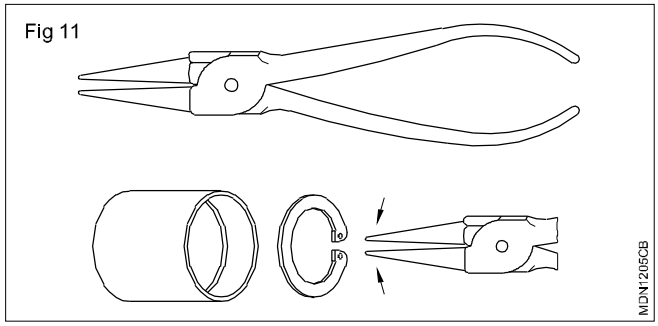
Fig 12



Slip-joint, multi-grip pliers

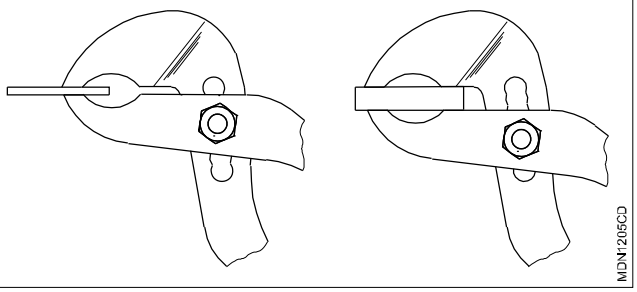
It is similar to the grip pliers but has more openings in the legs. It gives a range of jaw openings. It allows parallel gripping by the jaws in a number of positions. (Fig 12)

Fig 11



The shape and length of the leg are different from those of the slip-joint pliers. (Fig.13)

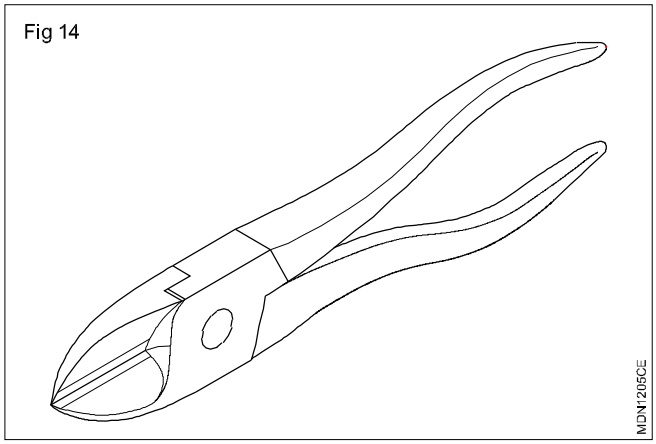
Fig 13



Side cutting pliers

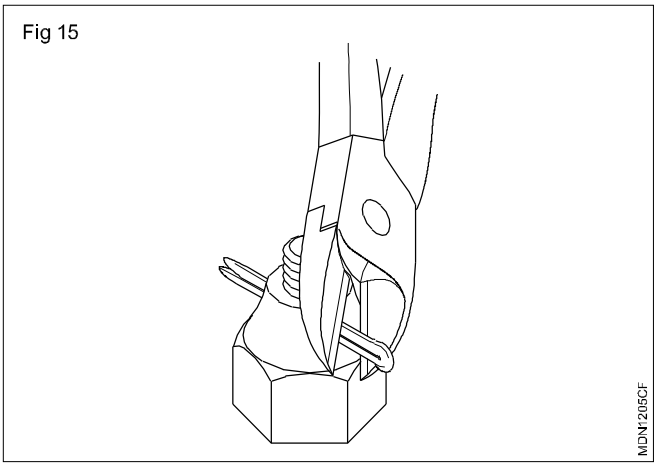
It is made with jaws set at an angle. (Fig.14)

Fig 14



They are used for shearing off wires in confined spaces and cutting off wires close to the surface level. (Fig.15)

Fig 15



They are also used for spreading the cotter pin.

External circlip pliers.

External circlip pliers are used to fit and remove the external circlip in the grooves of the shafts.

Locking pliers

The locking lever of the locking pliers is attached with a movable handle which clamps the jaws on to an object of any shape.

It has high gripping power.

The screw in the handle enables adjustment of the lever action to the work size.

SNIPS (Straight & Bent)

Objectives : At the end of this lesson you shall be able to
- **state the uses of straight and bent snips**
- **state the features and use of lever shears**
- **state the uses of circle cutting machines.**

A snip, also called a hand shear ans it is used like a pair of scissors to cut thin, soft metal sheets. Snips are used to cut sheet metal upto 1.2mm thickness.

Types of snips (shears)

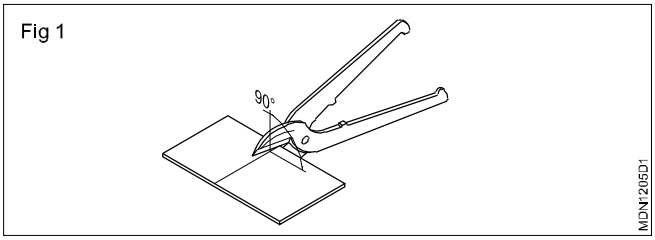
There are several types of snips available for making straight or circular cuts, the most common being straight snips and curved snips.

The choice of shears (snips) depends on the shape and type of the cut required.

Straight snips (Figs 1& 2)

These are used for making straight cuts and large external curves.

Fig 1



Straight snips have thin blades which are only strong on a vertical planes. They are, therefore, only suitable for straight cuts and external curves when surplus waste has to be removed.

While cutting, the blade of the snips should not cover the marking.

Bent snips (Fig. 3)

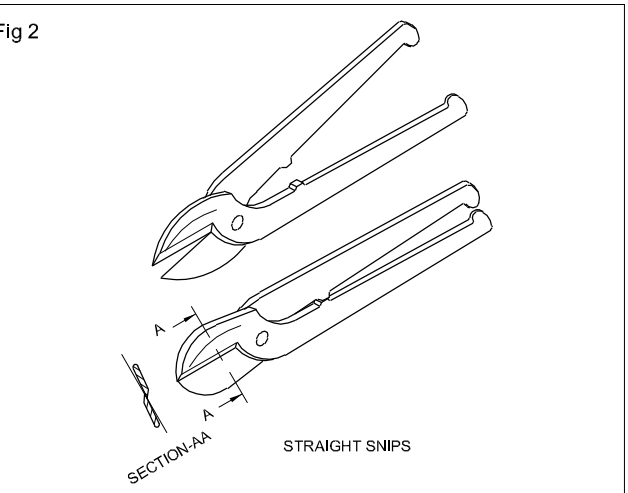
These snips have curved blades for making circular cuts. They are also used for trimming cylindrical or conical work in sheet metal.

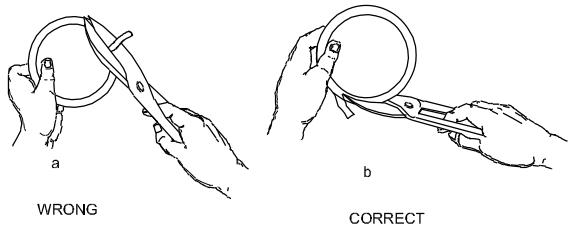
Snips are specified by the overall length and the shape of the blade.

Example

200mm straight snip (Fig.4)

Fig 2





CUTTING OUT A CIRCULAR DISC

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Fig 3

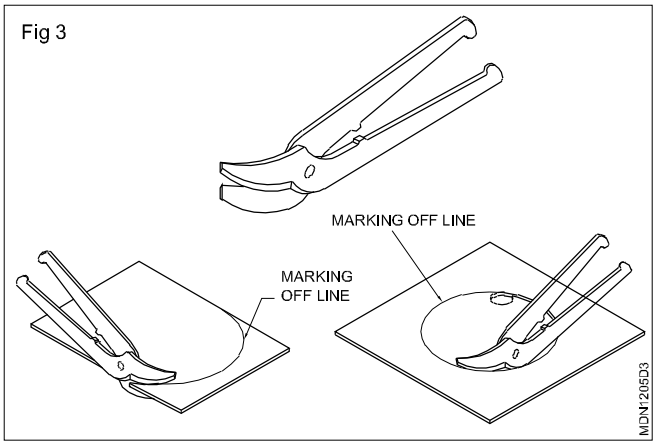

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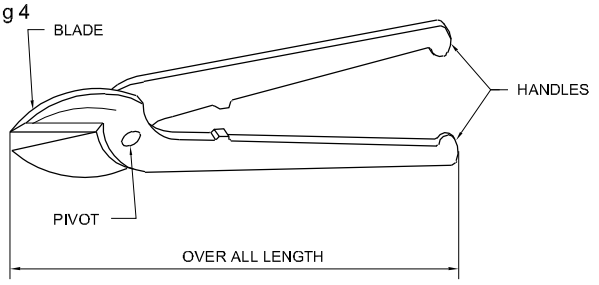
Fig 4



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Lever shears (Fig 5)

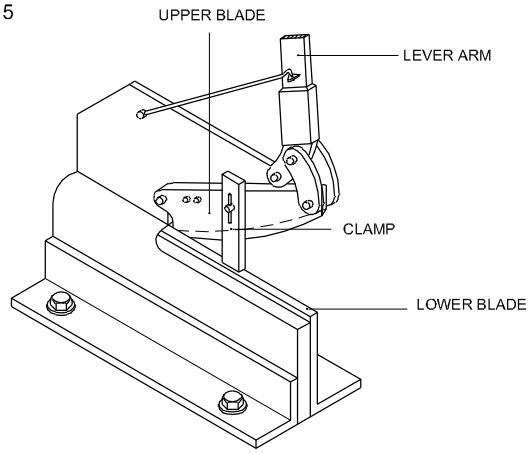
Lever shears are used to cut sheets which cannot be cut with hand shears.

The lever shear possesses a fixed lower blade and a moving upper blade. The sheet being cut is prevented from tilting by a clamping device which can be adjusted to the thickness of the sheet. The knife-edge cutter of the upper blade is curved so that the opening angle at the point of cut remains constant.

Circle cutting and curve cutting machines (Fig 6)

These machines are used to cut circles and curves of the desired shapes. When cutting curves, the sheet must be guided by the hand.

Fig 5



LEVER SHEARS

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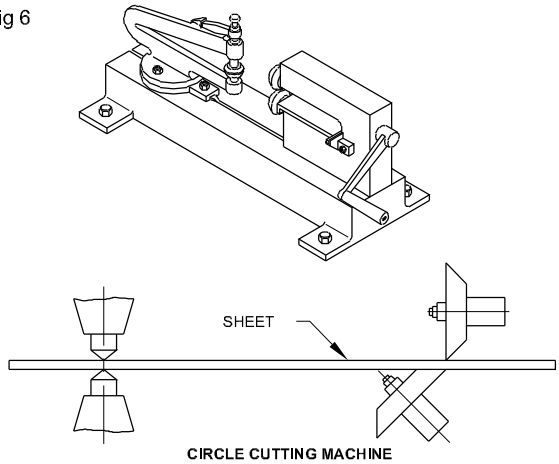
Fig 6



CIRCLE CUTTING MACHINE

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Wrenches

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

- **name the different wrenches used**
- **state the features of each type of wrenches.**

Types of wrenches

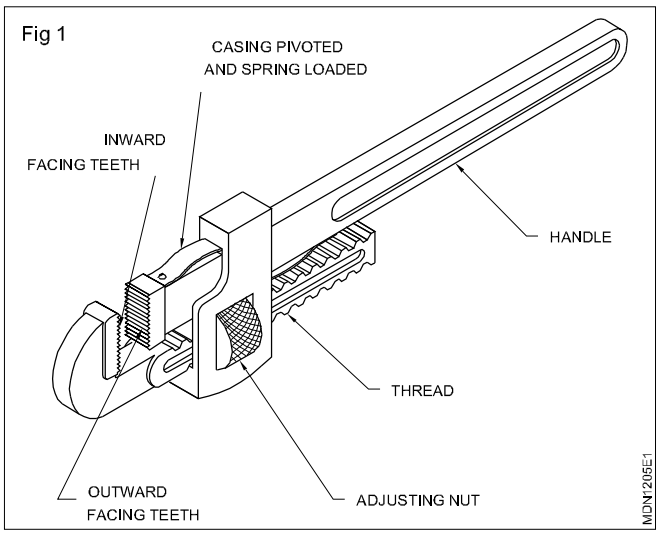
- **Stillson pipe wrench**
- **Footprint pipe wrench**
- **Tension wrench**
- **Hexagon socket wrench**

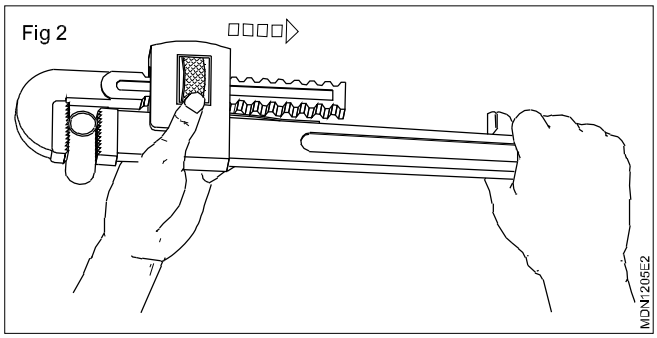
Stillson pipe wrenches (Fig 1 & 2)

These are used for gripping and turning pipes of a wide range of diameters.

The parts and their names are shown in the (Fig 1).

A jaw is fixed to the handle with outward facing teeth. Attached to the handle by a pivot pin is a spring-loaded casing that carries a knurled adjusting nut. This engages with a thread on the adjustable arm of a jaw with inward facing teeth.





Once the jaws are adjusted, the spring loading keeps them in contact with the work, and the toggle action causes the hardened serrations to bite into the work.

The jaws will mark the work. File off any burrs. Never use them on polished or plated surfaces. Never grip hardened materials with this type of wrench as this will damage the serrations.

Footprint pipe wrenches (Fig. 3)

These are used for gripping and turning pipes and round stock, particularly in confined spaces.

Adjust the size by fitting the removable pin in the hole that allows the pipe to be gripped, with the handles a comfortable distance apart. Thrust the jaws fully on to the pipe. Squeeze the handles firmly. Pull on the folded steel handle to turn the pipe. Stop squeezing and slide the jaws back round the pipe, squeeze and pull again.

File off any burrs raised by the jaws on the pipe.

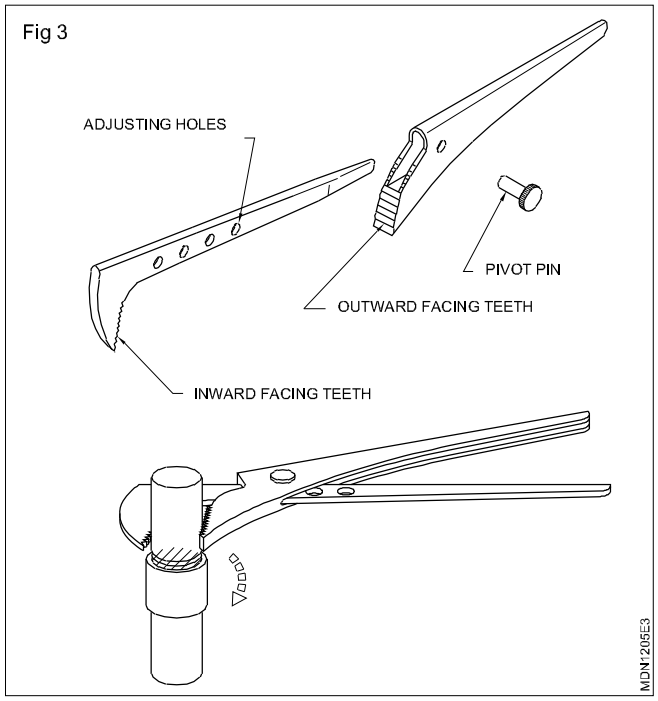
Tension wrench (Fig 4)

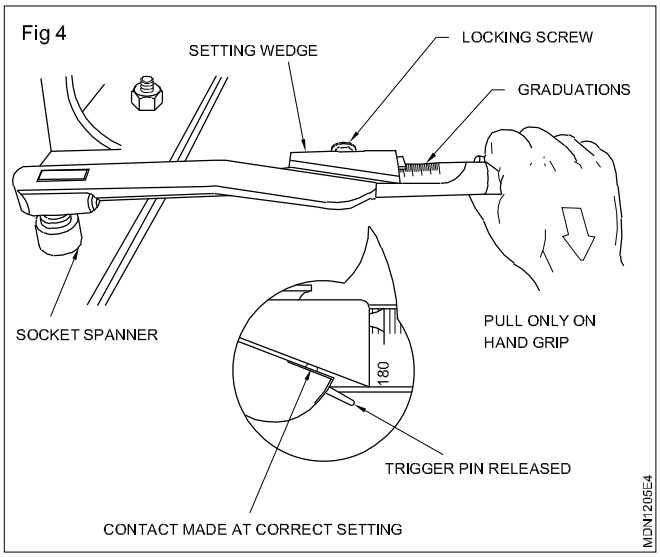
A tension wrench acts as a torque limiting device for turning (rotating) nuts to a predetermined degree of tightness. This avoids breaking the fasteners. It is also essential to avoid warping or springing components held by multiple fasteners that could be unevenly or excessively tightened, cylinder heads of engines, for example.

Some tension wrenches have direct reading indicators that you must watch as you pull the handle to the desired extent. With others, you preset to the desired graduation and pull until you detect a signal which may be an audible click, the release of a trigger pin or an automatic release within the wrench mechanism.

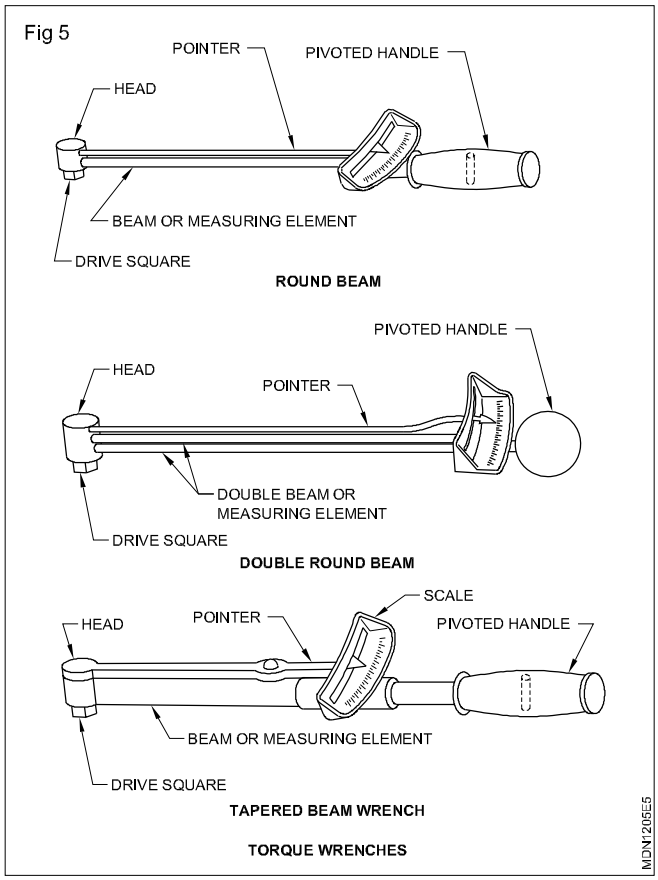
To apply the correct torque with a tension wrench :

- check that the threads of the nut and the bolt are clean and well formed.
- pull slowly with evenly increasing effort on the hand grip of the handle.





Torque wrench (Fig 5)**:** Torque wrench is used to tighten the bolts/nuts at recommended ended torque. The torque wrench will meausre the torque (twisting force) applied to the fastener. E.g. Cylinder head nuts, bearing cap nuts etc. (N.m; Kg m or Ib-ft)



Flaring, flare fittings and testing the joints

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

- **illustrate necessity, types of flaring methods**
- **list the types and applications of flare fittings**
- **pressurise the joint system and test for leaks.**

Flaring necessity: When connecting tubing to fittings, it is common practice to flare the end of the tube and to use fittings designed to grip the flare for a vapour tight seal. Special tools are used for making flares.

Types of flaring : There are two types of flaring

Single thickness flare

Double thickness flare

Single thickness flare : It can be made on smaller size copper tubing (Fig.1)

Double thickness flare : Double thickness flares are recommended for only the larger size tubing 5/16 inch (9mm) OD and over. Such flares are not easily formed on smaller tubing. The double flare makes a stronger joint than a single flare.

The Fig (2 & 3) shows some defects and correctly made flare. This also shows how defective flare made the fitting mismatched.

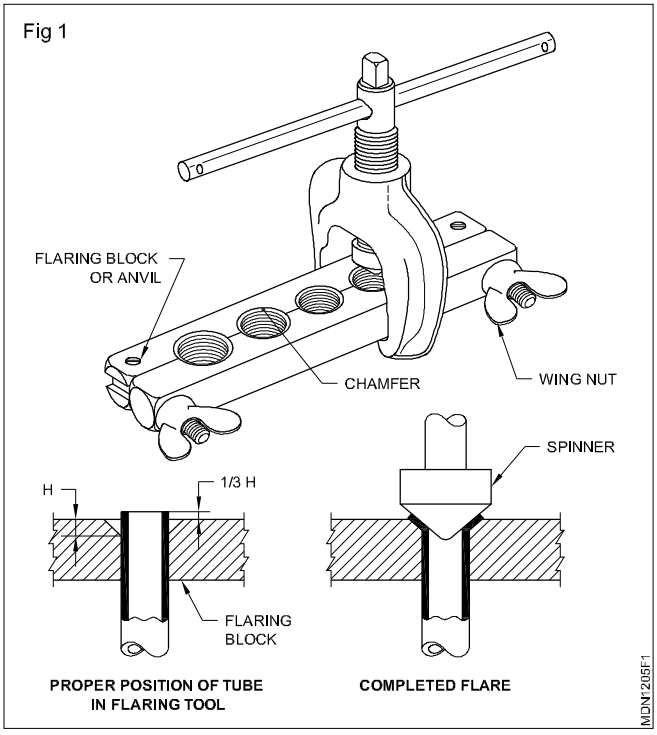
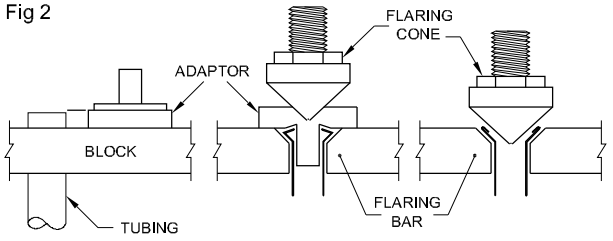


Fig 2



CORRECT PROCEDURE FOR FORMING DOUBLE FLARE

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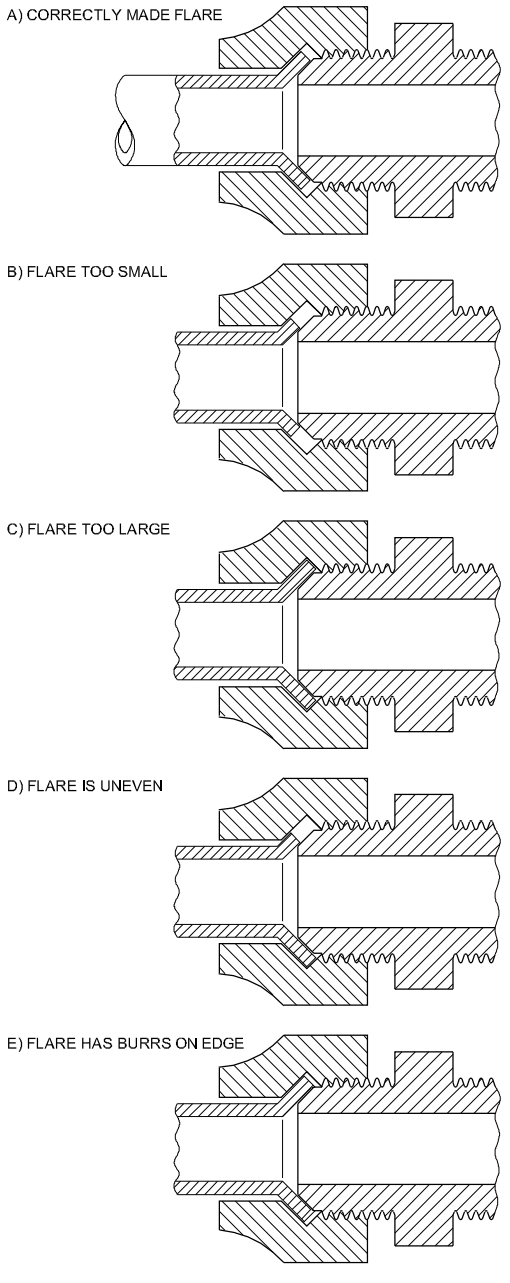
Fig 3



FLARED FITTINGS

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Flared tubing fittings : To attach a fitting to soft copper tubing, a flared type connection is generally used.

The following are some of the more common flared type fittings. (Fig. 4, 5 & 6)

Pressurising the joint on tubing : A flared joint or brazed joint needs to be tested for its firm. If it leaks while working it will put the whole system into problem. Before putting the joint into a system after it is made pressure test must be done.

Air pressure from

Air compressor - 150 PSI

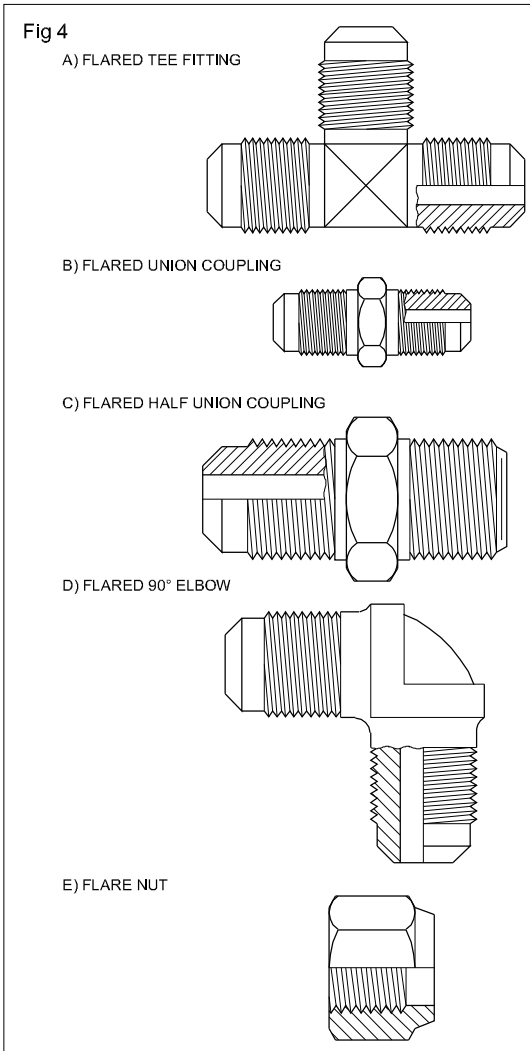
or - 10Kg/cm^2

The gas which is employed can be used for testing.

Leak can be detected with the use of soap solution. There are also other methods for leak detection.

Pressure tests are usually made on the joints above the working pressure.

Fig 4



FLARED TYPE FITTINGS

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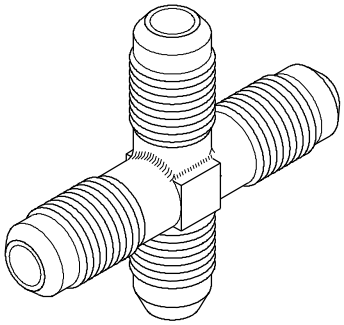
Fig 5



CROSS

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Fig 6

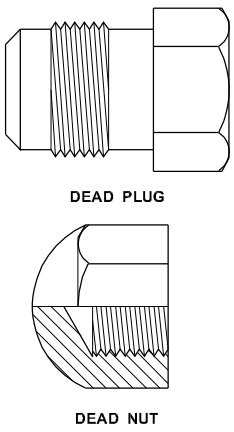


Fig 8

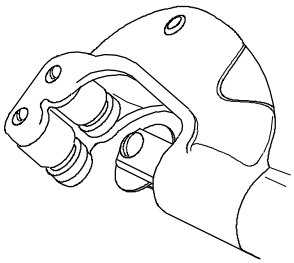
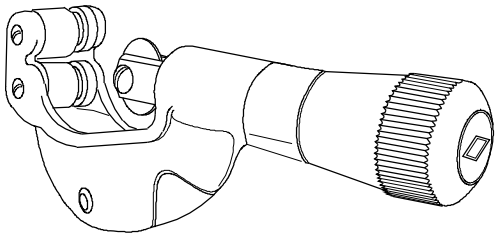


Fig 7



A pipe cutter is more convenient and better than a saw when cutting pipes and metal tubing. (Fig. 7)

The sharpened wheel does the cutting. As the tool turns around the pipe the screw increases the pressure, driving the wheel deeper and deeper through the pipe until it finally cuts rights through. (Fig. 8)

Puller

Objectives : At the end of this lesson you shall be able to
- **state the function of puller**
- **state the types of puller.**

Puller

The puller is a General Workshop tool which is used to remove Gears, bearings pulleys, flanges, bushes.

The puller is made out of steel material, generally with two or three legs and they are adjusted to hold the outside of the gears or bearing sleeves while the central threaded shaft is screwed forward exerting force on the gear/bearing. This enables to remove the bearing without damaging the shaft.

Pullers are classified according to the application and the number of leg.

Another classification is bsed on the power utilised i.e. Mechanical puller and Hydraulic puller.

Two legs puller is generally used for removing the gears. Where as puller with three legs are for removing pulleys. flanges and bearings. It is also called gear puller. Special pullers: These are mainly used for specialised application such as crank shaft bearing removal brake drum, removal pilot bearing removal.

Hydraulic puller : These pullers eliminate time consuming and unsafe hammering, heating or prying. Damage to past is minimised through the use of Hydraulic. pullers.

Safety

To avoid personal injury during system operation,

Always wear proper PPE gear

never use a tool to strike a puller

make sure that items are pulled is well and adequately supported

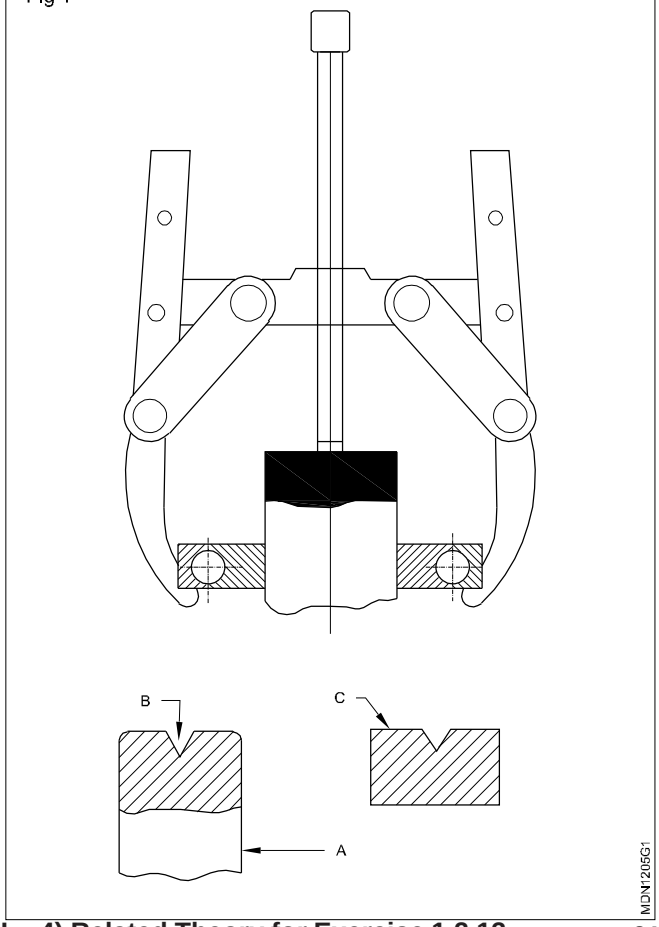
do not apply heat to a puller

before every use lubricate the centre bolt threads, with graphite - based lubricant

use puller only with recommended attachment

do not over load a pulley which may cause to break

Fig 1



Important: Always keep the guide parts of the lifting plate greased.

Hydraulic pullers are derigned to help you extend bearing life in your applications through proper installtion, removal and service.

Hydraulic pulling systems are available with capacity ranging from 4 tons to 30 tons, and are ideal for removing all kinds of shaft filled parts.

Hydraulic pulling system comprises of integrated pump. clyinder, hose, puller with safety-release valve. The pullers have self-contained hydraulic pump and are compact, handy. There are ideal for pulling variety of press-fit parts including bearing, wheels bushings, gears, pulleys.

In Automobiles Hydraulic Puller especially used for memoring Engine Liner from the cylinder block during engine Reconditioning Work.

Mechanical Puller Operation: (Figs 1 & 2)

1 Ensure that the spindle is clean and applied grease before use.

2 The Shaft (A) must have a center hole (B) as shown in the figure. If it does not, use a shaft protector (C) as shown in (fig 1)

3 Tighten strap bolts to hold jaws lightly in place

4 Position the puller that the spindle as shown in fig 2.

5 Tighten the spindle slightly by turning the spindle nut with proper wrench

6 Check that the jaws are fully contacting the part to be pulled.

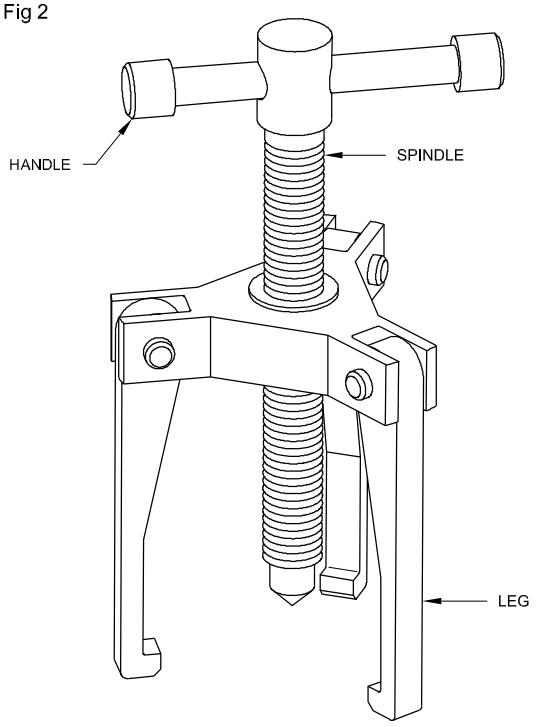
7 Tighten the strap bolts.

8 Apply pulling force by turning the spindle.

Post lock puller operation (Manual pullers)

1 Make sure that all items being pulled are supported by a means other than the puller. NO LOOSE PIECES!!!

Fig 2



2 Before each use, lubricate the center bolt of the puller with a graphite-based lubricant.

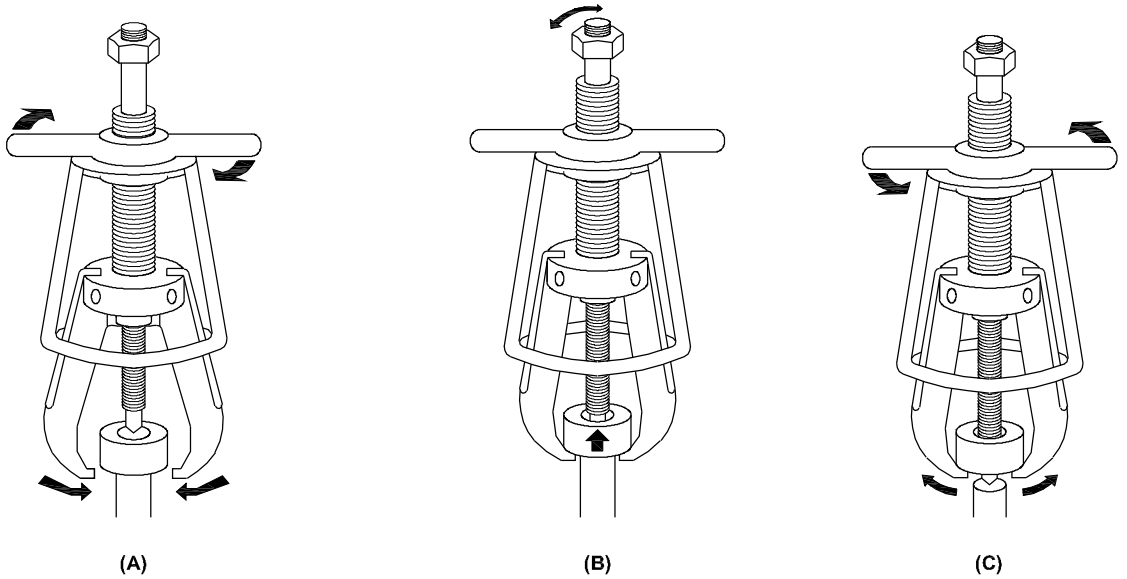
3 To operated the puller, grasp the puller with one hand and and turn the T-handle counter-clockwise with the other hand until the jaw opening is big enough to fit over the component to be pulled

4 Turn the T-Handle clockwise with the other hand until the jaw firmly onto the component. (Fig.3A)

5 Make sure that the center of the puller is aligned with the center of the component to be pulled. Using hand tools only, tighten the center bolt to pull the component off of its shaft. Never exceed the maximum torque ratings of the puller's drive bolt. (Fig.3B)

6 Turn the T-handle counter-clockwise to remove the puller from the component. (Fig.3C)

Fig 3



Hydraulic Puller Operation: (Fig. 4)

1 Make sure that all items being pulled are supported by a means other than the puller. NO LOOSE PIECES!!!

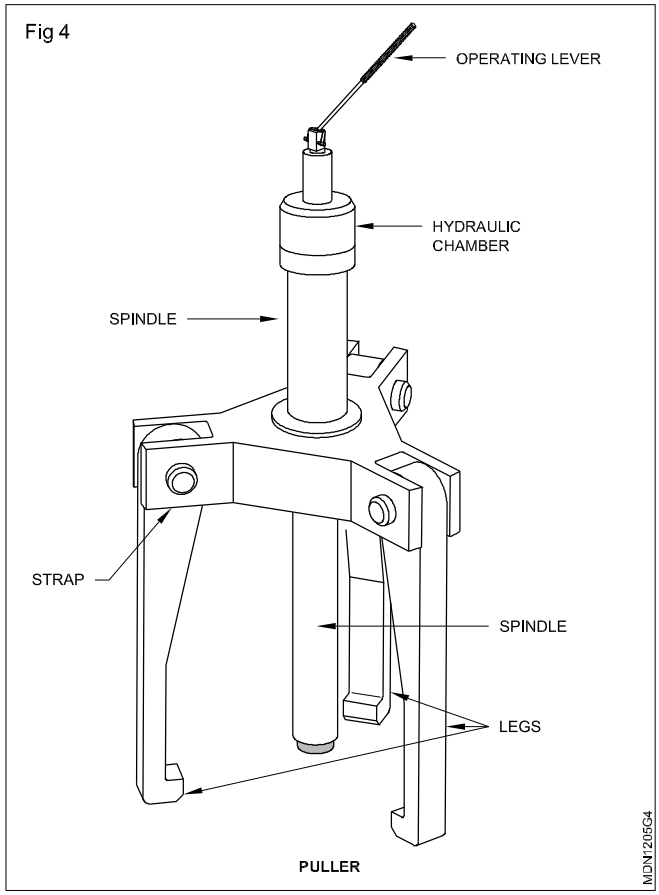
2 Install the cylinder into the puller by threading collar threads clock-wise into the jawhead assembly. Make sure that the puller collar threads are fully engaged in the puller. Attach lift plate to the coupler end of the cylinder. Remove the saddle from the cylinder and insert the ram point into the plunger. Select the ram point that will provide the maximum contact with the shaft.

3 To operate the puller, grasp the puller with one hand and turn the T-handle counter-clockwise with the other hand until the jaw opening is big enough to fit over the component to be pulled.

4 Turn the T-Handle clockwise to tighten the jaw firmly onto the component.

5 Make sure that the puller is square with the component to be pulled. Advance the plunger until the ram point contacts the shaft to insure correct alignment. The center point of the puller must be aligned with the center point of the shaft. Continue to advance the plunger slowly to pull the component off of the shaft. Never try to retighten the T-handle during the pulling operation.

Fig 4



PULLER