INDEX

CARPENTRY

THEORY

Marking and Measuring Tools:
Accurate marking and measurement is very essential in carpentry work, to produce parts to exact size. To transfer dimensions onto the work, the following are the marking and measuring tools that are required in a carpentry shop:

Steel rule:
It is an important tool for linear measurement. It can also be used as a marking tool

Steel tape:
It is used for large measurements, such as marking on board and checking the overall dimensions of the work

Marking gauge:
It is a tool used to mark lines parallel to the edge of a wooden piece. It consists of a square wooden stem with a sliding wooden stock (head) on it. On the stem is fitted a marking pin, made of steel. The stock is set at any desired distance from the marking point and fixed in position by a screw. It must be ensured that the marking pin projects through the stem, about 2 mm and the end is sharp enough to make a very fine line. A mortise gauge consists of two pins. In this, it is possible to adjust the distance between the pins, to draw two parallel lines on the stock.

Try-Square:
It is used for marking and testing the square ness and straightness of planed surfaces. It consists of a steel blade, fitted in a cast iron stock. It is also used for checking the planed surfaces for flatness. Its size varies from 150 to 300mm, according to the length of the blade. It is less accurate when compared to the try-square used in the fitting shop.

Compass and divider:
They are used for marking Arcs and circles on the planed surfaces of the wood.

Scriber or marking knife:
It is used for marking on timber. It is made of steel, having one end pointed and the other end formed into a sharp cutting edge.

Bevel:
It is used for laying-out and checking angles. The blade of the bevel is adjustable and may be held in place by a thumb screw. After it is set to the desired angle, it can be used in much the same way as a try-square. A good way to set it to the required angle is to mark the angle on a surface and then adjust the blade to fit the angle.

HOLDING TOOLS:

Carpenter's vice:
Carpenter's bench vice, used as a work holding device in a carpenter shop. Its one jaw is fixed to the side of the table while the other is movable by means of a screw and a handle. The jaws are lined with hard wooden faces.

C-Clamp:
Is used for holding small works.

Bar cramp:
It is a bar cram. It is made of steel bar of T-section, with malleable iron fittings and a steel screw. It is used for holding wide works such as frames or tops.

C. PLANING TOOLS:

Planning is the operation used to produce flat surfaces on wood. The cutting blade used in a plane is very similar to a chisel. The blade of a plane is fitted in a wooden or metallic block, at an angle.

Jack plane:
It is the most commonly used general purpose plane. It is about 35 cm long. The cutting iron (blade) should have a cutting edge of slight curvature. It is used for quick removal of material on rough work and is also used in oblique planning.

Smoothing plane:
It is used for finishing work and hence, the blade should have a straight cutting edge. It is about 20 to 25 cm long. Being short, it can follow even the slight depressions in the stock, better than the jack plane. It is used after the jack plane.

Rebate plane:
It is used for making a rebate. A rebate is a recess along the edge of a piece of wood, which is generally used for positioning glass in frames and doors.

Plough plane:
It is used to cut grooves, which are used to fix panels in a door.

CUTTING TOOLS:

Saws:
A saw is used to cut wood into pieces. There are different types of saws, designed to suit different purposes. A saw is specified by the length of different purposes. A saw is specified by the length of its toothed edge.

Cross-cut or hand saw:
It is used to cut across the grains of the stock. The teeth are so set that the saw kerf will be wider than the blade thickness. This allows the blade to move freely in the cut, without sticking.

Rip saw:
It is used for cutting the stock either along or across the grains. It is used for cutting tenons and in fine cabinet work. However, it is used for small and thin cuts. The blade of this saw is very thin and so it is stiffened with a thick back steel strip. Hence, this is sometimes called as back-saw. In this, the teeth are shaped like those of cross-cut saw.

Compass saw:
It has a narrow, longer and stronger tapering blade, which is used for heavy works. It is mostly used in radius cutting. The blade of this saw is fitted with an open type wooden handle.

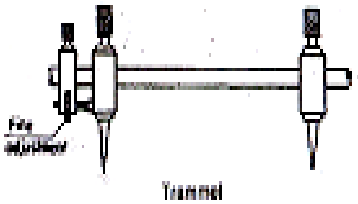
Chisels:
Chisels are used for cutting and shaping wood accurately. Wood chisels are made in various blade widths, ranging from 3 to 50 mm. They are also made in different blade lengths. Most of the wood chisels are made into tang type, having a steel shank which fits inside the handle. These are made of forged steel or tool steel blades.

Firmer chisel:
The work 'firmer' means 'stronger' and hence firmer chisel is stronger than other chisels. It is a general purpose chisel and is used either by hand pressure or by a mallet. The blade of a firmer chisel is flat.

Dovetail chisel:
It has a blade with a beveled back, due to which it can enter sharp corners for finishing, as in dovetail joints.

Mortise chisel:
It is used for cutting mortises and chipping inside holes, etc. the cross-section of the mortise chisel is proportioned to withstand heavy blows during mortising. Further, the cross-section is mad3e stronger near the shank.

INSIDE CHISEL



Trammel

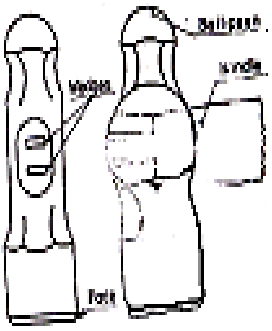
OUT SIDE CHISEL

Bow saw

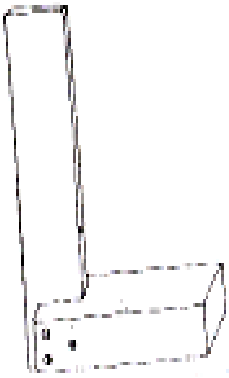
MORTISE CHISEL

FRAMER CHISEL

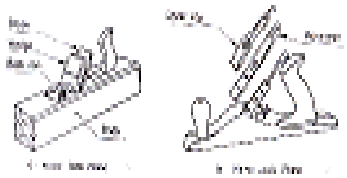
DOVE TAIL CHISEL



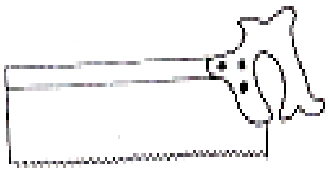
Ball peen hammer



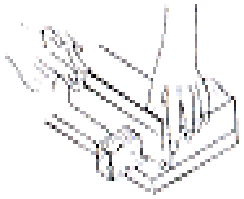
TRY SQUARE

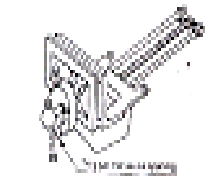


CLAW HAMMER

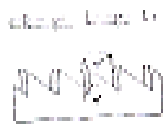


TENON SAW





CARPENTER'S VICE



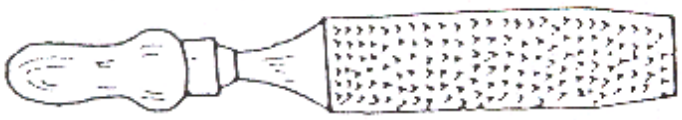
RIP SAW

CROSS CUT SAW

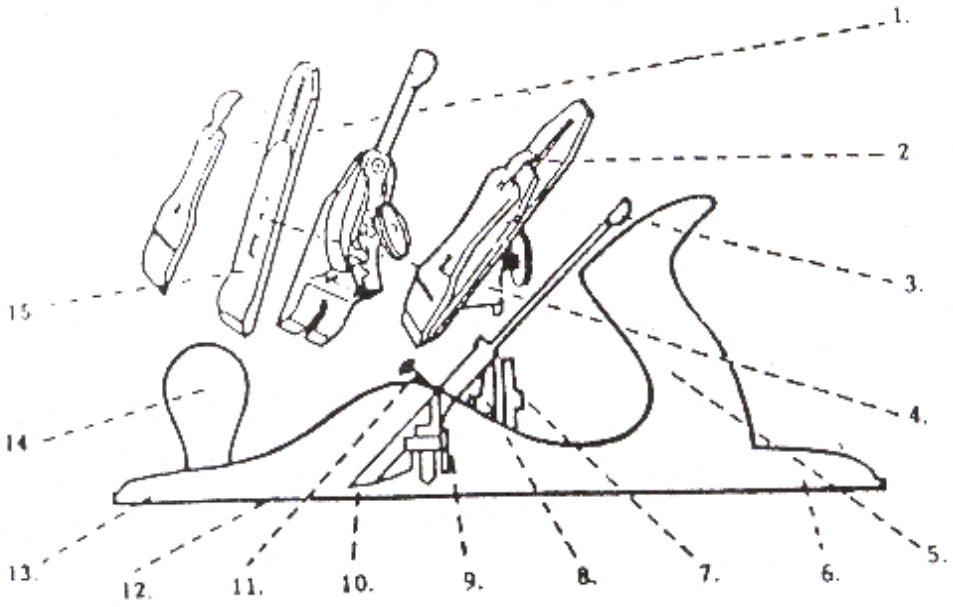
BAR CRAMP

STEEL RULE

MORTISE GUAGE



RASP AND FILE



1. LEVER CAP
2. CAM
3. LATERAL ADJUSTING LEVER
4. CAP IRON SCREW
5. HANDLE
6. HEEL
7. ADJUSTING NUT
8. "Y" ADJUSTING LEVER
9. FROG
10. MOUTH
11. LEVER CAP SCREW
12. PLANE BOTTOM

METAL JACK PLANE

REVIEW QUESTIONS:

1 Name the commonly available shapes of timber in the market.
2. Classify wood used for construction purpose.
3. What is the difference between marking gauge and marking knife?
4. What is the difference between C-clamp and bar cramp?
5. What for a plane is used in a carpentry shop?
6. Classify the planning tools.
7. Classify the chisels and their applications.
8. Name the tools used for pulling nails.
9. On what parameters, the strength of the joint depends?
10. Name the various joinery materials used in carpentry.
11. Name the various types of joints under,
    i. lap joints,
    ii. mortise and tenon joints, and
    iii. bridle joints.

T - LAP JOINT

Expt. No.:1

AIM: To make a T-lap joint as shown in Figure from the given reaper of size 50 x 50x 250 mm.

TOOLS REQUIRED : Carpenter's vice, steel rule, jack plane, try-square, marking gauge, 25 mm firmer chisel, cross-cut saw, tenon saw, scriber and mallet.

MATERIAL REQUIRED: 50X50X250mm wood - two pieces.

SEQUENCE OF OPTIONS

1. CUTTING
2. PLANING
3. INSPECTION

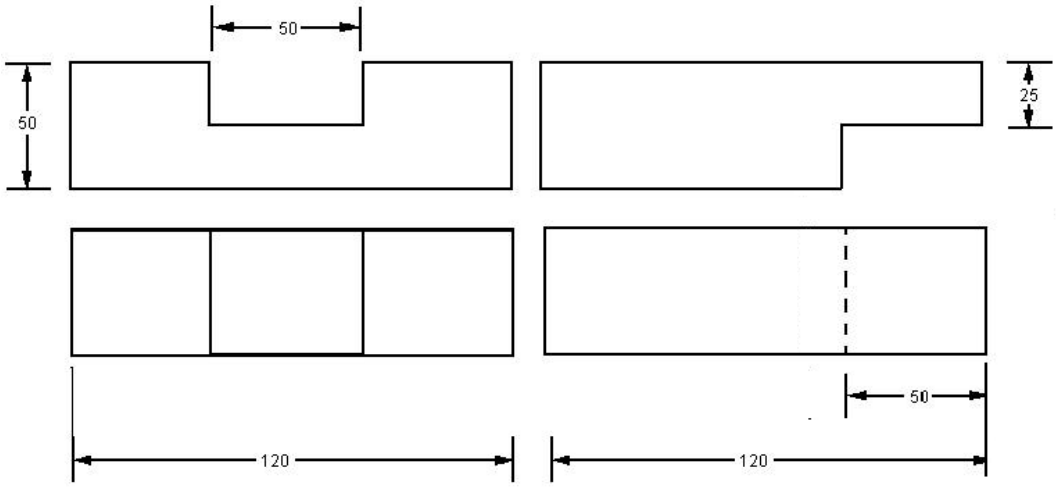
PROCEDURE

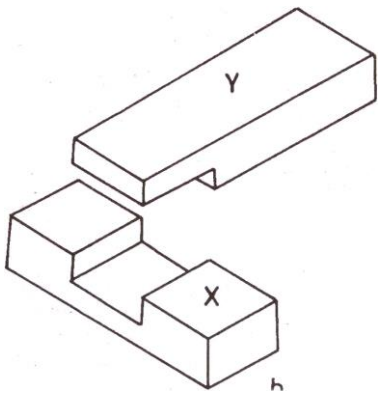
1. The given reaper is checked to ensure its correct size.
2. The reaper is firmly clamped in the carpenter's vice and any two adjacent faces are planed by the jack plane and the two faces are checked for square ness with the try-square.
3. Marking gauge is set and lines are drawn at 50 and 50 mm, to mark the thickness and width of the model respectively.
4. The excess material is first chiseled out with firmer chisel and then planed to correct size.
5. The mating dimensions of the parts X and Yare then marked using scale and marking gauge.
6. Using the cross-cut saw, the portions to be removed are cut in both the pieces, followed by chiseling and also the parts X and Yare separated by cross-cutting, using the tenon saw.
7. The ends of both the parts are chiseled to the exact lengths.
8. A fine finishing is given to the parts, if required so that, proper fitting is obtained.
9. The parts are fitted to obtain a slightly tight joint.

SAFETY PRECAUTIONS:

1. Tools that are not being used should always be kept at their proper places.
2. Make sure that hands are not in front of sharp edged tools while using them.
3. Sharp tools are only to be used. A dull tool requires excessive pressure, causing the tool to slip.
4. Wooden pieces with nails should never be allowed to remain on the floor.
5. Care should be taken, when the thumb is used as a guide in cross-cutting and ripping.
6. Test the sharpness of the cutting edge on wood or paper, but not on hand.
7. Never chisel towards any part of the body.
8. The tip of the screw driver must fit the slot without wobbling. The width of the tip should be equal to the length of the screw slot.
9. Keep the screw driver properly pointed to prevent injury to hands.

RESULT: The T-Lap joint is thus made by following the above sequence of operations.





DOVE TAIL LAP JOINT

Expt No: 2

AIM: To make a Dovetail lap joint

APPARATUS & TOOLS REQUIRED:

Carpenter's vice, steel rule, jack plane, try-square, marking gauge, 25 mm firmer chisel, cross-cut saw, tenon saw, scriber and mallet.

MATERIAL REQUIRED: 50X50X250mm wood - two pieces.

SEQUENCE OF OPTIONS

1. CUTTING
2. PLANING
3. INSPECTION

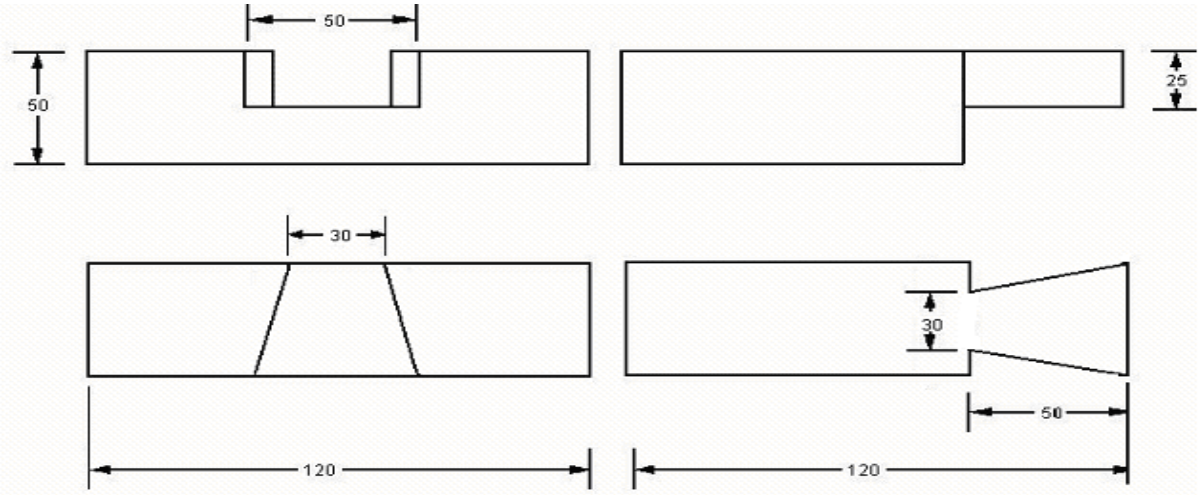
PROCEDURE:

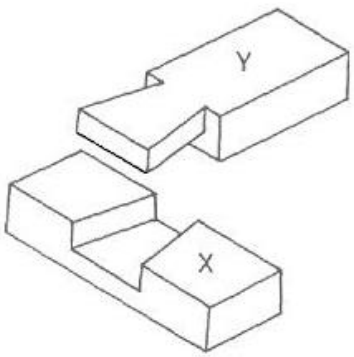
1. The given reaper is checked to ensure its correct size.
2. The reaper is firmly clamped in the carpenter's vice and any two adjacent faces are planed by the jack plane and the two faces are checked for square ness with the try square.
3. Marking gauge is set and lines are drawn at 50 and 50 mm, to mark the thickness and width of the model respectively. .
4. The excess material is first chiseled out with firmer chisel and then planed to correct Size.
5. The mating dimensions of the parts X and Yare then marked using scale and marking gauge.
6. Using the cross-cut saw, the portions to be removed are cut in both the pieces, followed by chiseling and also the parts X and Yare separated by cross cutting, using the tenon saw
7. The ends of both the parts are chiseled to exact lengths.
8. A fine finishing is given to the parts, if required so that, proper fitting is obtained.
9. The parts are fitted to obtain a slightly tight joint.

SAFETY PRECAUTIONS:

1. Tools that are not being used should always be kept at their proper places.
2. Make sure that hands are not in front of sharp edged tools while using them.
3. Sharp tools are only to be used. A dull tool requires excessive pressure, causing the tool to slip.
4. Wooden pieces with nails should never be allowed to remain on the floor.
5. Care should be taken, when the thumb is used as a guide in cross-cutting and ripping.
6. Test the sharpness of the cutting edge on wood or paper, but not on hand.
7. Never chisel towards any part of the body.
8. The tip of the screw driver must fit the slot without wobbling. The width of the tip should be equal to the length of the screw slot.
9. Keep the screw driver properly pointed to prevent injury to hands.

RESULT: The Dovetail lap joint is thus made by following the above sequence of operations.





FITTING

THEORY

Holding tools:

Bench vice:

The bench vice is a work-holding device. It is the most commonly used vice in a fitting shop. It is fixed to the bench with bolts and nuts. The vice body consists of two main parts, fixed jaw and a movable jaw. When the vice handle is turned in a clockwise direction, the sliding jaw forces the work against the fixed jaw. The greater the pressure applied to the handle, the tighter is the work held. Jaws are made of hardened steel. Serrations on the jaws ensure a good grip. Jaw caps made of soft material are used to protect finished surfaces, gripped in the vice. The size of the vice is specified by the length of the jaws.

The vice body is made of cast iron which is strong in compression, weak in tension and so fractures under shocks and therefor4e should never be hammered.

V-block with clamp:

The v-block is a rectangular or square block with a v-groove on one or both sides, opposite to each other. The angle of the 'v' is usually 90^o. V-block with a clamp is used to hold cylindrical work securely, during layout of measurements, for measuring operation or for drilling. For this, the bar is placed longitudinally in the v-groove and the screw of V-clamp is tightened. This grips the rod firmly, with its axis parallel to the axis of the V-groove.

C-clamp:

This is used to hold work against and angle plate or V-block or any other surface, when gripping is required. Its fixed jaw is shaped like English alphabet, "C" and the movable jaw is round in shape and directly fitted to the threaded screw at the end. The working principle of this clamp is the same as that of the bench vice.

Marking and Measuring Tools:

Surface plate:

The surface plate is machined to fine limits and is used for testing the flatness of the work piece. It is also used for marking out small works and is more precise than he marking table. The degree of fineness of the finish depends upon whether it is designed for bench work in a fitting shop or for using in an inspection room. The surface plate is made of cast iron, hardened steel or granite stone. It is specified by length' width' height' grade. Handles re provided on two opposite sides, to carry it while shifting from one place to another.

Angle plate:

The angle plate is made of cast iron. It has two surfaces, machined at right angle to each other. Plates and components, which are to be marked out, may be held against the upright face of the angle plate, to facilitate the marking. Slots are provide don the angle plate to clamp the work in position.

Universal Scribing block:
This is used for scribing lines for layout work and checking parallel surfaces. Referring the figure, it may be noted that its spindle can be quickly adjusted to any angle, by an adjusting screw. In some designs, the base of the block will have a "V" shaped groove, to enable the block to rest on round bars if required, to set-off the dimensions from the bar to the surface of the components.

Try-Square:
It is a measuring an marking tool for 90^o angle. In practice, it is used for checking the squareness of many types of small works, when extreme accuracy is not required. The blade of the try-square is made of hardened steel and the beam, of cast iron or steel. The size of the try-square is specified by the length of the blade.

Combination set:
It is a combination of measuring tools used for measuring linear dimensions, angular dimensions and for checking flatness of surfaces. It consists of a rule, square head, centre head, protractor and spirit level . This may be used as a rule, a square, a depth gauge, for marking meters (45°), for locating the centre on the end of a round bar and for measuring and marking angles. The rule is made of tempered steel with grooves. The combination set is specified by the length of its rule.

Scriber:
A scriber is a slender steel tool, used to scribe or mark lines on metal work pieces. It is made of hardened and tempered high carbon steel. The tip of the scriber is generally ground at 12° to 15°. It is generally available in lengths, ranging from 125 mm to 250 mm. It has two pointed ends. The bent end is used for marking lines where the straight end can not reach.

Odd-leg caliper:
This is also called 'Jenny Caliper' or 'Hermaphrodite'. This is used for marking parallel lines from a finished edge and also for locating the centre of round bars. As shown in figure, it has one leg pointed like a divider and the other leg bent like a caliper. It is specified by the length of the leg up to the hinge point.

Divider:
It is basically similar to the calipers except that its legs are kept straight and pointed at the measuring edge. This is used for marking circles, arcs, laying out perpendicular lines, bisecting lines, etc. It is made of case hardened mild steel or hardened and tempered low carbon steel. Its size is specified by the length of the legs.

Punches:
These are used for making indentations on the scribed lines, to make them visible clearly. These are made of high carbon steel. A punch is specified by its length and diameter, say as 150'12.5 mm. It consists of a cylindrical knurled body, which is plain for some length at the top of it. At the other end, it is ground to a point. The tapered point of the punch is hardened over a length of20 to 30 mm.

Dot punch:
This is used to lightly indent along the layout lines, to locate centre of holes and to

provide a small centre mark for divider point, etc. For this purpose, the punch is ground to a conical point having 60° included angle.

Centre punch:
This is similar to the dot punch, except that it is ground to a conical point having 90° included angle. It is used to mark the location of the holes to be drilled.

Calipers:
They are indirect measuring tools used to measure or transfer linear dimensions. These are used with the help of a steel rule to check inside and outside measurements. These are made of case hardened mild steel or hardened and tempered low carbon steel. While using, both the legs of the caliper are set against the surface of the work, whether outside or inside and the distance between the legs is measured with the help of a scale and the same can be transferred to another desired place. These are specified by the length of the legs.

NOTE:1. In the case of outside caliper, the legs are bent inwards and in the case of inside caliper, the legs are bent outwards.
2. The calipers , are known as spring calipers. While using, the legs are adjusted by means of a knurled nut, operating on a threaded adjusting screw.

Vernier calipers:
These are used for measuring outside as well as inside dimensions accurately. It may also be used as a depth gauge. It has two jaws. One jaw is formed at one end of its main scale and the other jaw is made part of a vernier scale. In the figure shown, 19 main scale divisions are divided into 20 equal parts in the vernier scale. Hence,
Least count of the vernier = 1 main scale division -1 vernier scale division
= 0.05 mm
Least count may be defined as the minimum dimension which can be measured by the device. For measuring the size of an object; it is held between its jaws and noting the main scale and vernier scale readings; the size can be arrived at.
Venire caliper is generally made of nickel-chromium steel. Its size is specified by the maximum length that can be measured by it.

Vernier height gauge:
The vernier height gauge, clamped with a scriber. It is used for layout work. An off-set scriber is used when it is required to take measurements from the surface, on which the gauge is standing. The accuracy and working principle of this gauge are the same as those of the vernier caliper. Its size is specified by the maximum height that can be measured by it. It is made of nickel-chromium steel.

Vernier depth gauge:
It is used for precision measurement of blind holes, slots, grooves, etc. The working principle of this instrument is the same as that of the vernier caliper. It is made of nickel-chromium steel. Its size is specified by the maximum depth that can be measured by it.

Outside micrometer:
This is used for measuring external dimensions accurately. A mircometer ofo-25mm

range with an accuracy of 0.01 mm, These are available in different ranges with interchangeable anvils.
It works on the principle of screw thread's pitch and lead. It consists of one jaw or anvil, fixed to one end of the frame; another movable jaw, in the form of a round bar, called the spindle. This spindle is mounted on the other end of the frame and housed in the thimble.

Inside micrometer:

This is used to measure inside dimension accurately inside micrometer of range 25 to 150mm, with extension rods. The construction of inside micrometer is the same as outside micrometer except that it has no frame. So, its spindle can be used to take measurements from inside of blind holes. Except this feature; the principle of working of inside micrometer is the same as outside micrometer.

Finishing Tools:

Files:

Filing is one of the methods removing small amounts of material from the surface of a metal part. A file is a hardened steel tool, having slant parallel rows of cutting edges or teeth on its surfaces. On the faces, the teeth are usually diagonal to the edge. One end of the file is shaped to fit into a wooden handle. 'The hand file is parallel in width and tapering slightly in thickness, towards the tip. It is provided with double cut teeth on the faces, single cut on one edge and no teeth on the other edge, which is known as the safe edge.

Types of files:

Files are classified according to their shape, cutting teeth and pitch or grade of the teeth. Table gives types of files and their description and uses.

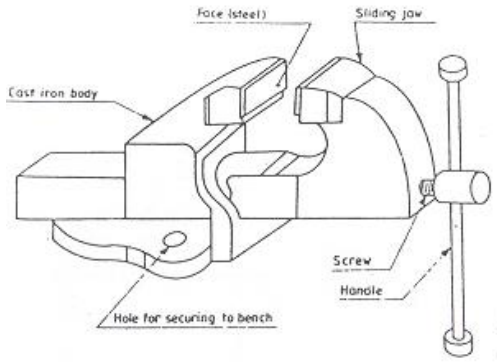
Type of file Hand file, Description and use:

Type of file	Description and use
Hand file	Rectangular in section, tapered in thickness but parallel in width. The faces have double cut teeth and one of the edges, single cut. The other edge does not have any teeth and hence called as safe edge file. It is used for filing a surface, at right angle to an already finished surface.
Flat file	Rectangular in section and tapered for 1/3rd length in width and thickness. The faces have double cut teeth, and the edges, single cut. Used for general purpose filing.
Square file	Square in section and tapered for 1/3rd length on all faces. All the faces have double cut teeth. Used for filing corners and slots and also to cut keyways.
Triangle file	Equilateral triangular in section and tapered for 1/3rd length on all faces. All the faces have double cut teeth. Used for filing internal corners.
Half round file	It has one flat face, connected by a curved face and tapered for 1/3rd length. The curved face is not exactly semi-circular but only a part of circle. The flat face has double cut teeth and the

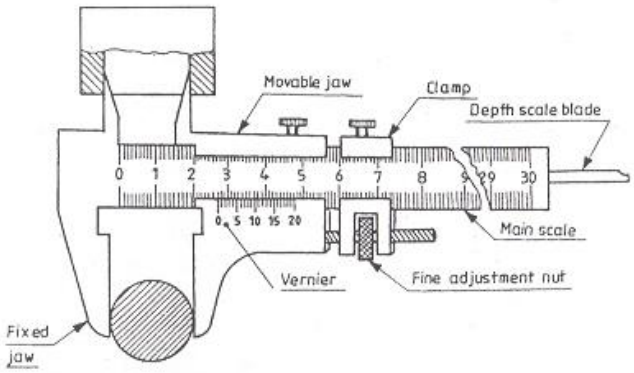
	curved face, single cut. Used for filing concave surfaces and internal corners.
Round file	Circular cross-section and tapered for 1/3rd length. It has double cut teeth. Used for filing concave surfaces and circular openings. It is normally 150mm long, with cut teeth. Used for filing comers, grooves, narrow slots, etc., in intricate work.
Swiss or needle file	It is normally 150 mm long, with cut teeth. Used for filing corner, grooves, narrow slots, etc., in intricate work.

Single cut files have rows of teeth running in one direction, across their faces and double cut files have a second row of teeth, cut diagonally to the first row, as shown in figure.. Single cut files are used for filing soft metals; whereas double cut files are used for filing hard metals. Based on the coarseness or the pitch of the teeth.
Files most often used are bastard, second cut and smooth. Other grades are used for special jobs only.

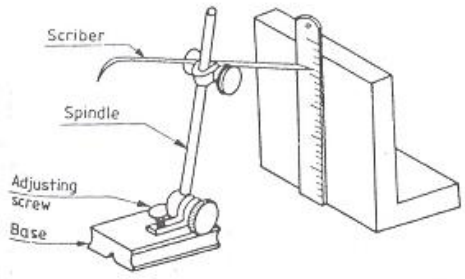
File card:
It is a metal brush, used for cleaning the files, to free them from filings, clogged in-between the teeth.



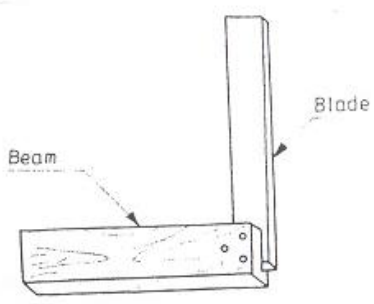
BENCH VICE



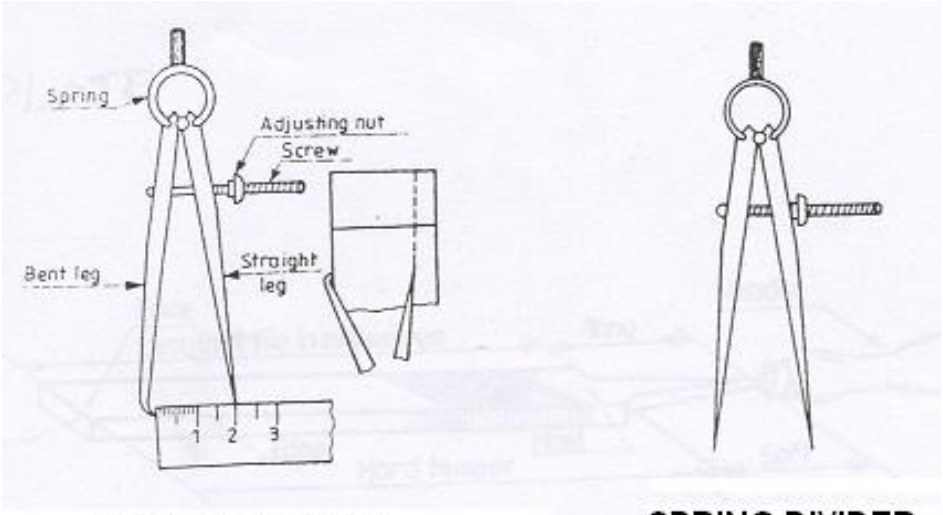
VERNIER CALIPERS



UNIVERSAL SCRIBING BLOCK

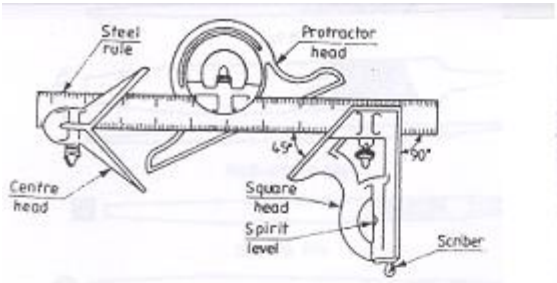


TRY SQUARE

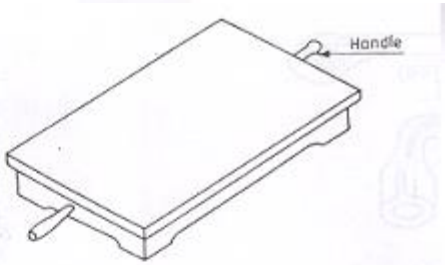


SPRING ODD LEG CALLIPER

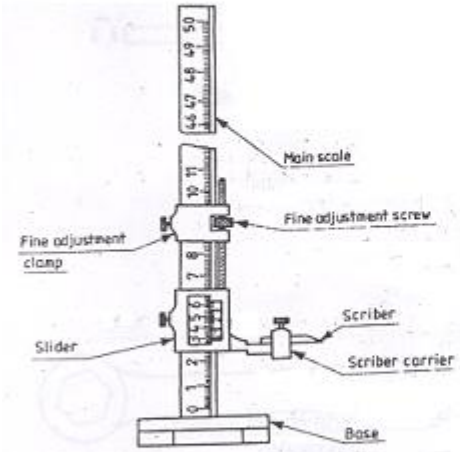
SPRING DIVIDER



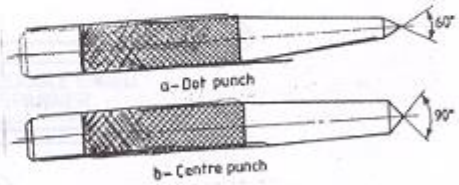
COMBINATION SET



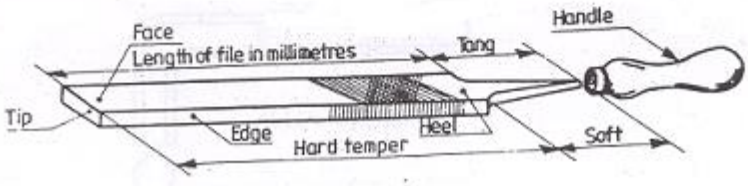
SURFACE PLATE



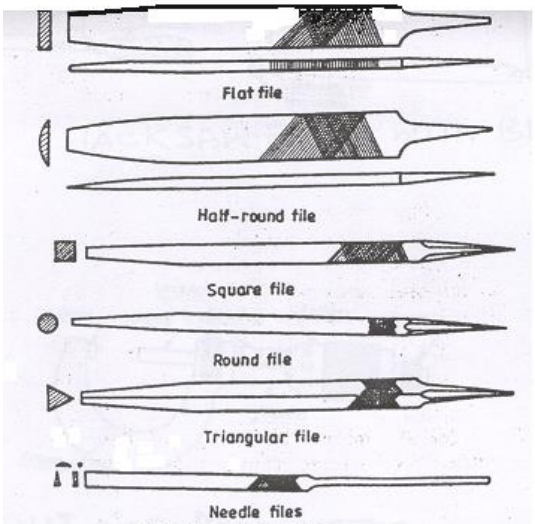
VERNIER HEIGHT GUAGE



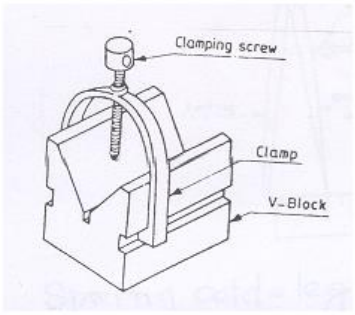
PUNCHES



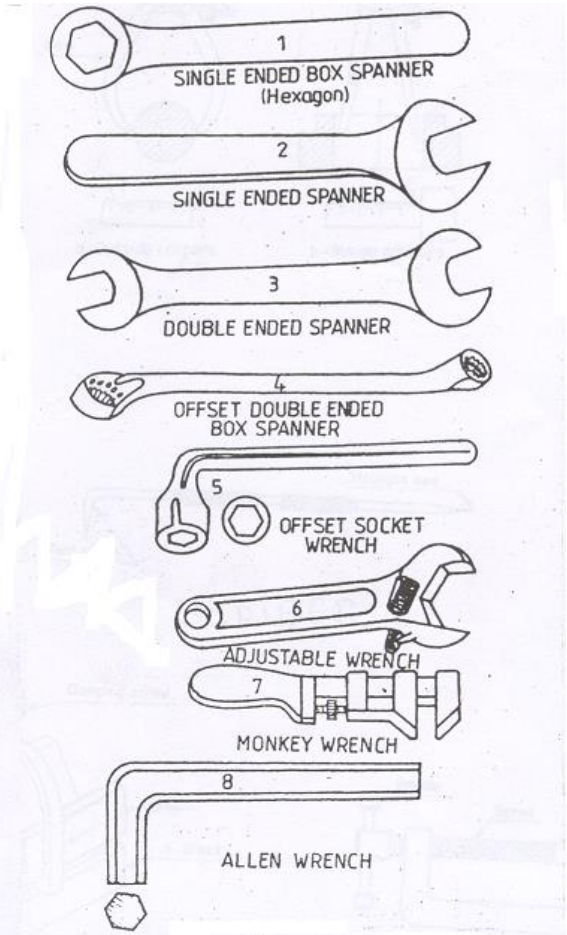
HAND FILE



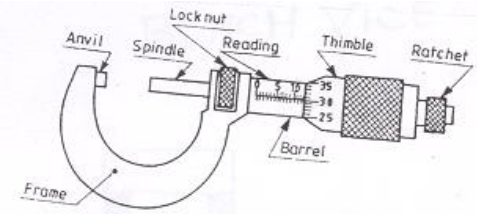
TYPES OF FILES



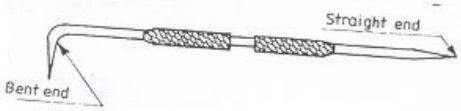
V- BLOCK



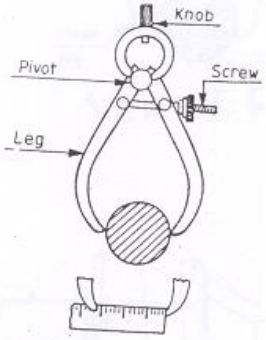
SPANNERS



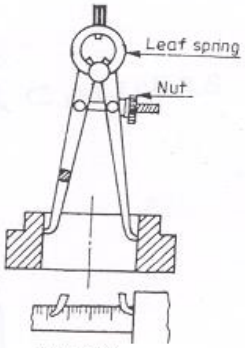
OUT SIDE MICROMETER



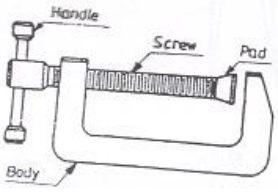
SCRIBER



OUT SIDE CALIPERS



INSIDE CALIPERS



CLAMP

V-FITTING

EXPT.NO: 01

AIM: To make a V-Fit from the given mid steel pieces. MATERIALS REQUIRED: Mild steel flat (40x40x3mm). TOOLS AND EQUIPMENT REQUIRED:

1.6”try square
2. 6”sriber
3. Odd leg caliper 3.12”hack saw Frame
4 Blades (12 TPI)
5.10”rough file
6.10”smooth file
7.10”triangle file
8. Knife Edge file
9. Dot punch
10. Ball peen hammer (0.5 Ib)
11. Steel Rule

Sequence of Operations:

1. Filling
2. Marking
3. Punching
4. Sawing
5. Filling
6. Finishing

PROCEDURE:

1. The given mild steel flat piece is checked for given dimensions.
2. One edge of given is filled with rough and smooth files and checked with try square for straightness.
3. An adjacent edge is also filled such that it is square to first edge and checked with try square.
4. Wet chalk is applied on one side of the flat and dried for marking.
5. Lines are marked according to given figure, using odd leg caliper and steel rule.
6. Using the dot punch, punches are made along the marked lines.
7. The excess materials removed from the remaining two edges with try square level up to half of the marked dots.
8. Finally buts are removed by the filling on the surface of the fitted job.

PRECAUTIONS: 1. the perpendicularity of face ends edges is checked perfectly by using try square.
2. Finishing is given by using only with smooth files.
3. Marking is done without parallax error.

RESULT: The required V-fit is done successfully according to the drawing.

DOVETAIL FITTING

Expt. No: 2

AIM: To make a dovetail fitting from the given two M.S. pieces.

APPARATUS & TOOLS REQUIRED: Bench vice, steel rule, try-square, ball-peen hammer, scriber, dot punch, set of files, surface plate, Jenny caliper, hack saw with blade and flat chisel.

MATERIAL REQUIRED: 50x50x6mm M.S. Flat Two Pieces.

SEQUENCE OF OPERATIONS:

1. CUTTING
2. FILING
3. ASSEMBLING
4. CHECKING / INSPECTION

PROCEDURE:

1. The burrs in the pieces are removed and the dimensions are checked with the steel rule.
2. The pieces are clamped one after the other and the outer mating edges are filed and checked for their flatness, with the help of the try-square.
3. The side edges of the two pieces are filed such that, they are at right angle to each other and widths are exactly 48 mm.
4. Chalk is then applied on the surfaces of the two pieces.
5. The given dimensions of the dovetail fitting are marked, by using the Jenny caliper, steel rule and surface plate.
6. Using the dot punch, dots are punched along the above scribed lines.
7. Using the hack saw, the unwanted portions are removed.
8. Using the flat chisel, the unwanted material in the piece Y is removed.
9. The cut edges are filed by the half round file.
10. The corners of the stepped surfaces are filed by using a square or triangular file to get the sharp corners.

The pieces (X and Y) are fitted together and the mating is checked for the correctness of the fit, any defects noticed, is rectified by filing with a smooth file.

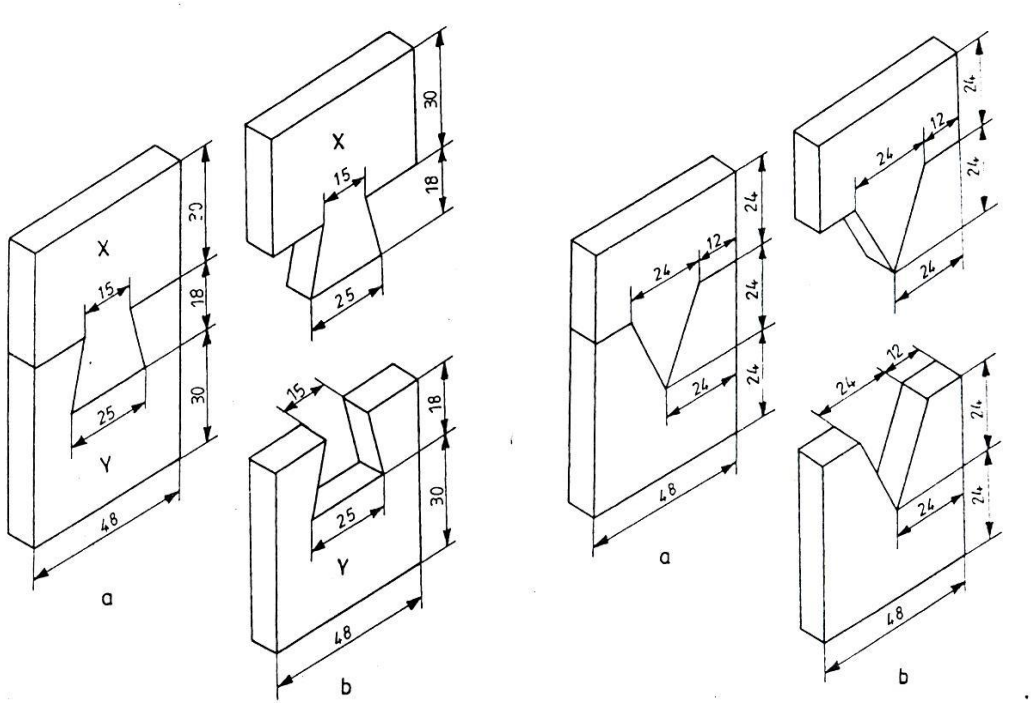
SAFETY PRECAUTIONS:

1. Keep the tools clean, free of dirt, oil and grease.
2. Keep the tools sharp and in good condition. Hold the pointed tool away from the

body to avoid injury.

3. When sawing in a vice, make sure that work is held tight. A loose vice is dangerous.
4. Cut a small groove with a corner of the file, where a saw cut is to be started. The groove permits the accurate positioning of the saw and also prevents the slipping of the teeth.
5. Apply force on the forward stroke only and relieve the force on the return stroke.
6. Do not hold the piece in hand while cutting.

RESULT: The required Dovetail fitting is obtained according to the drawing.



DOVETAIL AND V- FITTING

TIN SMITHY

THEORY

SHEET METAL MATERIALS:

A variety of metals are used in a sheet metal shop such as black iron, galvanized iron, copper, tin, aluminum and stainless steel.

BLACK IRON

Black iron is the cheapest metal. The name black iron is because of its black color. It is rolled to the desired thickness and then annealed. It corrodes rapidly, because it is not coated. The application of this metal is limited to articles that are to be painted.

GI

A sheet of soft steel, which is coated with molten zinc is known as galvanized iron. The zinc coat forms a coating that resists rust, improves the appearance of the metal and permits it to be soldered with greater ease.

COPPER

Copper sheets are available as cold or hot rolled sheets. Copper is highly resistant to corrosion. As it is a ductile material, copper sheets can be formed into complex shapes and the joints can be brazed easily.

TIN

Iron sheets, coated with tin are known as tin sheets. Tin sheets are used for dairy equipment, cans, pans, food containers, etc. The thickness of tin sheets are denoted by special marks and not by gauge numbers.

ALUMINIUM

Aluminium in the form of sheets can be used with the addition of small quantities of metals like copper, silicon, manganese and iron. It is widely used for processing vessels and tanks, house-hold appliances, refrigerator trays, kettles, etc. Aircraft structures are mainly made from aluminium and its alloys.

STAINLES STEEL

Stainless steel is an alloy of steel with 8-10% nickel, 18% chromium and traces of other metals. It has got greater resistance to corrosion and can be welded. It is used for making kitchen-ware, dairy and food processing plants, chemical plants, etc.

HAND TOOLS:
The common hand tools used in sheet metal work are, steel rule, usually of 60 cm length, wire gauge, dot punch, trammel, scriber, ball-peen hammer, straight-peen-hammer, cross-peen hammer, mallet, snips and soldering iron.

Trammel:
Sheet metal layout requires marking of arcs and circles. This may be done by using the trammel, as shown in Fig. 10.1. The length of the beam decides the maximum size of the arc that can be scribed.

Wire Gauge:
The thickness of sheet metal is referred in numbers known as standard wire gauge (SWG). The gaps in the circumference of the gauge are used to check the gauge number. Some of the standard wire gauge numbers with corresponding thick nesses are as follows

SWG No.	Thickness, mm
10	3.20
12	2.60
15	2.30
16	1.60
20	1.00
22	0.70
24	0.65
26	0.45
30	0.30

Bench Shear:
Sheet metal may be cut by shearing action. In this, the force is applied through a compound lever, making it possible to cut sheet metal upto 4 mm thick. The chopping hole can shear a mild steel rod upto 10 mm diameter.

Snips:
Snips are hand shears, varying in length from 200 mm to 600 mm, 200 mm and 250 mm being the lengths commonly used. The straight snip is used for cutting along outside curves and straight lines and curved snip or bent snip is for trimming along inside curves.

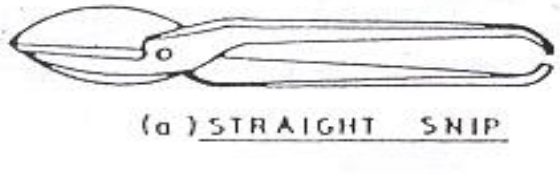
Hammers:
Light weight hammers and mallets are used in sheet metal work.

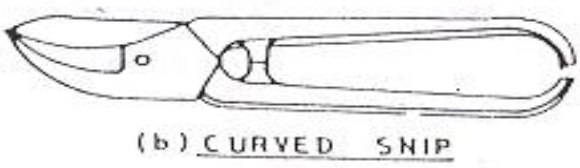
Ball-peen hammer :
It has a cylindrical, slightly curved face and a ball head. It is a general purpose hammer, used

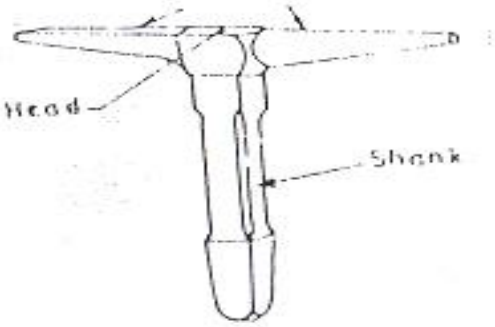
mostly for riveting in sheet metal work. Cross-peen hammer shown, has a tapered peen end and is perpendicular to the handle.

Straight-peen hammer

Straight-peen hammer has the peen end similar to the cross-peen, but it is positioned parallel to the handle which can be used conveniently for certain operations of folding, Mallet is used for bending and folding work. It is called as soft hammer. Generally, it is made of wood. It is light in weight, covers more area and does not dent the work.

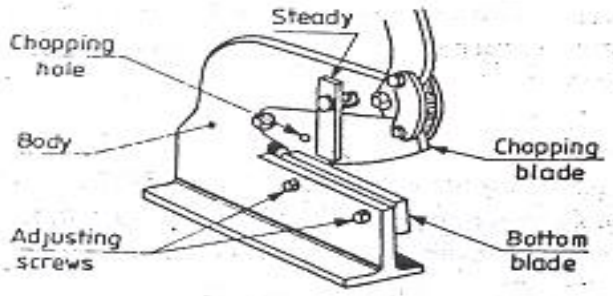




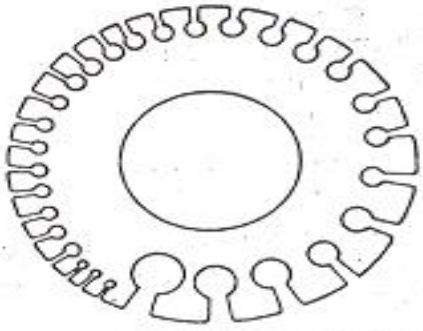


STAKE

BREAK HORN



Bench shear



Standard wire gauge

Many engineering and house hold articles such as hoppers, guards, covers, boxes, cans, funnels, ducts, etc., are made from a flat sheet of metal; the process being known as tin smithy. For this, the development of the article is first drawn on the sheet metal, then cut and folded, to form the required shape of the article. The edges of the article are then secured through

welding, brazing, soldering, riveting, etc. For successful working in the trade, one should have a thorough knowledge of projective geometry and development of surfaces. .
Allowance should be given in the drawing stage for folding and bending. This allowance depends upon the radius of the bend and thickness of the sheet metal.

REVIEW QUESTIONS:

1 Describe the process of sheet metal work.
2 What are the articles that are normally made of sheet metal?
3 What-are the points to be considered, during the sheet metal work?
4 Name the various materials that are used in sheet metal form.
5 What is the purpose of zinc coating on a G.I sheet?
6 What are the applications of tin sheets?
7 What are the applications of straight and bent snips?
8 Differentiate between cross-peen hammer and mallet.
9 What are stakes? Name the different types.
10 Name the means used for securing the joining edges in sheet metal
11 Sheet metal screws are known as self-tapping screws Why?
12 What is the material with which a solder is made of?
13 What are the advantages of soldering?
14 What is the purpose of flux used with the solder?
15 What are the applications of brazing?
16 What are the advantages of brazing?

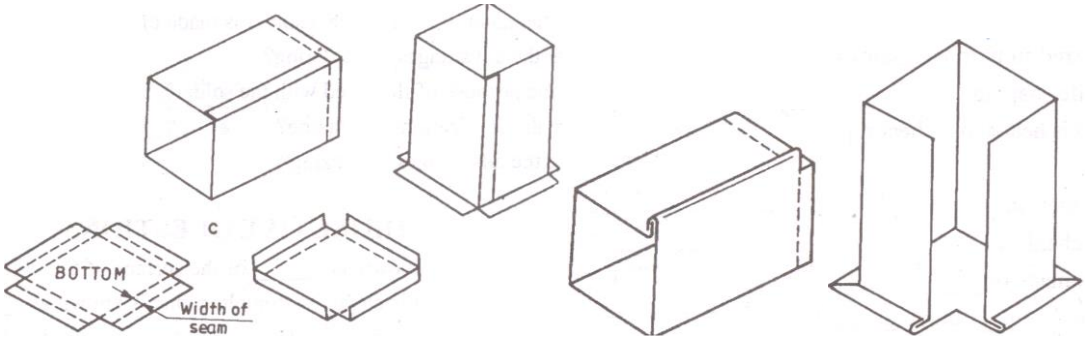
SQUARE TIN

Expt. No.:1

AIM: To make a square tin, using the given sheet metal.

APPARATUS & TOOLS REQUIRED: Steel rule, try-square, divider, scriber, straight snip, mallet, cross-peen hammer and stake.

MATERIAL REQUIRED : Galvanized iron sheet

1. 

SEQUENCE OF OPERATIONS

1. CUTTING
2. BENDING
3. INSPECTION

PROCEDURE:

1. The size of the given sheet is checked with the steel rule.
2. The layout the tin is marked on the given sheet by using scriber.
3. The layouts of the body and bottom are drawn on the tin sheet and cut as shown in Figure by using straight snips and bent snips.
4. The body is folded as per the requirement. .
5. The flanges are bent to receive the bottom.
6. The bottom is bent to get the required shape.
7. The bottom and body are placed in position and folded
8. The bottom flange portion is again folded-up to complete the joint

NOTE: Soldering can be done, if the leak proof joint is required.

SAFETY PRECAUTIONS:

1. Avoid feeling the cut portion by hand while cutting with snip.
2. Do not let sheet metal slip through your hands. Most cuts from sheet metal results from allowing it to slide through the hands.
3. Use snips only for metal that can be cut by force applied by hand.
4. Hand snips should never be used to cut wires. Such practice ruins the cutting edges of the blades.

RESULT: The square tin, closed at one end is thus made, from the given sheet metal.

RECTANGULAR TRAY

Expt. No.: 2

AIM: To make a rectangular tray, using the given sheet metal

APPARATUS & TOOLS REQUIRED

300 mm steel rule, try-square, divider, scriber, straight snip, mallet, ball peen hammer and hatchet stake.

MATERIAL REQUIRED : G.I. SHEET

SEQUENCE OF OPERATIONS

1. CUTTING
2. BENDING
3. INSPECTION

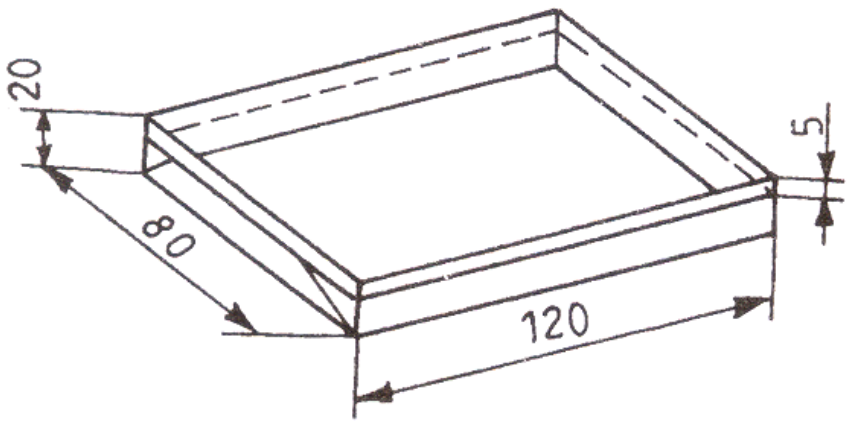
PROCEDURE:

1. The size of the given sheet is checked with the steel rule.
2. The layout of the tray is marked on the given sheet by using scriber.
3. The layout of the tray is cut by using the straight snip
4. The four sides of the tray are bent to 90°, as shown in Figure
5. The allowances on edges are folded to get the required joints on the four sides of the tray.

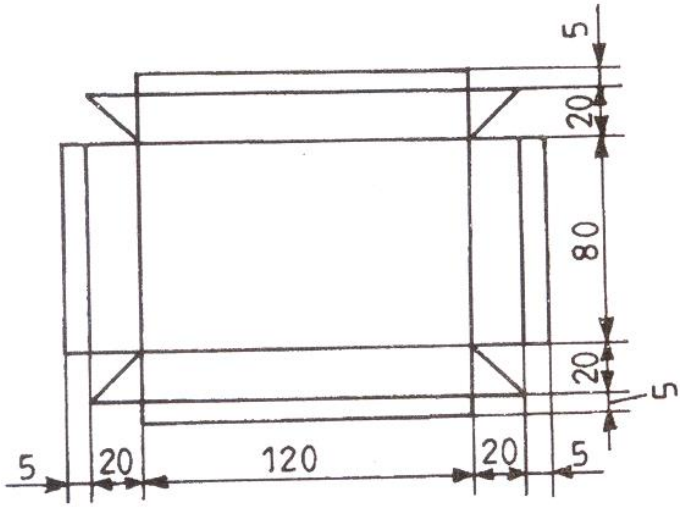
SAFETY PRECAUTIONS:

1. Avoid feeling the cut portion by hand while cutting with snip.
2. Do not let sheet metal slip through your hands. Most cuts from sheet metal results from allowing it to slide through the hands.
3. Use snips only for metal that can be cut by force applied by hand.
4. Hand snips should never be used to cut wires. Such practice ruins the cutting edges of the blades.

RESULT: The rectangular tray is thus made, from the given sheet metal.



Rectangular tray



Development

CONE

Expt. No.:3

AIM: To make a cone

APPARATUS TOOLS REQUIRED:

300 mm steel rule, divider, protractor, scriber, straight and bent snips, protractor, mallet and funnel stake.

MATERIAL REQUIRED : G.I. SHEET

PROCEDURE:

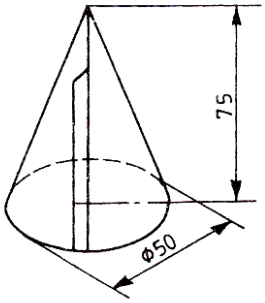
1. The size of the given sheet *is* checked with a steel rule.
2. The development of the cone is marked on the given sheet by using scriber.
3. The angle subtended by the arc of the sector is calculated from the relation,

   $\theta = 360^{o}$ x radius of the base circle of the cone / slant height.
4. The allowance for folding and bending is added to the development
5. The waste metal is cut-away by using the straight and bent snips.
6. The development of the cone is folded by using the funnel stake, after forming the single hemmed joint.

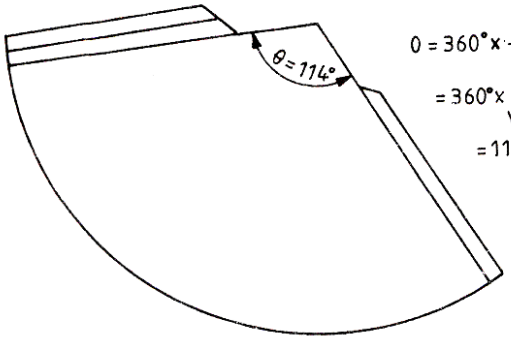
SAFETY PRECAUTIONS:

1. Avoid feeling the cut portion by hand while cutting with snip.
2. Do not let sheet metal slip through your hands. Most cuts from sheet metal results from allowing it to slide through the hands.
3. Use snips only for metal that can be cut by force applied by hand.
4. Hand snips should never be used to cut wires. Such practice ruins the cutting edges of the blades.

RESULT: The cone is thus made, from the given sheet metal.



a
Cone

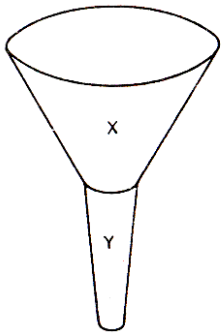


$$\theta = 360^\circ \times \frac{R}{L}$$

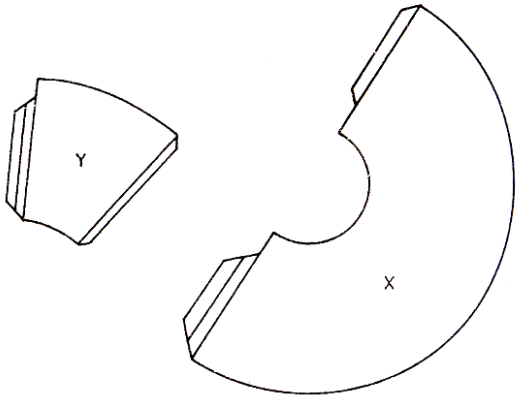
$$= 360^\circ \times \frac{25}{\sqrt{25^2+75^2}}$$

$$= 114^\circ$$

b
Development



a
Funnel



b
Development

BLACK SMITHY

THEORY

Forge or Hearth:

A smith's forge or hearth is used to heat the metal to be shaped. Hearths are used for heating small jobs to be forged by hand. Gas, oil or coal firing may be used for the purpose. The required air for the fire is supplied under pressure, by a blower through the tuyer in the hearth. The blowers may either be hand operated or power driven. In the latter case, the amount of air supply is controlled by valves near the forge. The rod, shown in figure, collects gases of combustion and sends through a chimney. The following are the forging temperatures of various metals.

S.No.	Material	Forging temperature Range (in ^{o}C)
1.	Mild steel	750-1300
2.	Wrought iron	900-1300
3.	Medium carbon steel	750-1250
4.	High carbon and alloy steel	800-1150

Heating of a metal to proper temperature is essential as excessive temperature may result in burning of the metal that destroys cohesion between atoms. Insufficient temperature will not induce sufficient plasticity to the metal, to shape is properly by hammering. Insufficient temperature also results in cold working defects like strain hardening and cracking.

Anvil:

It provides the necessary support during forging by resisting the heavy blows rendered to the job. It is also useful for operations such as bending, swaging, etc. Its body is generally made of cast steel, wrought iron or mild steel, with a hardened top layer of about 20 to 25 mm thick. The beak or horn in used for bending metal to round shape of different radii. The portion between the beak and face is called ledge, which is used for bending round rods and as a die for hot punching operation. Anvils are made in sizes weighing from 25kg to 250kg. An anvil weighing about 75 kg is suitable for general purpose.

Swage Block:

It is also a supporting tool used in a forge shop. It has a number of slots of different shapes and sizes along its four side faces and through holes of different shapes and sizes, running from its top to bottom faces. This is used as a support while forming (swaging) different shapes, bending and in punching holes. It is generally made of cast iron or cast steel.

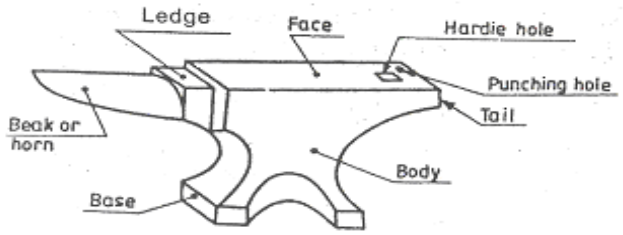
Leg vice:

It is a heavy duty vice, fixed to the work bench at one end of a leg or set in a concrete base. It is

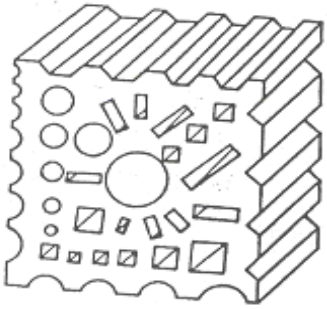
mainly used for light forging and bending work.

Hammers:
Hammers of different types and weights are used in smithy. The ball-peen hammer used for forging, weighs 0.5kg to 0kg. The sledge hammer which is used for heavy work, has flat ends on either side and weighs 3 kg to 8kg. The length of the handle of a hammer increases with its weight.

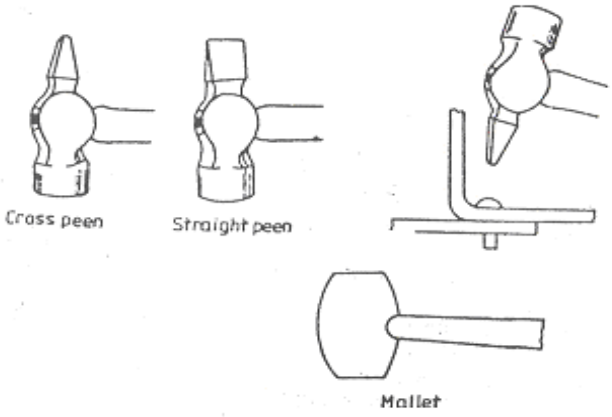
Tongs:
The metal to be forged must be held securely, while it is being shaped. A pair of tongs of suitable size and shape must be used for the purpose. They are made of mild steel and the sizes vary from 40 cm to 60 cm in length and 0.6 cm to 5.5cm opening.
A flat bit tongs can hold the job along the entire length of its jaws. It is used for holding work of rectangular section. Round bit tongs is used for holding a round rod. Square bit tongs is used for holding a square rod. Pick-up tongs is used for pick-up the heated rods from the hearth.



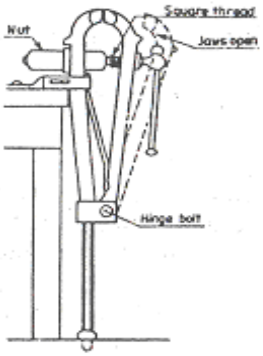
ANVIL



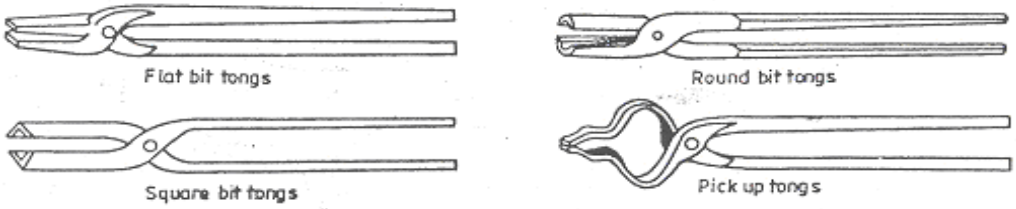
SWAGE BLOCK



HAMMERS



LEG VICE



TONGS

REVIEW QUESTIONS:

1 What is meant by smithy?
2. What are the various stages of hand forging to get the desired shape?
3 What are the advantages of forging?
4 Differentiate between hand forging and machine forging.
5 Describe an open hearth coal fired furnace, along with its working principle.
6 What for the 'ledge' part of the anvil is used?
7 What for swage block is used in a smithy shop?
8 Classify the tongs and their applications.
9 What is meant by 'Drawing-down', as applied to a process in a smithy section.
10 Define the following terms, as applied to smithy shop:
    a. Upsetting
    b. Fullering
    c. Swaging
11 With what, the fuller size is denoted?
12 Differentiate between 'hot' and 'cold' chisels.
13 What are the purposes of heat treating the forgings?

CHISEL

Expt. No.: 2

AIM: To make a Chisel from a given Cylindrical rod, by using hand forging operation..

APPARATUS & TOOL'S REQUIRED:

Smith's forge, anvil, 500 gm and I kg ball-peen hammers, flatter, square bit tongs and pick-up tongs.

MATERIAL REQUIRED: M.S. Round Rod Φ 10 x 150 mm

SEQUENCE OF OPERATIONS:

1. SIZING
2. HEATING
3. FORGING
4. INSPECTION

PROCEDURE:

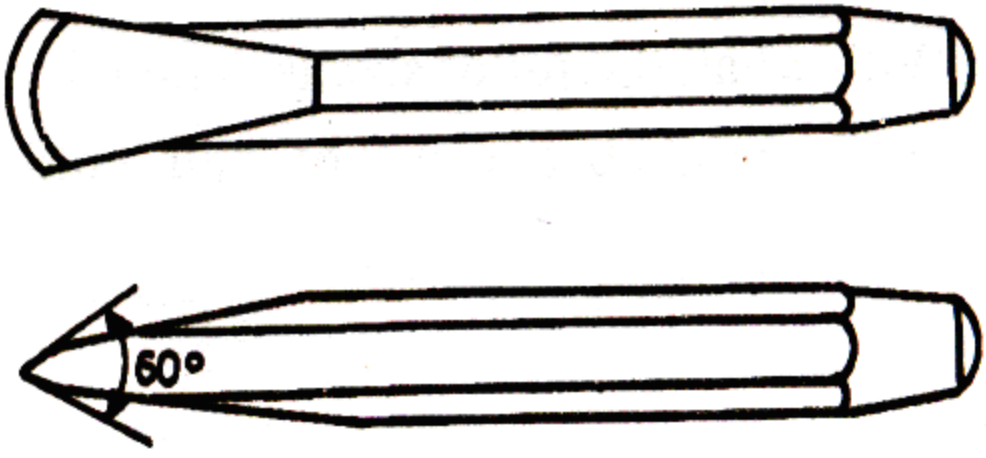
1. One half of the rod is heated to red hot condition in the smith's forge keeping it there for 15 to 20 minutes.
2. Holding the rod with square bit tongs; the rod is placed on the anvil face, the surface of the rod is then hammered such that, two flat faces (at the top and bottom) are formed.
3. The rod is turned through 90° and then placed on the anvil face.
4. The rod is then hammered such that, the square shape is formed over half of the length of the rod
5. Following the above stages; the remaining length of the rod is forged into square shape.
6. One end is heated to red hot condition and still flattened to form the taper surface.
7. The edge is made by cutting the extreme end with cold chisel.
8. The flat faces of the chisel formed are corrected, if required, using the flatter.

NOTE: In-between the stage, the rod is heated in the smith's forge, to facilitate forging operations.

SAFETY PRECAUTIONS:

1. Hold the hot work down wards close to the ground close to the ground, while transferring the piece from hearth to anvil, to minimize the danger of burns, resulting from collision with the others.
2. Use the correct size and type of tongs to fit the work. These should fit the work securely to prevent its bouncing out of control from repetitive hammer blows.
3. Care should be exercised in the use of hammer. The minimum force should be used and the flat face should strike squarely on the work.
4. Wear gloves when handling hot metal
5. Ensure that hammers are fitted with tight and wedged handles

RESULT: The chisel is thus made from the given cylindrical rod



Flat chisel

S-HOOK

Expt. No.: 3

AIM: To make S-hook

APPARATUS & TOOLS REQUIRED:

Smith's forge, anvil, 500 gm ball-peen hammer, flatters, swage block, half-round tongs and pick-up tongs.

MATERIAL REQUIRED: M.S. Round Rod Φ 10 x 150 mm

SEQUENCE OF OPERATIONS:

1. SIZING
2. HEATING
3. FORGING
4. INSPECTION

PROCEDURE:

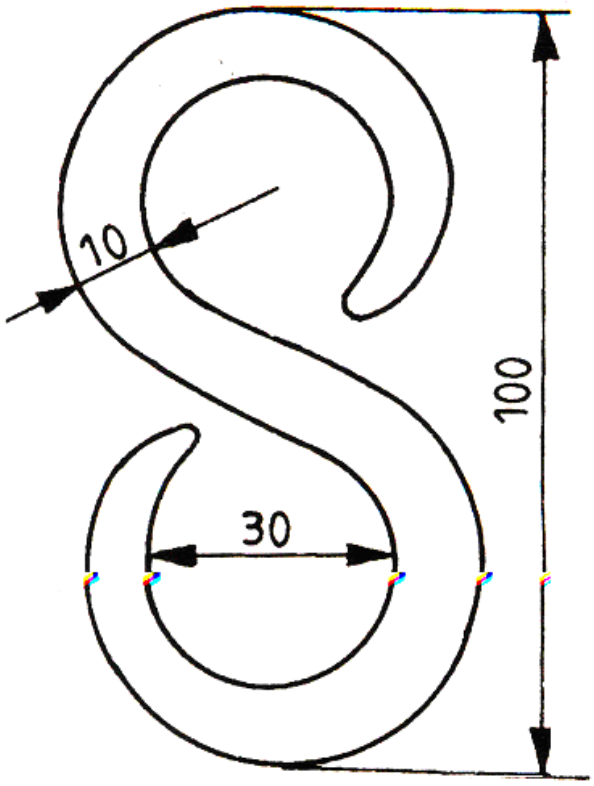
1. Using the pick-up tongs; the rod is taken from the forge, and holding it with the half-round tongs, the heated end is forged into a tapered pointed end (keeping it there for 15 to 20 minutes).
2. The length of the rod required for S-hook is estimated and the excess portion is cut off, using a cold chisel
3. One half of the rod towards the pointed end is heated in the forge to red hot condition and then bent into circular shape as shown.
4. The other end of the rod is then heated and forged into a tapered pointed end.
5. The straight portion of the rod is finally heated and bent into circular shape as required.
6. Using the flatter, the S-hook made as above, is kept on the anvil and flattened so that, the shape of the hook is proper

NOTE: In-between the above stage, the bar is heated in the smith's forge, to facilitate forging operations.

SAFETY PRECAUTIONS:

1. Hold the hot work down wards close to the ground close to the ground, while transferring the piece from hearth to anvil, to minimize the danger of burns, resulting from collision with the others.
2. Use the correct size and type of tongs to fit the work. These should fit the work securely to prevent its bouncing out of control from repetitive hammer blows.
3. Care should be exercised in the use of hammer. The minimum force should be used and the flat face should strike squarely on the work.
4. Wear gloves when handling hot metal
5. Ensure that hammers are fitted with tight and wedged handles

RESULT: The S-hook is thus made from the given round rod.



HOUSE WIRING

INTRODUCTION:

Power is supplied to domestic installations through a phase and a neutral, forming a single phase A.C 230 V, two-wire system. For industrial establishments, power is supplied through three-phase four wire system, to give 440 V. Fig shows the power tapping for domestic and industrial purposes. The neutral is earthed at the distribution sub-station of the supply.

When supplied to domestic utilities, power is fed to a kilowatt meter and then to a distribution panel. The panel distributes power along several circuits. It also protects these circuits from overload by safety devices like fuses or circuit breakers. The panel also serves as a main switch.

As a safe practice, all single-phase devices such as switches, fuses, etc., are connected to the live conductor. All electrical conducto0rs and cables are color coded and must be correctly connected-up. Electrical wiring is defined as a system of electric conductors, components and apparatus for conveying electric power from the source to the point of use. The wiring system must be designed to provided a constant voltage to the load.

ELEMENTS OF HOUSE WIRING:

Fuses and Circuit Breakers: These are the devices designed to provide protection to a circuit against excess current. In old type of distribution panels, open link fuses, plug or cartridge fuses were used. In newer panels, circuit breakers are used. If something goes wrong with an appliance or supply, the line becomes overloaded or short-circuited. Then, either the fuse blows-out or circuit breaker trips open, isolating that circuit or appliance. In such cases, the appliance must be checked for defects or it must be ensured that there are not too many appliances in that particular circuit.

Open link fuses are not safe in operation, even though they are cheaper and reliable. It consists of a thin strip of metal or wire. Here, when the fuse blows-off due to heavy current in the circuit, the metal is spilled around. A modified version of it consists of a porcelain fuse link, backing the wire safely.

Though the plug fuse confines the molten metal thrown out while blowing, it is not very accurate in operation. The length of the element also is very short. The cartridge fuse of non-renewable type, encloses the fuse element in a fiber tube with a non-inflammable material. During the blowing-off, the arc produced is chilled by the non-inflammable material. In case of a renewable type, a cheap renewable fuse material is used in the cartridge.

The trouble with fuses is that they must be replaced once they burn away, whereas the circuit breaker can be reset after the original condition is established. An electromagnetic circuit is shown. A set of switch contacts inside the circuit breaker is normally kept closed by an armature. When too much current flows through the coil, the armature is attracted, breaking the circuit. The circuit breaker may be reset by a toggle lever.

Electric Switch: This is a device that makes and breaks or changes the course of electric circuit. It consists of two or more contacts mounted on a n insulating structure and arranged such

that, they may be moved into and out of contact with each other by a suitable operating mechanism.

Plug: t is a device, carrying two or three metallic contacts in the form of pins, intended for engaging with corresponding socket contacts and arranged for attachment to appliances such as radio, T.V, table fan, etc.

Socket Outlet: It is a device, carrying two or three contacts, designed for engagement with the corresponding plug pins and arranged for connection to fixed wiring.

Lamp Holder: amp holder are designed to hold lamps and connect them in the circuit. Both bayonet cap and screw lamp holder are available upto 200 W lamps.

Ceiling Rose: A ceiling rose consists of a circular base and a cover made of bakelite. The base has two or three terminal plates. One end of the plates is connected to supply and the other end, to flexible wire connected to pendant lamp, ceiling fan, exhaust fan etc.

Main Switch: This is a switch intended to connect or cut-off the supply of electricity to the whole of an installation. It is generally of metal clad type. The metal clad type gives greater strength and safety. The main switch contains one or more fuses. Iron clad double pole switched are used for single phase A.C circuits.

REVIEW QUESTIONS:

1. Define electric wiring.
2. Name the safety devices used to protect the electric circuits from overload.
3. Name the various types of fuses.
4. Differentiate between a fuse and a circuit breaker.
5. What for a lamp holder is used in an electric circuit?
6. Name the types of lamp holders available in the market.
7. What for a ceiling rose is used?
8. Name the different forms of interior wiring.
9. What is meant by6 an electric circuit?
10. Name the three types of electrical circuits.
11. What are the places where "One lamp with independent control from two places", is used?
12. Name the motor driven household appliances.
13. Name the household appliances, which are of heating type.
14. What for a circuit breaker is used?
15. What are the precautions to be taken, while connecting the wires with electrical accessories?
16. Define the term "Earthing" or "Grounding".
17. Name the different methods of earthing.
18. Classify the fans. What are the commonly used types of fans that are working on A.C. power supply?
19. What are the precautions to be taken while installing a new ceiling fan?
20. Explain the principle of operation of an automatic electric iron.
21. Explain the principle of operation of a sodium vapor lamp.
22. What is the principle behind the operation of standby power supply?
23. What is the difference between emergency lamp and indicator lamp?

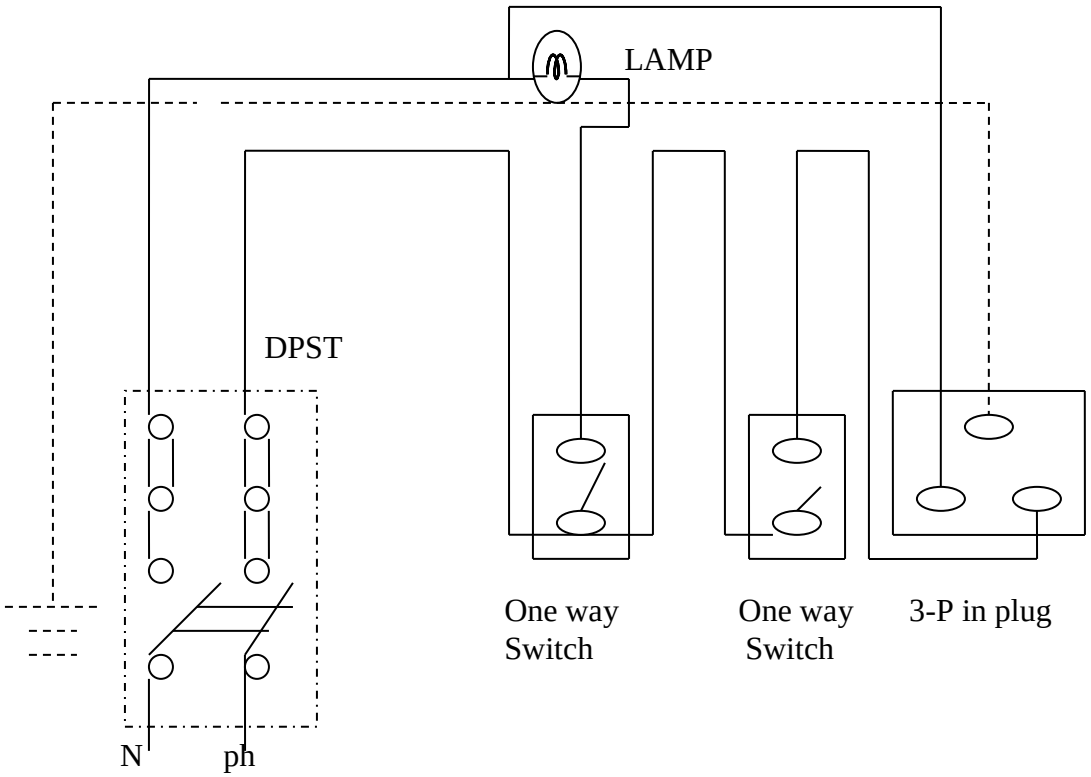
EXPERIMENT NO:1
ONE LAMP CONTROLLED BY ONE SWITCH WITH PROVISION FOR PLUG SOCKET WITH SWITCH CONTROL.

AIM: To give connection to one light, controlled by 1 – way switch

TOOLS REQUIRED: Wooden wiring board, 2 two-way switches, wooden round blocks, batten lamp holders, connector screw driver, wires, wire clips, nails, wood screws, poker and bulb.

SEQUENCE OF OPERATIONS

1. The outline of the wiring diagram is marked on the wooden wiring board.
2. Clips are nailed to the board, following the wiring diagram.
3. Wires are stretched and clamped with the clips.
4. Round blocks (3 No's) are screwed onto the board, as per the diagram.
5. Wires are connected to the holders and switch; which are then screwed onto the round blocks.
6. Bulbs are fitted to the holders.
7. The wiring connections are then tested, by giving power supply.



TOOLS:

Sl.No.	Tools	Quantity	Materials
1.	Combination plier 15 cm	One No	1) P.V.C Wire 1.5 mm^2
2.	Pocker	One No.	2) Wood Screw 35 mm 50 mm 20 mm 12 mm
3.	Measuring type	One No.	Round block wooden 8.5x3.5
4.	Side cutter	One No.	Neutral link.
5.	Hand drill Machine with 3/16" bit	One No.	Kit Kat fuse
6.	Firmer chisel 20 mm	One No.	One way switches-2 Nos
7.	Screw driver 15cm and 25 cm	One No.	One bulb 3-Pin socket- 1 No
8.	Electrician Knife	One No.	DPST switch (Double pole)
9.	Connector screw driver	One No.	Single through switch
10.	Mallet	One No.	Fuse wire 35 SWG
11.	Ball Pin hammer ¼ kg	One No.	G.I. Wire 14 Nos

PROCEDURE:

1) Make the circuit diagram and get it checked

2) With the help of plum bob draw straight lines on the board according to the layout diagram.

3) With the help of scale mark the lines according to the given size

4) Make guide holes for cleats at proper places

5) Fix the cleats loosely

6) Draw the wires into the cleats and tighten the screws of cleats.

7) Make holes in the blocks and boards for holder and switches and pass the wire through these holes.

8) Fix the blocks and boards with two screws on each block and board

9) Fix the switch and holders etc, by doing proper connections

10) Check the wiring with series test lamp or Megger

RESULT:

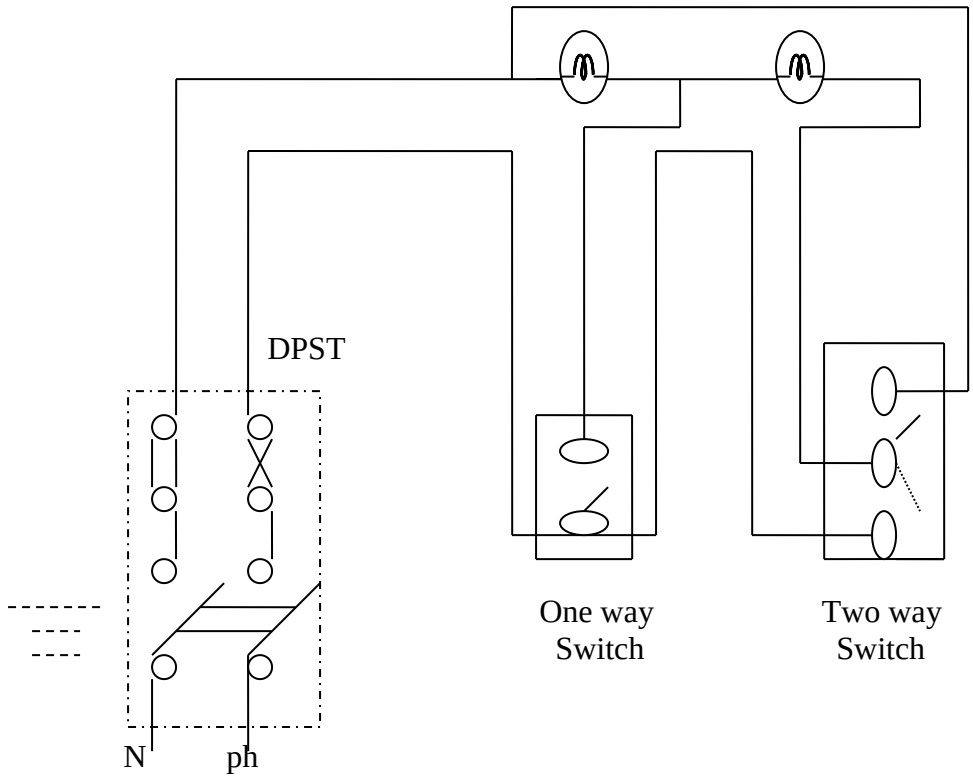
2. TWO LAMPS CONTROL USING TWO WAY SWITCHES

AIM: To give connection to Two light, controlled by 2 two – way switches

TOOLS REQUIRED: Wooden wiring board, 2 two-way switches, wooden round blocks, batten lamp holders, connector screw driver, wires, wire clips, nails, wood screws, poker and bulb.

SEQUENCE OF OPERATIONS

1. The outline of the wiring diagram is marked on the wooden wiring board.
2. Clips are nailed to the board, following the wiring diagram.
3. Wires are stretched and clamped with the clips.
4. Round blocks (3 No's) are screwed onto the board, as per the diagram.
5. Wires are connected to the holders and switch; which are then screwed onto the round blocks.
6. Bulbs are fitted to the holders.
7. The wiring connections are then tested, by giving power supply.



TOOLS:

Sl.No.	Tools	Quantity	Materials
1.	Combination plier 15 cm	One No	1) P.V.C Wire 1.5 mm^2
2.	Pocker	One No.	2) Wood Screw 35 mm 50 mm 20 mm 12 mm
3.	Measuring type	One No.	Round block wooden 8.5x3.5
4.	Side cutter	One No.	Neutral link.
5.	Hand drill Machine with 3/16" bit	One No.	Kit Kat fuse
6.	Firmer chisel 20 mm	One No.	One way switches-1 Nos
7.	Screw driver 15cm and 25 cm	One No.	Two way switch 1 No
8.	Electrician Knife	One No.	DPST switch (Double pole)
9.	Connector screw driver	One No.	Single through switch
10.	Mallet	One No.	Fuse wire 35 SWG
11.	Ball Pin hammer ¼ kg	One No.	G.I. Wire 14 Nos

PROCEDURE (1) :

1) Make the circuit diagram and get it checked

2) With the help of plum bob draw straight lines on the board according to the layout diagram.

3) With the help of scale mark the lines according to the given size

4) Make guide holes for cleats at proper places

5) Fix the cleats loosely

6) Draw the wires into the cleats and tighten the screws of cleats.

7) Make holes in the blocks and boards for holder and switches and pass the wire through these holes.

8) Fix the blocks and boards with two screws on each block and board

9) Fix the switch and holders etc, by doing proper connections

10) Check the wiring with series test lamp or Megger

PROCEDURE (2) :

1. S_1 down S_2 up – Both off
2. S_1 down S_2 down – L_1 on
3. S_1 up S_2 up – Both parallel
4. S_1 down S_2 down-L_1L_2 series

FOUR CONDITIONS

1. Both off
2. One lamp L_1 bright
3. Both parallel (bright)
4. Both in series (dim)

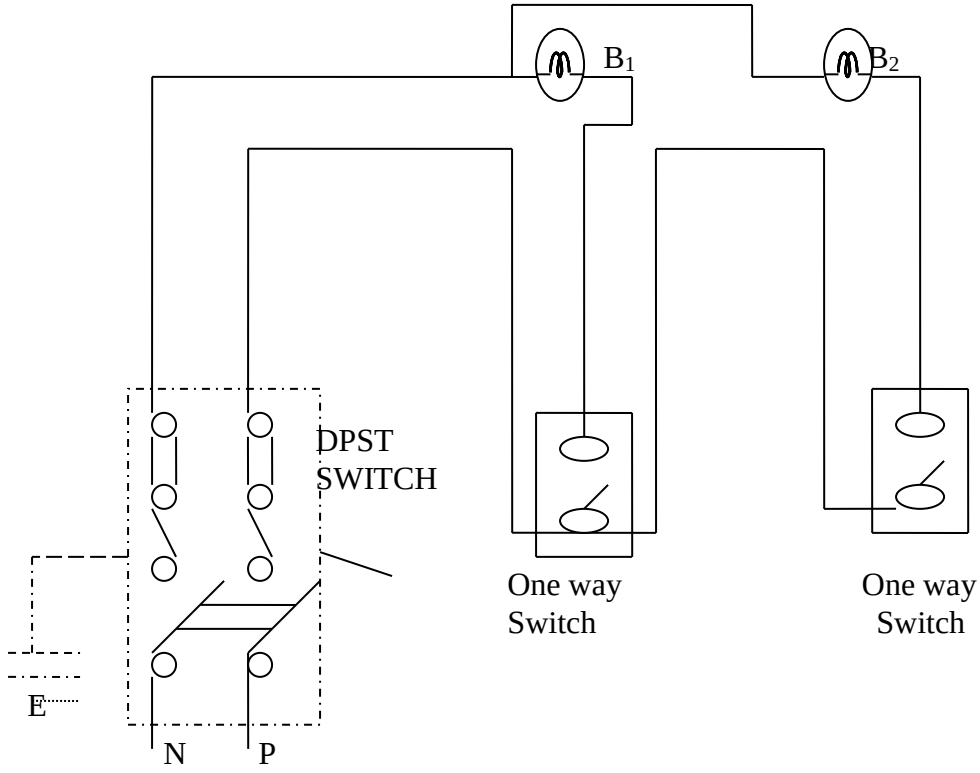
If the switch is put in the circuit as shown fig. fifth condition can be obtained I,e only L_2 will be on.

RESULT:

3. TWO LAMPS CONTROL BY A SINGLE SWITCH

AIM: To give connection to two lights, controlled by one switch in series

APPARATUS: Wooden wiring board, one way switch, wooden round blocks, batten lamp holders, connector screw driver, wires, wire clips, nails, wood screws, poker and bulbs.



TOOLS:

Sl.No.	Tools	Quantity	Materials
1.	Combination plier 15 cm	One No	1) P.V.C Wire 1.5 mm^2
2.	Pocker	One No.	2) Wood Screw 35 mm 50 mm 20 mm 12 mm
3.	Measuring type	One No.	Round block wooden 8.5x3.5
4.	Side cutter	One No.	Neutral link.
5.	Hand drill Machine with 3/16" bit	One No.	Kit Kat fuse

6.	Firmer chisel 20 mm	One No.	One way switches-2 Nos
7.	Screw driver 15cm and 25 cm	One No.	Two Bulbs
8.	Electrician Knife	One No.	DPST switch (Double pole)
9.	Connector screw driver	One No.	Single through switch
10.	Mallet	One No.	Fuse wire 35 SWG
11.	Ball Pin hammer ¼ kg	One No.	G.I. Wire 14 Nos

PROCEDURE:

1) Make the circuit diagram and get it checked

2) With the help of plum bob draw straight lines on the board according to the layout diagram.

3) With the help of scale mark the lines according to the given size

4) Make guide holes for cleats at proper places

5) Fix the cleats loosely

6) Draw the wires into the cleats and tighten the screws of cleats.

7) Make holes in the blocks and boards for holder and switches and pass the wire through these holes.

8) Fix the blocks and boards with two screws on each block and board

9) Fix the switch and holders etc, by doing proper connections

10) Check the wiring with series test lamp or Megger

RESULT:

FOUNDRY
THEORY

SPECIFICATIONS:

The tools and equipment needed for molding are: Molding board, molding flasks (boxes), bellows, shovel, riddle and molder's tools.

Trowel:
It consists of a metal blade fitted into a wooden handle. It is used to smoothen the surface of the mould. It may also be used for repairing the damaged portion of the mold. Trowels are made in many different styles and sizes, each one suitable for a particular job.

Spike or Draw Pin:
If is a pointed steel rod with a loop at the other end. It is used to remove the pattern from the mould. A draw screw, with a threaded end, may also be used for the purpose.

Slick:
It is a small double ended tool having a flat on one end and a spoon on the other. It is used for mending and finishing small surfaces of the mold.

Lifters:
Lifters are made of thin sections of steel of various widths and lengths, with one end bent at right angles. These are used for cleaning and finishing the bottom and sides of the deep and narrow pockets of the mold.

Gate Cutter:
It is a semicircular piece of tin sheet, used to cut gates in the mould. Gates are meant for easy flow of molten metal into the mould.

NOTE A gate is a channel made on the surface of the drag, to connect the sprue hole to the mold cavity. The size of the gate depends upon the size of the mold cavity.

Bellows:
It is a hand tool, used to blow air, to remove the loose sand particles from the mold cavity.

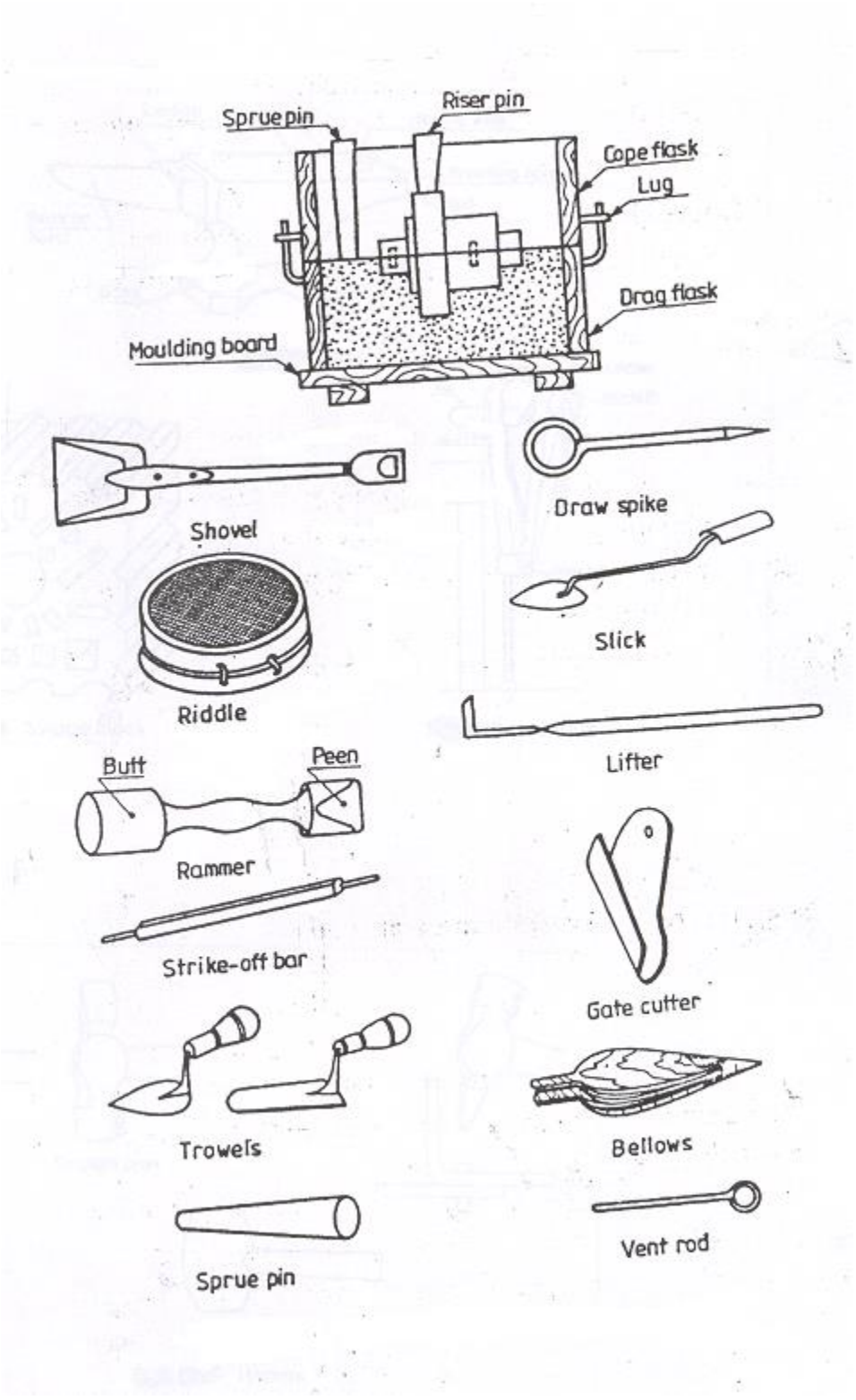
Vent Rod:
It is a thin rod used for making vents or holes in the sand mould to allow the escape of mould gases generated during the pouring of molten metal. .

NOTE:

(i) To make a mold with a split pattern, half of the pattern is rammed-up first in the drag. After inverting the drag and placing the cope in position, place the other half of the pattern over the first half and repeat the rest of the molding procedure. When two pieces of the split pattern are different in sizes, place the largest piece in the drag. Figure 11.4 shows a mold with split or two piece pattern.

(ii) To make a mold with three piece pattern; after completing the drag work, place the middle part of the pattern in position and complete the ramming in cheek before placing the cope and the last part of the pattern. shows the method of molding a three-piece pattern.

(iii) In machine molding, packing / ramming the sand, lifting the pattern, etc., are done by mechanical devices, operated pneumatically.


Sprue pin
Riser pin
Cope flask
Lug
Drag flask
Moulding board
Shovel
Draw spike
Slick
Riddle
Lifter
Butt
Peen
Rammer
Strike-off bar
Gate cutter
Trowels
Bellows
Vent rod
Sprue pin

Foundry practice deals with the process of making castings in moulds, formed in either sand or some other material. The process involves the operations of pattern making, sand preparation, molding, melting of metals, pouring in moulds, cooling, shake-out, fettling, heat treatment, finishing and inspection.

NOTE: Casting is the process of making parts by pouring the molten metal into moulds and allowing them to solidify.

There is no limit to the size and shape of the article to be produced by the casting process. It also offers one of the easiest and most economical methods of producing intricate parts.

Mould is a cavity formed by a pattern. It is similar in shape and size to that of the actual casting plus some allowances for shrinkage, machining, etc. Molding is the process of making moulds.

Moulds are classified as temporary and permanent. Temporary moulds are made of refractory sand and other binding materials and may be produced either through hand molding or machine molding. Permanent moulds are made of ferrous metals and alloys, i.e., cast iron, steel, etc.

In this chapter, manual methods of making green sand moulds are presented. The stages involved in the sand molding process are: Sand preparation, pattern making, core making (if required), molding and closing.

NOTE:(i) Melting furnaces convert the charge materials into the molten state by heating to a temperature above their melting point. Melting furnaces can be fired on liquid, solid or gaseous fuel or heated by electric energy.

(ii) For production requirements, cupola furnace is used for producing molten metal (cast iron)

REVIEW QUESTIONS:

1 List-out the stages involved in a sand molding process.
2 List-out the various operations that are performed under "Foundry Practice".
3 What is a mold and what is meant by molding?
4 Classify the molds and their uses.
5 Differentiate between, "Natural molding sand" and "Synthetic sand".
6 List-out the various types of synthetic binders used in molding sands.
7 What is the part played by binders in molding sand?
8 What is a pattern?
9 What are the various types of patterns that are used in practice?
10 What is a core print?
11 What are the points to be considered while designing a pattern?
12 What is a molding board?
13. What for a draw pin -is used in the molding process?

A SOLID FLANGE (SINGLE PIECE PATTERN)

Expt No.: 1

AIM: To prepare a sand mold cavity of solid flange (single piece pattern).

APPARATUS & TOOLS REQUIRED:

Molding board, drag and cope boxes, molding sand, parting sand, rammer. Strike-off bar, bellows, riser and sprue pins, gate cutter, vent rod and draw spike.

MATERIAL REQUIRED: Moulding sand, parting sand, bentonite, water.

MOULDING COMPOSITION:

Silica Sand – 80 to 90%
Clay – 10 to 12%
Water – 8 to 10%
Additives - 2 to 4%

SEQUENCE OF OPERATIONS:

1. FILLING
2. RAMMING
3. STRIKE-OFF
4. INSPECTION

PROCEDURE:

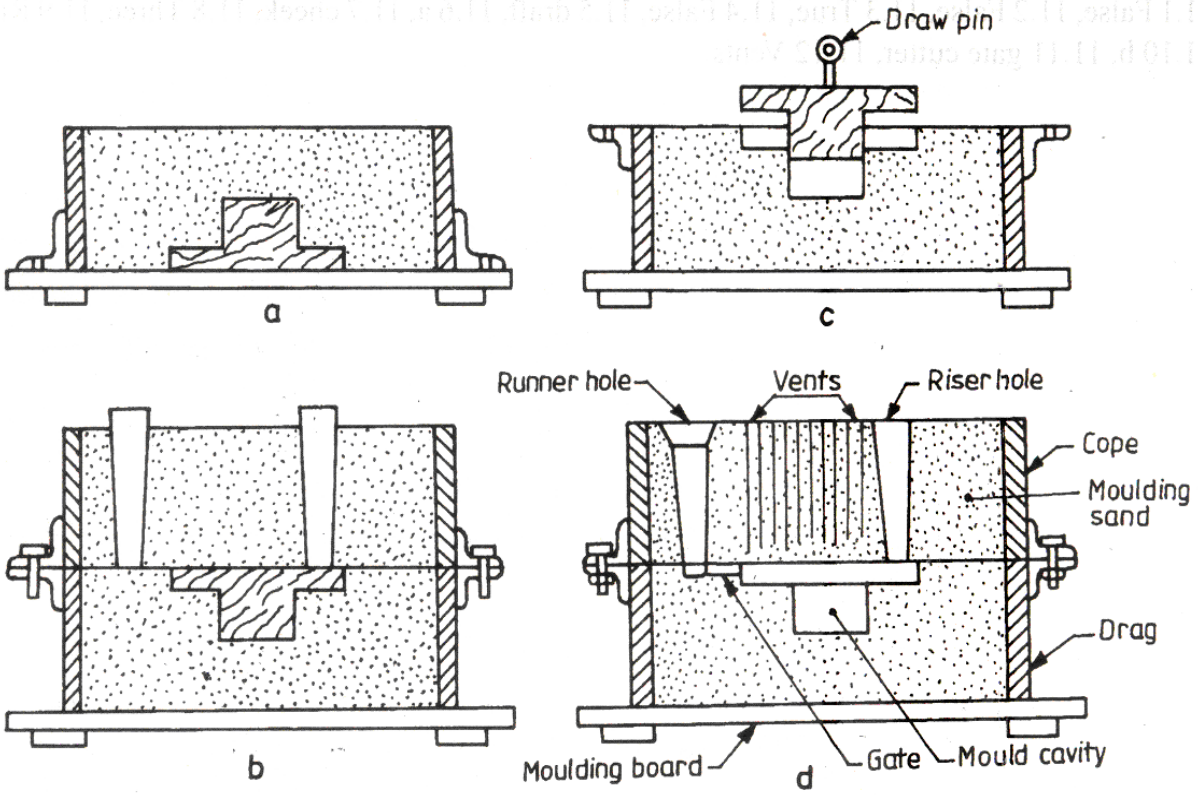
1. The pattern is placed on the molding board, with its flat side on the board.
2. The drag box is placed over the board, after giving it a clay wash inside.
3. Parting sand is sprinkled over the pattern and the molding board.
4. Foundry sand is placed over the pattern, until it is covered to a depth of 20 to 30 mm.
5. Using fingers, sand is packed around the pattern and into the corners of the box.
6. Some more sand is then placed in the box and packed with the rammer, using first, the peen end and then with the butt end.
7. The excess sand from the top surface of the drag is removed by striking-off with the strike-off bar
8. The drag is turned upside down.

9. The loose sand particles are blown-off with the bellows and the surface is smoothened.
10. The cope box is placed in position on top of the drag box, after giving it a clay was inside. The riser pin is then located on the surface of the pattern.
11. The sprue pin is placed at about 50 to 60 mm from the pattern, but on the opposite side of the riser pin.
12. Parting sand is sprinkled on the upper surface.
13. Steps 4 to 7 are repeated, appropriately (Fig)
14. Using a vent rod, holes are made to about 10 mm from the pattern.
15. The sprue and riser pins are removed, by carefully drawing them out. A funnel shaped hole is made at the top of the sprue hole, called pouring basin/cup.
16. The cope is lifted and placed aside on its edge.
17. A draw spike is inserted into the pattern and the edges around the pattern are wetted. Then the pattern is loosened by tapping, and then drawn straight up (Fig)
18. The mold is repaired by adding bits of sand, wherever the mold is found defective.
19. Using a gate cutter, a gate is cut in the drag, from the sprue to the mold.
20. The loose sand particles that are present in the mold are blown-off.
21. The mold is finally closed by replacing the cope on the drag and placing weights on it

SAFETY PRECAUTIONS:

1. Do not let the sand too wet. Water is an enemy of molten metals.
2. Pattern should be removed slowly and carefully because the size of the mould may become more.
3. While working with molten metal, wear protective clothing.
4. Provide adequate ventilation to remove smoke and fumes.

RESULT: The sand mold for a solid flange is thus made, which is ready for pouring the molten metal.



Mold for a solid flange

STEPPED GROVE PULLEY (SPLIT PATTERN)

EXPT NO.: 2

AIM: To prepare a sand Mould cavity for stepped groove pulley:

APPARATUS & TOOLS REQUIRED:
Molding board, drag and cope boxes, molding sand, parting sand, rammer, strike-off bar, bellows, riser and sprue pins, gate cutter, vent rod and draw spike.

MATERIAL REQUIRED: Moulding sand, parting sand, bentonite, water.

MOULDING COMPOSITION:

Silica Sand – 80 to 90%
Clay – 10 to 12%
Water – 8 to 10%
Additives - 2 to 4%

SEQUENCE OF OPERATIONS:

1. FILLING
2. RAMMING
3. STRIKE-OFF
4. INSPECTION

PROCEDURE:

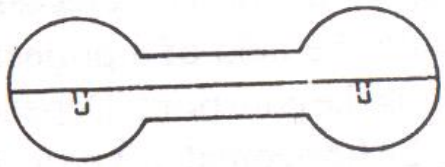
1. One half of the pattern is placed on the molding board with its flat side on the board.
2. The drag box is placed over the board, after giving it a clay wash inside. Parting sand is sprinkled over the pattern and the molding board.
3. Foundry sand is placed over the pattern, until it is covered to a depth of20 to 30 mm. Using fingers, sand is packed around the pattern and into the comers of the box.
4. Some more sand is then placed in the box and packed with the rammer, using first the peen end and then with the Butt end.
5. The excess sand from the top surface of the drag is removed with the strike-off bar. The drag is turned upside down.
6. The loose sand particles are blown-off with the be1lows and the surface is smoothened.
7. The second half of the pattern is located over the first half, using the dowel pins.
8. The cope box is placed in position on top of the drag box, after giving it a clay wash

9. The runner and the riser are placed at appropriate positions
10. Foundry sand is placed over the pattern, until it is covered to a depth of20 to 30 mm. Using fingers, sand is packed around the pattern and into the comers of the box.
11. Some more sand is then placed in the box and packed with the rammer, using first the peen end and then with the. Butt end.
12. The excess sand from the top surface of the drag is removed with the strike-off bar. The drag is turned upside down.
13. The loose sand particles are blown-off with the be1lows and the surface is smoothened.
14. Runner and riser are removed from cope box and sprue is prepared.
15. Cope box is removed from the assembly.
16. The pieces of the pattern are removed from the mold boxes using draw spike
17. Gates and runners are cut to get the complete molding

SAFETY PRECAUTIONS:

1. Do not let the sand too wet. Water is an enemy of molten metals.
2. Pattern should be removed slowly and carefully because the size of the mould may become more.
3. While working with molten metal, wear protective clothing.
4 Provide adequate ventilation to remove smoke and fumes.

RESULT: Sand Mould was prepared for the given split pattern



b - Split pattern

GROOVED PULLEY

EXPT NO.:3

AIM: To prepare a sand mold cavity of a grooved pulley. (split pattern with core)

Note: Groove pulley is used as an element in power transmission through V – belt drive.

APPARATUS&TOOLS REQUIRED:

Molding board, drag and cope boxes, core box, molding sand, core sand, parting sand, rammer, strike-off bar, bellows, riser and sprue pins, gate cutter, vent rod and draw spike.

MATERIAL REQUIRED: Moulding sand, parting sand, bentonite, water.

MOULDING COMPOSITION:

Silica Sand – 80 to 90%
Clay – 10 to 12%
Water – 8 to 10%
Additives - 2 to 4%

SEQUENCE OF OPERATIONS:

1. FILLING
2. RAMMING
3. STRIKE-OFF
4. INSPECTION

PROCEDURE:

1. Using the core box and core sand, the core is prepared and kept aside safely.
2. One half of the pattern is placed on the molding board with its flat side on the board.
3. The drag box is placed over the board, after giving it a clay wash inside.
4. Parting sand is sprinkled over the pattern and the molding board.
5. Foundry sand is placed over the pattern, until it is covered to a depth of 20 to 30 mm.
6. Using fingers, sand is packed around the pattern and into the corners of the box.
7. Some more sand is then placed in the box and packed with the rammer, using first, the peen end and then with the butt end.

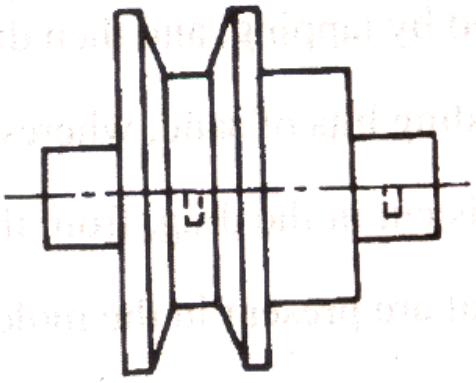
Note: As the height of the pattern is more compared to its lateral dimension; the sand around the pattern must be packed, using fingers till the pattern is covered with the sand.

8. The excess sand from the top surface of the drag is removed by strike-off bar
9. The drag is turned upside down.
10. The loose sand particles are blown-off with the bellows and the surface is smoothened.
11. The second half of the pattern is located over the first half, using the dowel pins.
12. The cope box is placed in position on top of the drag box, after giving it a clay was inside. The riser pin is then located on the surface of the pattern.
13. The sprue pin is placed at about 50 to 60 mm from the pattern, but on the opposite side of the riser pin.
14. Parting sand is sprinkled on the upper surface.
15. Steps 5 to 8 are repeated, appropriately
16. Using a vent rod, holes are made to about 10 mm from the pattern.
17. The sprue and riser pins are removed, by carefully drawing them out. A funnel shaped hole is made at the top of the sprue hole, called pouring basin/cup.
18. The cope is lifted and placed upside down on another molding board.
19. Using a draw spike and wetting the edges around the split pattern in both the molding boxes, the patterns are loosened by tapping and then drawn straight up.
20. The mold is repaired by adding bits of sand, wherever the mold is found defective.
21. Using a gate cutter, a gate is cut in the drag, from the sprue to the mold cavity.
22. The loose sand particles that are present in the mold are blown-off.
23. The core is positioned in the mold cavity carefully.
24. The mold is finally closed by replacing the cope on the drag and placing weights on it (Fig)

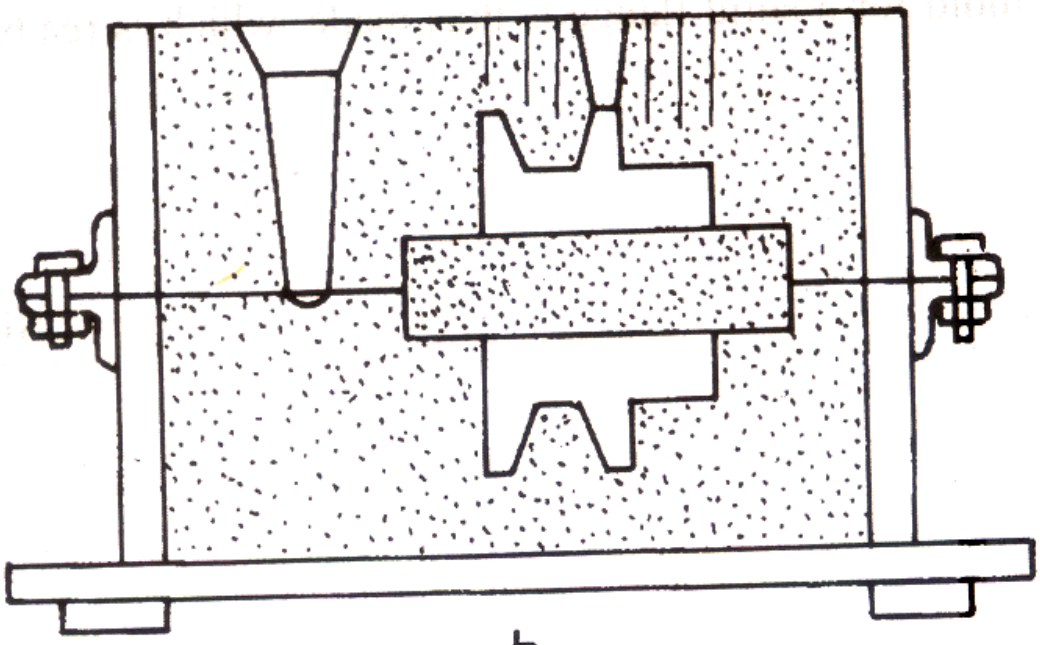
SAFETY PRECAUTIONS:

1 Do not let the sand too wet. Water is an enemy of molten metals.
2 Pattern should be removed slowly and carefully because the size of the mould may become more.
3 While working with molten metal, wear protective clothing.
4 Provide adequate ventilation to remove smoke and fumes.

RESULT: The sand mold for the grooved pulley is thus made, which is ready for during the molten metal.



a- Split pattern



b

Mold for a grooved pulley

Experiment 1

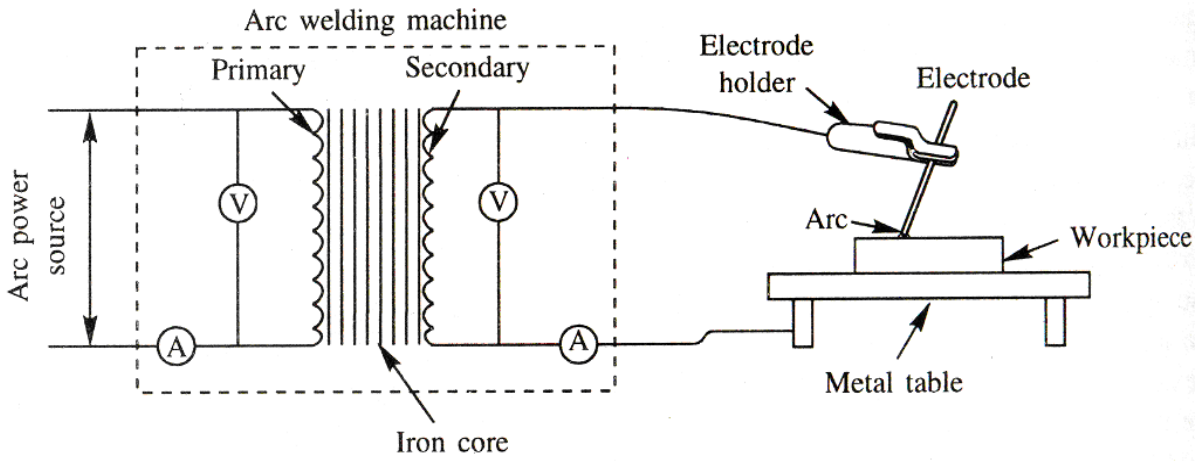
ARC WELDING – LAP JOINT

I AIM

To study the effect of polarity on weld strength and heat effected zone in Arc welding.

II EQUIPMENT & MATERIAL REQUIRED

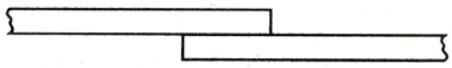
D.C. welding Machine (input supply voltage 230 V, single phase, 50 hertz frequency, maximum welding current 200 amps.) Bench vice Tensile testing machine, metallurgical microscope, M.S. plates of 100X50X5 mm (2 Nos.)



Sectional view of representation of the arc welding setup

III TOOLS REQUIRED

Hack saw, chipping hammer, wire brush, safety goggles, hand gloves, face shield, files.



Lap joint

IV WELDING TEMINOLOGY

The terminology of welding is shown in the figure

Backing: It is the material support provided at the root side of a weld to aid in the control of penetration.
Base Metal: The metal to be joined or cut is termed as the base metal.

Bead or weld bead: Bead is the metal added during a single pass of welding. The bead appears as a separate material from the base metal.

Crater: In are welding, a crater is the depression in the weld metal pool at the pint where the are strikes the base metal plate.

Deposition rate: The rate at which the weld metal is deposited per unit time, is the deposition rate and is normally expressed as kg/h.

Fillet weld: The meal fused into the corner of a joint made of two pieces placed at approximately 90^0 to each other is termed fillet weld.

Penetration: It is the depth up to which the weld metal combines with the base metal as measured from the top surface of the joint.

Puddle: The portion of these weld joint that melted by the heat of welding is called puddle.

Root: It is the point at which the two pieces to be joined by welding are nearest.

Tach Weld: A small weld, generally used to temporally hold the two pieces, together during actual welding, is the tack weld.

Weld face: It is the exposed surface of the weld.

Weld metal: The metal that is solidified in the joint is called weld metal. It may be only base metal or a mixture of base metal and filler metal.

Weld pass: A single movement of the welding torch or electrode along the length of the joint which results in a bead, is a weld pass.

V DESCRIPTION

Principle of Arc: An arc is generated between two conductors of electricity, cathode and anode (considering direct current, DC), when they are touched to establish the flow of current and then separated by a small distance. An arc is a sustained electric discharge through the ionized gas column called plasma between the two electrodes. Electrons liberated from the cathode move towards the anode and are accelerated in their movement. When they strike the anode at high velocity, large amount of heat is generated. In order to produce the arc the potential difference between the two electrodes should be sufficient to allow them to move across the air gap. The larger air gap requires higher potential differences. If the air gap becomes to large for the voltage the arc may be extinguished.

Straight and Reverse Polarity: When more heat is required at the work piece side for welding thicker sheets or for the work materials which have high thermal conductivity such as aluminum and copper the work is made as anode liberating the large heat near it. This is termed as straight

polarity or DCEN. This gives rise to higher penetration required in thick work pieces. However for the thinner materials where less heat is required in the weld zone the polarity is reversed making the work negative. This is termed as reversed polarity or DCEP. In reverse polarity the penetration is small.

Selection of Electrodes: The electrodes for welding operation should be selected properly depending on the requirements of the welding. The main points to be considered are

1. The composition of the base metal which determines the electrode composition.
2. The tensile strength of the required joint.
3. The thickness of the base metal. For thinner metals the current setting should be lower.
4. The required metal deposition rate.
5. The type of the arc welding equipment used.
6. The weld position (flat, horizontal, vertical, overhead.) A flat position can accommodate large size electrode.
   The electrodes are marked with six digits numeral associated by a prefix, and suffix. The meaning of these and various values it can take is shown in the figure.

Electrode sizes based on metal thickness to be welded is given in the table shown below:

Weld Position	**Metal thickness (mm)**	**Electrode diameter (mm)**	**Root Electrode diameter (mm)**
All	3 to 6	3.2	-
Down hand	6 9 12 12 16 16 20 to 25	4 6 8 6 8 6 9	- 4 4 5 5 5 5
Vertical	6 8 to 12 16 to 20 25	3.24 5 5	- 3.2 4 5
Weld Position	**Metal thickness (mm)**	**Electrode Diameter (mm)**	**Root Electrode Diameter (mm)**
Horizontal	6 to 9 12 to 20 25	4 6 6	3.2 4 5

Heat Affected Zone: A heat effected zone (HAZ) of a weld is the part of welded joint which has been heated to temperature up to the solidus of the parent material resulting in varying degree of micro structure as a consequence of heating and cooling cycle. When the metals and alloys without polymorphous transformation (Cu, Ni, Ai) are welded, the micro structure in the HAZ remains unaltered through grain growth or recrystalization may takes place, while in the case of metals and alloys with polymorphous transformation (steels) significant microstructure changes

take place in HAZ that in turn influence the mechanical properties and consequently the service behaviour of the welded joint.

Tensile Test: Tensile tests are carried out to determine the ultimate tensile strength under static loading of the base metal, weld metal on the welded joint. To determine the tensile strength of the joint usual procedure of finding tensile strength is used.

VI PROCEDURE

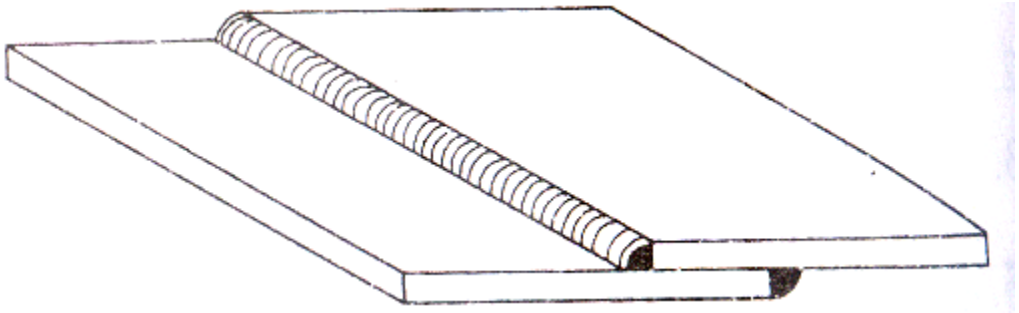
1. Given two MS plates are filed at an angle of 45 degrees at the surfaces to be joined. (V – groove is formed when we put two pieces together)
2. The electrodes is to be fixed in the electrode holder.
3. The connections to be given such that electrode is negative and work piece is positive
4. Now welding is to be done carefully for the half length of the plates.
5. The work piece is to be cut in to two half by power hack saw.
6. The beads are polished, etched with two percent natal solution and studied under the microscope whose magnification factor X 10 for heat effected zone.
7. By gripping the beads between the jaws of Tensile testing machine and load is applied until the work piece breaks and the reading is to be noted.
8. The same procedure is repeated for the remaining half which is welded by the reversed polarity and the results are to be compared.

VII PRECAUTIONS

1. Edge preparation should be done very carefully.
2. Before welding ensure that the surfaces are extremely clean
3. While welding always use face shield or goggles.

VIII REVIEW QUESTIONS

1. What is a weld bead?
2. Write the deference between lap and butt joint?
3. What is DCEN?
4. What is DCEP?
5. When do we use DCSP and DCEP?
6. What is the effect of polarity on weld strength and HAZ?



Experiment 2

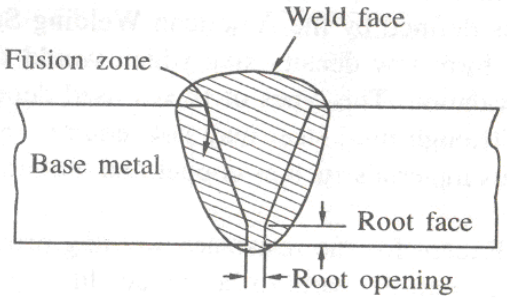
ARC WELDING – BUTT JOINT

I AIM

To study the effect of polarity on weld strength and heat effected zone in Arc welding.

II EQUIPMENT & MATERIAL REQUIRED

D.C. welding Machine (input supply voltage 230 V, single phase, 50 hertz frequency, maximum welding current 200 amps.) Bench vice Tensile testing machine, metallurgical microscope, M.S. plates of 100X50X5 mm (2 Nos.)



(a) Butt weld

III TOOLS REQUIRED

Hack saw, chipping hammer, wire brush, safety goggles, hand gloves, face shield, files.

IV PROCEDURE

1. Given two MS plates are filed at an angle of 45 degrees at the surfaces to be joined. (V – groove is formed when we put two pieces together)
2. The electrodes is to be fixed in the electrode holder.
3. The connections to be given such that electrode is negative and work piece is positive
4. Now welding is to be done carefully for the half length of the plates.
5. The work piece is to be cut in to two half by power hack saw.
6. The beads are polished, etched with two percent natal solution and studied under the microscope whose magnification factor X 10 for heat effected zone.
7. By gripping the beads between the jaws of Tensile testing machine, load is applied until the work piece breaks and the reading is to be noted.
8. The same procedure is repeated for the remaining half which is welded by the reversed polarity and the results are to be compared.

V PRECAUTIONS

1. Edge preparation should be done very carefully.
2. Before welding ensure that the surfaces are extremely clean
3. While welding always use face shield or goggles.

VI. REVIEW QUESTIONS

1. What is a weld bead?
2. Write the deference between lap and butt joint?
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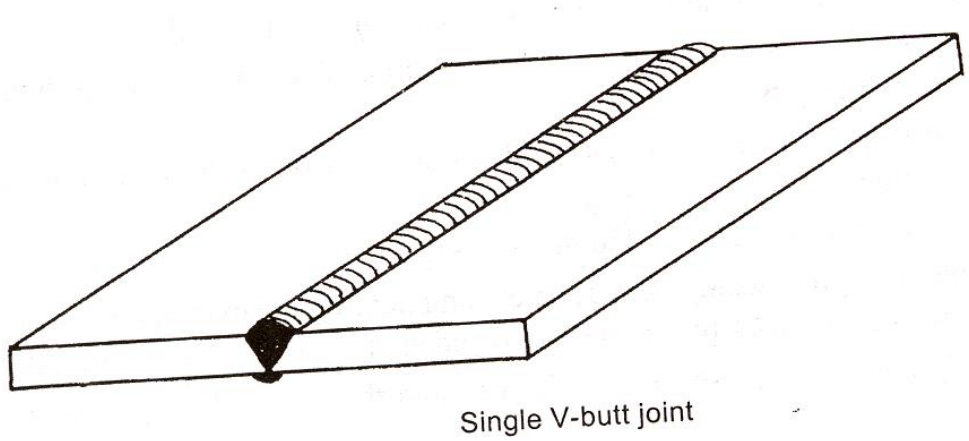


Single V-butt joint

WOOD WORKING

Introduction

Wood turning has had a definite place in the commercial world for a great many years. It is used in various forms in making furniture and furniture parts, building trim, tool parts, toys, athletic paraphernalia and many other useful and beautiful articles in common use.

THE LATHE

The sizes of turning lathes are given as 10", 12", etc. These figures denote the diameter, or size, of the largest piece of work that can be turned on them. The measurement is taken from the center point of the live center to the bed of the lathe (usually 5" or 6") and is one-half the diameter of the entire circle. The length of a lathe is determined by the length of a piece of work that can be turned. This measurement is taken from the points of the live and dead centers when the tail stock is drawn back the full extent of the lathe bed. Fig. 1 shows a turning lathe with sixteen principal parts named. The student should learn the names of these parts and familiarize himself with the particular function of each.

CARE OF THE LATHE

The lathe should be oiled every day before starting. At the end of the period the lathe should be brushed clean of all chips and shavings, after which it should be rubbed off with a piece of waste or cloth to remove all surplus oil. All tools should be wiped clean and put in their proper places. If a student finds that his lathe is not running as it should, he should first call the attention of the instructor to that fact before attempting to adjust it; and then only such adjustments should be made as the instructor directs.

SPEED OF THE LATHE

The speed of the lathe should range from 2400 to 3000 revolutions per minute when the belt is on the smallest step of the cone pulley. At this speed stock up to 3" in diameter can be turned with safety. Stock from 3" to 6" in diameter should be turned on the second or third step, and all stock over 6" on the last step. The speed at which a lathe should run depends entirely upon the nature of the work to be done and the kind of material used. Pieces that cannot be centered accurately and all glued-up work with rough corners should be run slowly until all corners are taken off and the stock runs true. At high speed the centrifugal force on such pieces is very great, causing the lathe to vibrate, and there is a possibility of the piece being thrown from the lathe thus endangering the worker as well as those around him. After the stock is running true the speed may be increased.

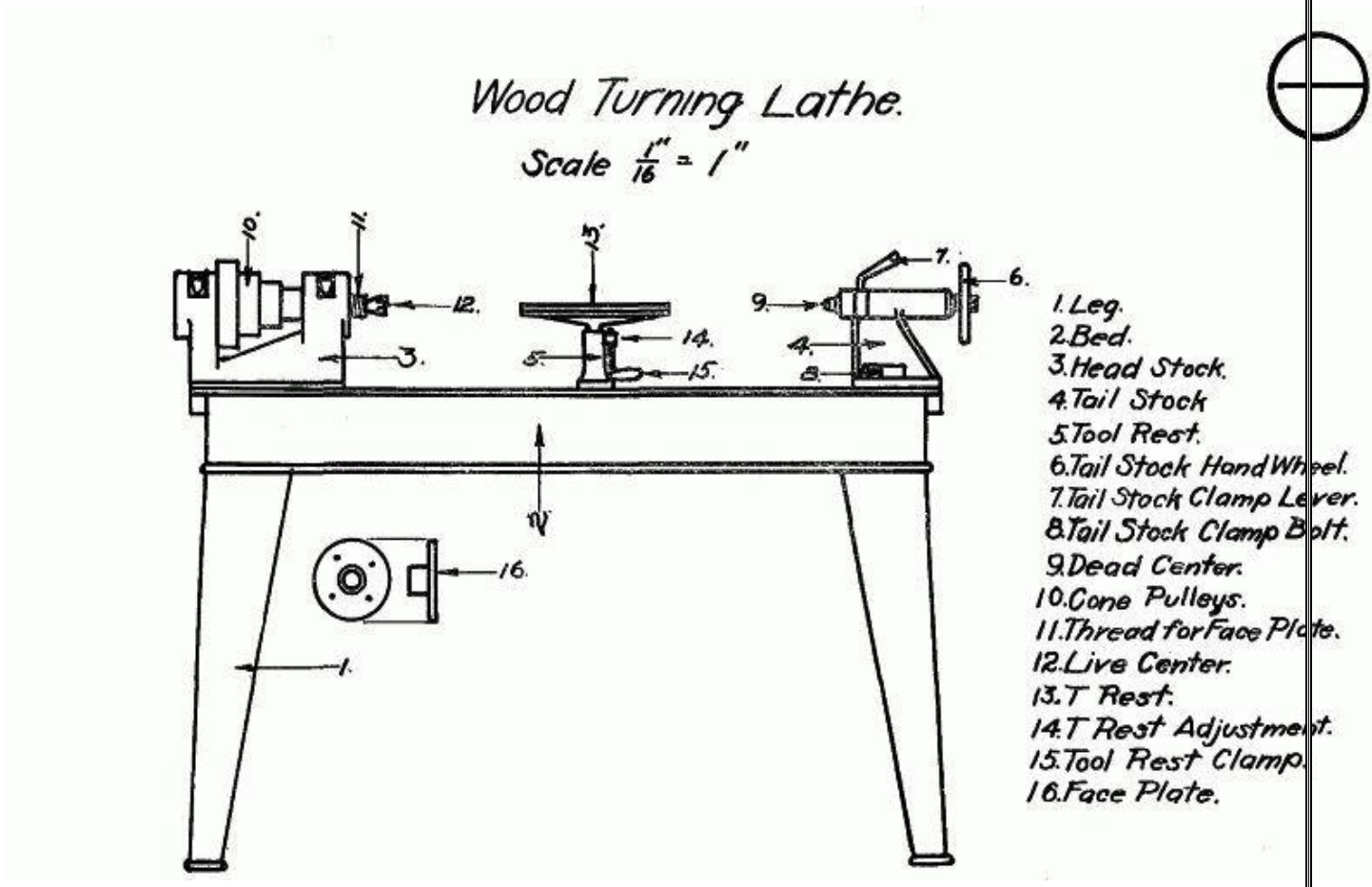


Fig. 1. - Wood Turning Lathe

WOOD TURNING TOOLS

A wood turning kit should consist of one each of the following tools. Fig. 2 shows the general shape of these tools.

1¼"Gouge
¾"Gouge
½"Gouge
¼"Gouge
1¼"Skew
¾"Skew
½"Skew
¼"Skew
⅛"Parting Tool
½"RoundNose
¼"RoundNose
½"SquareNose
¼"SquareNose
½"SpearPoin
½"RightSkew
½"LeftSkew
Slip Stone with round edges
6"InsideCalipers
8"Dividers
12"Rule
½pt.OilCan
Bench Brush

GRINDING AND WHETTING TURNING TOOLS

Skew Chisel

The skew chisel is sharpened equally on both sides On this tool the cutting edge should form an angle of about 20° with one of the edges. The skew is used in cutting both to the right and to the left, and therefore, must be beveled on both sides. The length of the bevel should equal about twice the thickness of the chisel at the point where it is sharpened. In grinding the bevel, the chisel must be held so that the cutting edge will be parallel to the axis of the emery wheel. The wheel should be about 6" in diameter as this will leave the bevel slightly hollow ground. Cool the chisel in water occasionally when using a dry emery. Otherwise the wheel will burn the chisel, taking out the temper; the metal will be soft and the edge will not stand up. Care should be exercised that the same bevel is kept so that it will be uniformly hollow ground. The rough edge left by the emery wheel should be whetted off with a slip stone by holding the chisel on the flat side of the stone so that the toe and heel of the bevel are equally in contact with it. Rub first on one side and then on the other. The wire edge is thus worn off quickly as there is no metal to be worn away in the middle of the bevels. The chisel is sharp when the edge, which may be tested by drawing it over the thumb nail, is smooth and will take hold evenly along its entire length. If any wire edge remains it should be whetted again.

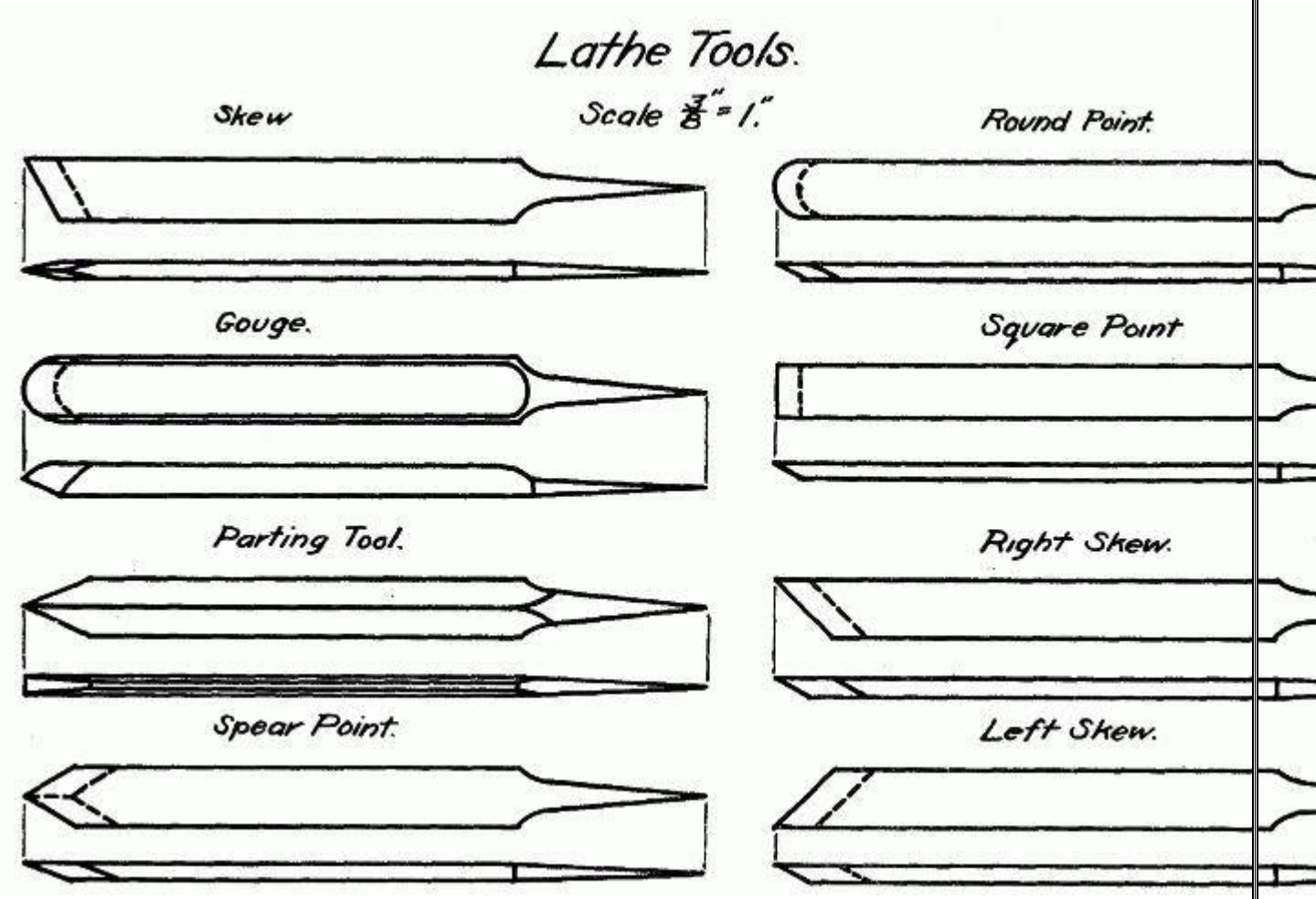


Fig. 2. - Lathe Tools

Gouge

The gouge used in wood turning is beveled on the outside and is ground so that the nose is approximately semi-circular in shape. The tool is a combination of the round nose chisel and the ordinary gouge. The bevel should extend well around to the ends so that the cutting edge extends to each side. This is necessary to avoid the abrupt corners which would be present if the nose were left straight across as in the ordinary wood-working gouge. In making shearing cuts the round nose permits the tool to be rolled to the side to avoid scraping the work. The length of the bevel should be about twice the thickness of the blade at the point where the sharpening begins.

The sharpening of a gouge for turning is rather difficult for the average student. The ordinary gouge which has a square nose may be beveled by merely turning it half way around and back again. In working out the round nose of a gouge for wood turning, it is necessary that the handle be swung from one side to the other while, at the same time, the chisel is revolved to cut the bevel evenly. It is sometimes necessary to allow some pupils to use the side of the emery wheel in sharpening the gouge. This kind of grinding, however, does not leave the tool hollow ground as when the face of the wheel is used.

To complete the sharpening the rough edge is worked smooth on a slip stone, the cross section of which is wedge-shaped and the edges of which are rounded. The toe and heel of the beveled side of the gouge are brought into contact with the flat side of the stone. As the sharpening proceeds the wire edge is worked to the inside of the gouge. The rounded edge of the stone is then placed inside the gouge and is worked back and forth until the rough edge disappears. Great care must be taken not to bevel the inside of the gouge when whetting with the round edges of the stone, as the result will be the same as with an ordinary chisel or plane bit.

Parting Tool

The parting tool is sharpened on both sides. This tool differs from the ordinary chisel in that it is between ⅝" and ¾" thick and only about ?" wide at the widest point, which is in the center of its entire length. The bevels must meet exactly at the center, or the widest point, and should make an angle of about 50° with each other. If the bevels do not meet at the widest point the tool will not clear, and the sides will rub against the revolving stock; the tool will be burned and will thus lose its temper. The bevel should be hollow ground slightly as then comparatively little metal need be removed when whetting.

Scraping Tools

The round nose, square nose, spear point, right skew and left skew are scraping tools, used chiefly in pattern work and sometimes in face-plate work. They are sharpened on one side only, and the bevel is about twice the thickness of the chisel at the point where sharpened. These tools should be slightly hollow ground to facilitate the whetting. Scraping tools become dull quite easily as their edges are in contact with the wood almost at right angles. After sharpening, the edges of these tools may be turned with a burnisher or the broad side of a skew chisel in the same manner that the edge of a cabinet scraper is turned though not nearly to so great a degree. This will help to keep the tool sharp for, as the edge wears off, the tool sharpens itself to a certain extent. The chisel is of harder material than a cabinet scraper so that it will not stand a great amount of turning over on the edge. Small pieces will be broken out, unless a flat surface is rubbed against the edge at a more acute angle than was used in the whetting. If a narrow burnisher is used, pieces are more likely to be broken out from the sharp edge and thus make the tool useless.

SPINDLE TURNING

Spindle turning is the term applied to all work done on a lathe in which the stock to be worked upon is held firmly between the live and dead centers. There are two methods in common use in wood turning: first, the scraping or pattern-makers' method; and second, the cutting method. Each has its advantages and disadvantages, but it is necessary that both be learned in order to develop a

well rounded turner. Care should be exercised, however, that each method be used in its proper place. The first is slower, harder on the cutting edge of tools, and less skill is required to obtain accurate work; the second is faster, easier on the cutting edge of tools, and the accuracy of results obtained depends upon the skill acquired. As skill is the one thing most sought for in high school work, the use of the cutting method is advocated entirely for all spindle turning and, with but few exceptions, for face-plate and chuck turning.

TO CENTER STOCK

If the wood to be turned is square or rectangular in shape the best way to locate the center is to draw diagonals across the end of the stock. The point of intersection locates the center.

CLAMPING STOCK IN THE LATHE

Take the live center from the spindle and with a wooden mallet drive the spur deep into the wood. Never drive the wood onto the live center while in the spindle because serious injury may be done the machine by such practice. When extremely hard wood is being used, it is a good practice to make saw cuts along the diagonal lines and bore a hole at the intersection, thus allowing the spur to enter the wood more freely. Oil the other end of the wood while holding it in a vertical position, and give the oil a chance to penetrate into the wood. Then replace the live center by taking the stock and center and forcing it into the spindle by a sudden push of the hand. The tail stock is then moved about ½" to 1" from the end of the piece to be turned, having the tail spindle well back in the tail stock. The tail stock is then clamped to the lathe bed. Turn the tail stock hand wheel until the wood is held firmly. Work the cone pulley by hand at the same time, so that the cup or dead center will be forced deeply into the wood, so deeply that the live center will not continue to turn. Now turn the dead spindle back until the live spindle begins to turn freely and clamp the dead spindle fast.

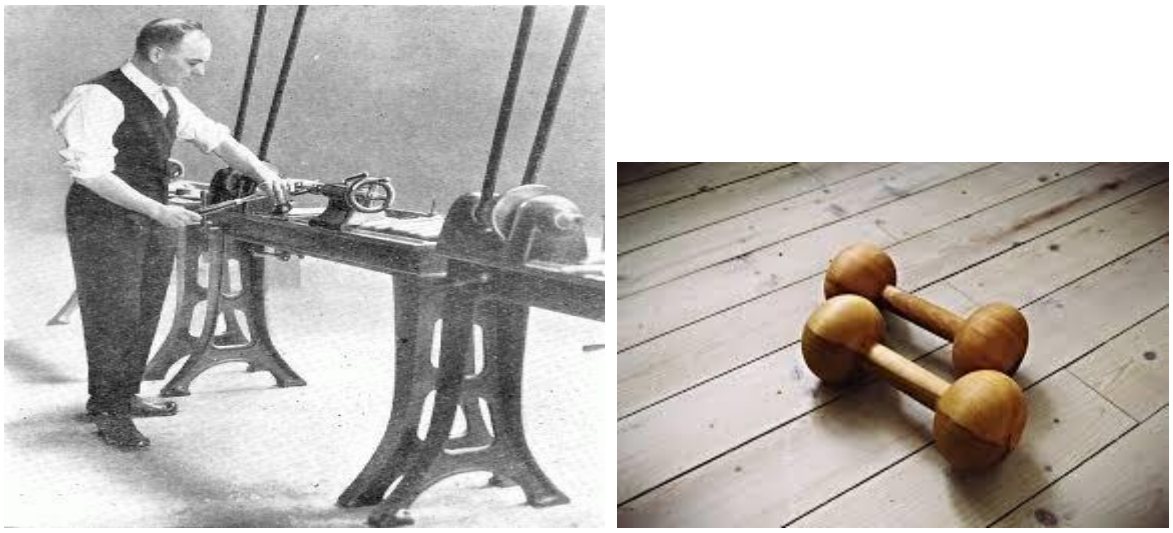


Fig. 3

ADJUSTING THE TOOL REST

Horizontally the tool rest should be set about ⅛" from the farthest projecting corner of the wood and should be readjusted occasionally as the stock diminishes in size. The vertical height varies slightly according to the height of the operator. It is even with the center of the spindle for a short person; ⅛" above for a medium person; and ¼" above for a tall person. So long as the stock is in its square form the tool rest should never be adjusted while the machine is in motion as there is danger of the rest catching the corners and throwing the stock from the machine. Also see that everything is clamped tight before starting the lathe.

POSITION OF THE OPERATOR

The operator stands firmly on the floor back far enough from the lathe to allow him to pass the tools from right to left in front of his body without changing the position of the feet. It may be found convenient to turn slightly, bringing the left side of the body a little closer to the lathe. In no case, however, should the tools be brought in contact with the body as the cutting operation from right to left should be accomplished by a movement of the arms alone and not the swaying of the body. (Fig. 3.)

HOLDING THE TOOLS

All tools should be held firmly but not rigidly. The right hand should grasp the handle at the extreme end for two reasons: first, to give as much leverage as possible so that the tool will not be thrown from the hands in case it should catch in the wood; second, a slight wavering of the hand will not cause as much variance in the cuts as when held closer up to the rest. The left hand should act as a guide and should be held over the tool near the cutting edge. The little finger and the back part of the palm of the hand should touch the tool rest thus assuring a steady movement. The left hand should not grasp the tool at any time. (Fig. 3.)

DUMBBELLS

Expt. No.:1

AIM: To make Dumbbells

TOOLS REQUIRED: Skew Chisel, Gouge, Parting Tool, Scraping Tools, Round point, square point, and Right skew, left skew.

MATERIAL REQUIRED: wood pieces.

PROCEDURE

1. With the Power Switch in its "OFF" position and the Lathe unplugged from its electrical outlet, make all necessary adjustments to the machine as previously discussed.
2. To set up a spindle turning operation, mark both ends of the workpiece by drawing diagonal lines from corner to corner. The intersection point of these two lines will indicate the center of the workpiece.
3. Use a wood mallet and punch to tap the point of the center of the workpiece so that it leaves a center mark.
4. Use a 1/8" drill bit to drill a 3/16" deep hole at the center mark on the workpiece.
5. Cut the corners off the workpiece if it is over 2" x 2" to make turning safer and easier.
6. Use a wood mallet to drive the Headstock Spur Center into the center of the workpiece at least 1/4" deep.
7. With the workpiece still attached, insert the Headstock Spur Center into the Headstock Spindle.
8. With the Cup Center installed in the Tailstock, slide the Tailstock toward the workpiece until the Cup Center touches the workpiece center point. The lock the Tailstock in position.
9. Use the Tailstock Hand wheel to push the Cup Center into the workpiece at least 1/4".
10. Position the Tool Rest approximately 1/4" away from the workpiece and approximately 1/8" above the center line.
11. Make sure to test the set up by hand turning the workpiece to ensure there is enough clearance all the way around before starting.
12. Find the center of the workpiece in the same way as when spindle turning.

13. Center the Faceplate on the workpiece and attach it through the Faceplate mounting holes with no tapered head wood screws.

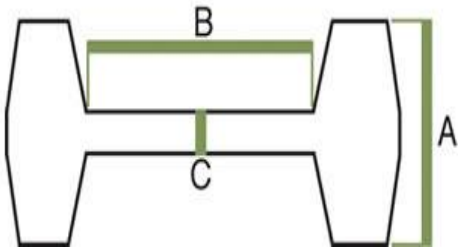
14. After turning, the workpiece can be sanded and finished before removing it from the Lathe. IMPORTANT: Whenever sanding or finishing, remove the Tool Rest to increase safety and gain adequate working room.

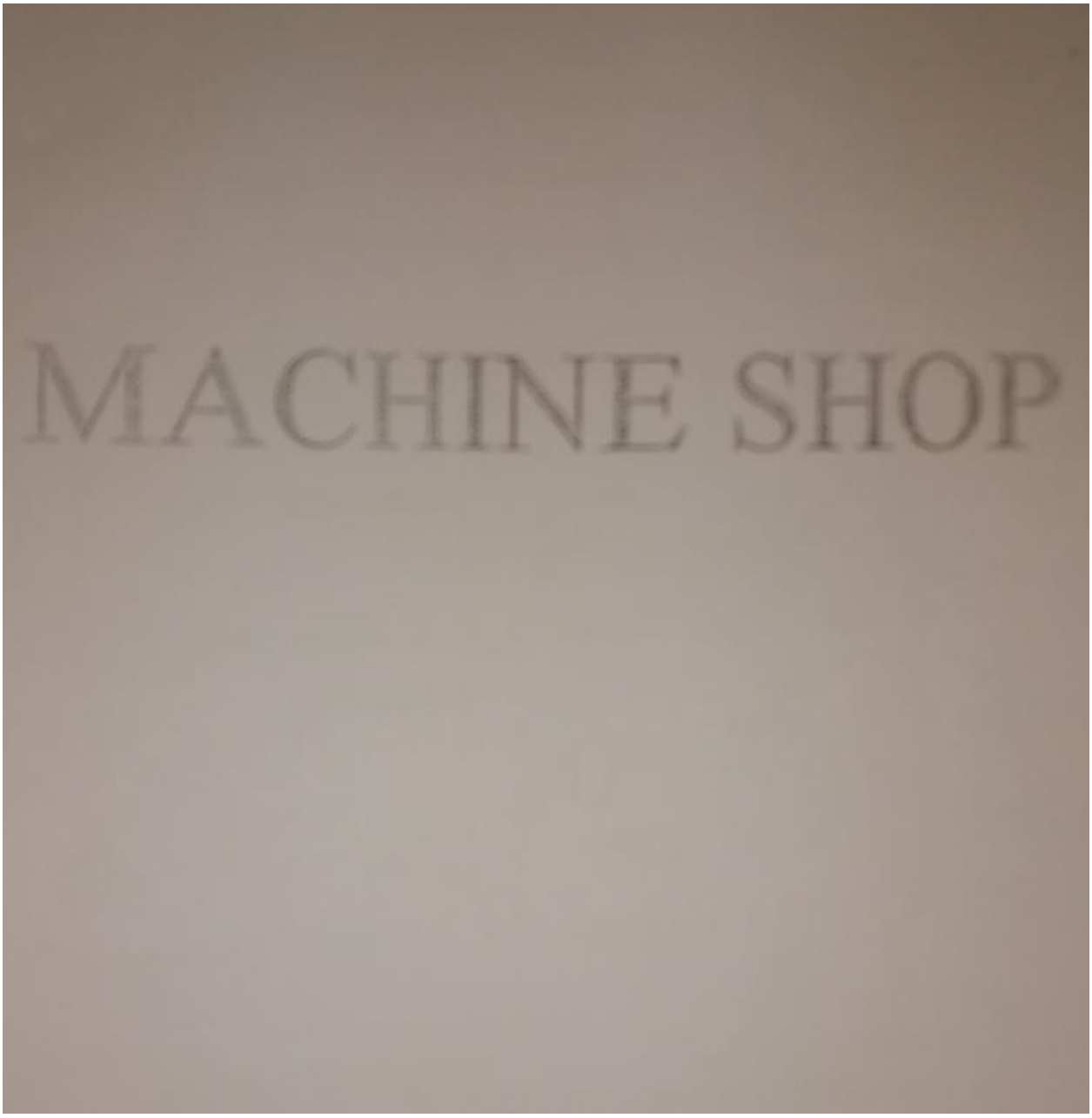
Dumbbells

A. End Size

B. Bit Width

C. Bit Diameter




MACHINE SHOP

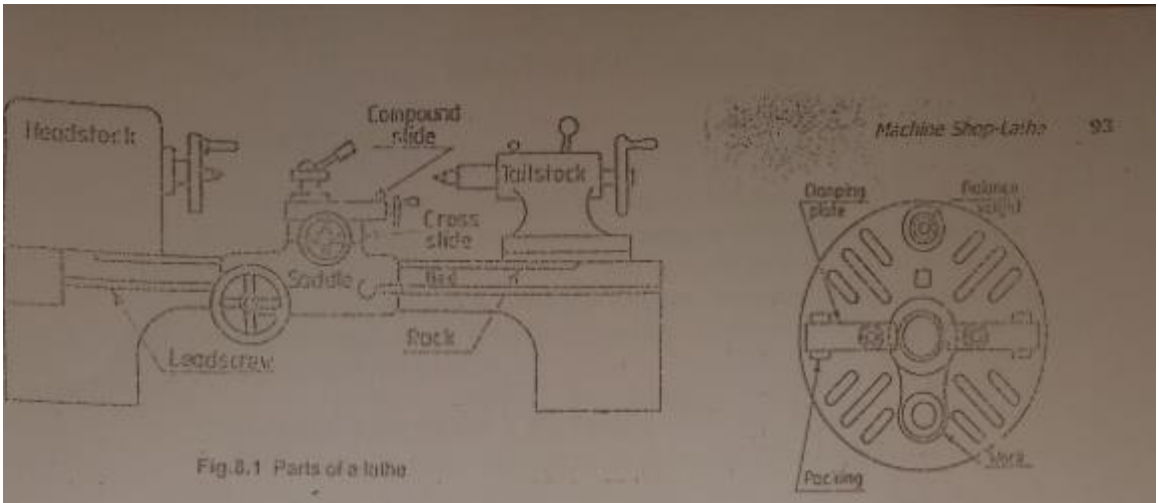


Fig.8.1 Parts of a lathe

Fig.8.3 Face Plate

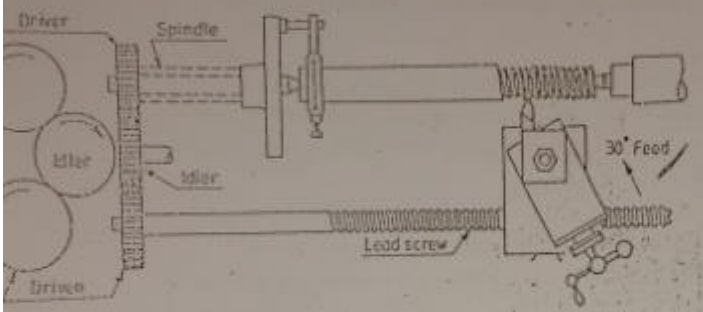


Fig.8.11 Threading

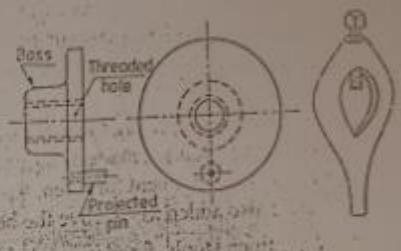


Fig.8.4 Drive plate and dog

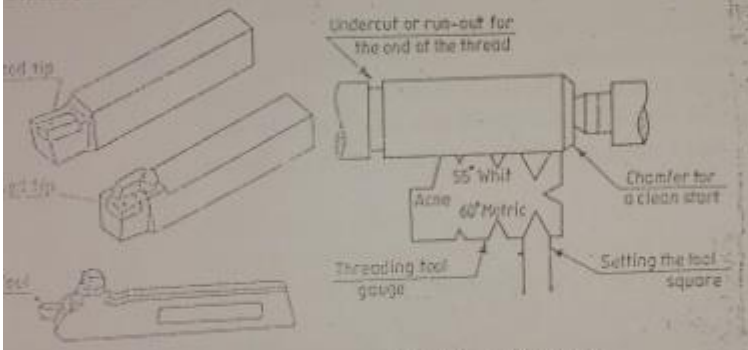
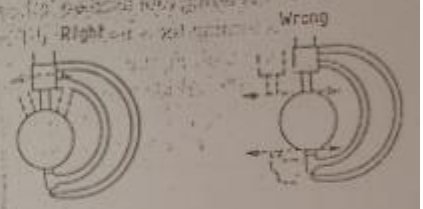


Fig.8.12 Centre gauge



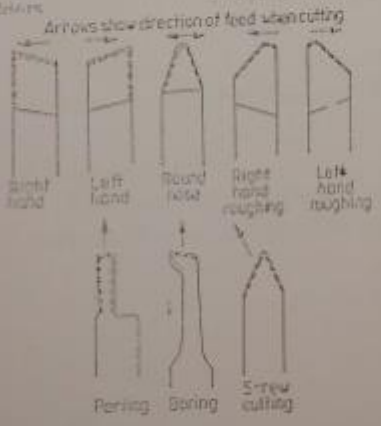


Fig.8.6 Common turning tools

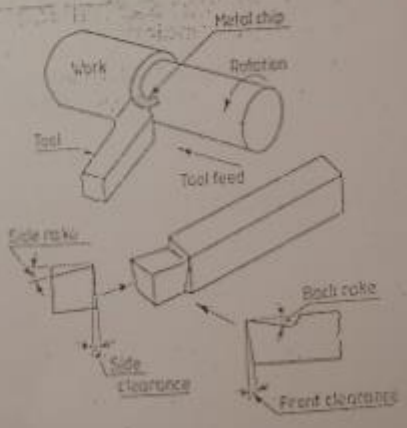


Fig.8.7 Tool geometry

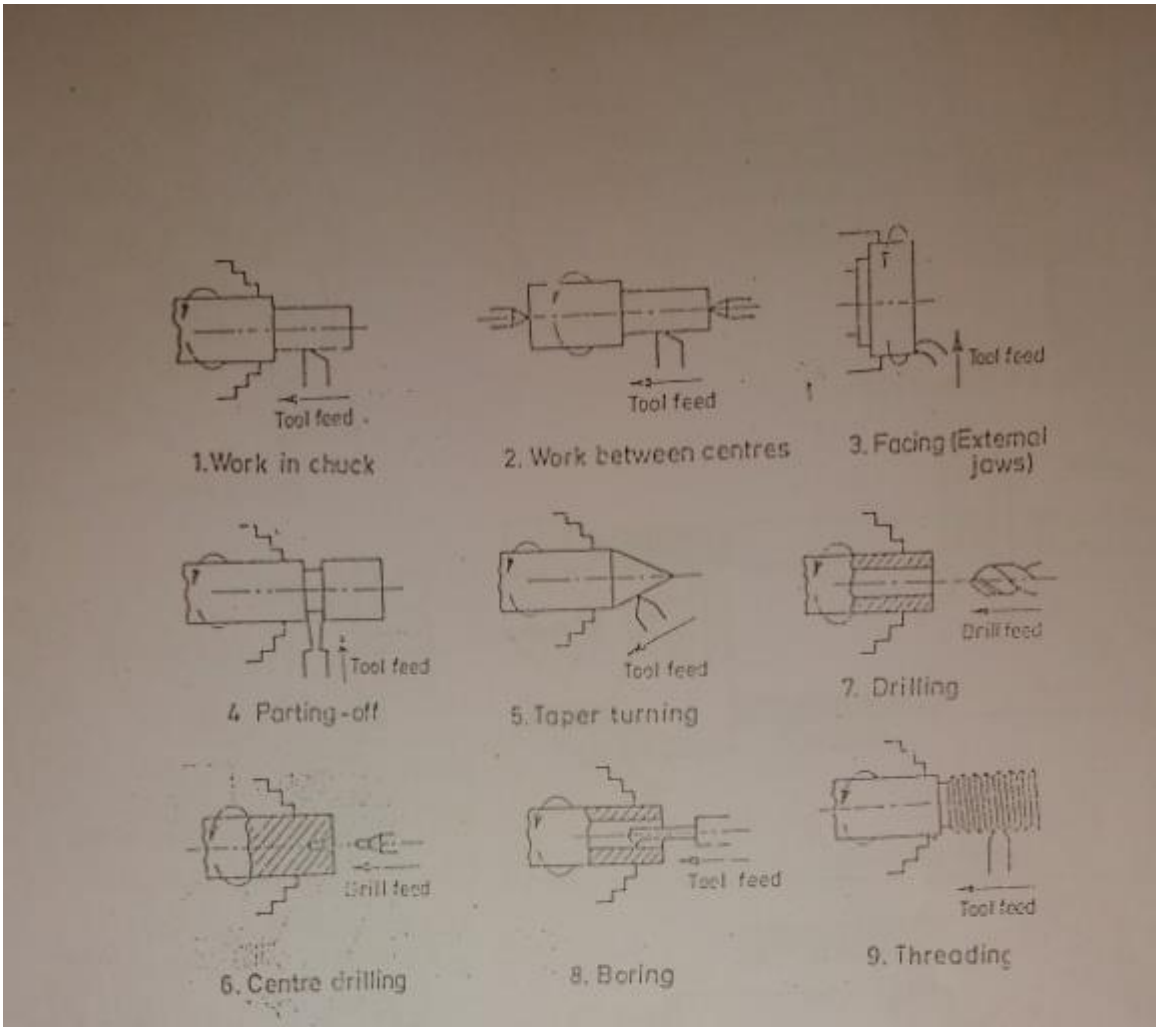


Fig.8.9 Lathe operations

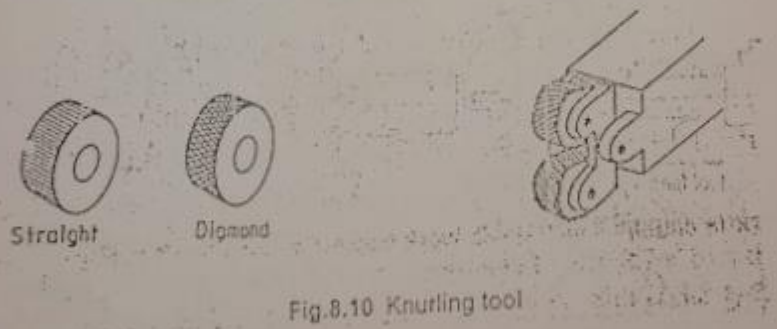


Fig.8.10 Knurling tool

MACHINESHOP-LATHE

INTRODUCTION

In a machine shop, metals are to shape on different machine tools. A lathe is used to cut and shape the metal by revolving the work against a cutting tool. The work is clamped either in a chuck, fitted on to the lathe spindle or in-between the centers. The cutting tool is fixed in a tool post, mounted on a movable carriage that is positioned on the lathe bed. The cutting tool can be fed into the work either lengthwise or cross wise.

PRINCIPAL PARTS OF A LATHE

Shows a centre lathe, indicating the main parts. The name is due to the fact that work pieces are held by the centers

Bed

It is an essential part of a lathe, which must be strong and rigid. It carries all the parts of the machine and resists the cutting forces. The carriage and the tail-stock move along the guide ways provided on the bed.

Head-stock

It contains either a cone pulley or gearings to provide the necessary range of speeds and feeds. It contains the main spindle, to which the work is held and rotated.

Tail-stock

It is used to support the right hand end of a long work piece. It may be clamped in any position along the lathe bed. The tail-stock spindle has an internal morse taper to receive the dead centre that supports the work. Drills, reamers, taps may also be fitted into the spindle, for performing operations such as drillings, reaming and tapping.

Carriage or saddle

It is used to control the movement of the cutting tool. The carriage assembly consists of the longitudinal slide, cross slide and the compound slide and apron.

The cross slide moves across the length of the bed and perpendicular to the axis of the spindle. This movement is used for facing and to provide the necessary depth of cut while turning.

The apron, which is bolted to the saddle, is on the front of the lathe and contains the longitudinal and cross slide controls.

Compound rest

It supports the tool post. By swiveling the compound rest on the cross slide, short tapers may be turned to any desired angels.

Toll post

The tool post, holds the tool holder or the tool, which may be adjusted to any working position.

Lead screw

It is a long threaded shaft, located in front of the carriage, running from the head-stock to the tail-stock. It is geared to the spindle and controls the movement of the tool, either for automatic feeding of for cutting threads.

Centers

There are two centers known as dead centre and live centre. The dead centre is positioned in the tail-stock spindle and the live centre, in the head-stock spindle. While turning between centers, the dead centre does not revolve with the work while the live center revolves with the work.

WORK-HOLDING DEVICES

Three jaw chuck

It is a work holding device having three jaws(self-centering) which will close open with respect to the chuck centre or the spindle centre. It is used for holding regular objects like round bars, hexagonal rods, etc.

Fore jaw chuck

In a four jaw (independent) chuck, all jaws have independent movement. It is used for holding square, octagonal or irregular shaped works.

Face plate

It is a plate of large diameter, used for turning operations. Certain types of work that cannot be held in chucks, are held on the face plate with the help of various accessories.

Lathe dogs and driving plate

These are used to drive a work piece that is held between centers. These are provided with an opening to receive and clamp the work piece and dog tail. The tail of the dog is carried by the pin provided in the driving plate for driving the work piece.

MEASURING INSTRUMENTS

Outside and Inside calipers

Firm joints or spring calipers are used for transfer of dimensions with the help of a steel rule. The proper use of these calipers to take outside and inside measurements.

internal surfaces is often called the boring operation in which a hole previousiy drilled is enlarged.

For turning long work, first it should be faced and centre drilled at one end and then supported by means of the tail-stock centre.

Facing

Facing is a machining operation by which material is removed from the surface that is perpendicular to the axis of a taper turning attachment.

Drilling

Holes that are axially located in cylindrical parts are produced by the drilling operation, using a twist drill.

Knurling

It is the operation by which a surface may be roughened. These rough surfaces on cylindrical parts are used for securing a good grip of the hand. The knurling rollers and tool holder are shown in fig. 7.10.

Threading

Threads may be cut either on the internal or external cylindrical surfaces. A specially shaped cutting tool, known as a thread cutting tool is used for this purpose.

Thread cutting in a lathe is performed by traversing the cutting tool at a definite rate, in proportion to the rate at which the work revolves. The saddle which control the tool movement, is in turn, traversed by the movement of the lead screw nut along the lead screw. If the driving gear on the spindle and driven gear on the lead screw are of the same size and with a single idler gear in-between, the lead screw and the spindle revolve at the same speed, producing threads on the work, with the pitch , same as that of the lead screw. If the driven gear is double the size of the driver gear, the lead screw revolves at half the spindle speed, producing threads with the pitch, half that of the lead screw.

The sizes of the gears required to produce threads of any given pitch, say 1 mm may be found as follows:

Vernier calipers:

Vernier calliperse is a versatile instrument with which both out side and inside measurement

Vernier calipers

Vernier calipers is a versatile instrument with which both outside and inside measurements may be made accurately. These instruments may have provision for depth measurement also.

Micrometers

Outside and inside micrometers are used for measuring components where greater accuracy is required. Correct usage of the micrometer.

TOOL MATERIALS

General purpose hand cutting tools are usually made from carbon steel or tool steel. The single point lathe cutting tools are made of high speed steel (H.S.S). The main alloying elements in 18-4-1 H.S.S tools are 18 per cent tungsten, 4 per cent chromium and 1 per cent vanadium. 5 to 10 per cent cobalt is also added to improve the heat resisting properties of the fool.

Carbide tipped tools, fixed in tool holders are mostly used in production shops.

TOOL GEOMETRY

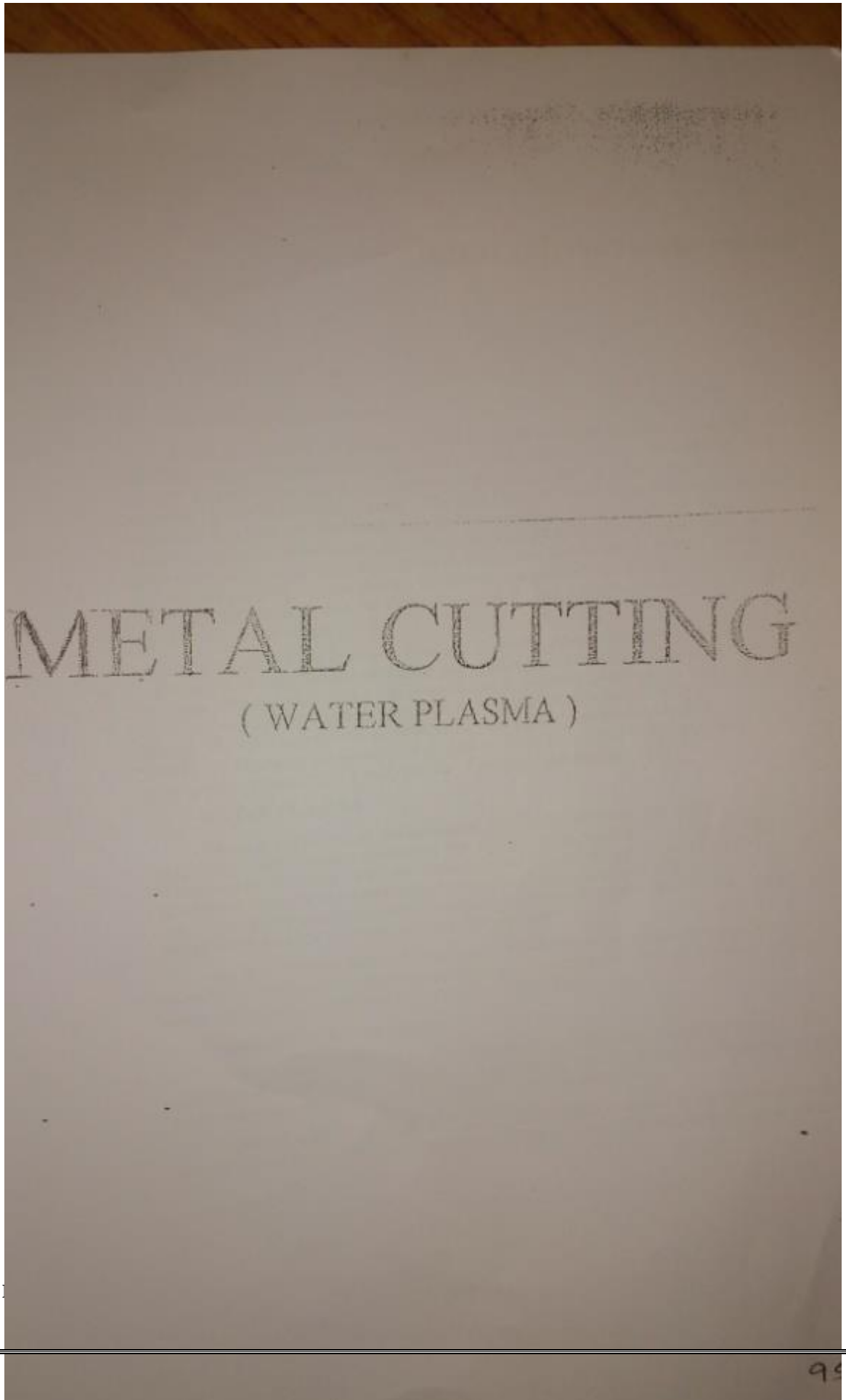
A single point cutting tool used on lathe may be considered as a simple wedge. The common turning tools used for different operations. The basic angles of a simple turning tool. The lathe tool holder with H.S.S tool mounted and tool holders used with carbide tipped tools.

LATHE OPERATIONS

Some of the typical operations performed on a lathe are listed below and shown in fig.8.9

Turing

Cylindrical shapes, both external and internal are produced by turning operation. Turning is the process in which the material is removed by a traversing cutting tool, from the surface of a rotating work piece, The operation used for machining


METAL CUTTING
(WATER PLASMA)

METAL CUTTING (water plasma)

INTRODUCTION

Plasma may be defined as charged particles which are close together so that, each particle influences many charged particles rather than just interacting with the nearby particles. Plasma is typically an ionized gas and it is considered to be distinct state of matter, because of its unique properties. It is a fourth state of matter. The term "ionized" refers to the presence of one or more free electrons, which are not bound to an atom or molecule. The free electric charges make the plasma electrically conductive so that it responds strongly to electro-magnetic fields. Plasma is formed by heating and ionizing a gas, stripping electrons away from atoms; thereby enabling the +ve and –ve charges to move more freely. The ionized gas contains ions and electrons in about equal numbers so that the resultant space charge is very small. This region containing balanced charges of ions and electrons is called plasma.

For plasma to exist, ionization is necessary. Plasma density refers to the electron density that is the number of free electrons per unit volume. The degree of ionization of plasma is the proportion of atoms which have lost (or gained) electrons and is controlled mostly by the temperature. Even a partially ionized gas in which as little as 1% of the particles are ionized, can have characteristic of a plasma. Plasma temperature is commonly measured in Kelvin or electron volts and is a measure of thermal kinetic energy per particle. A plasma is sometimes referred to as being hot if it is nearly fully ionized, or cold if only a small fraction of the gas molecules are ionized.

WATER PLASMA

Plasma in a water vapor, can be made at different temperatures, depending upon the pressure of the water vapor. In water plasma, the free electrons, water vapor and +ve ions like OH^+, O^+, and H^+ are present. To ionize water, the electrons should have an energy of 12 electron volts. If it is to be achieved thermally; the water has to be heated to a temperature of 12000^0K. So it is difficult to make water plasma purely thermally. By applying a voltage across the space in water vapor, we can initiate water plasma at a pressure of 1 torr of water vapor.

The new technical devices for heat energy as well as energy containing gases (hydrogen and oxygen) from water will be the future industrial power installations. The use of water as a source of energy will solve many environmental problems in the planet.

Applications of water plasma

Water plasma device is a multi-functional, portable, and hand-held device. It is a technological breakthrough in the area of metal cutting, welding, soldering, tempering, spraying, etc., as maximum efficiency is achieved when plasma technique is used.

Usage of water plasma tool for welding in gas mode is similar to the regular gas welding process. The difference is that electric power and water are used instead of gas tanks to produce a

high temperature jet flame. Filler rods and fluxes used for water plasma welding are the same which used for conventional welding. For carrying out welding in plasma arc mode, it is necessary to take into account, an increased level of heat flow, capable of heating the metal upto its whole depth. The high production rate and quality of plasma jet precision cutting, supersedes processes such as gas-oxygen cutting and it is a more sophisticated method of welding when used for welding.

Water plasma can also be used for heat treatment of 0.5 to 10 mm thick metal.

CONSTRUCTION OF PLASMA TORCH

Figure 14.1 shows a plasma torch with the main parts indicated and which is in the form of a handgun. It is connected to the power supply unit via the power cable. The power supply unit is connected to the conventional electric system (220V, AC, 50Hz) through a grounded power outlet.

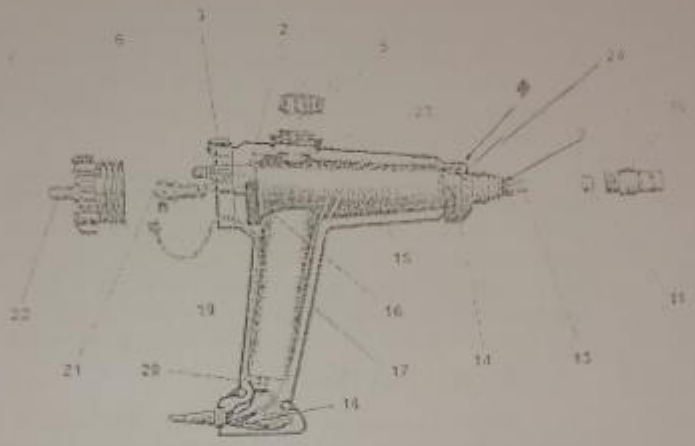


Fig. Plasma torch

1. Cathode adjusting cap
2. Sealing bush
3. Ring
5. Filling plug
6. Adjusting cap limiting device
8. Overheat sensor
9. Evaporator
10. Spout
11. Nozzle-ANODE
13. CATHODE
14. Torch body tightening nut
15. Metal tank
16. Tank gasket
17. Plastic body
18. Connecting cable
19. MINUS power supply terminal
20. PLUS power supply terminal
21. Cathode module
22. Torch activating knob
23. Packing ring
24. Thermocontractable ring

Majority of the main parts of the plasma torch, are located inside the plastic body 17 which is in two halves, fitted together. The metal tank 15 is filled with liquid absorbing material. Sliding cathode assembly 21 connected to the negative terminal of the power source through the contact plate 19, consists of cathode holder with replaceable cathode, 13, screwed into its front part. Nozzle anode 11, connected to the metal tank 15 by means of spout 10, is powered by positive voltage from power supply (terminal 20). Nozzle-anode 11 and cathode 13 form a discharge chamber, where the steam of the working fluid heats upto the plasma generation temperature due to the energy of electric arc.

Principle of operation of plasma tool

Figure illustrates the principle of plasma tool operation. Brief pressing of the torch activating knob activates the torch already filled with working fluid. When the knob is pressed, movable cathode module slides forward and touches the nozzle anode; and completes the anode-cathode short circuit. After releasing the knob, the cathode module moves back by means of the return spring and an electric arc occurs between the cathode tip and nozzle-anode.

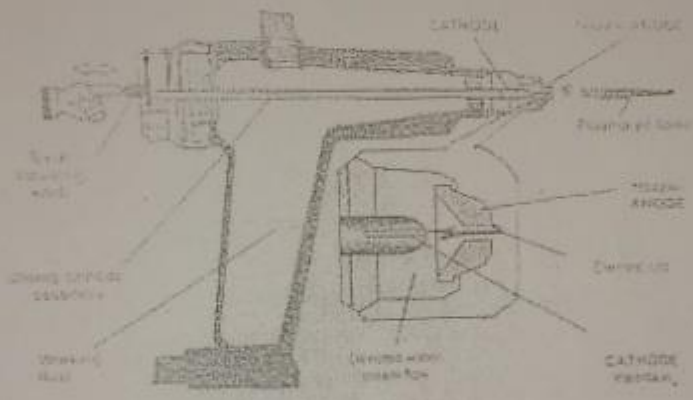
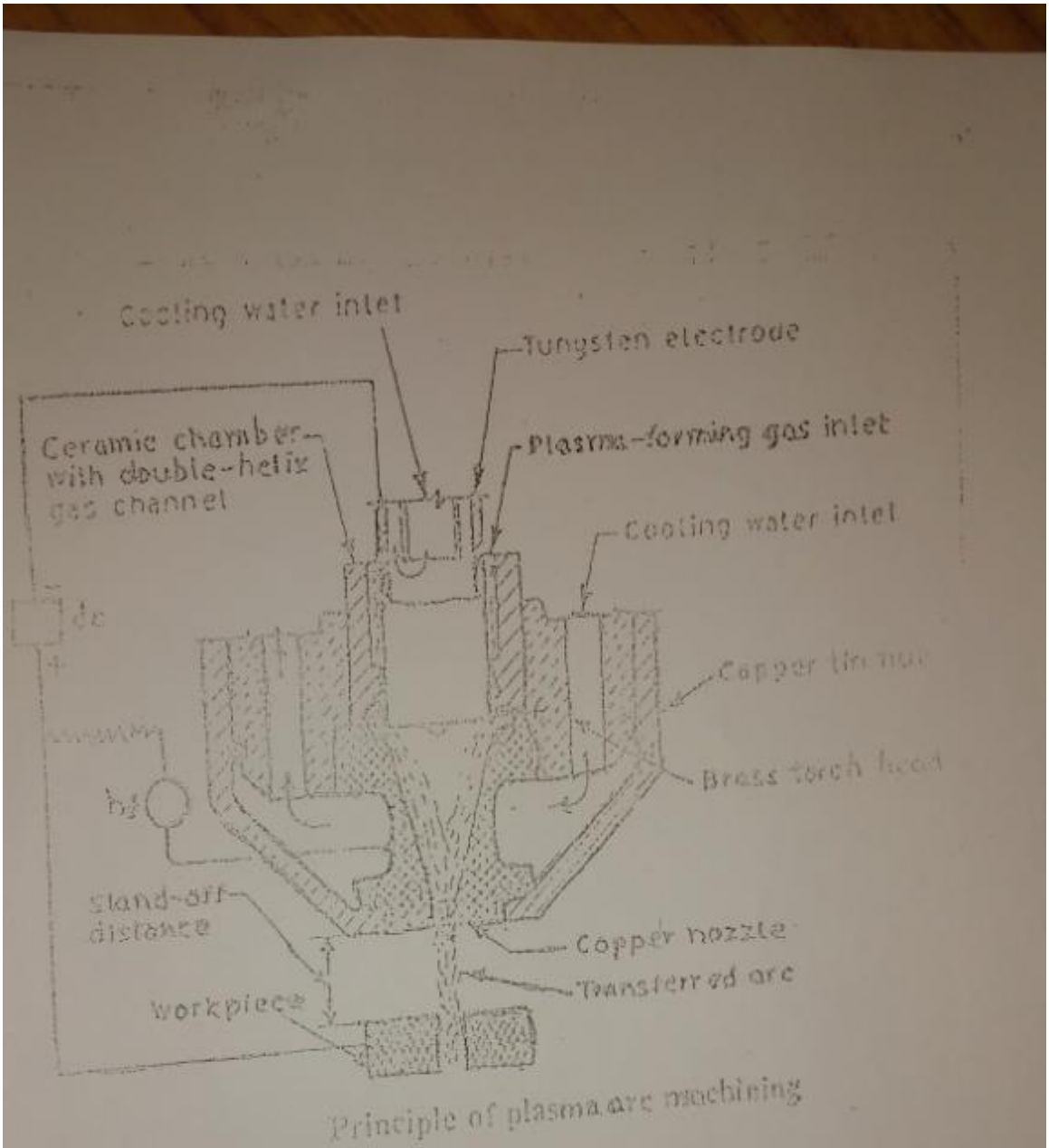


Fig. Plasma tool operation

Thermal energy of the electric arc heats the water and it evaporates. The resulting pressure forces the steam to run to the opening of the nozzle-anode. While passing through the electric arc area, the steam "tears" the arc from the internal surface of the nozzle, "pulls" it out and connects to the outer side of the outer edge of the nozzle-anode. The steam surrounds the arc inside the fine-bored nozzle, opening and centers it; thus not allowing the arc to close onto the side walls of the opening.

While passing through the electric arc, part of the steam turns into the fourth state of matter-plasma with the temperature upto 8000^0C, by means of which cutting, welding, soldering, and heat treatment of non-combustible materials is performed. Water plasma device is also highly efficient for pipe line heating and central heating systems, power supply systems, assembly, plumbing, repairs of refrigerators, air conditioners, and ventilation systems. The device is indispensable for operations performed in water trenches, underground tunnel engineering operations, assembly of all kinds of under- ground utility systems, for the use on board of the ships and is also widely used in the nuclear



Principle of plasma arc machining

TRADES FOR DEMONSTRATION AND EXPOSURE

PLUMBING

MACHINE SHOP

METAL CUTTING

(WATER PLASMA)

PLUMBING

INTRODUCTION

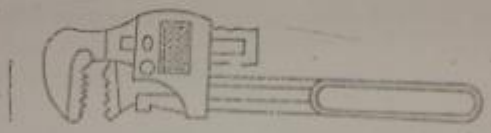
Plumbing deals with the laying of pipe lines. Pipe line provides the means of transporting the fluid. It is obvious that laying-out the pipe line, requires a number of joints to be made and a number of valves incorporated, while connecting different length of pipes.

Plumbing work does not require many tolls except pipe wrenches, hacksaw, pipe cutter, threading equipment and a pipe vice.

PLUMBING TOLLS

Pipe wrench

Pipe wrenches are used for holding and turning the pipes. Rods and machine parts. Wrenches of size 300mm and 450mm are more useful. The adjustable wrench shown in figure consists of a fixed jaw and a movable jaw. The movable jaw facilitates the adjustment of the opening between the jaws. The jaws are serrated inside, to enable a firm grip over the pipes.

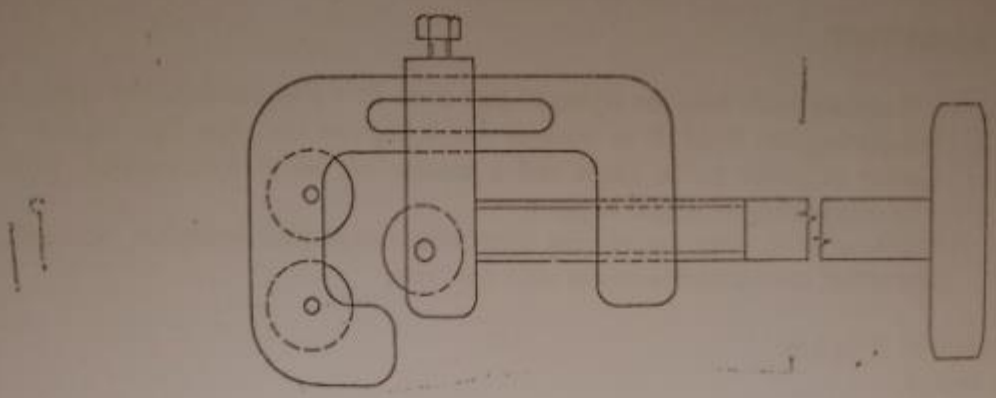


Pipe vice

The use of a regular pipe vice is advisable , through ordinary bench vice can serve the purpose in most of the occasions. The pipe vice is fitted on the work bench. It holds the pipes in position during cutting, threading and fitting of bends, couplings, etc. figure shows a pipe vice. It consists of two jaws for holding the work, which are serrated to ensure firm grip.

Pipe cutter

For an occasional pipe work, a hacksaw is quite satisfactory. Pipe cutter are also used where considerable amount of pipe work is involved. The pipe cutter mainly consists of three while are hardened and with sharp cutting edges along their periphery. Of these three wheels, one can be adjusted to any desired distance from the other two fixed wheels, to accommodate different sizes of pipes. After adjusting the cutter on a pipe, it is turned around the pipe along a circle. Figher10.3 shows a pipe cutter



Pipe bending machine

While laying the pipe line, sometimes a part of a pipe may have to be bent to the required curvature. For this, a pipe bending machine is used. It is mounted on a tripod stand and can swivel about a vertical axis to any desired angle., to cover the required range for the operation. The unit consists of a number of bending blocks and dolly blocks to obtain any desired curvature at bend.

Dies

A pipe-die is used for cutting external threads on pipes. One or two pipes dies are used in the die stock. It is a hand operated tool, which may be considered as a hardened steel unit, having flutes cut along its inside surface.

Pipes and pipe fittings:

Pipe are available in either black or galvanized form. Black pipes are used for oil, gas or air. Galvanized pipes are used for water supply system as they resist rusting and corrosion. Pipe fittings are made of wrought iron. These fittings are available either in black or galvanized finish.

The size of a pipe is designated by its inside diameter. The size of the pipe on which in it fits. There are different types of pipe fittings available in the market.

Coupling

It is a short cylindrical sleeve with internal threads throughout. It is used for joining two pipes in a straight line end where at least one can be turned.

Union :

It is used for joining two pipes, where neither can be turned. It consists of three parts, two parts will be screwed on to the two pipe ends and third one, which is a nut, draws the pipes together tightly.

Nipple :

It is short piece of pipe (less than 300mm in length) with external threads at both ends. Nipples are available in standard short lengths. It is used to make up the required length of the pipe line.

Elbow :

It is used to make an angle between adjacent pipes. The angle is always 90deg, unless another angle is stated.

Tee :

It is a fitting that has one side outlet at right angles to the run. It is used for a single outlet branch pipe.

Bush :

It is a short sleeve-like piece, used to reduce the size of a threaded opening. It is threaded fully on the inside and at one end on the outside. The other outer end is hexagon shaped.

Plug :

It is used to screw onto a threaded opening, for closing it temporarily, it is a short piece with external threads at one end and square end and square end on other, to receive the spanner for operation. A cap may be used for closing external threaded openings temporarily.

Flange :

Flange are available either in oval or in circular shapes. These contain internal threads in the hub and holes in the body to receive bolts. Two pipes may be joined together in line, using flanges and bolts.

Gate valve :

Pipe valves are fitted in the pipe line to control the fluid flow through it. Gate valve offers less resistance to the flow of water through it. It is used where it is important, not to obstruct the flow and where the valve is closed only rarely. In this valve, the flow is reduced by lowering the wedge shaped gate towards its seat.

Globe valve :

This controls the fluid flow in a pipe line how ever the passage of flow is restricted.

Check valve :

It is used to prevent reverse flow in a pipe line. The swing type valve is more commonly used in this category.

Common tap :

This is used for tapping the fluid flow at required points in the pipe line.

Pipe layout

PIPE LAYOUT

For better pipe work, it is advisable to sketch first, the pipe layout ,showing dimensions and types of fitting to be used. Careful planning makes it possible to complete the work with fewer joints and fittings. In cutting pipe to length, the portion of the pipe that will screw into the fittings, must be taken into accovat.

Pipe threading :

After pipes are cut to lengths, to suit the layout, they must be threaded before the assembly. The following are the steps involved while threading a pipe by means of a pipe die:

1. clamp the pipe securely in a pipe vice.
2. select proper size of the die and insert into the stock.
3. place the die on the end of the pipe and apply pressure, while the die is slowly turned
4. once the threading is started, apply cutting oil and continue to turn the die into the pipe, till one thread projects through the die.

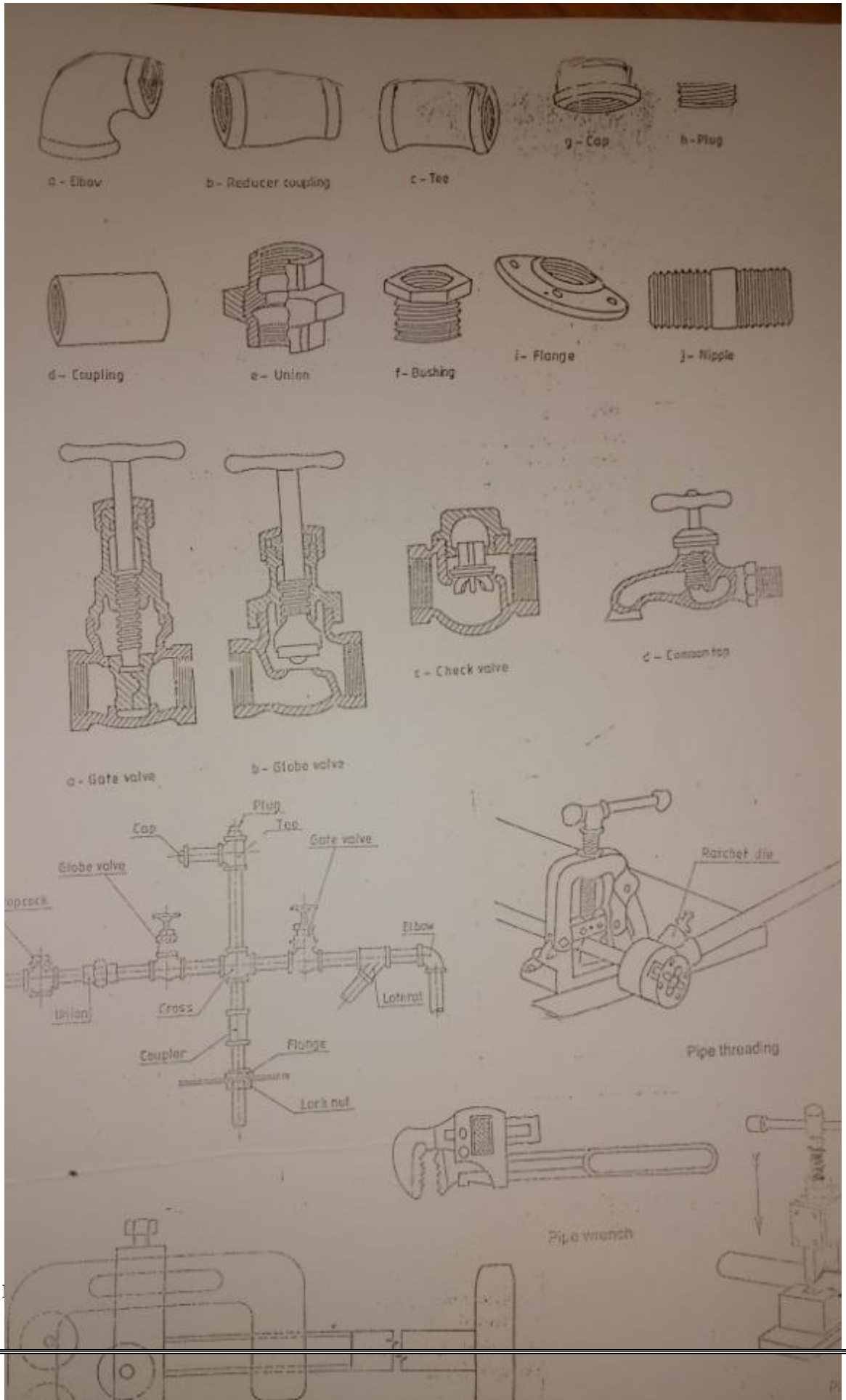
NOTE i. pipe die produces tapered threads. The tapered pipe threads tighten securely into the pipe, fittings.

ii. while threading, turn the die stock handle back and forth frequency, to loosen the chips.

Assembly

Pipe layout should be made so as to avoid strains and bending at the joints. To ensure tight joints in pipe work, the threads are applied with some kind of thread compound, before screwing them together. While screwing the pipe in its fittings it is advised to use two pipe wrenches, making one to fit the pipe and the other to fit the pipe fitting. To avoid the damaging a valve of a tap with wench marks, it is advised to use a monkey wench with smooth jaws.

Some fittings like unions and flanges require gaskets to make tight joints. When fittings are disassembled gaskets are usually damaged must be replaced. Gaskets are made from such a rubber or leather.


a - Elbow
b - Reducer coupling
c - Tee
g - Cap
h - Plug
d - Coupling
e - Union
f - Bushing
i - Flange
j - Nipple
a - Gate valve
b - Globe valve
c - Check valve
d - Common tap
Plug
Tee
Cap
Gate valve
Globe valve
Elbow
Union
Cross
Coupler
Flange
Lock nut
Ratchet die
Pipe threading
Pipe wrench