CARPENTRY

INTRODUCTION:

Carpentry and joinery are common terms used with any class of work with wood. Strictly speaking, carpentry deals with all works of carpentry such as roofs, floors, Partitions etc., of a building, while joining deals with making of doors, windows, Cupboards, dressers, stairs and all the interior filaments for a building. Timber is the basic material used for any class of woodworking. Wood is one of the most valuable biodegradable raw materials of industry and daily uses.

In order to successfully work on different forms to get accurate shapes and dimensions, the wood-worker must know the use of a large number of tools. The principal types of which are manipulated by hand are described and illustrated below. A student studying the fundamentals of wood working has to know about timber and other carpentry materials, wood working tools, carpentry operations and the method of making common types of joints.

Materials Used in Carpentry:

Basic materials used in carpentry shop are timber and plywood. Auxiliary materials used are nails, screws, adhesives, paints, varnishes, etc.

Timber:

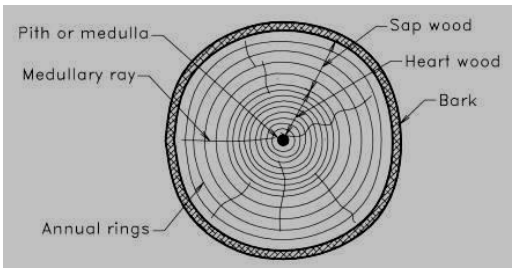
Timber is the name given to wood obtained from exogenous (outward growing) trees. In these trees, the growth is outward from the centre, by adding almost concentric layers of fresh wood every year known as annual rings. After the full growth, these trees are cut and sawed to convert into rectangular sections of various sizes for engineering purposes.

Classification of Wood

The timber used for commercial purposes can he divided into two classes as soft wood and hard wood

Soft wood

A soft wood is light in weight and light colored. They may have distinct annual rings but the medullar rays (radial lines) are not visible and the color of the *sap wood* (outer layers) is not distinctive from the heart wood (inner layers). These woods cannot resist stresses developed across their fibers; hence, not suitable for wood working.



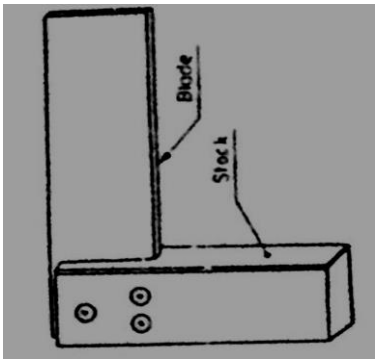
Hard wood

In this type of wood the annual rings are compact and thin and the medullar rays (radial lines} are Visible in most cases Figure6.1. Hard woods are nearly equally strong both along and across the fibers. Hand wood is the material used for wood working

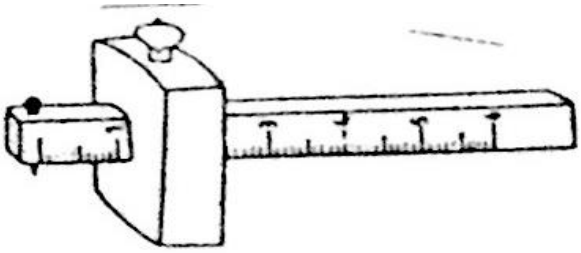
TOOLS AND EQUIPMENT:

1. Making and Measuring Tools:----

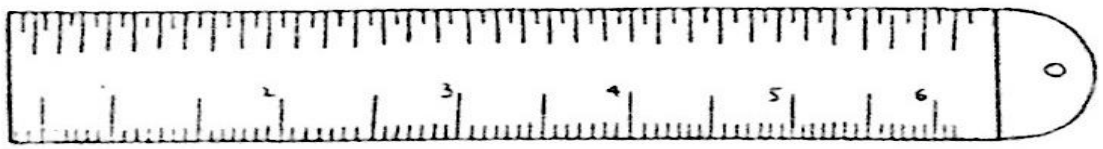
a) Try square: Try square is used for marking and testing angles of 90^o.



b) Marking gauge: The marking gauge is used for marking lines parallel to the edge.

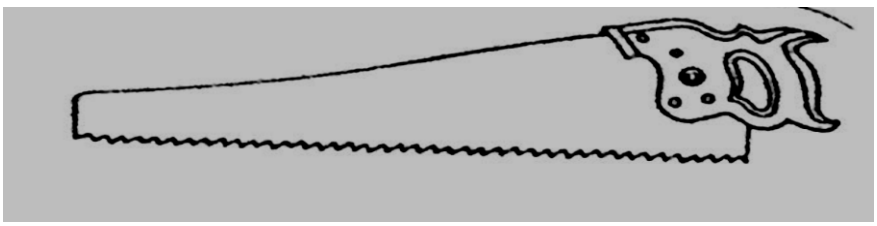


c) Steel rule: The steel rule is commonly used for measuring the thickness of the wooden block and for marking the dimensions.

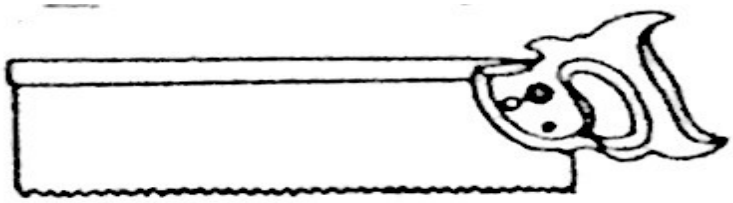


2. Cutting Tools:

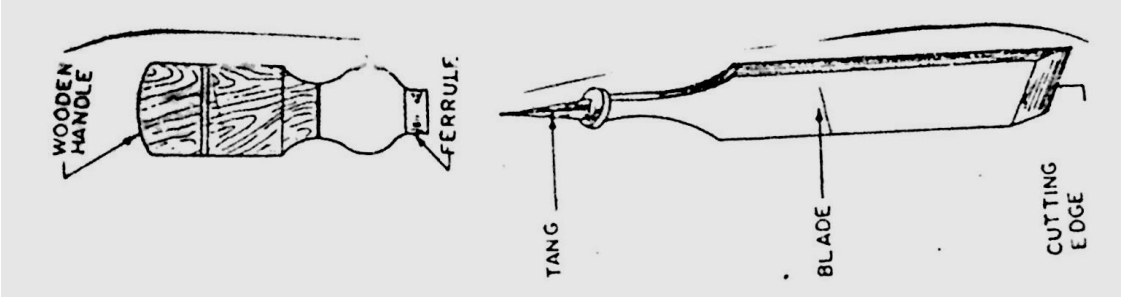
a) Cross Cut saw (or) Hand Saw: It is used for cutting across the grain in thick wood. In this teeth are bend away from line of hand saw. So that large width groove is cut and saw can move freely. It is used to cut large depth.



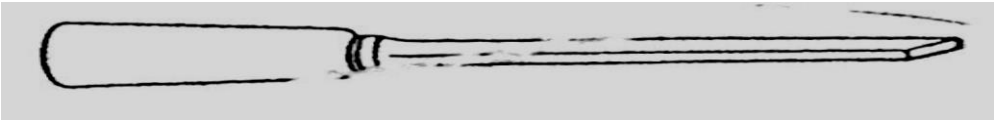
b) Tenon saw: It has a parallel blade 25 to 40 cm wide, having 5 to 8 Paints per cm length. Its teeth are designed as those of a crosscut saw.It is used finer work than the rip saw, panned saw or cross cut saw. The main use of this saw is taking short straight cuts.



c) Firmer Chisel: The firmer chisel is used for general purposes and used by hand pressure or by wooden mallet.



d) Mortise Chisel: The mortise chisel, as its name indicates, is used for chopping out mortises. These chisels a design to withstand heavy work.



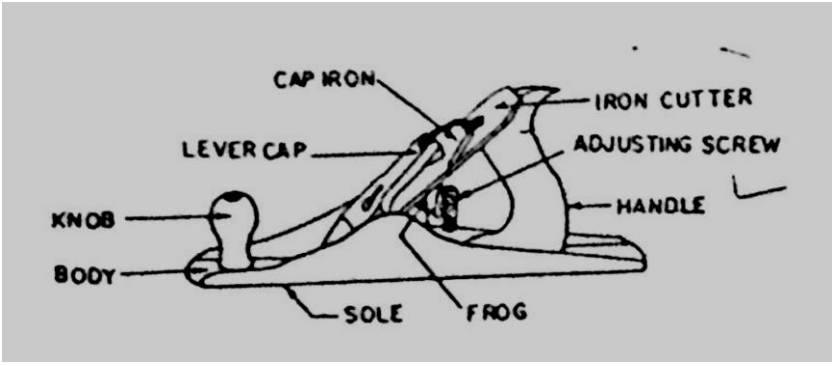
3. Planes:

a) Wooden jack plane

This is the most commonly used plane in carpentry shop. The main part of a wooden jack plane is a wooden block called sole, in which steel blade having knife edge is fixed at an angle with the help of wooden edge. The angle of the blade is kept about 45 ° to bottom surface of the blade.

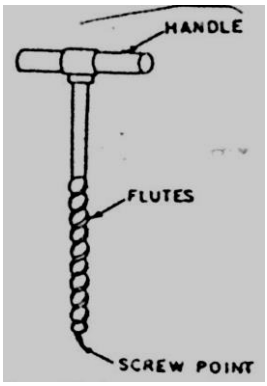
b) Metal Jack Plane

It serves the same purpose as the wooden jack plane but facilitates a smoother operations and better finish. The body of a metal jack plane is made from a grey iron casting with the side and sole machined and ground to better finish.

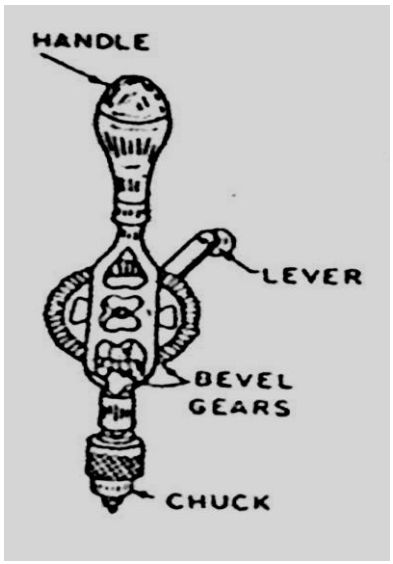


4. Boring Tools :

a) Bradawl and Gimlet: The Bradawl and Gimlet are hand operated tools used to bore small holes, used to drive a screw or a nail.

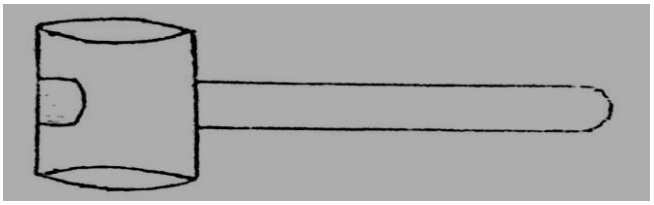


b) Hand Drill: The hand drill is used to hold parallel shank drill, which are used to drill small holes.



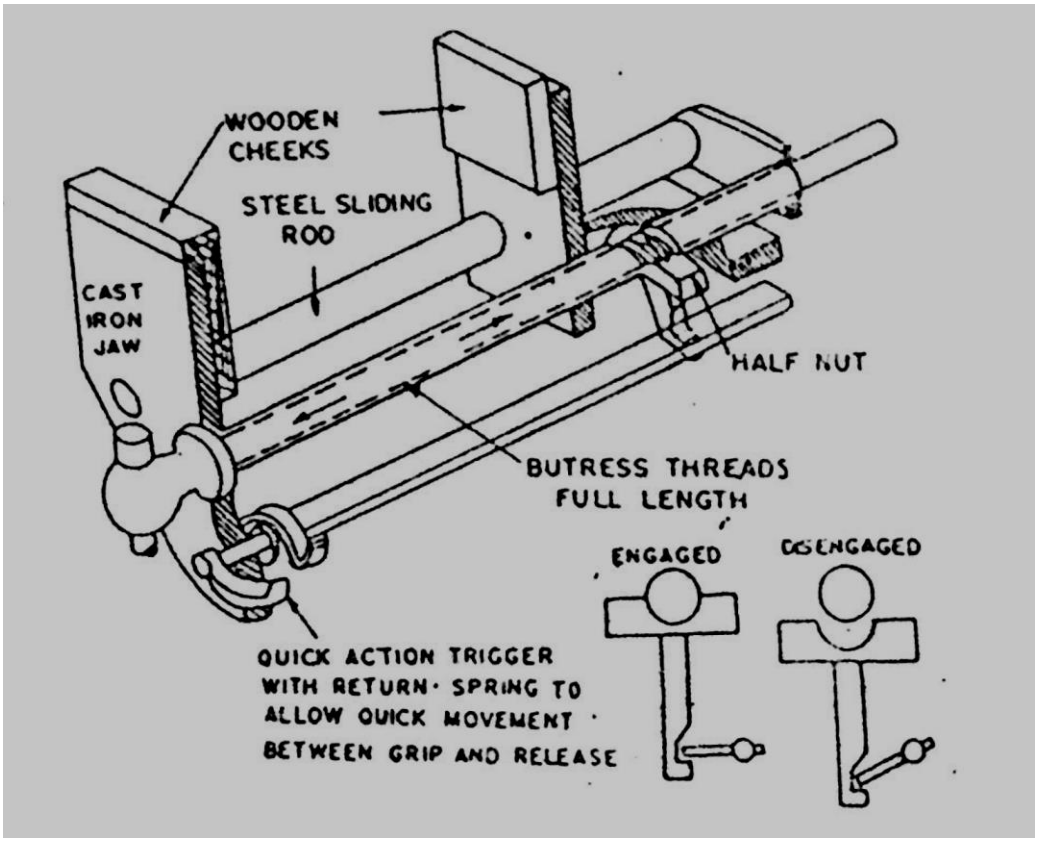
5. Striking Tools:

a) Wooden Mallet: The wooden mallet is a wooden hammer of round or rectangular cross section. The striking face is made curved at the edges.

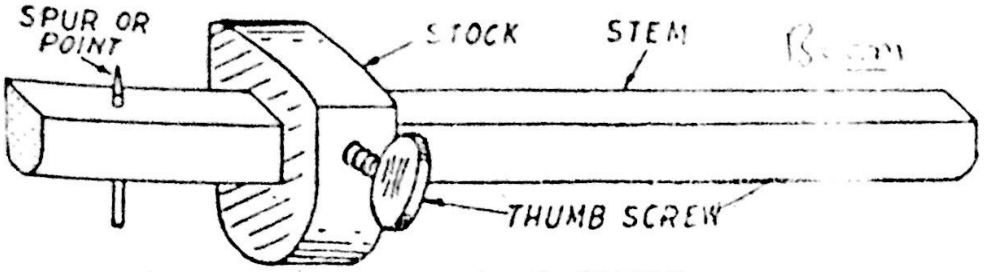


6. Carpentry Vice:

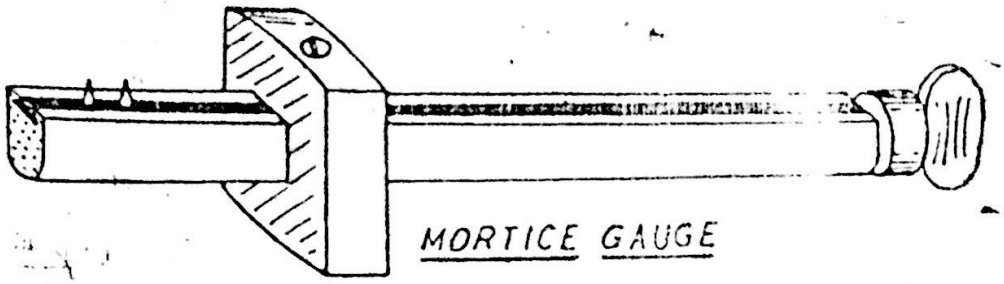
a) Carpentry: One jaw is fixed to the side of a table, while the other is kept movable by means of a screw and a handle using Bolt and Nut Principle.


WOODEN CHEEKS
STEEL SLIDING ROD
CAST IRON JAW
HALF NUT
BUTRESS THREADS FULL LENGTH
ENGAGED
DISENGAGED
QUICK ACTION TRIGGER WITH RETURN SPRING TO ALLOW QUICK MOVEMENT BETWEEN GRIP AND RELEASE

MARKING TOOLS

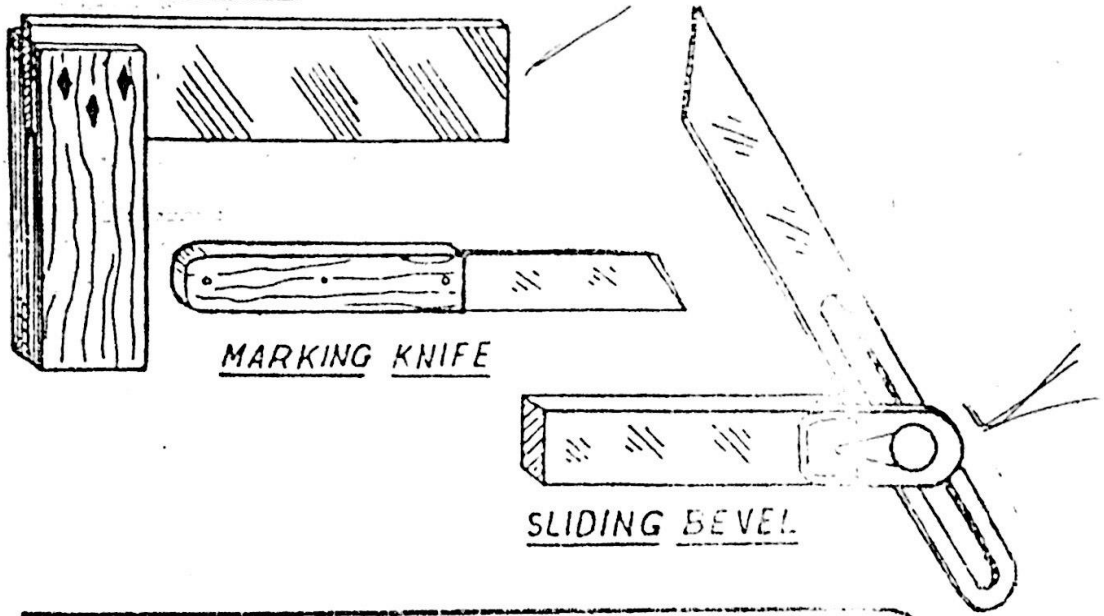


MARKING GAUGE



MORTICE GAUGE

TRY SQUARE



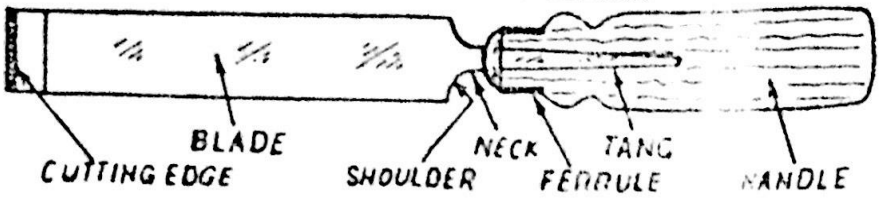
MARKING KNIFE

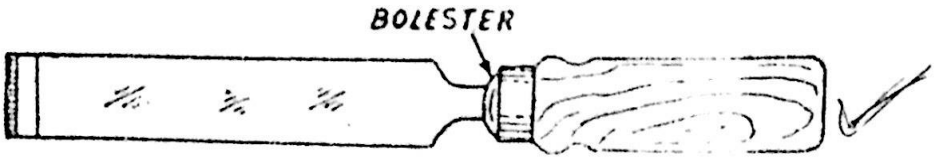
SLIDING BEVEL

STEEL RULE

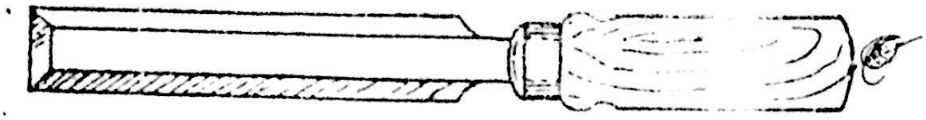
CHISELS & GOUGES

SECTIONAL VIEW OF CHISEL

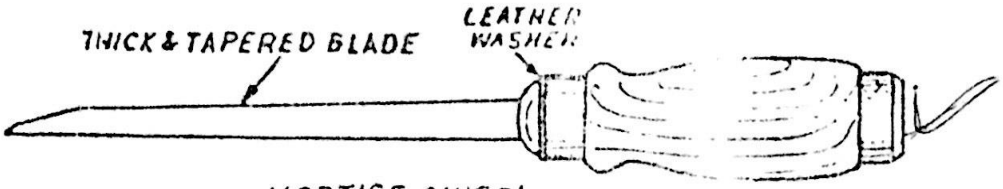




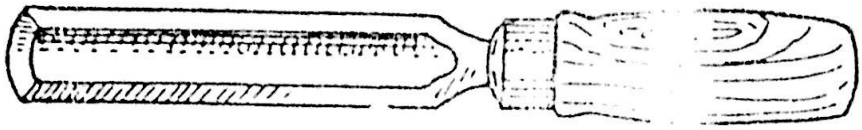
FIRMER



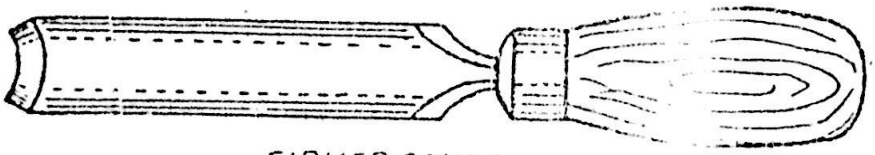
BEVEL EDGE



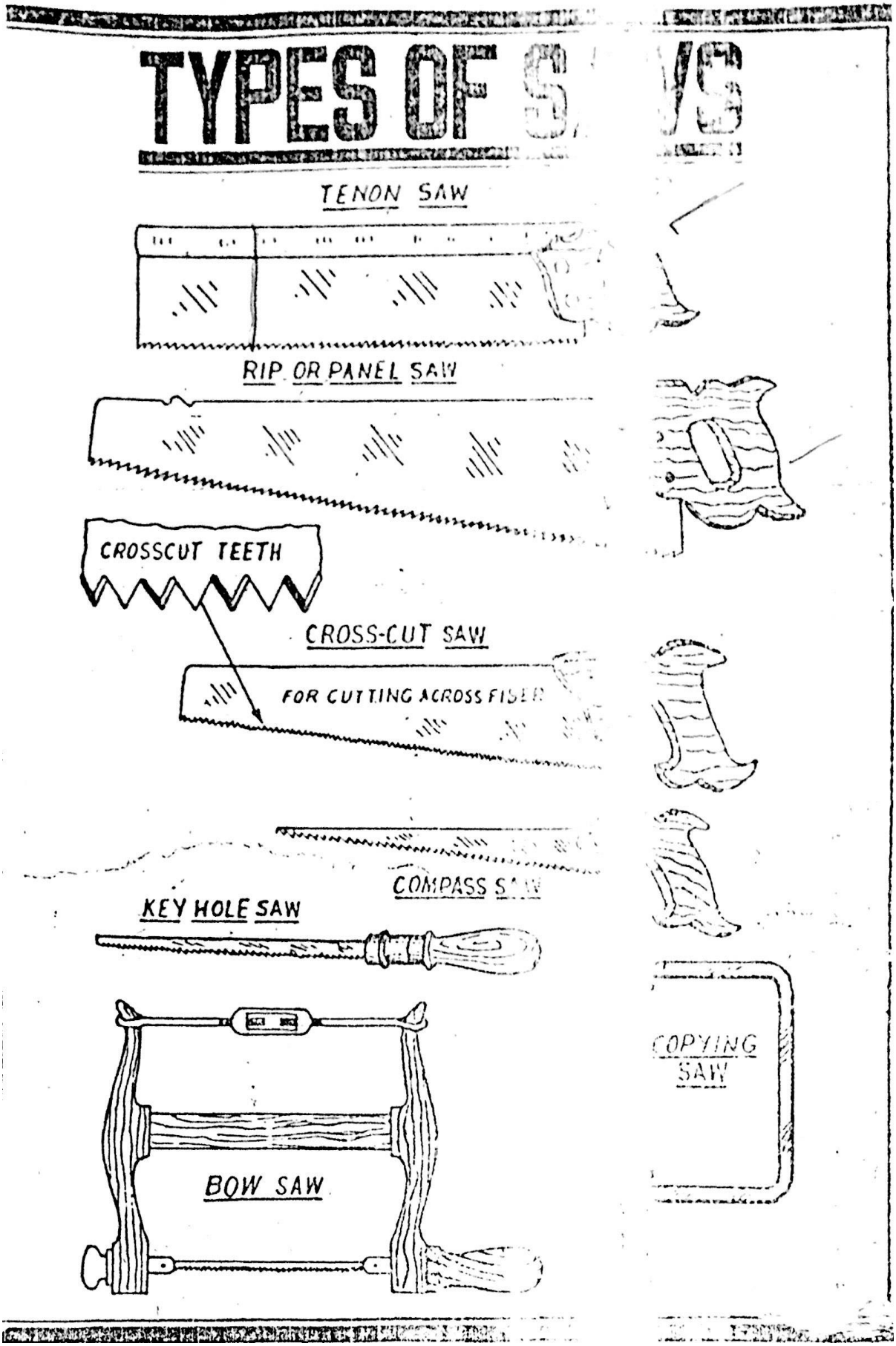
MORTISE CHISEL

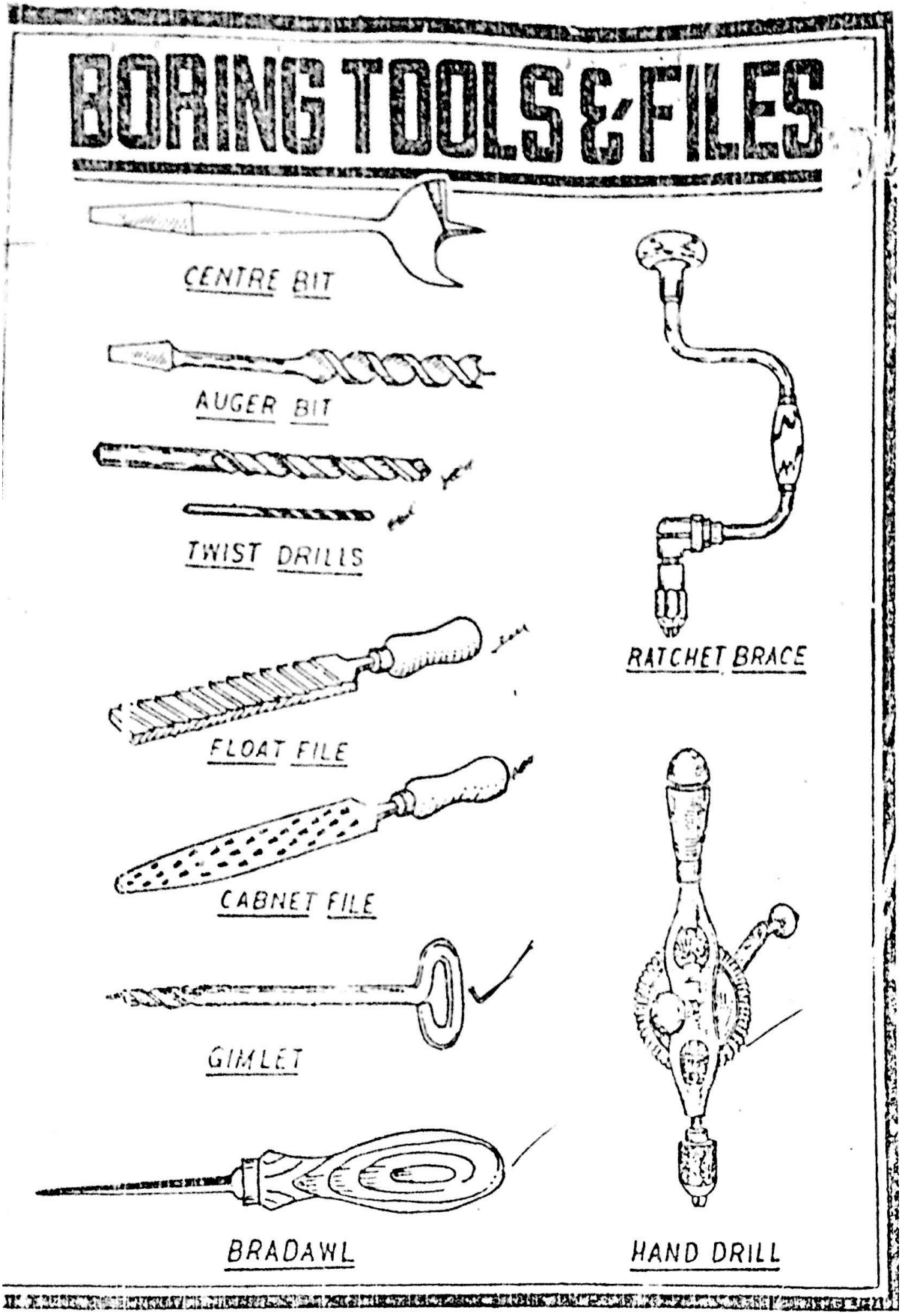


SCRIBING GOUGE

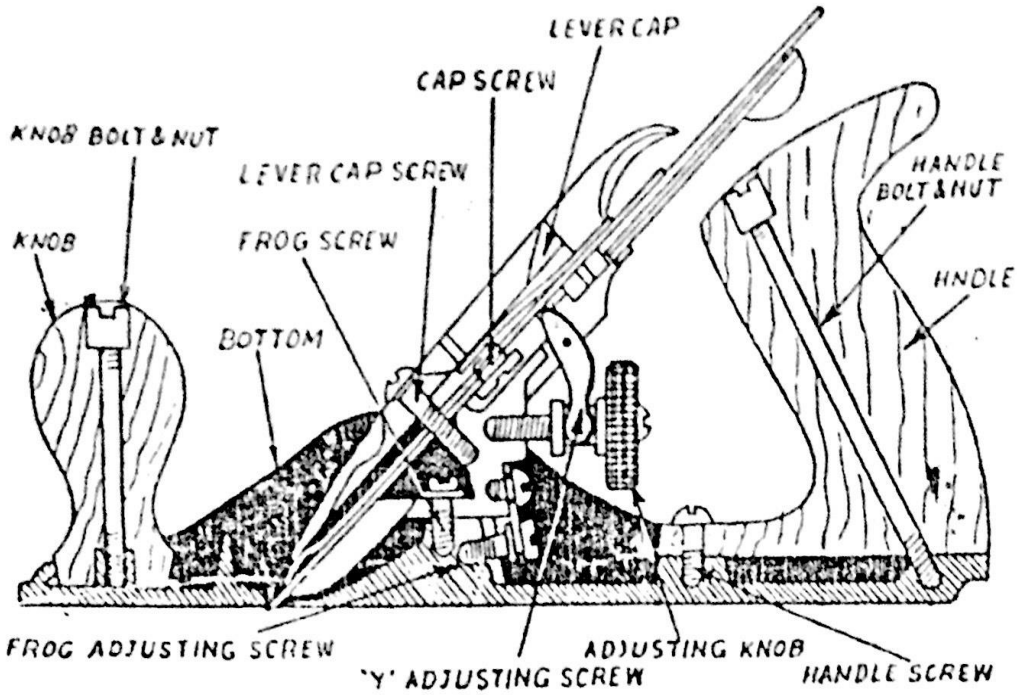


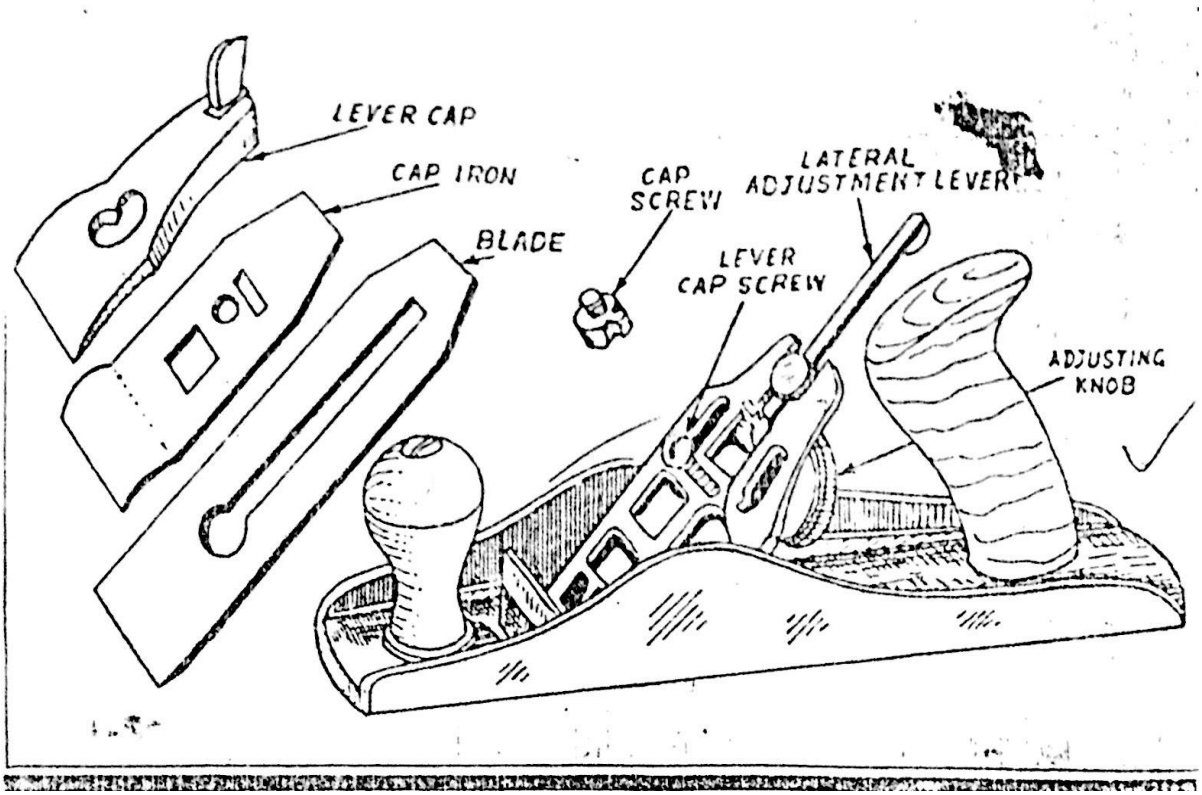
FIRMER GOUGE

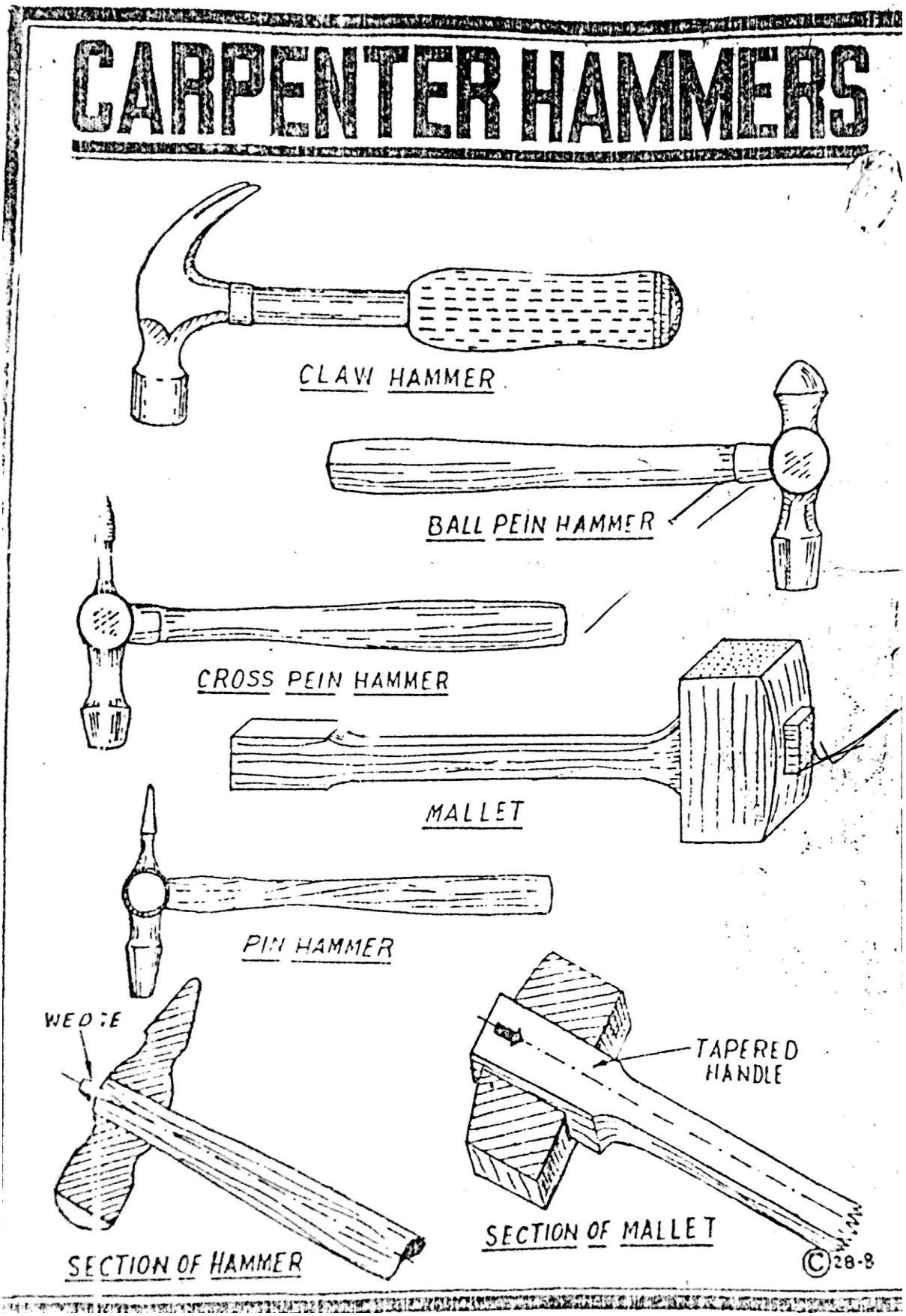

TYPES OF
TENON SAW
RIP OR PANEL SAW
CROSSCUT TEETH
CROSS-CUT SAW
FOR CUTTING ACROSS FIBER
COMPASS SAW
KEY HOLE SAW
COPYING SAW
BOW SAW


BORING TOOLS & FILES
CENTRE BIT
AUGER BIT
TWIST DRILLS
RATCHET BRACE
FLOAT FILE
CABNET FILE
GIMLET
BRADAWL
HAND DRILL

METAL PLANES






CARPENTER HAMMERS
CLAW HAMMER
BALL PEIN HAMMER
CROSS PEIN HAMMER
MALLET
PIN HAMMER
WEDGE
SECTION OF HAMMER
TAPERED HANDLE
SECTION OF MALLET
©28-8

FITTING

Introduction : Fitting is the process of assembling of parts by removing metals to get the necessary fit. Under this trade there are three broad categories.

a) Machine fitting
b) Bench fitting
c) Pipe fitting

Important tools in fitting

I. Cutting Tools
II. Measuring Tools
III. Marking Tools
IV. Dismantling and assembling Tools

I. CUTTING TOOLS :

1) Hacksaw : Hack is a tool; consisting of a frame and a blade. It is used for cutting the surplus metal on scribed line. The operation is called hack sawing. The frame is made from mild steel, case hardened except the handle which is made of wood.

Description of frame :

a) Fixed frame : It is more rigid used to hold a particular size of the blade.

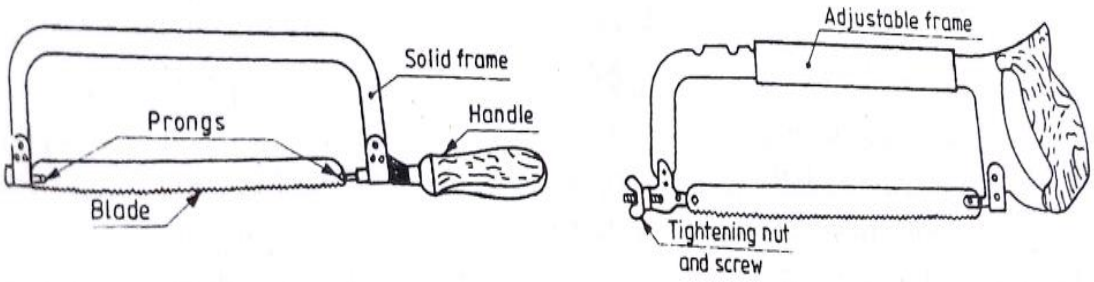
b) **Adjustable frame** : It is used to hold the hack saw blade of different lengths. The frame is made of two pieces and easy for adjustment to hold a desired length of blade.

c) Deep Cutting frame : It is similar to fixed type of frame but used for deep cutting on channel guides and beams.

Hacksaw blade : Hacksaw blade is a cutting tool fitted in a frame to a correct tension and may be tested from sound by giving blows with a finger on it after tightening it is made of high carbon steel, high speed steel, alloy steel, and low tungsten steel, hardened and tempered.

2) File : A file is a cutting tool used to remove a small quantity of surplus metal, the files have cutting points incorporated in the body at equal distances. Usually on all four faces over the length from the shoulder to tip. Files are made of special tool steel and high carbon steel.

Types of Files : Files are classified according to their shape, cutting teeth and pitch or grade of the teeth.

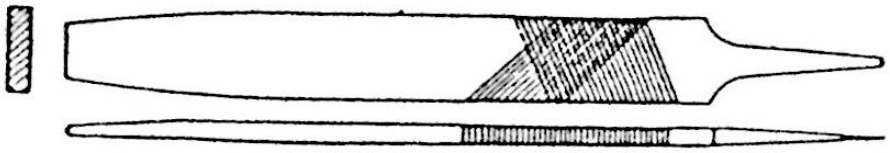


Classification of files :

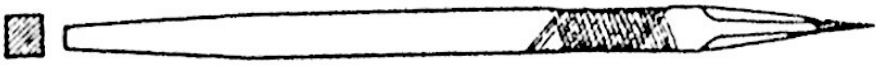
1) On the basis of length (4", 6", 8", 12",)
2) On the basis of shape
3) On the basis of grades (smooth, dead, smooth, rough, super smooth)

Shape of the file :

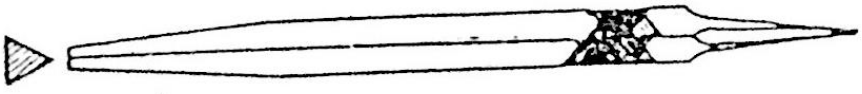
a) Flat File : Rectangular in section and tapered for 1/3rd length in width and thickness the faced have double cut teeth and the edges, single cut used for general purpose filling.



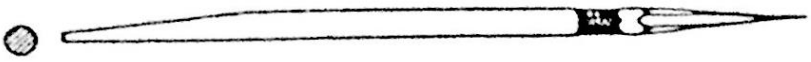
b) Square file : Square is a section and tapered for 1/3rd length on all faces. All the faces have double cut teeth used for filling corners and slots and also to cut keyways.



c) Triangular file : Equilateral triangular in section and tapered for 1/3rd length on all faces, all the faces have double cut teeth used for filling internal corners.



d) 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 circle. The flat face has double cut teeth and the curved face single cut, used for filling concave surface and internal corners.



e) <u>Needle file</u> : It is normally 150mm long, with cut teeth used for filling corners, grooves, narrow slots, etc in intricate work. Further, single cut and double cut files, single cut file have rows of teeth running in one direction across their faces and double files have a second row of teeth cut diagonally to the first row as show, single cut files are used with light pressure to produce smooth finish based on the coarseness or the pitch of the teeth. File card it is metal brush, used for cleaning the files to free them from fillingt clogged in between teeth.

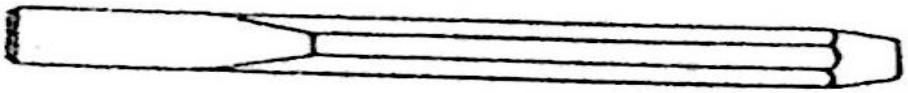
3) CHISELS :

Chisels are used for removing surplus metal or for tin sheets. These tools are made from 0.9% to 1.0% carbon steel of octagonal or hexagonal section. Chisels are annealed hardened and tempered to produce a tough shank and a hard cutting edge, annealing relieves the internal stresses in the metal, the cutting angle of the chisel for general purposed is about 60.

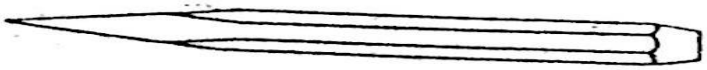
<u>TYPES OF CHISELS :</u>

a) Flat Chisel
b) Diamond Point Chisel
c) Half round Chisel

a) <u>Flat Chisel</u> : It is used for chipping large surface & for all general purpose



b) <u>Diamond Point Chisel</u> : It is used for chipping the 'V' shaped oil grooves & all so working of shape corners in square or angular holes.

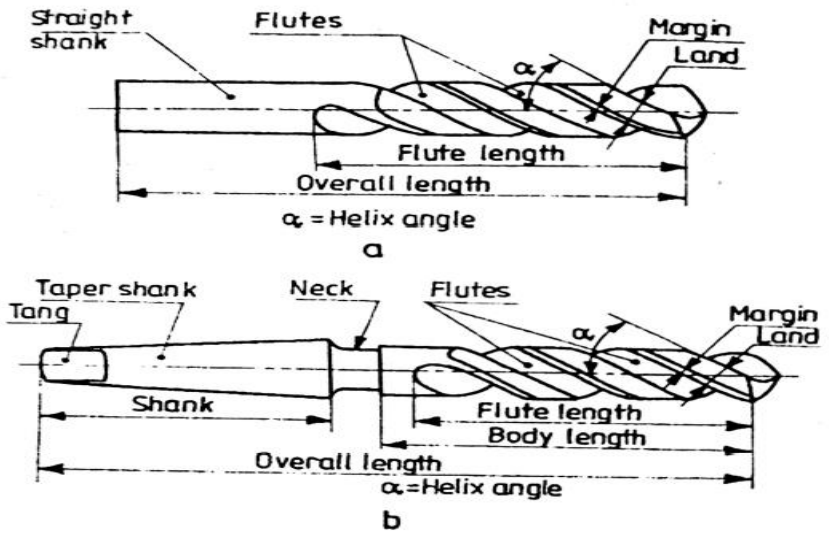


c) <u>Half round Chisel</u> : It is used for cutting of oil grooves in the bearings, pulleys & bushes.

4. DRILL BIT :

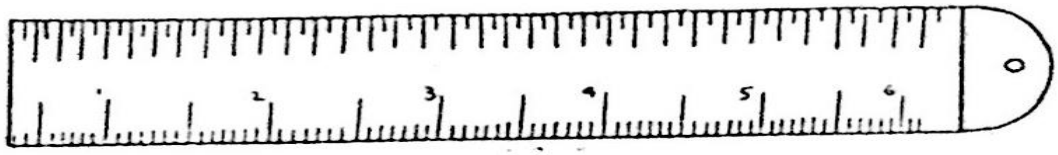
A drill bit is a cutting tool used to make round holes, it is made of high speed steel. The most popular drill bit is Twist drill.

Twist drills are used for marking holes. These are made of high-speed steel.

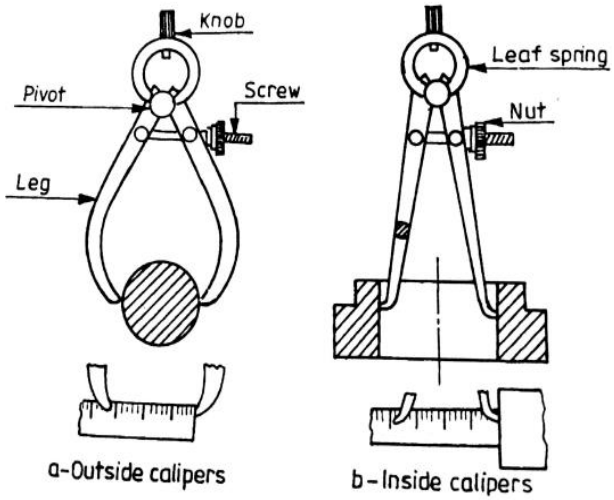


II) MEASURING TOOLS :

1) Steel rule : The steel rule is commonly used for measuring the thickness of the plates and for marking the dimensions.

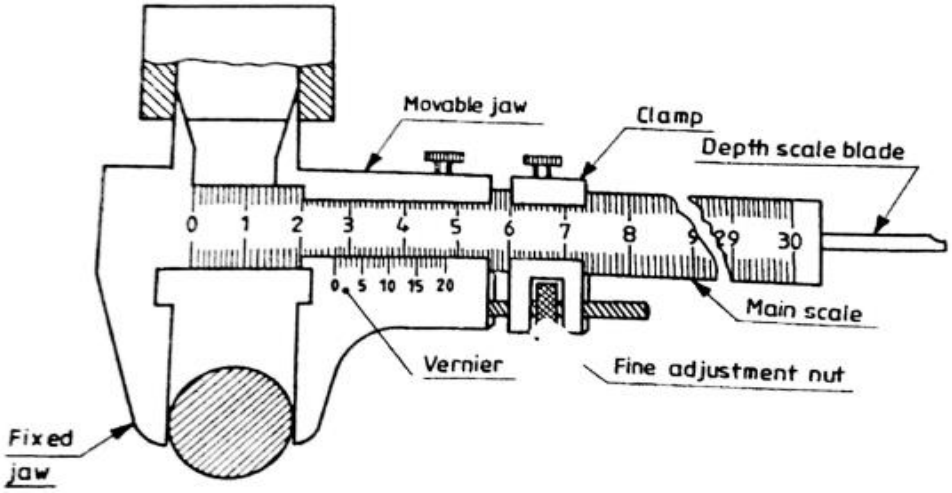


2) Caliper: These are used with the help of steel rule to check the inside and outside measurements. It is made of high carbon steel.



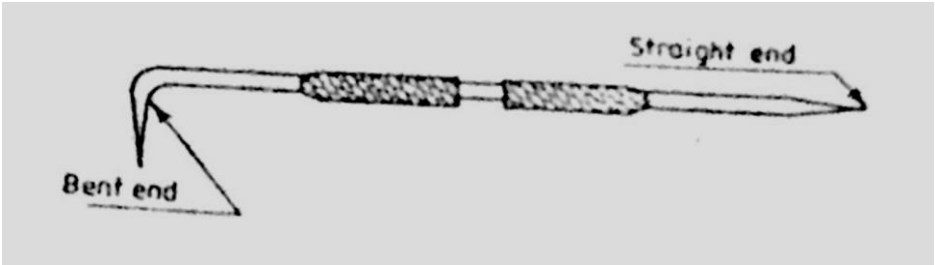
3) Vernier Calipers: It is used for measure the outer dimensions of round, flat, square components & also the inner size of the holes & bores. A narrow blade is used to measure the depth of bar

slots etc, the reading accuracy of in metric system is 0.02mm, and British system to 0.001". It is made of stainless steel.

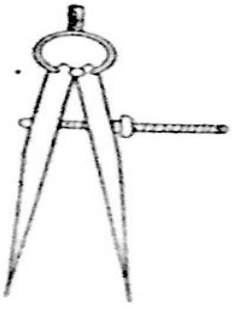


III) MARKING TOOLS :

1) Scriber : A Scriber is appointed tool used for marking lines on metal parts. It is made of high carbon steel.



2) Divider : This tool consists of two pointed legs having a joint at the top end. It is used for marking circles, arcs, laying out perpendicular lines, bisecting lines etc, size ranges from 100mm to 300mm

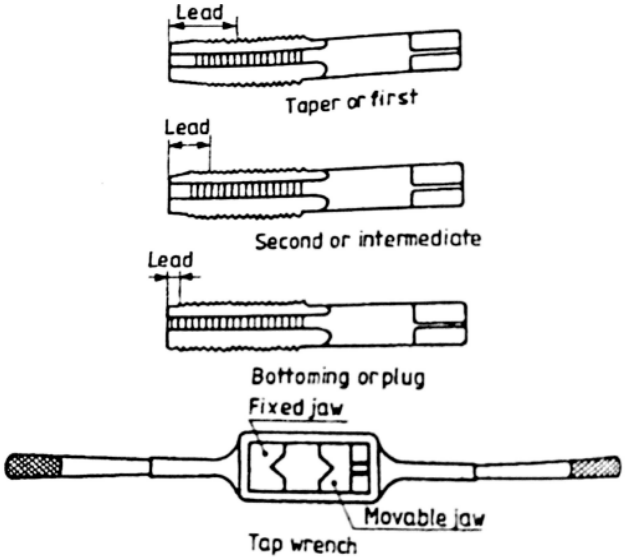


IV) Dismantling & Assembling hand tools

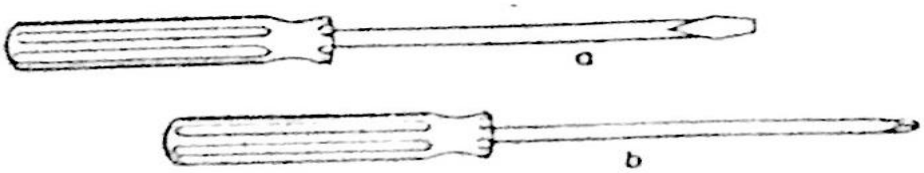
1) Tap Wrench : A tap is hardened steel tool, used for cutting internal threads in a drilled hole. Hand taps are usually supplied in sets of three for each diameter and thread size. Each set

consists of a taper tap, intermediate tap, and plug or bottoming tap. The following are the stages involved in tapping operation.

1) Select the correct size tap, with the desired pitch.
2) Select the correct size tap drill, usually indicated on the tap.
3) Drill the hole
4) Secure the tap in the tap wrench
5) Insert or taper tap in the hole and start turning clockwise, by applying downward pressure.
6) Check the alignment of the tap with a try square and correct it if necessary, by applying sidewise pressure, while turning the tap.
7) Apply lubricate while tapping in steel.
8) Turn the tap forward about half a turn and then back until chips break loose. Repeat the process until threading is completed with intermediate and bottoming taps.
9) Remove the tap carefully. If it gets stuck, work it back and forth gently to loosen.

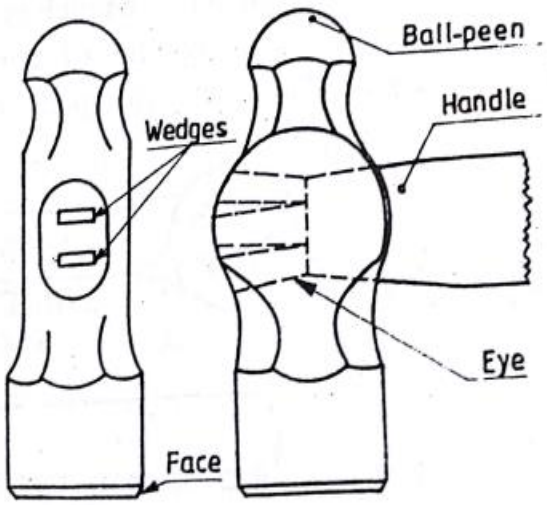


2) <u>Screw Driver</u>: A screw driver is designated to turn screws (fig(a)). The blade is made of steel and is available in different lengths and diameters. The grinding of the tip to the correct shape is very important. A Phillips (star) screw driver (fig(b)) is especially fluted instead of flattened.

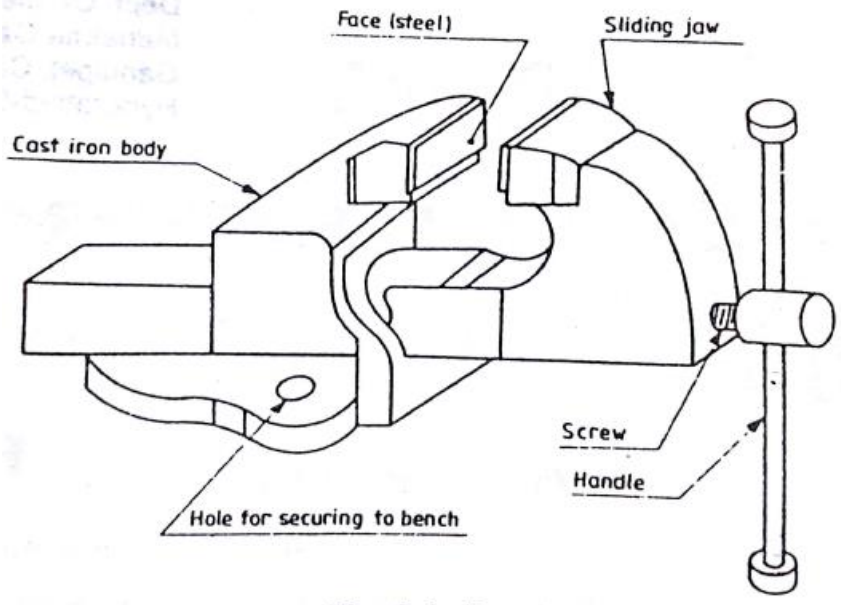


3) <u>Hammer</u>: Hammers are named, depending on their shape and material and specified by their weight.

A ball-pen hammer has a flat face, which is used for general work and ball end, particularly used for riveting etc.



4) Bench vice: The bench vice is a work-holding device. 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 vice body is made of cast iron which is strong in compression but fractures under shocks and therefore should never hammered.

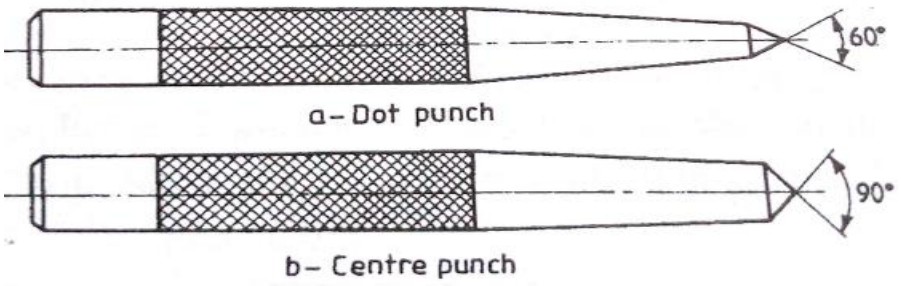


5) Punches : A tool used for a registered mark to keep up the lines visible. Till the operation is over that is called a punch. It is made of tool steel.

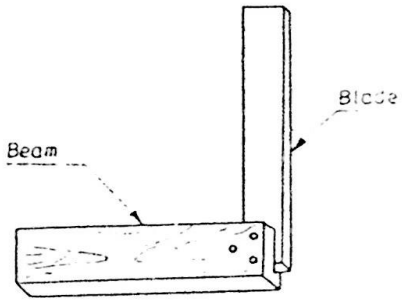
Types of punches : a) Dot punch b) Center Punch

a) Dot Punch : This is used to locate center of holes and provide a small center mark for divider point etc. for this purpose, the punch is ground to a conical point having 60^0 included angle.

b) Center Punch : This is a similar to the dot punch, except that is ground to a conical point having 90^0 included angle. It is used to mark the location of the center where holes are to be drilled. The center punch mark facilitates easy locations of the drill tip and center accurately.

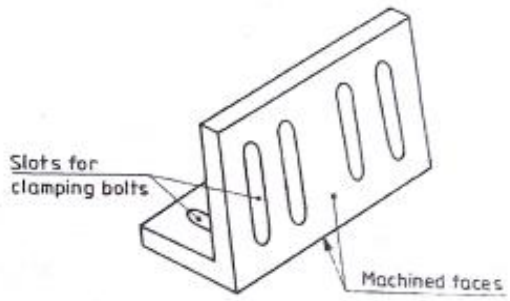


6) <u>Try-Square:</u> Try square is used for checking the squareness of small works. When extreme accuracy is not required. The size of the try square is specified by the length of the blade.

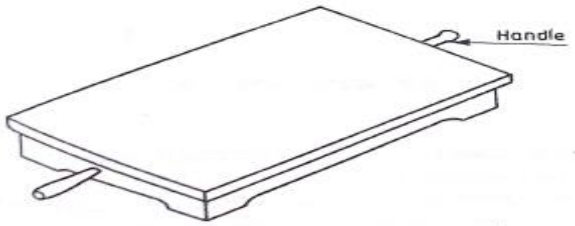


7) <u>Angle-plate:</u> The angle plate is made up of cast iron. It has two surfaces, machined at right angles to each other.

Plates and components, which are to marked out, may be held against the upright face of the angle plate, to facilitate the marking.

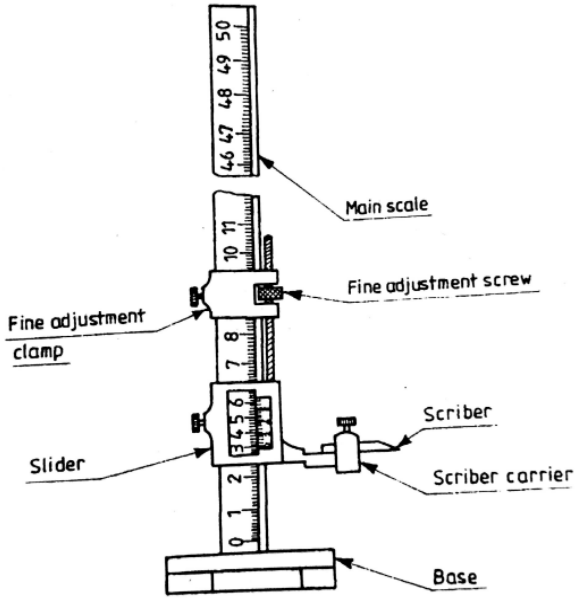


7) <u>Surface Plate</u>: the surface plate is used for testing the flatness of the work piece. It is used for marking out small works and is more precise than the marking table. The surface plate is made of cast iron, hardened steel or granite stone. It is specified by length*width*grade.



8) <u>Vernier height gauge</u>: The vernier height gauge, clamped with a scriber, is shown in fig. it is used for layout work. An offset 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.



TINSMITHY

Introduction:-

Sheet metal work has got its own signification as a useful trade in engineering works and also for our day to day requirements. Generally sheet metal works is regarded as the working of metal from 16 gauge down to 30 gauge, with hand tools and simple machines into various forms by cutting, forming into shape, and joining.

Examples:- Hoppers, Containers, Guards, Covers, Pipes, Hoods, Funnels, Bends, Boxes etc., Such articles are found less expensive, lighter in weight and replace the use of the castings or forgings.

Materials used in sheet metal work

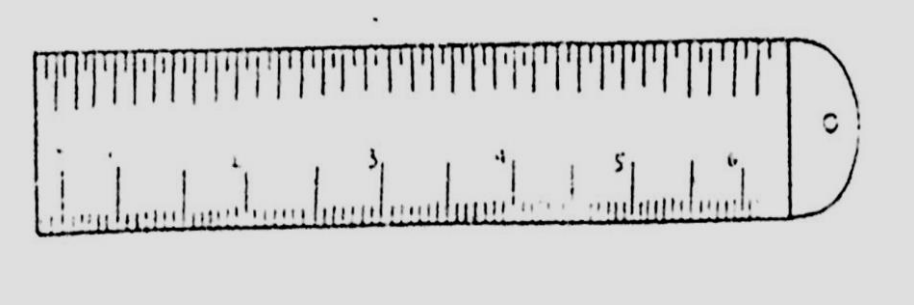
In sheet metal work, the sheet metal used is Black iron, galvanized iron, stainless steel, Copper, Brass, Zinc, Aluminum, Tin plate and lead. The sheets are specified by standard gauge numbers.

Hand tools

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

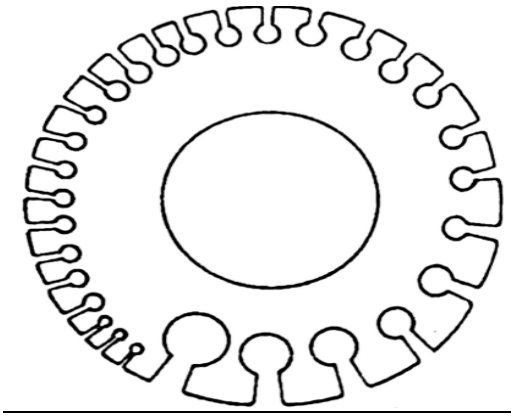
Measuring tools

Steel rule: This is perfectly useful in measuring and laying out small work. It can be measure with an accuracy of 0.5mm.



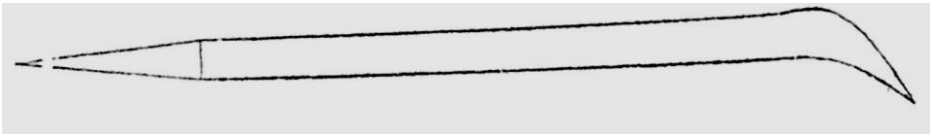
Sheet metal gauge: The thickness of sheet is referred in numbers known as standard wire gauge (S.W.G). The gap in the circumference of the gauge is used to cheek the gauge number as shown in figure. Some of the standard wire gauge numbers with corresponding thickness are as follows.

S.W.G.No.	Thickness (mm)
10	3.20
12	2.60
14	2.30
16	1.60
20	1.00
22	0.70
24	0.65
26	0.45
30	0.30

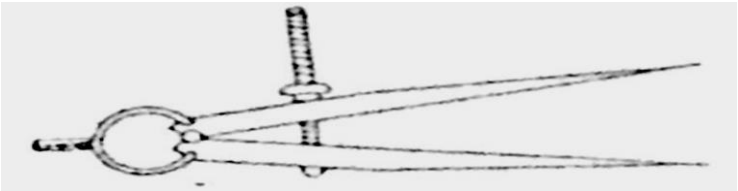


Marking tools

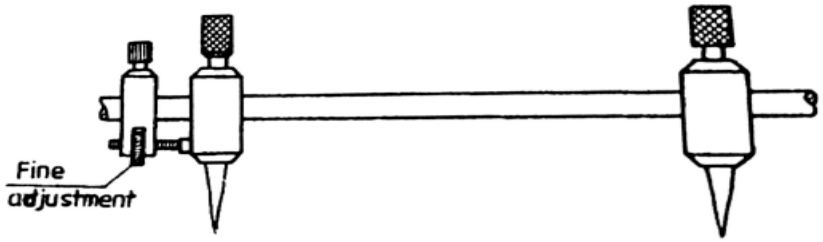
Scriber : This is sometimes called the metal workers pencil. It is long wire of steel with its one end sharply pointed and hardness to scratch lines on sheet metal in laying out patterns



Divider : It is used for drawing circles or arcs on sheet metal. They are also used to mark a desired distance between points and to divide lines into equal parts.



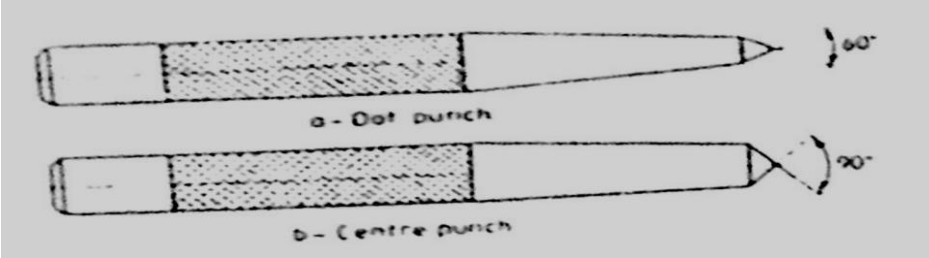
Trammel: Sheet metal layout requires marking of arcs and circles. Using the trammels, shown in figure may do this. The length of the beam decides the maximum size of the arc that can be scribed.



Punches: It is used in sheet metal work for marking on sheet, locating centers. There are two types of punches.

a) Dot Punch
b) Prick punch

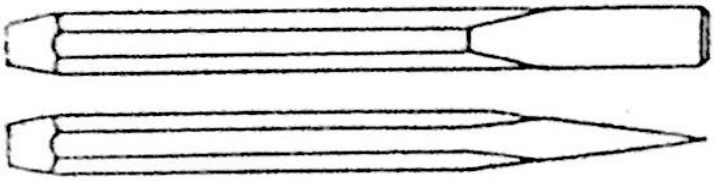
Dot punch : It is used to give small round indentations, when struck with hammer.
Prick punch : It is used to make small marks on layout lines.



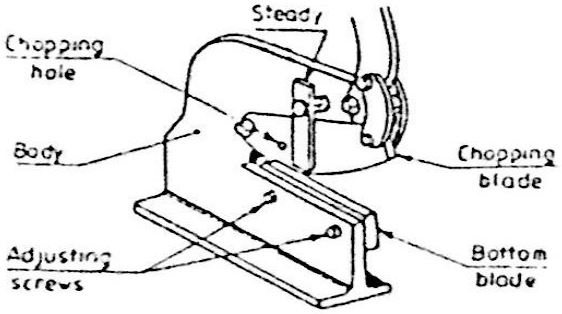
Cutting tools

Chisel : Chisels are generally used in sheet metal work for cutting sheets, rivets, bolts and chipping operations.

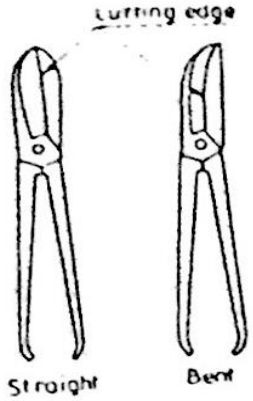
a) Cold chisel b) Flat chisel c) Round nose chisel



Bench Shears: Sheet metal may be cut by shearing action. Figure shows a bench shear. In this, the force is applied through a compound lever, making it possible to cut sheet metal up to 4mm thick. The chopping hole can shear a mild steel rod up to 100mmm diameter.



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

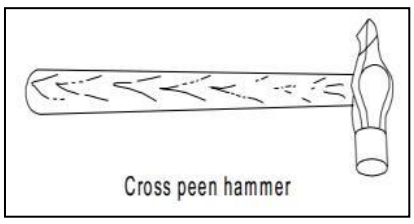


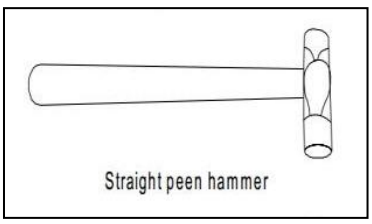
Hammers: Hammers are used fir forming shapes by hammering.

a) Ball-pen Hammer
b) Riveting Hammer

Ball-pen hammer : It is used for all Kinds of engineering works for sheet metal forming

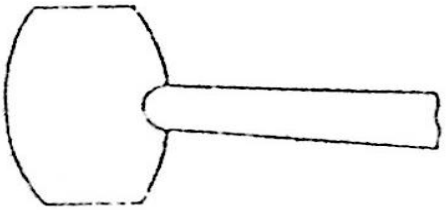
Riveting hammer : It is used for riveting.





Ball peen hammer

Mallets : To avoid damage to machined surfaces mallets are used. In sheet metal work the usually used mallets are bossing mallet, tin means mallet and raw wide mallet.



Stakes:

Stakes are used when bending or forming sheet metal articles. These are made with wrought iron faced with steel

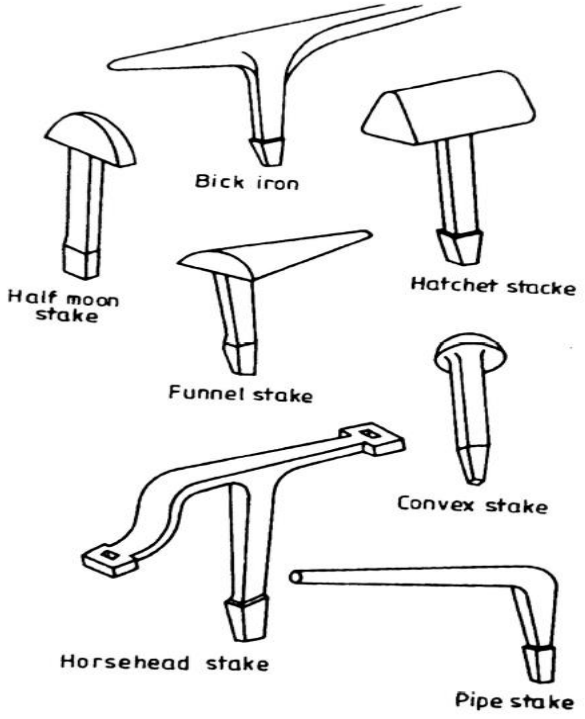
a) Hatchet stake: It is a straight edge, beveled along one side, it is useful for making sharp bends, folding the edges of sheet metal, forming boxes, and pans by hand tucking in metal wired edges and seaming.

b) Half moon stake: It is used for throwing up flanges or metal discs or countered blanks.

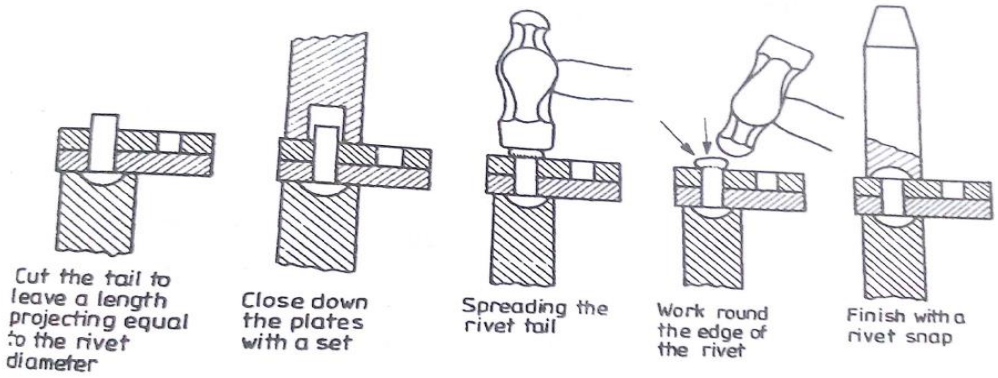
c**) Bike-iron stake:** The stake has horns one of which is tapered and other rectangular shaped anvil. The thick tapered horn is used when making spots and sharp tapering articles. This anvil may be used for squaring corners, seaming and light riveting.

d) Funnel stake: The funnel stake is used when shaping and seaming funnel and tapered articles, with part conical corners such as square to round.

e) Creasing iron stake : It has two rectangular shaped horns one of which is planed and the other horn contains the series of grooving slots of various sizes. The grooves are used when sinking a bead or straight edge in flat sheet.



Rivet set : This is a hardened steel tool with a holding at one end. It is used to shape the end of a rivet.



Soldering

Soldering is the method of joining two pieces of metal with an alloy that melts at lower temperature than the metals to be joined. To get a good joint, the metals to be joined must be free from the dirt, grease and oxides. Solder is an alloy of tin and lead, usually in equal proportions. It comes either in the form of wire or bar.

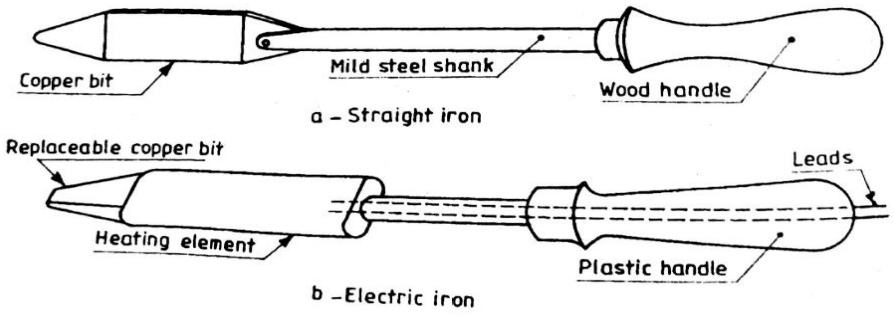
Solder with 60% Tin and 40% Lead is known as tinman's solder with a melting temperature of 183^0c.

Plumbers solders has 40% Tin & 60% Lead and melting temperature of 203^0c. This is used for joining lead pipes or lead sheathing of electric cables.

Sliver Solder has a composition of 34% Cu, 50% Ag, and 16%Zn. With a melting temperature of 600^0C. Silver Soldering is done with acetylene flame with small nozzle.

Flux is used to remove oxides from the metal and to make the solder flow smoothly. An acid flame is used for black iron and galvanized iron. Arson flux is used for tin plate, copper and electric wire.

Soldering Iron: Soldering requires a source of heat. A common method of transmitting heat to the metal surface is by using a soldering iron. The working end of this tool is made of copper, which is good conductor of heat.



Sheet metal Joints :

Straight flat Joints :

a)Butt Joint b) Lap Joint c) Sunk Lap Joint d) Riveting Joint e) Corner Lap Joint (or) Edge Over Joint f) Locked Joint

a) Butt Joint : It is used in sheet metal ring pieces. In these joints the two edges are butt against each other and brazed or soldering. This is used for thicker guage.

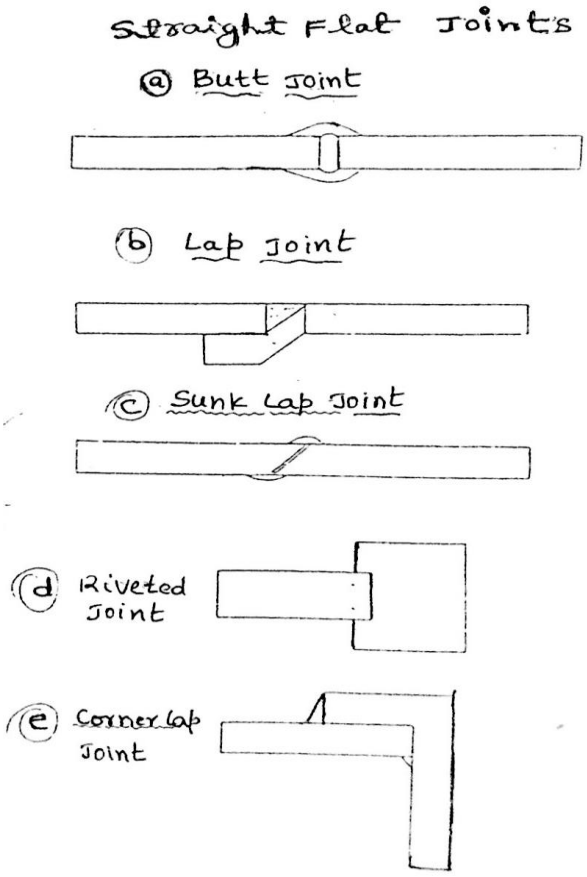
b) Lap Joint : It is stronger than butt joint, one sheet is placed over the other sheet for some distance and then it is either soldered or brazed. It is used mostly in structural work.

c) Sunk Lap Joint: It is also Lap Joint, but in this case the overlapping edges are beaten evenly at that joint. The thickness of the joint is same as that of sheets and then the joint is brazed or soldering.

d) Riveted Joint : It is also a lap joint, but in this case the joint is riveted.

e) Corner Lap joint: One edge is bent at right angle and the other edge is placed inside the bent edge this is soldered. This is often used in containers.

f) Locked Joint: In locked joints the edges of the sheet are curled and adjusted into each other and beaten, to make the joint water proof. It is essential to solder it.

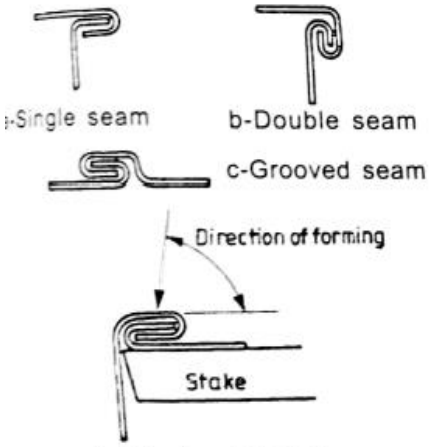


Various forms of seams and hems are associated with sheet metal works as described below.

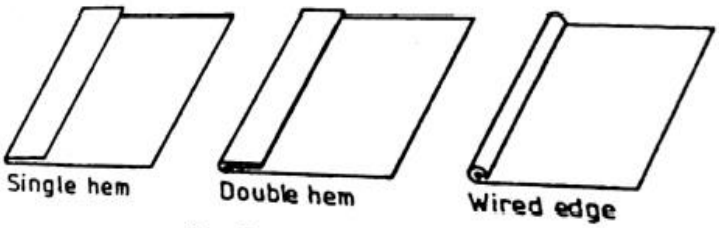
A seam is a joint made by fastening two edges together. The following are the types of seams.

Single Seam: It is used to join a bottom to a vertical body.
Double Seam: It is similar to a single seam, with the main difference that its formed edge is bent upward against the body. The layout process for this seam is similar to that used for a single seam.
Grooved Seam : It is made by hooking two folded edges together and then off- setting the seam.

A hem is an edge made by folding. The following are the types of hems.
Single hem: It is made by folding the edge of the sheet metal, to make it smooth and stiff.
Double hem : It is a single hem, with its end bent.
Wired edge: It consists of an edge which has been wrapped around a piece of wire. The edge is used more strength is needed.



A-Sheet metal joints



B - Folded edges

BLACK SMITHY

Introduction to Smithy and Forging

Blacksmithy or hand forging is an ancient trade. It consists of heating a metal stock till it acquires sufficient plasticity, followed b hand forging, involving hammering, bending, pressing etc., till the desired shape is attained.

Hand forging is the term used when the process is carried out by hand tools. The hand forging process is generally employed for relatively small components. However, it calls for a remarkably high degree of skill and judgement. The difference between smithy and forging is as follows.

Smithy	Forging
➢ Smithy is restricted to simple jobs. ➢ Hand Hammers are used ➢ Jobs are heated in smithy furnace ➢ Initial cost is less	➢ Forging can be applied to complicated jobs ➢ Power hammers are used ➢ Jobs are heated in closed furnace ➢ Tooling and handling cost are high

The following are the forging temperatures of various metals:

Material	Forging Temperature
Stainless steel	1200˚C
Brass	650-800˚C
Bronze	825-900˚C
Aluminium alloys	350-500˚C
Wrought iron	900-1300˚C
Copper	600-800˚C
Medium carbon steel	750-1250˚C
High carbon and alloy steel	800-1150˚C

All metals cannot be forged. It is important that metal should posses following three characteristics before it can be shaped by (1) plasticity, (2) ductility (3) malleability

Forgeability: The term Forgeability has been defined as the capacity of being forged with easiness and readiness.

Relative Forgeability of various alloys

Good material: Aluminium alloys, Magnesium alloys, Copper Alloys and Alloy Steels.

Somewhat difficult: Stainless steel (Martensite) and Steel Nickel Alloys

Difficult: titanium alloys, iron base super alloys and cobalt base super alloys.

Very difficult: Nickel base alloys, tungsten alloys, beryllium alloys and molybdenum alloys.

METHODS OF FIRING SMITHY FORGE

Open Fire: (LOOSE FIRE) Air enters in only one direction, Least Expensive method, Non Uniform heating.

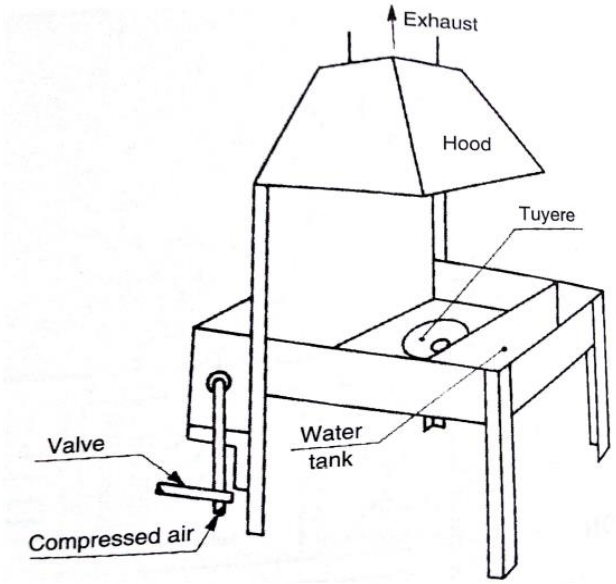


Fig.Smith's forge

Stock fire: Air enters in all directions. It is suitable for large pieces. Uniform heating , Expensive method.

Heating Devices:

Box furnace: (slot furnace) Least expensive suitable for heating small and medium size stock

Rotary hearth furnace: they are set to rotate slowly so that stock is heated to correct temperature during arc rotation.

Conveyer furnace: the pieces are changed at one end conveyed through furnace and are moved at other end at the correct temperature for forging,

Induction Furnace: Stocks are passed through induction tools in the furnace. This can be operated by one person, no scale formation, less maintenance and faster.

Resistance furnace: Faster than the induction furnace and are often automated. Stock is connected into circuit at step down transformer.

Advantages and Disadvantages of Forging:

Advantages	Disadvantages
1. Forging parts can be welded	1. High initial cost due to tooling cost
2. High impact strength	2. Poor surface finish due to oxidation of metal
3. Porosity in the ingots is eliminated	3. Close tolerance cannot be maintained
4. Internal structures of metal gets refined	4. Over heating cracks will be formed
5. The continuity of gain in the structure is maintained in the direction of the shape.	

Applications of Forging:

1. Riveting of shells for boils, tanks, furnaces etc.
2. Domestic & Scientific appliances
3. Machinery parts &steel structures
4. Arms, weapons &cutting tools.
5. Hooks links & other lifting shifting tables.

6. Bolts, nails, nuts, keys, eye, bolts &hooks etc.
7. Laminated springs
8. Connecting rods crane shafts
9. Automobile industries
10. Airplane industries

Fuels:

Fuels are divided into 3 categories. They are :

1) **Solid fuels:** Solid fuels are coal charcoal and coke.
   - **Coal:** It gives out volatile matters. It maintained heat for longer period and has calorific values. Coal which has sulfates and phosphorous &harmful for metal. Anthracite coal carbon burns slowly and suitable for forging.
   - **Coke:** obtained by distilling bituminous coal a special over in absence of oxygen. It has high calorific value. It is mostly used for melting purpose.
   - **Charcoal:** it gives a clear fire but it doesn't maintain for longer periods.
2) **Liquid fuels:** Generally furnace oil is used in oil fired furnace.
3) **Fuel gases:** Use of gas is better in forging at all times.

FORGING: Forging refers to the production of those parts which must be heated in a furnace. The work is mainly performed by means of hammers, forging machines and presses.

Colours visible at various temperatures for mild steel

Temperatures (˚C)	Colour
600-650˚C	Dark red
700-750˚C	Dark cherry
800-850˚C	Cherry red
900-950˚C	Light cherry red
1000˚C	Orange
1100-1200˚C	Yellow

Steels	Carbon (%)	Hardening Temp (˚C)	Tempering Temp(˚C)	Applications
Mild steel	0.1	800-840	250-300	Chains, rivets, soft-wire, sheets,
	0.25	800-840	250-300	Tubes, rods, strips,
	0.5			Girders

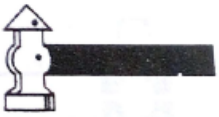
Medium carbon steel	0.75 0.9 1.0	760-800 760-800 760-800	250-300 250-300 250-300	Cold chisels, smithy tools. Taps, dies, punches, hot shearing blades. Drills, reamers, cutters, blanking and slotting tools large turning tools.
High carbon steel	1.2 1.35 1.5	720-760 720-760 720-760	250-300 250-300 250-300	Small cutters, tools, files, drill. Extra hard planing, turning and slotting tools, dies and mandrels. Razor blades

STRIKING TOOLS

Ball –Peen Hammer: Ball Peen Hammer also called as chipping hammer. It is specified by its weight ranging from 0.5-2Kg. this is made of cast steel and the ends are hardened and tempered. It is used for setting, chipping and riveting.

Ball peen hammer

Cross Peen Hammer: This is similar to Ball-Peen Hammer in size and shape except beam, which is cross for the shaft or eye. This is mainly used for bending, stretching, hammering into shoulders inside curves etc.



Cross peen hammer

Straight Peen Hammer: It has a peen straight to the shaft and parallel to the axis of the shaft.

Straight peen hammer

Sledge Hammer: It is used to hammer the work piece heavily. Its weight varies from 1-5Kg.

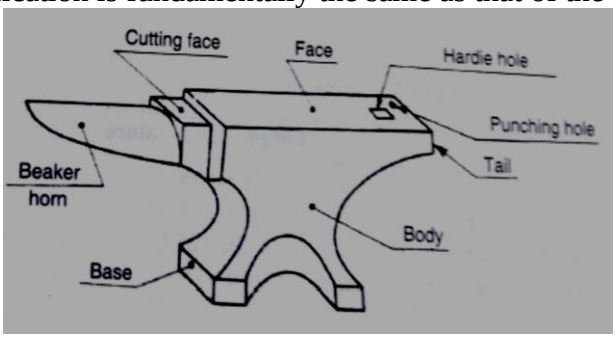
Sledge hammer

Measuring Tools: Steel rule and Vernier Calipers come under measuring tools. These are used to measure the various dimensions of the work piece.

Hand Forging Tools

Anvil

It is an important implement of head forging that has been used in practically the same shape and form for many centuries. Occasionally anvils of special shapes are designed for hand foging operations, but their application is fundamentally the same as that of the common anvil.



Anvil

Forging of hot metal pieces is done by supporting the piece on the anvil. The upper part of the anvil is made of tough steel to stand the job. The top surface of the anvil consists of two holes: (a) a square hole called hardie hole and (b) circular hole called punching or stud hole. The ends of the hot metal piece are inserted into these holes when it is desired to shape or bend the workpiece.

Swage block

It is a solid rectangular block as shown in fig. made of either cast steel or forged steel. It carries a number of blocks of different shapes and sizes along its four side faces and through holes of different sizes from top face to bottom face.

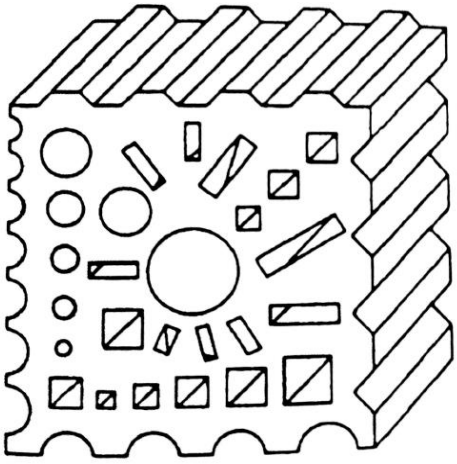
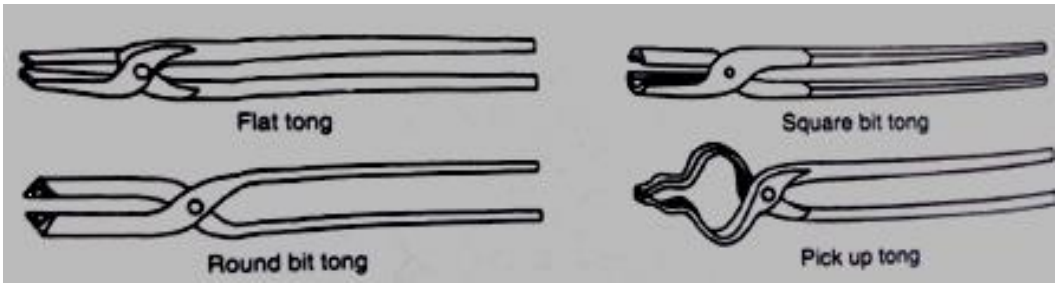


Fig. Swage block

HOLDING TOOLS

Tongs

Tongs are used by the smith for holding and turning the hot metal workpieces. They are made of steels containing 0.3 to 0.4% carbon. Tongs are made in two pieces, riveted suitably to form a hinge as shown in fig.



Swages

Different types of swages are used for forming and finishing convex surfaces and different shapes. It is used for giving a finish to round or hexagonal surfaces. Swages are used in pairs, (a) the top swage and (b) the bottom swage. A typical swage is shown in fig.

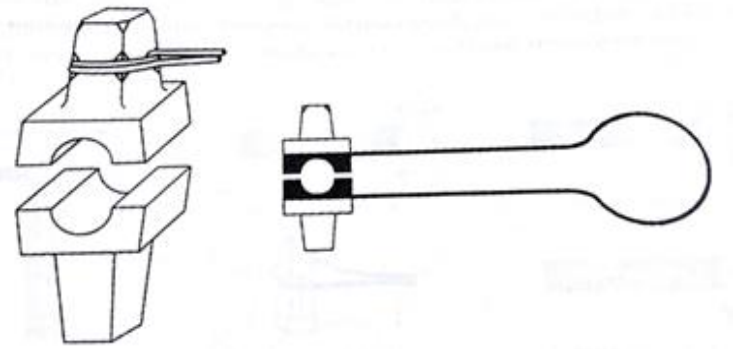


Fig. Swages

Fullers

Fullers are tools used for forming grooves or necks by reducing the cross-section of a job and also in drawing out. A fuller set consists of a top tool and a bottom tool as shown in fig.

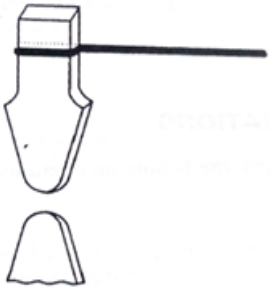
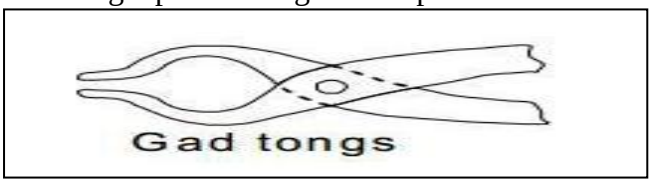
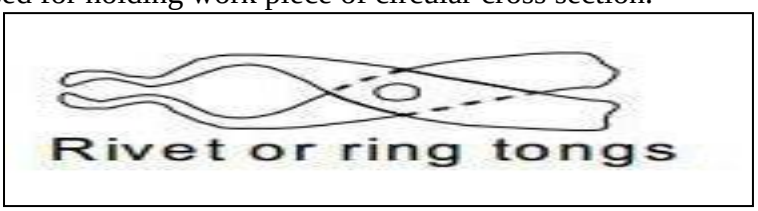


Fig. Fuller

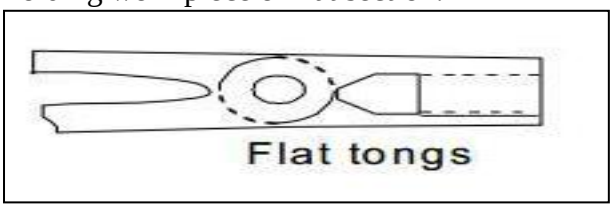
Gad Tong: It is used for holding taper or straight work piece.



Ring Tong: It is used for holding work piece of circular cross section.



Flat Tong: It is used for holding work piece of flat section.

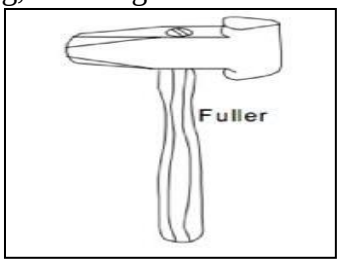


Pickup Tong: It is used for upsetting process

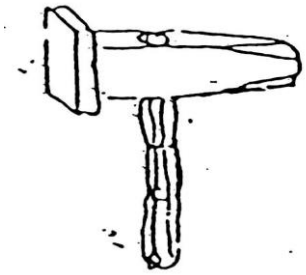
Punch: It is used for making and punching square or round holes on the work piece.

FINISHING TOOLS

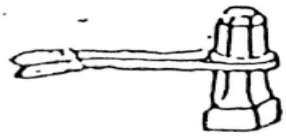
Fullers: Fullers are used for necking, finishing curves on the work piece.



Flatters: they are used to give smoothness and accuracy to articles which are already been shaped by fullers and swages.

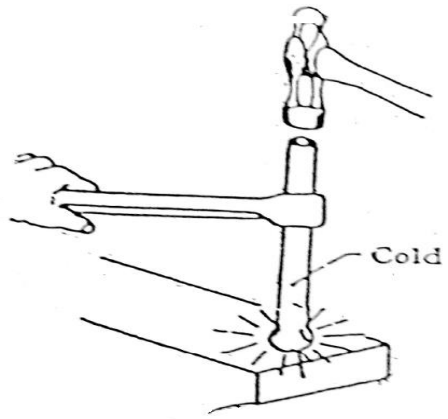


Set Hammer: It is a form of flatter and is used for finishing corners in shouldered work piece, where flatter would be inconvenient. It is also used for drawing.

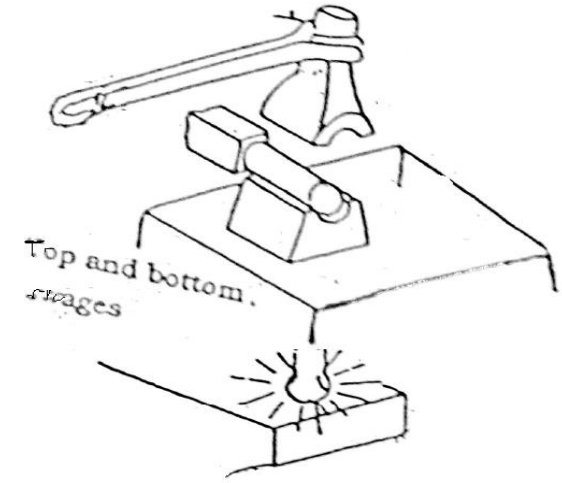


SMITHY FORGING OPERATIONS

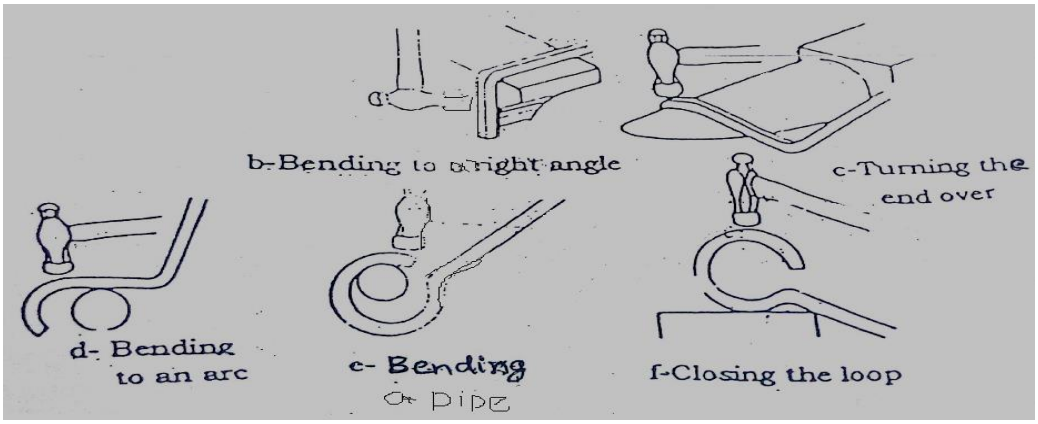
1. **Upsetting (Heading):** It is a process of increasing the thickness of the bar at the expense of its length.



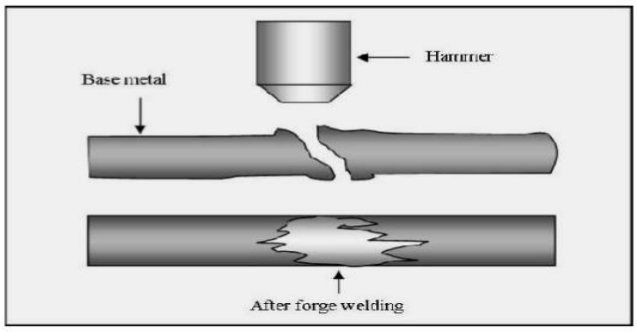
2. **Drawing Down (or) Swaging:** It is a process of increasing length of the bar at the expense of its width or thickness or both.



3. **Setting down:** It is a localized swaging operation.
4. **Punching:** It is the process of producing holes generally cylindrical holes by using hot punch over the pritchel (round) hole of anvil.
5. **Bending:** It is the process of bending the rod on the anvil.

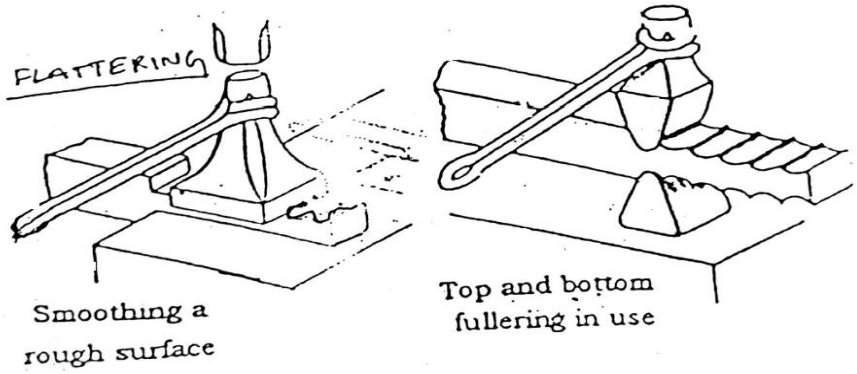


6. **Forge Welding:** It is the process of joining two work-pieces by the application of heat and pressure.



Schematic representation of
FORGE welding using Hammer

7. **Fullering:** Fullering is spreading the metal along the length of the work piece.



HOUSE WIRING

Wiring is defined as a system of electric conductors, components and operators for conveying electric power from the source to the point of use. The wiring system must be design to provide a constant voltage to the load.

Electric power is supplied to domestic installation through a phase and a neutral forming a single-phase A.C230V, two-wire system. For industrial establishments, power is supplied through three-phase four-wire system, to give 440V

BASIC KNOWLEDGE OF ELECTRICITY

CURRENT: The flow of electricity is called current. Its unit is ampere. The instrument used to measure the current is called ampere meter or Ammeter.

QUANTITY OF ELECTRICITY: The product of current and time gives the quantity of electricity. Their unit is coulomb.

Q=I*t coulomb

ELECTRO MOTIVE FORCE (E.M.F): It is that pressure which makes the current to flow. Its unit is Volt and the instrument used to measure is called voltmeter. Its unit is Volt.*R Volts

RESISTANCE: The opposition to the flow of electric current is called resistance .Its unit is Ohm and instrument used to measure resistance is called Ohmmeter.

R=V/I Ohm

Or R=ρl /a Ohm

Where ρ=Specific resistance of the conductor

l= Length of the conductor

a=Cross –sectional area of the conductor.

ELECTRICAL POWER: The rate of transfer of energy is called electrical power. Its unit is Watt and the instrument used to measure electric power is called Wattmeter.

Power (P) = Voltage * current Watts

ELECTRICAL ENERGY: The product of power and time is called Electrical energy .Its unit is Kilowatt –hour and is measured by energy meter or Kilowatt –hour meter.

1KWh = 1000watts for one hour

= $36*10^5$ joules/second or Watts

= 1 unit of power.

CONDENCER (or) CAPACITOR: It is a device for storing the electrical charge.

SERIES AND PARALLEL CIRCUITS:

The series circuit provides a single, continuous path through which current flows. In this the device are connected one after another and the current flows through them until it returns to power source. In this, even when one device breaks down, the remaining devices will not operate, because the circuit is broken.

In parallel circuit, the devices are connected side by side, so that current flows in a number of parallel paths. In this type of circuit, each device is connected across the power source so that even if one device breaks down, the other devices continue to operate. Hence, this type of circuit is used in house wiring. The wires used in house wiring contain multi-strand copper wires, covered with PVC insulation.

CONDUCTORS AND INSULATORS: Conductors are those materials, which allow the current to flow through them easily and insulators are those materials, which does not allow the current to flow through them easily.

***EXAMPLES FOR GOOD CONDUCTORS*:**

1. **SILVER:** It is used in meters and relays at contacts etc.

2. **COPPER:** It is used in wires, contact strips or terminals etc.
3. **ALUMINIUM**: It is also used in wires, contact strips or terminals etc.

INSULATORS:

1. Mica It is used in conductors in the construction of commutators, in the construction of resistance units. Such that in heaters, iron, kettle elements.
2. Marble and Slate: These are used for switch boards, switches and residences, frames etc.
3. Porcelain: It is used in construction of pin type, shackle type and suspension type insulators in the construction of fuse carriers and switch bases, cleats etc.
4. VIR and PVC: Used for insulating and protecting covering for low and medium voltage cables and conductors.
5. Asbestos: It is used for winding resistance wires on it and preparing heat resistance moulding composition. It is heat proof.

WIRES AND WIRE SIZES: An electric wire is an insulated conductor consisting of one of several strands. The insulation material is made of Vulcanized India Rubber (VIR) or Polyvinyl Chloride (PVC). The wire may consist of one or several twisted strands. A multi - core conductor consists of several cores insulated from one another and enclosed in common sheathing.

Wire sizes are specified by the diameters of the wire, using a Standard Wire Gauge (SWG), which also gives an idea of current carrying capacity. The specification consists of both number of strands and the diameter of each wire in it. For example, the specification

i. silk wire 14/36 consist of 14 strands of 36 gauge each and
ii. 3/18 PVC consists of 18 gauge each.

FUSES AND CIRCUIT BREAKERS:

These are the devices designed to provide protection to a circuit against excess current. In old type of distribution panels, 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 over loaded 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.

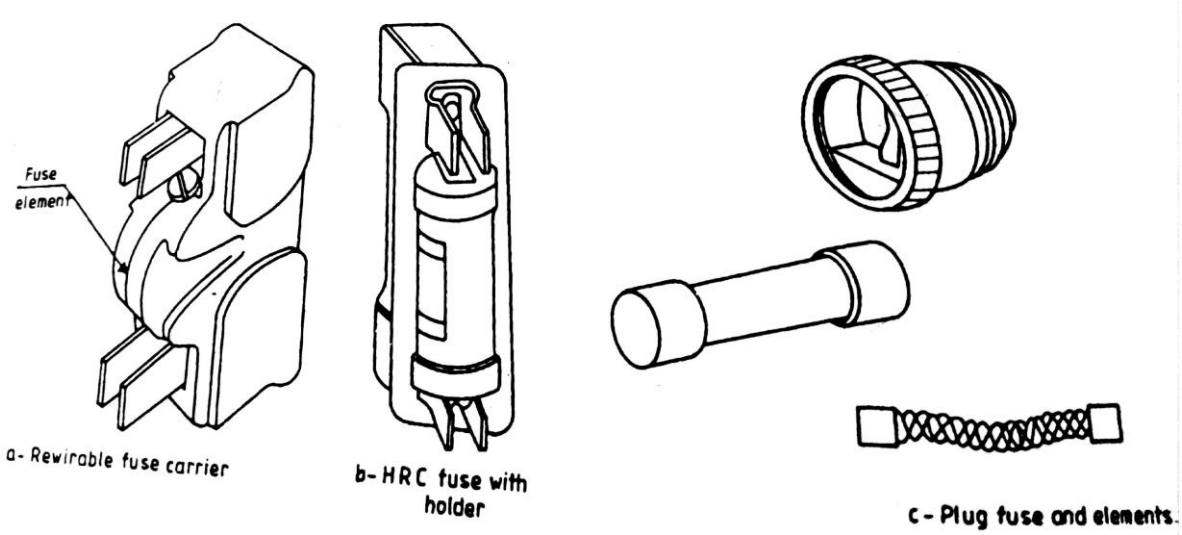


Fig. Forms of fuses

Most commonly used materials for fuse wire are, lead, tin, zinc, silver, lead, and tin alloy, tinned copper, silver alloy and copper alloys.

General specification of House wiring:

1. Power wiring should be carried out separately from lighting wiring.
2. Copper conductors should be used.
3. Mechanical connections should be used for joining conductor ends.
4. Wooden pegs used in walls or ceiling should be of hard seasoned wood.
5. The iron clad main switch, conduit fitting and 3-pin wall sockets should be earthen.
6. The main board should be at a height of 150cm from the level of the ground.
7. The switch board of room should be fixed on the left side of the door and at a height of 150cm.
8. In Kitchen, the wiring should be in conduit system to protect the wires from smoke.
9. The iron clad switch should be used for each load up to 10 ampere.

Types of Tests on a complete Wiring Installation

1. Insulation resistance test between conductors.
2. Insulation resistance test between conductors to earth.
3. Continuity test – Open, closed and short-circuit.
4. Testing to earth.
5. Testing of polarity of switches.

Earthing or Grounding: It means to connect any electrical appliance or equipment at zero potential of earth with the wire and thus to avoid the electric shock to the operator.

SAFETY PRACTICES:

1. When closing the electric switch, always grasp the switch by the insulated handle

2. Do not run too many electrical items from one point

3. Use fuses in the circuit breakers of proper capacity, so as to interrupt the current before it becomes dangerous

4. Disconnect the units to be repaired, free from power supply and make sure that they might not be energized while the repair work continues

5. Do not pour water to put off fires in electric wires and electric equipment. You will be subjected to electric shock or you will be electrocuted use sand to put off fires in electric items.

6. Whenever there is power failure put-off the power supply to all equipments in order to prevent spontaneous recovery

7. Never remove a plug from an outlet by pulling the cord. Always pull by the plug.

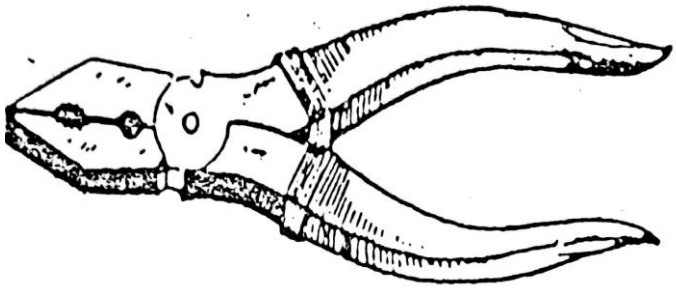
8. While testing, always keep one hand in your pocket. If the hands are in contact with a circuit, a current will flow across your body and is more dangerous.

9. Electricity has no respect for ignorance. Do not apply voltage or turn-on any device until it has been properly checked.

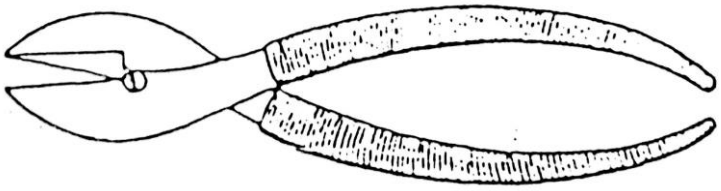
10. Check the earth connection before switching-on portable equipment like drill guns etc.

ELECTRICIANS HAND TOOLS:

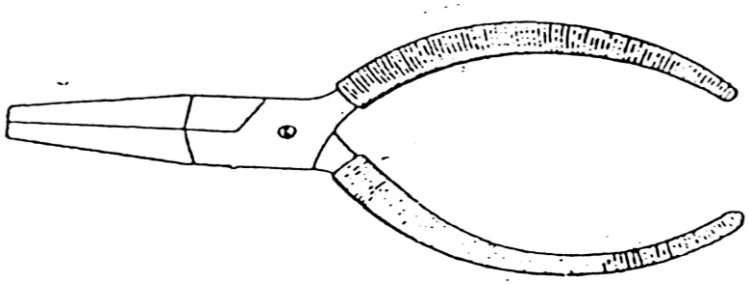
1. **Insulated combination pliers**: It is used for cutting and twisting the wires. They are specified in length and the range is 15, 20, 25 and 30cm. either they are insulated or non insulated. Insulated plier is particularly used on live wires because to avoid from shocks.



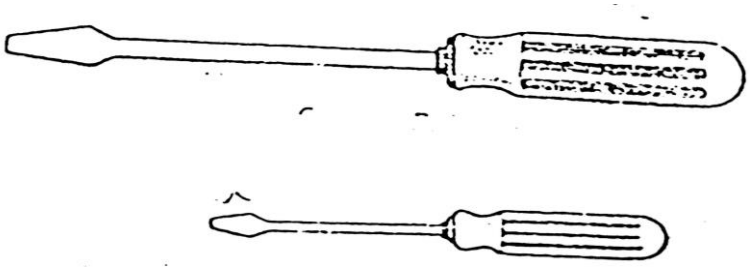
2. **Side cutting pliers:** It is used for cutting wires and nipping the insulation from them. It is widely used for winding works, radio assembling and other delicate instruments.



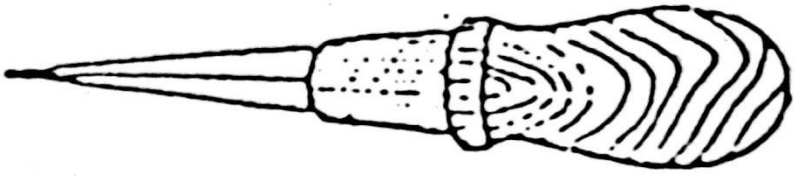
3. **Long nose pliers:** It is used for working in space for holding, tightening and loosening small nuts.



4. **Screw drivers:** Screw drivers of different sizes are used for different types of jobs. They are used for taking out or driving in slotted head screws by turning them. The size is measured by its blade. A good driver has a hardened and tempered edge.

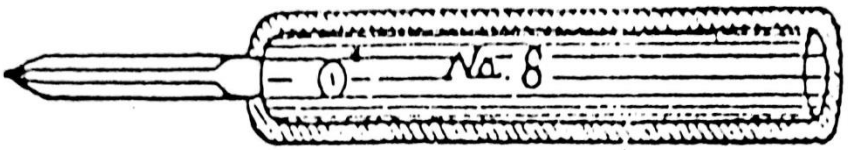


5. **Poker:** It is a pointed tool with flat sides and is used for making pointed holes for screws in wood casing, boxes etc.



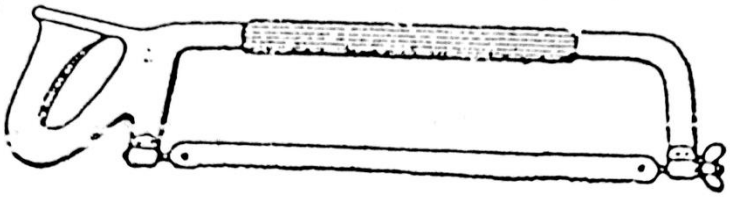
6. **Firmer Chisel:** It is used for chipping, scrapping and grooving the wood. The size varies and is taken from the width of the blade. The size in general is from 3mm to 3.8mm.

7. **Rawl Plug:** Brick work, concrete construction and in fact, most masonry work, offer stiff resistance to hole punching. A special tool called a rawl plug tool can be used to punch through such walls. The tool is rotated by hand after each hammer stroke to prevent the drill from becoming frozen during its passage through the wall. This turning motion, at the same time, forces cut particles the wall substances out of the hole.

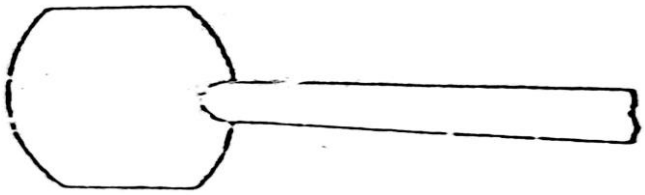


8. **Tenon saw and |Hand saw:** These are designed with sharp-teeth blade to cut the wooden material etc. And the wooden handles to hold on one end. These are used in case of cutting the wooden pieces and making the edges of casing-carping, batten, wooden boards and wooden blocks etc.

9. **Hack saw**: Hack saw frames are made with either a straight handle or with the pistol grip type of handle. The blade is tightened by means of wing nut on the frame at the end opposite the grip. These are used to cut cable armour and conduit pipes, etc. Frame is either fixed or adjustable.

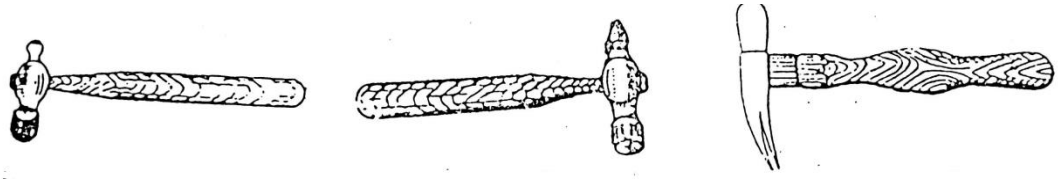


10. **Wooden Mallet**: It is used for where iron hammers are prohibited. It is of wood and is widely used in sheet-metal works and for straightening copper wires.



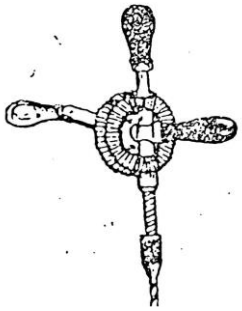
11. **Hammers:** In electrical work mostly three types of hammers are used like ball peen and claw hammers. These are made of mild steel and the long wooden handles are provided

to hold them. These are mostly used for driving the nails into wood and also used for extracting the nails from wood by the claw hammer specially.

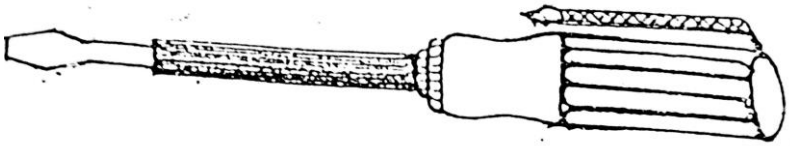


Ball peen hammer Cross peen hammer Claw hammer

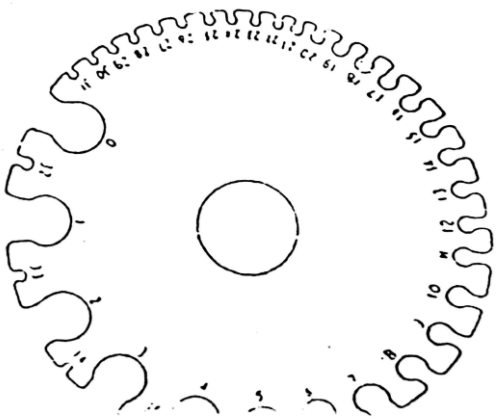
12. **Hand Drill machine**: These are designed to hold steel twist drills and to rotate them freely. Different types of drill bits can be fitted in these drill machines for different types of works. These are used to punch the wooden boards or metal sheets etc. for wiring purposes.



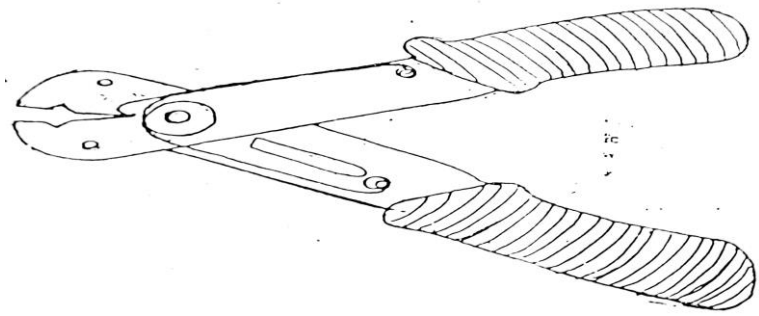
13. **Neon Tester:** In other words it is also called line tester or testing pen. This is used to test the line or phase wire before starting the work on line. In this way it is used to check the presence of voltage.



14. **Standard wire gauge:** A thin circular plate of steel has a number of slots on its circumference. The numbers are marked on each slot. Holes are provided at the end of each slot for moving the wires easily. To find the gauge of wire, the particular slot is found by trail into which a bare wire just slides without being damaged. The number stamped opposite to the slot is number of the gauge required.



15. **Insulation Remover:** It is used to remove insulation of the wire and also for cutting purpose.



4

ACCESSORIES AND USES:

Switches: These are used to switch "on" and switch "off" the current in any circuit with the phase wire.

Double pole main switch: It is used in the circuits to control the supply mains at the mains board and the whole circuit.

Batten or Angle holders: These are used in the circuits in the the bulbs are attached for lighting fixed on the wooden blocks or junction boxes with walls.

Pendent Holders: These are used where hanging lighting is required. These are mostly connected with ceiling roses fixed on the wooden boards or junction boxes with roofs.

Ceiling Roses: These are used in the circuits fixed on the wooden blocks or junction boxes with roofs with which connection for ceiling fans, exhaust fans, tube lights and pendent lights are made.

Wooden Boards: These are used in the circuits for fixing up the switches, wall sockets and regulators etc.

Wooden round blocks: These are used in the circuit on which the batten holders, brackets,

ceiling roses and switches etc are fixed.

DIFFERENT TYPES OF WIRES AND THEIR USES

1. Vulcanized Indian Rubber wire (V.I.R) - Various sizes.
2. Lead Covered wire –single core, two cores and three cores- Various sizes.
3. Tough rubber sheathed or Cab Tyre sheathed wire (T.R.S or C.T.S)- Various sizes.
4. Cotton flexible or rubber flexible wire-Various sizes.
5. P.V.C wires
6. Single Cotton Covered and Double Cotton Covered wire(S.C.C. and D.C.C)
7. Single silk covered and double silk covered wire (S.S.C. and D.S.C).
8. Enameled wire (Super enameled)(S.S.C., D.S.C.,S.C.C.,D.C.C)
9. Motor car flexible for low and high tension.
10. Motor car armoured cable.
11. Armoured cables.
12. Nichrome wire, Nickle-chromium or nichrome strip
13. Eureka Wire.
14. Tungsten wire.
15. Bare copper wire and aluminium wire.
16. Galvanized Iron wire

No.1 to 5 wires are used for house-wiring purposes.

No.6, 7, 8 wires are used for armature winding and field coil purposed.

No.9, 10 wires are used for wiring of automobiles.

No.11 wire is used for underground mains.

No.12 wire is used for heating elements.

No.13 wire is used for heating elements

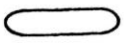
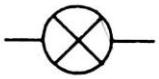
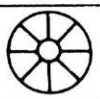
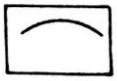
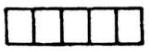
No.14 wire is used for lamp filaments.

No.15 wire is used for over-head mains.

No.16 wire is used for drawing, earth and grounding purposed and also mostly used for telephone mains.

TYPES OF WIRING:

1. **Cleat wiring**: This method of wiring is well adapted to temporary work and has been used in huts built for military and naval purpose. Faults are easily located in this method of wiring.
2. **C.T.S, T.R.S or P.V.C wiring:** This type of wiring is suitable for every place as it is water proof, steam proof within limit and appearance is good one. It can be erected easily and quickly (Ordinary house and workshops). Faults can be easily located. Wiring can easily be replaced.
3. **Casing Caping Wiring:** The appearance is good one. This type of wiring can be generally seen in buildings and houses etc.
4. **Lead Covered Wiring: Appearance** is good and maintenance is easy. This type of wiring is generally used in high building or for consumers, mains by supply undertakings.
5. **Conduit and Concealed Wiring:** It gives efficient mechanical protection. Ready inspection for alteration and repairs. Can be made mechanically and electrically perfect. Absolute freedom from fire.

S. No.	Description	Symbol	S. No.	Description	Symbol
1	Main switch (Light)		15	Single tube light	
2	Main switch (Power)		16	Double tube light	
3	Meter		17	Bell	
4	One way switch		18	Buzzer	
5	Two way switch		19	Horn	
6	Lamp		20	Siren	
7	Two pin socket 5 Amp.		21	Ceiling fan	
8	Two pin socket with switch 5 Amp.		22	Bracket fan	
9	Three pin socket with switch 5 Amp.		23	Exhaust fan	
10	Three pin socket 15 Amp.		24	Fan regulator	
11	Three pin socket with switch 15 Amp.		25	Earth	
12	Bell push		26	Heater	
13	Single light pendent		27	Fire alarm push	
14	Batten lamp holder		28	Fire alarm bell	

S. No	Description	Symbol		Description	Symbol
29	D.C		43	Choke	
30	A.C		44	Two pin socket	
31	Single phase alternating current	50c/s	45	Three pin socket	
32	Three phase alternating current	3	46	Cell	
33	Neutral	N	47	Battery	
34	Resistor	R	48	D.C volt meter	V
35	Variable resistor	R	49	D.C ampere meter	A
36	Inductor	L	50	D.C/A.C ampere meter	A
37	Capacitor		51	Watt meter	W
38	Variable capacitor		52	Ohm meter	
39	Generator	G	53	Energy meter	kwh
40	Motor	M	54	Oil circuit breaker	
41	Alternator	G	55	Fuse	
42	A.C motor	M	56	Lamp	

FOUNDRY

INTRODUCTION:

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

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

Mould is a cavity in a moulding box, formed by a pattern. It is similar in shape and size to that of the actual casting plus some allowance for shrinkage, machining, etc. Moulding 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 moulding or machine moulding. Permanent moulds are made of ferrous metals and alloys, i.e., cast iron, steel, etc.

The stages involved in the sand moulding process are: sand preparation, pattern making, and core making (if required), moulding and closing.

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 fuels or heated by electric energy.

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

MOLDING SAND

Sand is the principal material used in foundry. The principal ingredients of molding sands are: (i) Silica sand, (ii) clay, (iii) moisture. Clay imparts the necessary bonding strength to the molding sand. Moisture in requisite amount furnishes the bonding action of clay. Special additives and binders are also added to develop certain desired properties to the moulding sands. Silica sand can withstand very high temperatures and doesn't react with the molten metal.

Natural molding sand is available in river beds or dug from pits. They possess an appreciable amount of clay and are used as received with addition of water.

Synthetic sands are prepared by adding clay, water and other materials to silica sand so that desired strength and bonding properties are achieved.

Most of the moulding is done with green sand, i.e., sand containing 6 to 8 percent moisture and 10 percent clay content to give it sufficient bond. Green sand moulds are used for pouring the molten metal, immediately after preparing the moulds. Green sand moulds are cheaper and take less time to prepare. These are used for small and medium size castings.

Dry sand moulds, obtained after drying or baking green. Sand moulds are used for large castings. Parting sand, which is clay free, fine grained silica sand, is used to keep the green sand from sticking to the pattern and also to prevent the cope and drag from clinging.

Core sand is used for making cores. This is silica sand mixed with core oil and other additives.

Sand moulds are suitable for all types of ferrous castings, i.e., cast iron, wrought iron, steel, etc. However, the main drawback is that a mould is suitable for one casting only and it has to be made afresh for another casting, with the help of pattern. Further, sand moulding

contributes to rejections and rework done to casting defects, costly maching and generally lower quality in mass production.

To overcome the above problems permanent or metal moulds are used. Though, initial cost of metal moulding equipment is high, it can be justified with the large number of castings that can be cast per mould repeatedly.

PATTERNS:

A pattern is the replica of the desired casting, which when packed in suitable material produces a cavity called the mould. This cavity when filled with molten metal produces the desired casting after solidification.

TYPES OF PATTERNS:

Wood or metal patterns are used in foundry practice. Single piece, loose split, multi piece and cored match plate patterns are some of the common types.

a. ***Single piece***: It os the simplest of all the patterns. This has a flat surface on the cope side. This makes possible a straight line parting on the joint between the cope and drag of the mould.

b. ***Split pattern:*** Split patterns are adopted for intricate castings, where removal of the pattern from the mould is difficult. Dowel pins put the two halves of the pattern together if the two pieces are similar in size and shape, it is called a split pattern; otherwise, it is known as a two-piece pattern.

c. ***Loose piece pattern:*** When a pattern cannot be withdrawn front the mould due to its complexity, loose pieces are provided to facilitate this. However, only two moulding boxes are required for making a mould in this case.

d. ***Multi-piece pattern***: This type of pattern is made in three or more parts that makeup the pattern is held together with dowel pins. The number of moulding boxes requied will be equal to the pieces on the pattern.

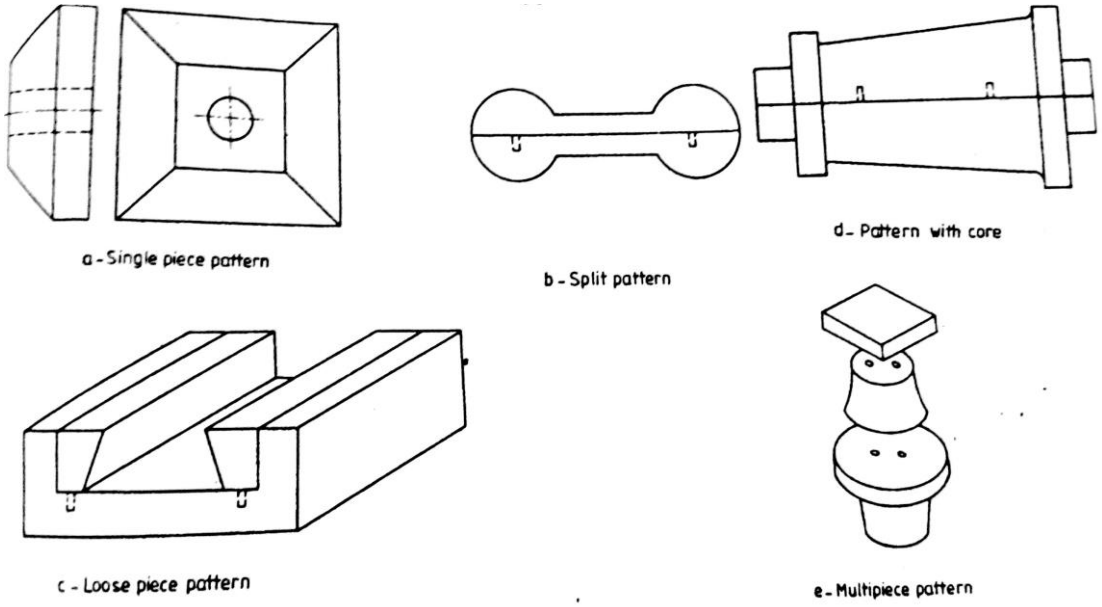


Fig. Types of patterns

e. ***Cored pattern:*** When a casting with holes or recesses is to be made, a cored pattern is needed. This type of pattern is made with core prints added to the surface. After moulding, the core prints leave impressions in the sand for positioning a dry sand core. A sand core is prepared separately, dried and then positioned in the mould before it is closed. When molten metal is poured onto the mould, a cavity or recess is formed in the casting, the shape of which is determined by that of core.

f. ***Core print***: An impression in the form of a recess is made in the mould, to support a core in the mould. This is obtained with the help of a projection, suitably added to the pattern. This projection on the pattern is known as the core print. Depending upon the casting shape, core print may be horizontal or vertical.

g. ***Core box:*** A core box is a pattern, made of either wood or metal, onto which sand is packed to form the core. Wood is commonly used for making a core box; but metal boxes are used when cores are to be made on large numbers. Specially prepared core sand is used in making cores.

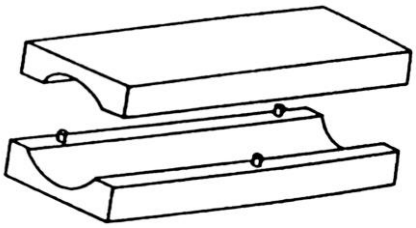


Fig.Core box

h. ***Pattern design:*** While designing a pattern, the following must be considered:

1. Avoid abrupt changes in cross section.
2. Avoid sharp corners and edges, to enable smooth flow of molten metal.\
3. Provide the following pattern allowances:
   (i) *Shrinkage allowance*, to allow for shrinkage when casting cools in the mould.
   (ii) *Slight taper or draft*, to allow easy withdrawal of the pattern from the mould.
   (iii) *Machining allowance*, to take care of the machining on the surfaces.

TOOLS:

The tools and equipment need for moulding are: moulding flasks (boxes) bellows,

MOULDING BOARD:

It is a wooden board with smooth surface. It supports the flasks and the pattern, while the mould is being made.

a. Moulding flask:

It is a box made of wood or metal, open at both ends. The sand is rammed in after placing the pattern to pattern to produce a mould. Usually, it is made of two parts. Cope is the top half of the mould, having guides for the aligning pins. Drag is the bottom half of the flask, having aligning pins. Cheek is that of the flask, which comes in between the cope and drag. Cheek is used when the pattern consists of more than two parts.

b. Shovel:

A shovel is used for mixing and tempering molding sand and for sand for transferring the sand into the flask. It is made of steel blade with a wooden handle.

c. Riddle:

Hand riddle consists of a wooden frame fitted with a screen of standard wire (No.8) at its bottom. It is used for hand riddling (sieving) of sand to remove coarse sand particles and other foreign material from the foundry sand. It also produces the required to the sand.

d. Rammer:

It is used for packing or ramming the sand around the pattern. One of its ends, called the peen end, is wedge shaped and is used for packing sand in spaces, pockets and corners, in the early stages of ramming. The other end called the butt end, has a flat surface and is used for compacting the sand towards the end of molding.

e. *Strike Edge or Strike-Off Bar*:

It is a piece of metal or wood with straight edge. It is used to remove excess sand from the mould after ramming, to provide a level surface.

f. Sprue (runner) Pin:

It is a tapered wooden pin. It is used to make a hole in the cope through which the molten metal is poured into the mould.

g. Riser pin:

It is a straight wooden pin used to make a hole in the cope over the mold cavity for the molten metal to rise-in and feed the casting to compensate the shrinkage that may take place during solidification.

h. Trowels:

It consists of a metal blade fitted in to 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 mould. Trowels are made in many different styles and sizes, each one suitable for a particular job.

i. Spike or drawn pin:

It 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.

j. Slick:

It is a small double ended tool having a flat on one end and a spoon on the other end. Slicks are used for repairing and finishing small surfaces of the mould.

k. Lifters:

Lifters are made of thin sections of steel of various widths and lengths with one end bent at right angles. These are used to cleaning and finishing the bottom and sides of deep, narrow openings in mould.

l. Gate cutter:

It is a semi circular piece of thin sheet, used to cut gates in the mould. Gates are meant for easy flow of molten metal into the mould.

m. Bellows:

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

n. 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.

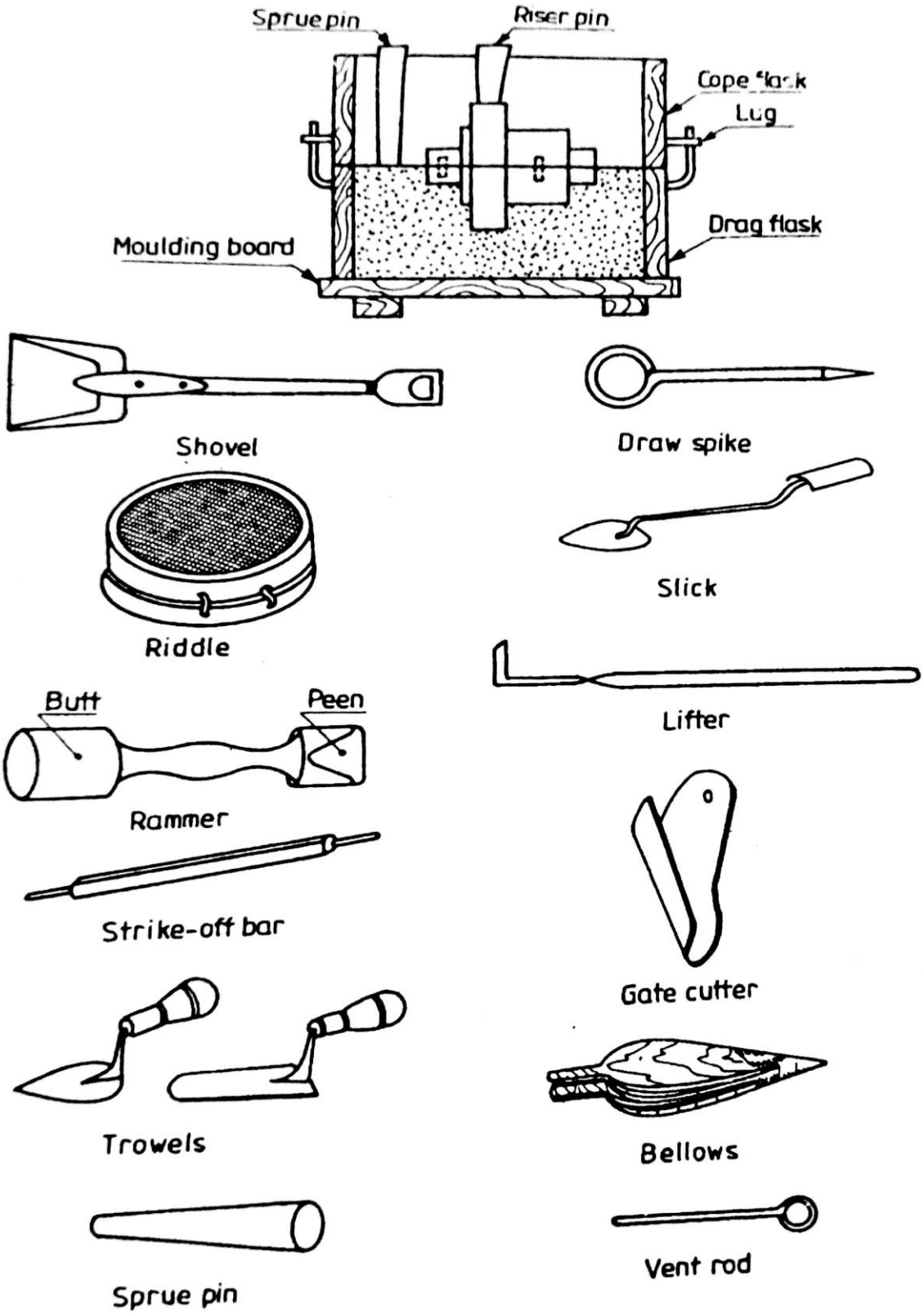


Fig. Foundry tools and equipment

WELDING

Definition:

Welding is a process by which two similar or dissimilar metals may be joined by heating them to suitable temperature with or without the application of pressure and with or without the use of filler metal. The filler metal has its melting point approximately the same as that of the work piece material.

Autogeneous welding :

It consists of those processes in which similar metals are joined with the help of filler rod of the same material.

Heterogencous welding:

It is a method in which dissimilar metals are joined. The metals being joined are brought up to critical temperature or plastic state and the filler rod is used. The filler rod material will have melting point less than the parent material.

Classification of welding processes

Fusion or non-pressure welding

1)Arc welding.
- a) Metal arc welding
- b) Carbon arc
- c) Inert gas arc.
- d) Atomic hydrogen arc
- e) Submerged arc

2) Gas welding.
- a) Oxy-Acetylene
- b) Oxy-Other fuel gases.

3) Thermit welding

4) Braze or Bronze welding

Pressure welding

1) Resistance welding
- a) Spot
- b) Seam
- c) Flash
- d) Projection
- e) Percussion.

2) Pressure-gas welding

3) Forge welding

4) Cold or pressure welding

5) Stud welding

Are welding:

Arc welding is the process in which welding is done by producing heat from an electric arc maintained between the work piece and electrode. Electric arc is produced when contact is first made between the electrode and the work piece to form an electric circuit and then by separating the electrode in such a way that arc is maintained, welding is done by moving electrode gradually along the joint to be welded.

Welding equipment

Arc welding equipment

Direct current D.C plant
- a) Motor generator set
- b) Transformer-Rectifier set.

Alternating current (A.C)plant
- a) Transformer type.

1) Air cool

2) Oil cool

Motor-generator set

In this D.C.Power required for welding is obtained from a D.C.generator driven by a motor (A.C or D.C) or engine. The motor generator set (generator usually driven by A.C. motor) is the most commonly used of all welding plants. It has rotating parts. The output voltage 40 to 80 volts and the current 25 to 300 Amperes. In D.C. generators, the polarity can be changed, i.e any of the two output terminals of the machine can be made positive (+) or negative (-).

A.C. Transformer type

A.C. plant has low initial cost, reduced maintenance cost, decreased power consumption and has no rotating parts. It has the highest efficiency of about 85%. The normal size of the machine is 300 Amperes. For A.C. welding, transformer type plant is the only one which is most common in this country. All types of electrodes used on A>C. should have sufficient amount of arc stabilizing alloys in their flux coating. No change of polarity is possible on A.C. plants.

A.C. and D.C. rectifier welding set

These machine provide both A.C. or D.C. power of welding and so the operator has the liberty to use any type of electric current for welding. The machine consists of transformer and rectifier stacks. A.C. can be taken from transformer and D.C. from rectifier stacks.

Comparison between A.C. and D.C arc welding

A.C	D.C
A.C.welding plant has no rotating parts	D.C.welding plant has rotating parts like generator and motor etc.,
The transformer is cost less.	The initial cost of generator set is high
The maintenance cost of transformer plant is low	The maintenance cost of D.C. plant is high
Distribution of heat is equal and there and there is no possibility of changing the polarity.	Heat distribution is different in both the poles i.e 2/3 of heat is obtained at positive pole and 1/3 a negative pole.
The problem of "arc blow" does not arise as it is very easy to control in A.C. welding.	The problem of "arc blow" is sever and is not easily controlled.
All type of electrodes cannot be controlled used with A.C. only Coated once can be used effectively.	All types of electrodes bare or coated, can be used with D.C.
Usually ferrous metals are welded by A.C. and not the non ferrous ones.	All types of metals can be welded with D.C
Arc is never stable.	The arc is more stable.

Arc welding electrodes:

An electrode is made of a metallic wire called core wire coated uniformly with Flux. While fluxing the electrode, about 20 mm of its length is left bare at one end for inserting it in the electrode holder. Bare end of the metallic core wire helps in transmitting full current from electrode holder to the front end of the electrode. The flux coating on the electrodes is a bad conductor of electricity.

Functions of flux coating:

1) It helps in producing a protective gaseous shield around the arc because the flux consists of materials like wood, flour, starch and carbonates. At the times of welding, these materials burn and produce carbon dioxide, carbon monoxide and hydrogen around the arc there by protecting the arc from atmosphere.
2) It helps in maintaining the arc because of the flux consists of arc stabilizing materials like titanium dioxide, calcium carbonate and potassium compounds.
3) Flux produces slag by reacting with the impurities present in the parent materials covers over the newly formed weld bead and thus protects the metal from attack by atmospheric oxygen and nitrogen. Iron oxide, manganese dioxide, mica, china clay and silicates present in the flux helps in producing slag.
4) The flux contains deoxidizing materials like Ferro-silicon, Ferro-titanium and Ferro-manganese. These materials help to deoxidized the newly formed bead metal.
5) Flux helps to modify and improve also the strength of the weld because it contains Alloying elements like Ferro-manganese and Ferro – molybdenum.
6) Spattering of metal during welding also prevented by the use of flux.

Different sizes of electrodes

Electrode size (in mm)	Current for light work(amps)	Current for heavy work(amps)	Current for normal work(amps)
6	220	320	260
5	180	240	210
4	140	180	165
3.2	90	130	110
2.5	55	85	70
2	40	60	60
1.6	25	40	30

Gas welding

In this method the heat required for welding is produced by a flame obtained by burning a mixture of oxygen and acetylene or any other fuel gas. It is used for all type of metals. Ferrous or non ferrous and alloys as well. The base metal is heated up to the molten state or welding temperature when a filler rod of the base metal is used for completing the joint.

Oxy-Acetylene flame

When oxygen and acetylene are brought to the tip or nozzle and burnt a flame is produced which is so called oxy-acetylene flame. Approximately equal volume of oxygen and acetylene are mixed in the blow pipe producing a flame which consists of three regions or zones. (1) The inner luminous zone. (2) The intermediate zone, (3) The flame envelope or streamer zone.

Kinds of Oxy-Acetylene flames

1) Neutral flame:

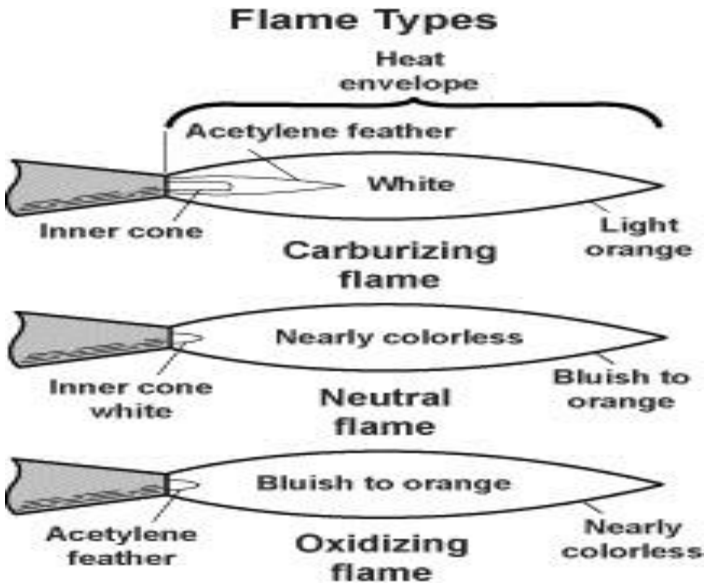
When oxygen and acetylene are in equal proportion or little more than one part of oxygen are properly mixed and burnt, the neutral flame is produced. In this flame the inner cone is white and there is no greenish tinge of acetylene. This flame is used for most welding operations and is most suited for welding steels.

2) Carburising flame:

By burning excess of acetylene we get carburizing flame. In this flame there are three zones instead of two as shown in neutral flame. Between the luminous zone and outer envelope there is another zone having whitish color. This flame is used on aluminum because it prevents excessive formation of aluminum oxide which interferes in the proper fusion of metal. It is also used on monel metal, stainless steel and die cast metal.

3) Oxidizing flames:

This flame is obtained by burning excess of oxygen. The inner cone is shorter and pointed with a sharp hissing sound. Oxygen is a rapid supporter of combustion and when hot steel is fed with pure oxygen the steel rapidly burns. Hence this flame is not used frequently as it is harmful to many metals. This flame is used in fusion welding of brass and bronze.



Brazing:

Brazing is a process of joining two similar or dissimilar metals with the help of some fusible alloy having its melting point above 600^0C but lower than the melting point of material of the parts to be brazed.

Soldering:

It is also a process of joining two similar or dissimilar metals. It is similar to brazing but differs only in the sense that it involves the use of lower temperature filler metals (below 600^0C) like lead and tin.

Oxy-Acetylene cutting:

Oxy-Acetylene cutting is purely a chemical process, that is, a very rapid form of rusting and this may not be considered as melting. It consists in burning the metal along a specified path and removing the oxides from the cut with a jet of oxygen.

Principle of flame cutting:

Flame cutting is based on, the steel will burn in an atmosphere of pure oxygen after bringing it to its required temperature. In the steel the product of combustion is iron oxide and its melting point is below the melting point of steel. The heat generation by the burning steel is enough to melt the iron oxide.

Welding tools

Welding screen

It is used for protect the eyes and face from u.v rays present in the arc. a hand screen held by the hand head screen is put on the head is made of fiber body with opaque glass.

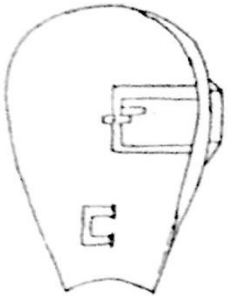


Fig. Welding screen

Leather apron

It is worn to protect the body and cloths from the spatters and rays. It is usually made of heat resistance chrome lather and tied around the waist and neck.

Fig. Leather Apron

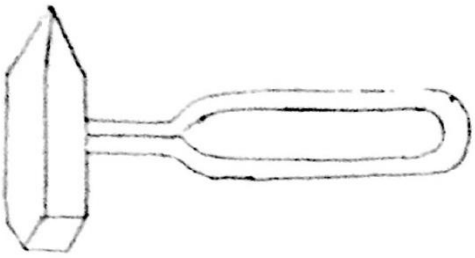
Hand gloves

The purpose of hand gloves to protect hands from the heat and spatters. It is made of chrome lather.

Fig.Hand gloves

Chipping hammer

It is used for removing the slag and spatters from the weld bead. It is made of cast steel or wrought iron.

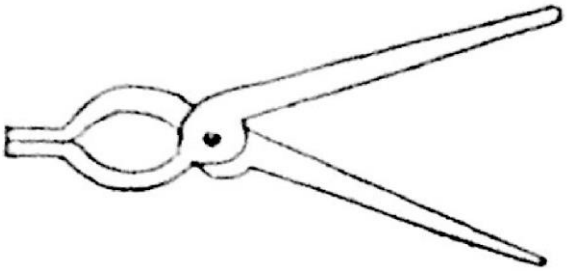


Wire brush

Wire brush is used to clean the oxides on the weld metal.

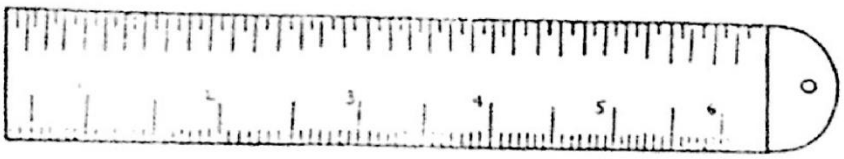
Iron tong

Tong is used to hold the work piece. It is made of mild steel.



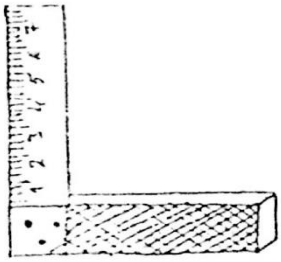
Steel rule

The steel rule commonly used for measuring the various dimensions. It is made of stainless steel.



Try square

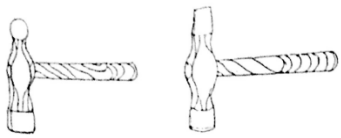
It is used to check right angles and mark perpendicular lines to the edges. It is made of mild steel.

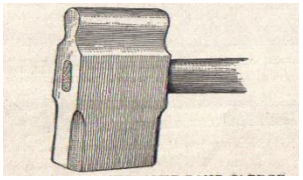


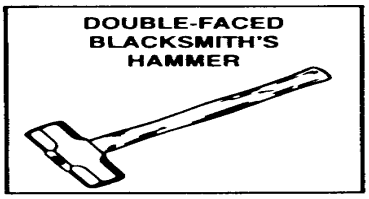
Hammer

It is simple striking tool which is used to make the desired shape either in cold or in hot conditions by striking directly top of the job piece.

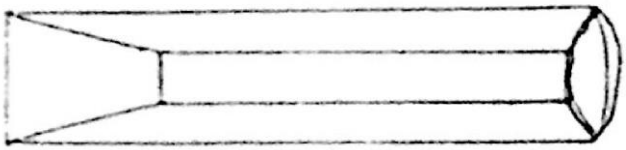
1) Ball peen 2) Cross peen 3) Straight peen 4) Sledge



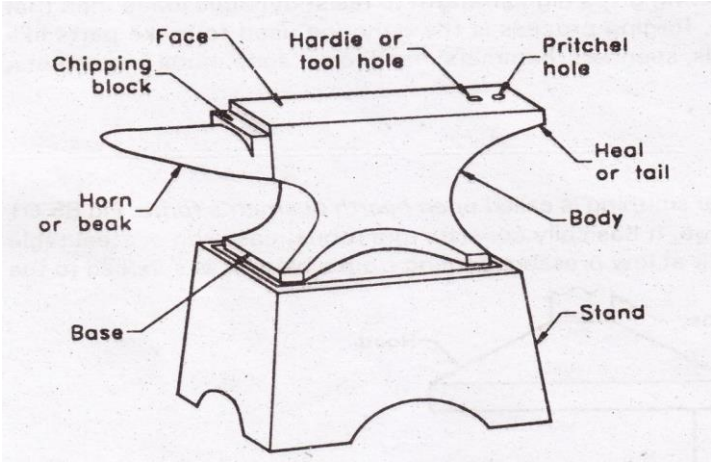




Chisel: It is used for cutting work pieces. It is made of medium carbon steel.

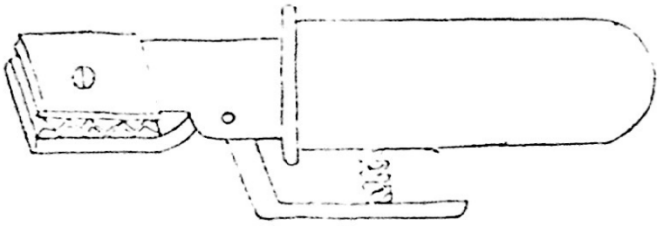


Anvil: It is used as base to cut the metal and to bring the metal to required shape. It is made of mild steel on the top face, hard steel provided.



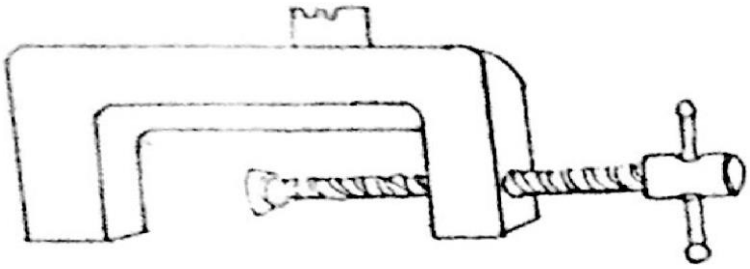
Electrode holder:

It is used to grip the electrode, with help of handle jaws. It is provided with a hylem insulation to safe guard the worker using it from shocks.



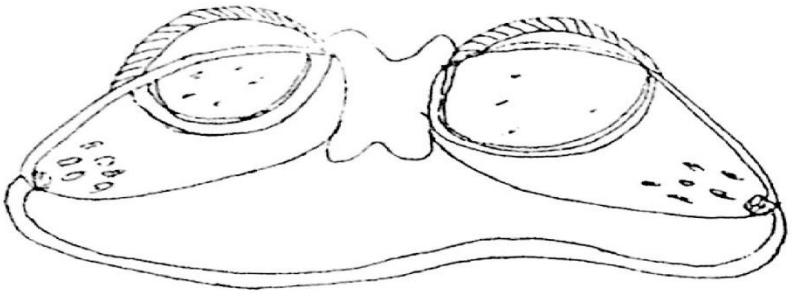
Earth clamp:

It has a proper grip and used to ensure good electrical contact. It is made of gun metal.

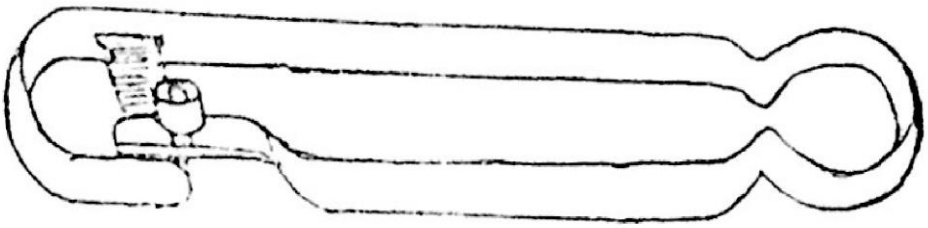


Welding goggles:

It is used in gas welding only to protect eyes from light and spatters.



Spark lighter: It is used to ignite the fuel gas (acetylene) in gas welding.



POWER TOOLS

1. INTRODUCTION – A Power tool is a device that is powered by an electric motor. Power tools are classified as either stationary or portable. Portable electric tools may be either corded or battery powered. Compressed air may also be the power source for some of the power tools.

Power tools are used in industry, in construction, and around the house for cutting, shaping, drilling, sanding, painting, grinding and polishing. Stationary power tools for metal working are called machine tools. The term, "machine tool" is not normally applied for stationary power tools for wood working, drill presses and bench grinders.

2. SAWING MACHINE

In production shops, it is often necessary that the bar stock should be cut to convenient lengths before they are fed to the machine for further operation. The hand hacksaw process, though commonly used, is not commercially sound and economical, as it requires lot of labour and time. In modern workshops, the power driven metal sawing has become almost indispensable, due to economic considerations.

The basic principle of metal sawing is that the workpiece should be rigidly held in a vice. In case of power hacksaw, the saw, as it reciprocates, is fed every time deep into the workpiece. In case of band saw and circular saw, the workpiece is fed to the revolving saw till it is cut into the required pieces.

3. POWER HACKSAW

This is a power tool which imparts a reciprocating motion by means of a crank to a hack-saw blade which is held in a frame (Fig.1). The frame is lifted slightly during the return stroke to relieve the blade from cutting action so that wear on the blade can be avoided during the return stroke. Cutting force may be applied to the frame by a dead weight or by a spring or a hydraulic system. The stroke of the power hacksaw is intermittent. It is not a rapid method of cutting bar stock but the machine is simple in design and easy to operate and to maintain. The blades of the machine are not very expensive.

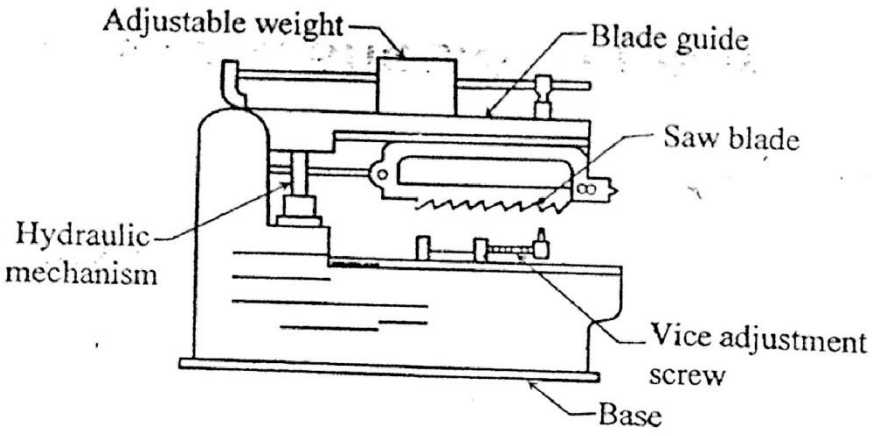


Fig.1: Power Hacksaw

4. CIRCULAR SAW

The circular saw is more rigid machine for performing sawing operations. It consists of a metal disc, having teeth cut on its periphery and equipped with an electric motor, which causes the disc to spin. It is a power tool that can be used for cutting wood or metal. It may be hand-held (portable) or table mounted.

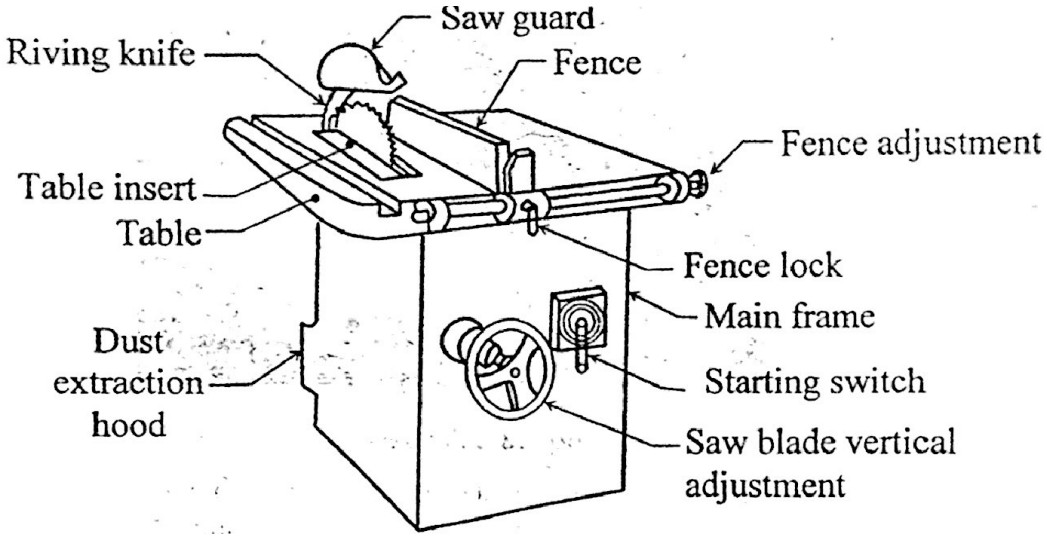


Fig.2: Circular Saw (Table Mounted)

4.1 Table mounted Circular Saw

The circular saw can be either of tilting table type or tilting arbor type. (Fig: 2) A table mounted tilting arbor type circular saw. To make certain angular cuts, either the table or the arbor is tilted. For accuracy, convience and safety, tilting arbor circular saw is always recommended. The size of a circular saw is specified by the diameter of the blade; the usual sizes being 200, 250 and 300 mm.

4.2 Portable Circular Saw

Fig: Shows portable circular saw, which is preferred to hand saw. Basically all circular saws consist of a housed motor with a circular blade fitted on a spindle(arbor). The upper half of the blade consists of a fixed guard while the lower half, a retractable guard. The guard is automatically swiveled up and down when the tool is used.

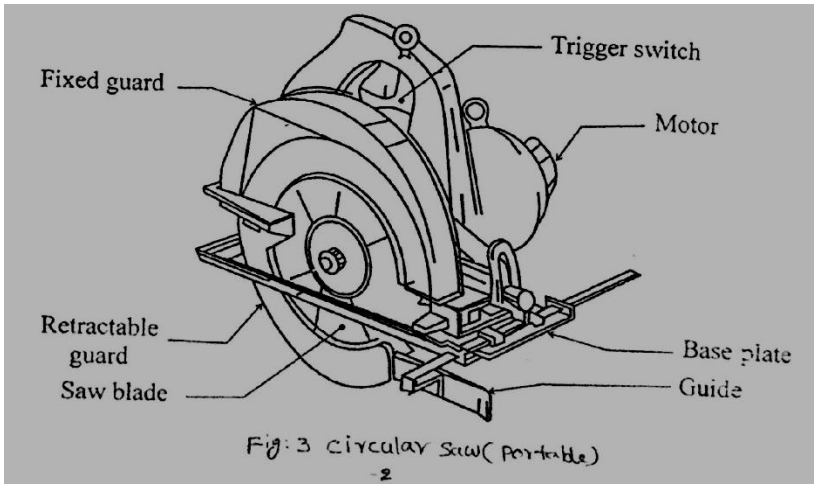


Fig: 3 Circular saw (Portable)

5. THICKNESS PLANER

It is a wood working machine which is used to produce boards that are even in thickness through out their length. It consists of three elements:

1. A cutter head containing cutter knives,
2. A set of feed rollers for drawing the board through the machine, and
3. A table which is adjustable relative to the cutter head to control the thickness of the board. (Fig: 4)

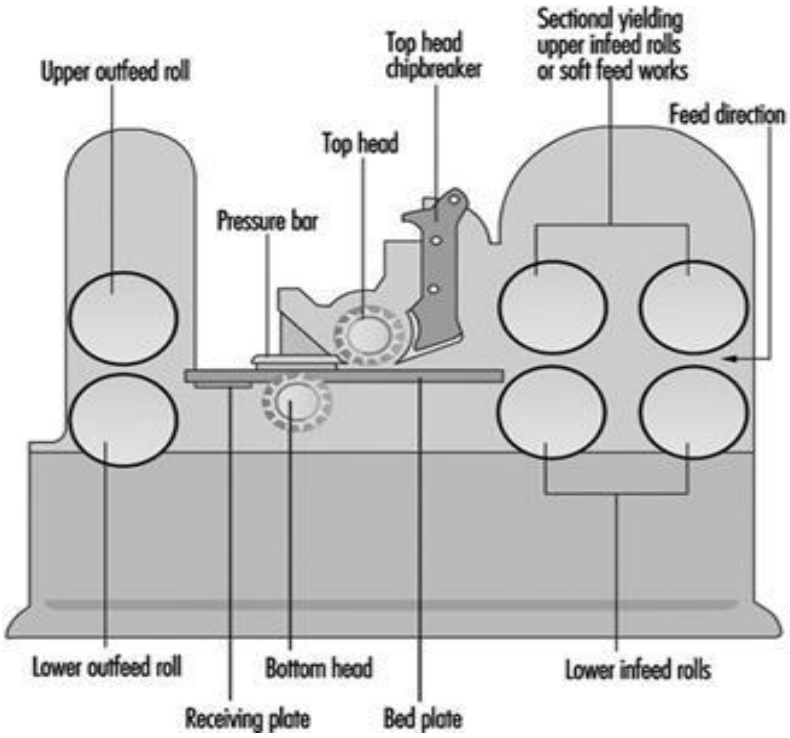


Fig: 4 Thickness Planer

Operation

The table set to the desired height and then the board is fed into the machine until it makes contact with the in-feed roller which grips the board and draws it past the rotating cutter head of the machine. The knives remove the material on the way and the out-feed roller pulls the board and ejects it from the machine at the end of the pass. In order to achieve a board that is flat and of uniform thickness along its length, it is necessary to start with a board that has at least one perfectly flat reference face. The board is fed with this reference face, flat on the table and the cutter head removes an amount of material from the opposite face so that it is made parallel to the reference face.

6. WOOD TURNING LATHE

Wood working (turning) lathes are the oldest type of lathes. Wood turning is used to create wooden objects on the lathe. One can perform external and internal taper turning and threading on wood pieces. Other irregular shapes can also be obtained with the help of special tools. An adjustable horizontal metal rail (tool rest) between the material and the operator accommodates the shaping tools, which are usually hand held. (Fig:5) Wood turning differs from other forms of intricate shapes and designs can be made by turning wood.

There are two distinct methods of turning wood: spindle turning and face plate turning, bowls and vessels are face plate turned. Furniture legs are spindle turned.

Wood turning tools are generally made of carbon steel or high speed steel. High speed steel tools maintain their edge longer; requiring less frequent sharpening. Unlike other wood working tools, wood turning tools require more frequent sharpening, as the wood passes against the tool at a very high speed.

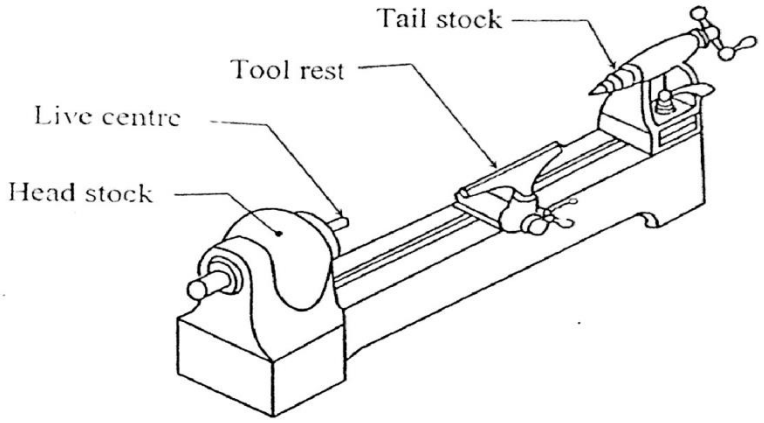


Fig: 5 Wood Turning Lathe

While carrying out wood turning, it is essential to wear certain protective equipment. Eye protection through safety goggles, is a must while turning wood. Respiratory equipment is also important while doing any kind of wood working that creates dust. This can range from a simple disposable dust mask to a full face helmet with built-in respirator.

7. BENCH GRINDER

A bench grinder consists of a motor with a double-end spindle on which the wheels are supported between flanges and are held by a nut each end, two grinding wheels, two guards for wheel safety, and two rests to support the work. (Fig:6) Depending upon the grade of the grinding wheel, it may be used for sharpening cutting tools such as lathe tools or drill bits. Alternatively, it may be used for rough shaping the metal prior to welding or fitting. Safety glasses should be worn to protect the operator's eyes from the sparks and metal filings that may result. The tool rest should be mounted slightly below the centre of the grinding wheel, with 1 to 2 mm clearance from the wheel. The small amount of clearance prevents the work from jamming between the wheel and the rest.

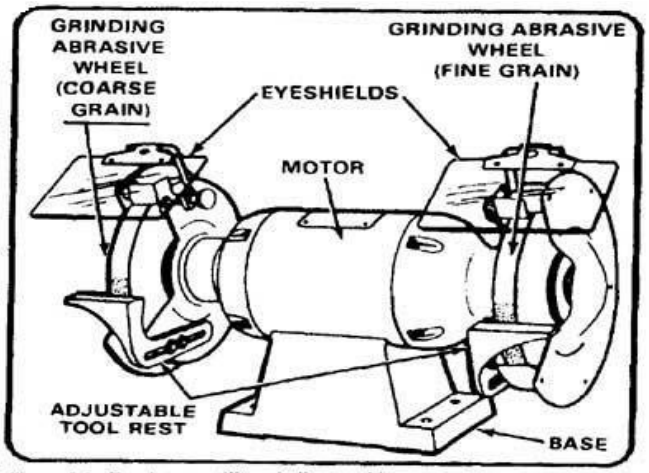


Figure 5-2. Bench-type utility grinding machine.

Fig: 6 Bench grinder

The grinding wheels designed for steel, should not be used for grinding softer metal like aluminum. The soft metal gets lodged into the pores of the wheel and expand due to the heat of grinding. This can dislodge pieces of the grinding wheel. The machine needs to be securely mounted to a pillar or a bench.

Viva Questions

1. What is a power tool and what are the applications of power tools?
2. Classify power tools?
3. What is the principle of operation of a power hacksaw?
4. What is meant by the size of a circular saw?
5. Describe the principle of operation of a thickness planer?
6. What are the two methods of turning wood?
7. Wood turning tools require more frequent sharpening. Why?
8. What are the various applications of a bench grinder?
9. The grinding wheels designed for steel, should not be used for grinding softer metal like aluminum why?

PLUMBING

Introduction – Plumbing deals with laying of pipe lines. Pipe line provides the means of transporting fluids. It is obvious that laying out the pipe lire requires a number of joints to be made and a number of valves incorporates while connecting different length of pipes.
Plumbing work does not require many tools except pipe wrenches, hack saw, pipe cutter, threading equipment and a pipe vice.

PLUMBING TOOLS:-

1. 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. It consists of a fixed jaw and a movable jaw facilitates the adjustment of the opening between the jaws.

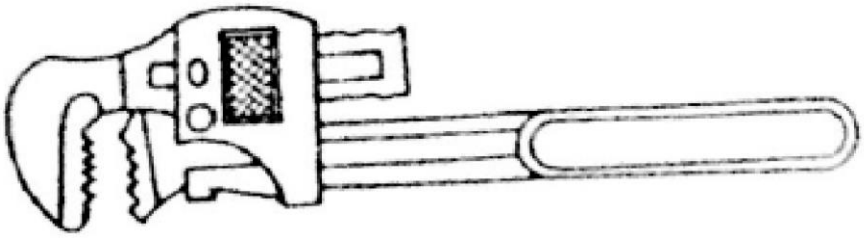


Fig: Pipe wrench

2. **Pipe vice**: the use of a regular pipe vice is advisable though 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.

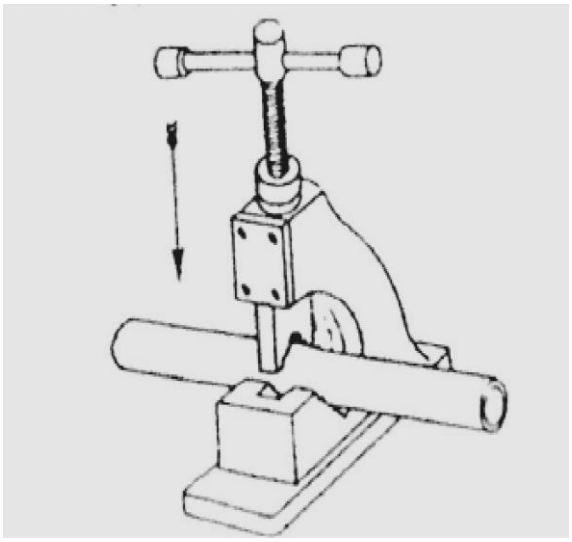


Fig: Pipe vice

3. **Pipe cutter**: For an occasional pipe work a hack saw is quite satisfactory. Pipe cutters are also used where considerable amount of pipe work is involved. The pipe cutter mainly consists of three wheels which are hardened and with sharp cutting edges along their periphery of these 3 wheels, one can be adjusted to any diagonal distance from the other two fixed wheels.

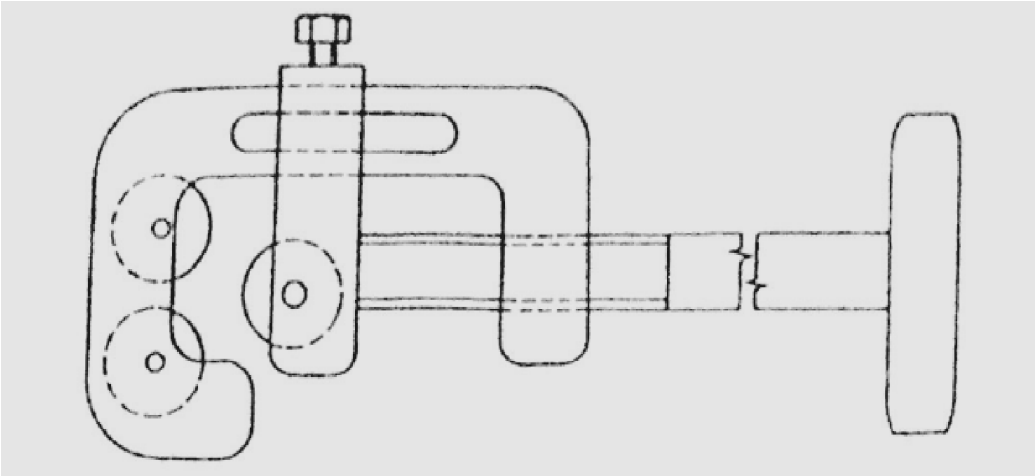


Fig: Pipe cutter

4. **Pipe bending machine**: while laying the pipe line, some times 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.

5. **Dies**: A pipe die is used for cutting external threads on the pipes. One or two piece dies are used in the die stock. It is a hand operated tool, which may be considered as the hardened steel nut having flustes cut only its inside surface. These flustes serve the same purpose can in the twist drill.

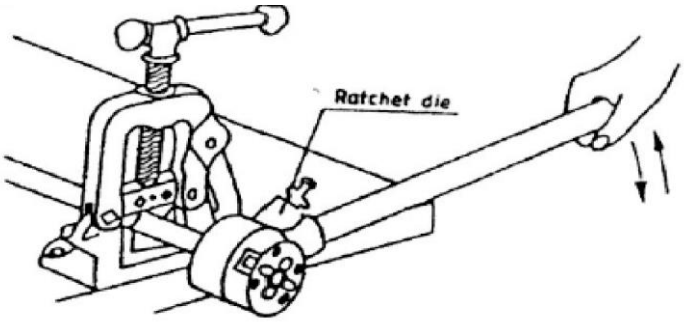


Fig: Pipe threading

6. **Pipes and pipe fitting** : Pipes are available in either black or galvanized form black pipes are used for oil, gas or air. Galvanished 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 Galvanished form. The size of pipe is designated by the size of the pipe which it fits.

The most common fittings are shown in fig.

i) **Coupling :** it is the short cylindrical sleeve with internal threads three out. It is used for joining two pipes in a straight line and where atleast one pipe can be turned.

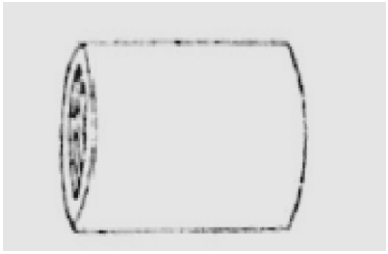


Fig: Coupling

ii) **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 pipe end and the third one which is a nut.

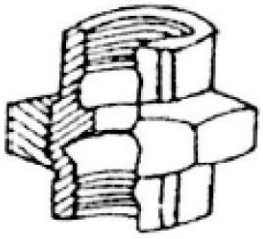


Fig: Union

iii) **Nipple :** It is a short piece of pipe. Nipples are available in standard short lengths. It is used to make up the required length of the pipe line.

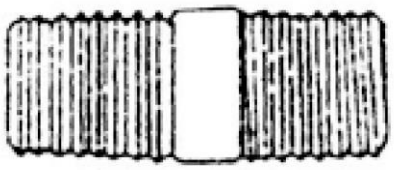


Fig: Nipple

iv) **Elbow :** It is used to make an angle between adjacent pipes. The angle is always 90^0. unless another angle is stated.

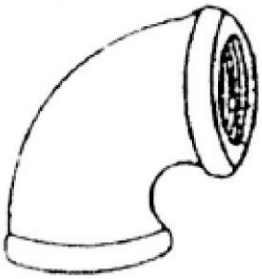


Fig: Elbow

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

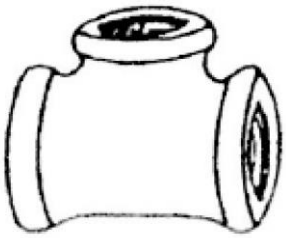


Fig: Tee

vi) **Reduce coupling :** it is used to 2 different sized pipes.

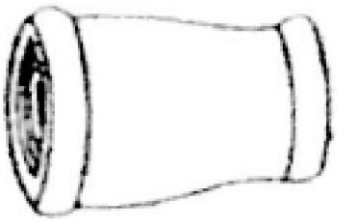


Fig: Reduce Coupling

vii) **Bush :** it is a short sleeve like piece, used to reduce the size of a threaded opening. It is threaded fully in side at one end, on the outside.

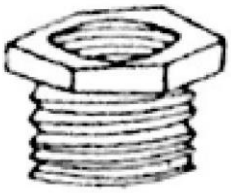


Fig: Bush

viii) **Plug :** it is used to screw onto a threaded opening to closing it temporarily. It is a short piece with external threads at one end and a square end on the other to receive the spanner for operation.

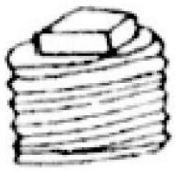


Fig: Plug

ix) **Flange :** Flanges 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.

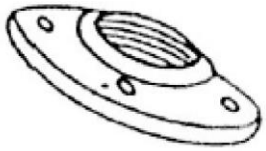


Fig: Flange

x) **Gate valve :** pipe valves are fitted in the pipe line to control the fluid flow through it. Gate vale 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 value, the flow is reduced by lowering the wedge shaped gate towards it seat.

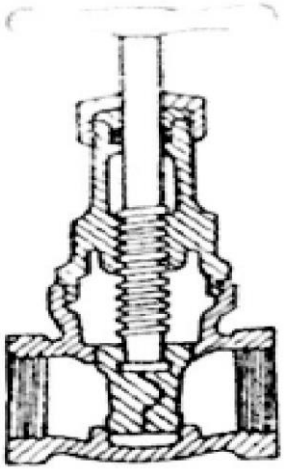


Fig: Gate Valve

While threading turn the die stock handle back and forth frequently to loosen the chip.
Assembly : Pipe layout should be made so as to avoid strains and bendings at the joints. To ensure tight joints in pipe work, the threads are applied with same kind of thread compound

before screwing them together. While screwing the pipe is its fitting, it is advised to use two pipe wrencher.

Some fittings, like unions and flanges require gaskets to make tight joints. When fittings are disassembles gaskets are casually changed and must be replaced. Gaskets are made from materials such as rubber or leather.

xi) **Globe valve :** This controls the fluid flow in a pipe line however the passage of flow is restricted.

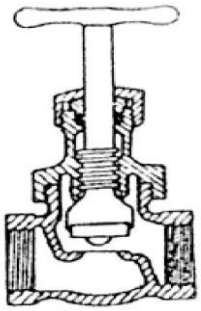


Fig: Globe Valve

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

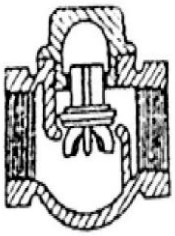


Fig: Check Valve

xiii) **Common tap :** This is used for tapping the fluid flow at required points in the pipe line.

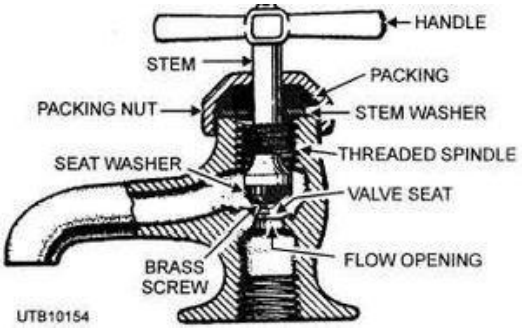


Fig: Common Tap

Pipe layout : For better pipe work, it is advisable to sketch first, the pipe layout, showing dimension and types of fittings to be used. In cutting pipe to length the portion of the pipe that will screw into the fittings.

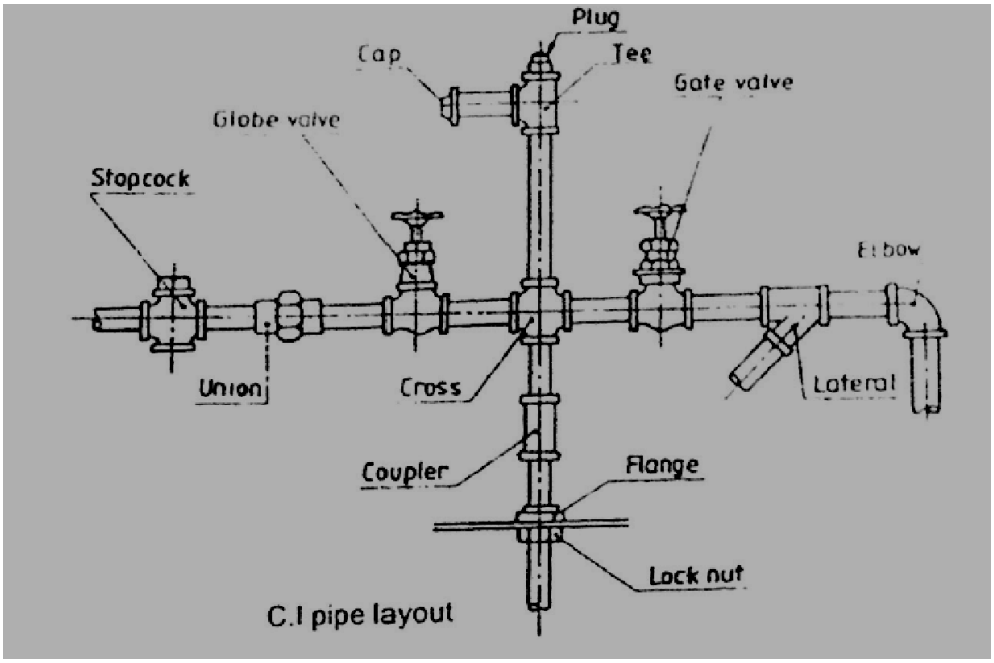


Fig: Pipe Layout

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

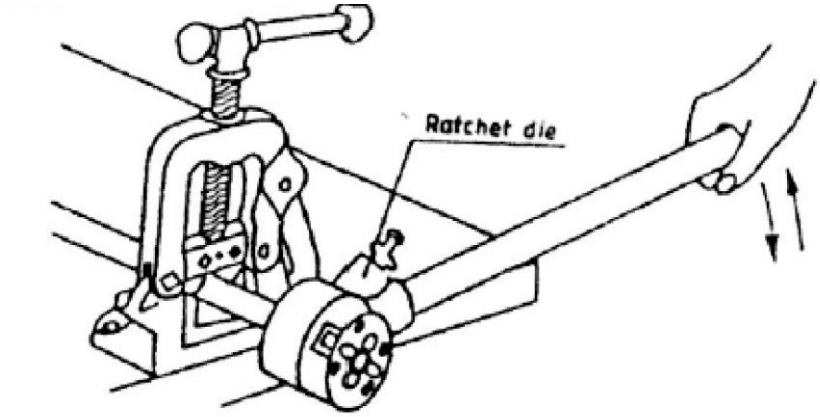
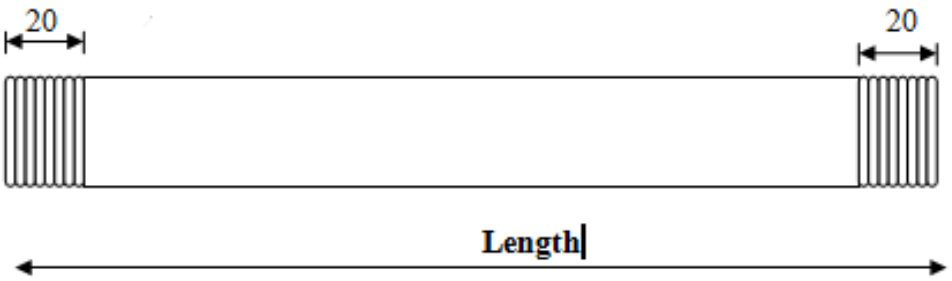


Fig: Pipe threading

Note 1 : Pipe die produces tapered threads. The tapered pipe threads tighten reversely into the pipe fittings.

EXPERIMENT -1

Aim : Cutting of external pipe threads using hand die on the given GI pipe for plumbing.



Material required: GI pipe size ½" X 12"

Tools required :

1. Pipe vice
2. Pipe cutter
3. pipe die with die stock handle
4. oil can
5. pipe wrench
6. steel rule or measuring tape

Sequence of operations:

1. Length marking
2. Cutting to required lengths
3. Threading with pipe die and checking quality for proper fit.
4. Assembly and quality testing with rating components to ensure proper fit.

Procedure :

1) Measuring the length of given GI pipe
2) Mark to the required length
3) Hold the pipe in pipe vice, cut the pipe to length with paper cutter or hack saw
4) Hold the pipe in the pipe vice adjust die set screw to half or 1/3 of the thread depth and cut external threads.
5) Increase the depth cut by adjusting die set screw and finish cut threads fill one threads projects through the die.
6) Assemble, coupling / elbow and test the quality of threads for proper fitting and remove.
7) Hold the GI pipe in the vice in position for the other side and follow the above procedure cut threads on the second end.

Precautions :

1. Clamp the pipe securely in the pipe vice
2. For GI pipes once the threading is started, apply cutting oil.
3. While threading, turn the die stock handle back and forth frequently to loosen remove the chips.
4. For PVC pipes application of cutting oil is not necessary.
5. While screwing the pipe in its fittings, it is advised to use two pipe wrenches making one to fit the pipe and other to fit the pipe fitting.
6. To avoid damaging a valve or a tap with wrench marks it is advised to use a marking wrench with smooth jaws.

Result :

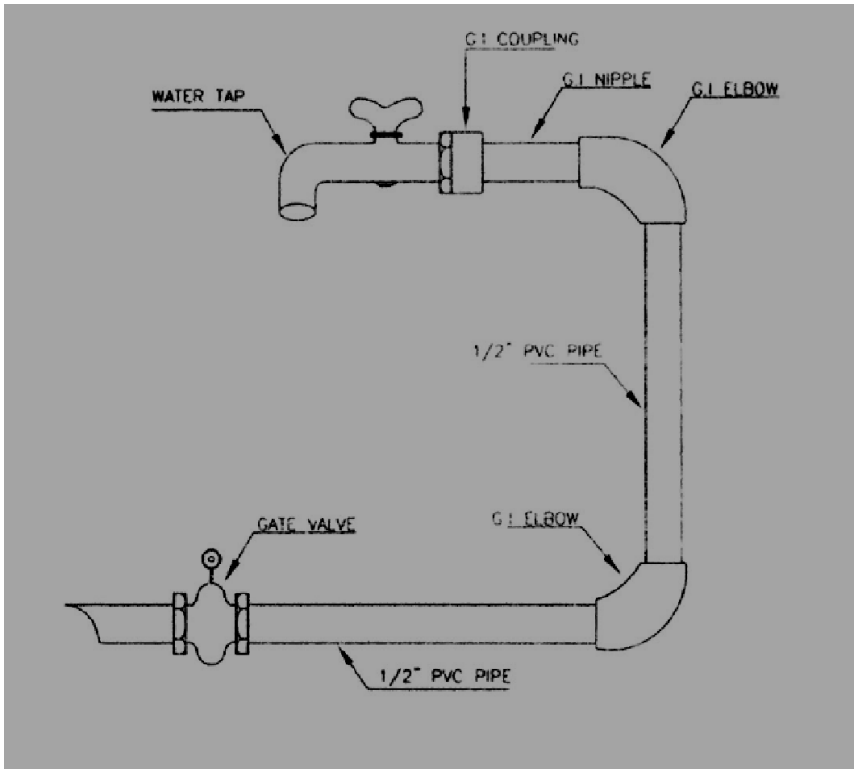
Applications :

Viva Questions :

1. With what kind of work, the term "plumbing", deals?
2. Name the various plumbing tools
3. What for the jaws of a pipe wrench are separated inside?
4. When, a pipe cutter is used instead of a hacksaw, for cutting pipes?
5. What is a pipe die?
6. List-out the commonly used pipe fittings.
7. When, a union is used in pipe layout?
8. Name the various valves used in a pipe line, to control the fluid flow
9. When, a monkey wrench is preferred in place of ordinary pipe wrench?
10. List-out the steps to be followed while joining PVC pipes.
11. What are the steps to be followed while threading a metallic pipe?
12. Name the commonly used types of steel trusses.
13. Define the following terms, as applied to door shutters :i) stile, ii) rail and iii) mullion
14. Name the various furniture joints used in practice.

EXPERIMENT -2

Aim : Plumbing of water tap connection as per the layout using PVC / GI pipe and relevant pipe fitting.



Material required :

1) PVC /GI pipe size ½”
2) Gave valve ½”
3) GI Tee ½”
4) GI elbow 90^0-1/2”
5) GI coupling ½”
6) Nipple ½”
7) Water tap ½” [plastic /brass / CI]
8) Cotton thread
9) Dummy plug

Tools required:

1) Pipe vice
2) Pipe cutter or hack saw
3) Pipe die with die stock and handle
4) Oil can
5) Pipe wrench
6) Steel rule or measuring tape

Sequence of operations:

1. Length marking
2. Cutting to required lengths of pipes
3. Threading with pipe due and checking thread quality for proper fit.
4. Assembly of pipes and pipe fitting as per layout
5. Fix water tap.

Procedure:

1. Measure the length of given pipe
2. Mark to the required lengths of the pipe
3. Hold the pipe in pipe vice cut the pipe to different lengths required with pipe cutter or hack saw
4. Hold the pipes one by one in pipe vice in position, adjust die set screw to form half thread depth. Cut external threads one once and using pipe die.
5. Increase the depth of cut by adjusting die set screw and finish cut threads till one thread projects through die.
6. Wind cotton thread or Teflon thread seal or jut and lappan. Assemble pipes, with pipe fittings and gate valve to the inlet supply pipe as per layout.

Precautions :

1. Clamp the pipe securely in the pipe vice
2. For GI pipes once the threading is started, apply cutting oil.
3. While threading, turn the die stock handle back
4. For PVC pipes application of cutting oil is not necessary.
5. In cutting pipe to length the portion of the pipe that will screw into the fittings must be taken.
6. While screwing the pipe in its fittings, it is advised to use two pipe wrenches, marking out to fit the pipe on other to fit the pipe fitting.

Result :

Applications :

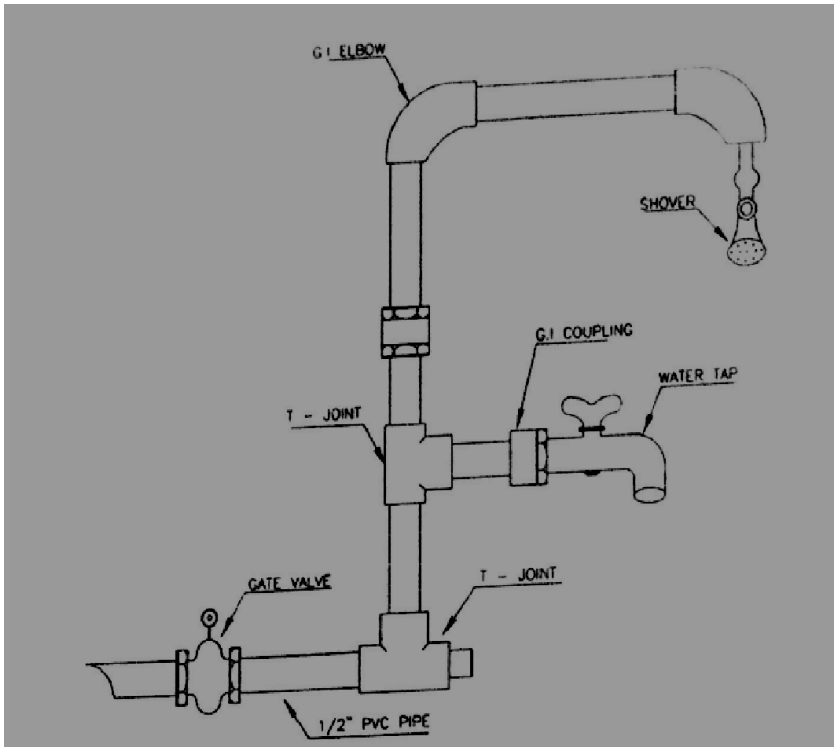
Viva Questions :

1. With what kind of work, the term “plumbing”, deals?
2. Name the various plumbing tools
3. What for the jaws of a pipe wrench are separated inside?
4. When, a pipe cutter is used instead of a hacksaw, for cutting pipes?
5. What is a pipe die?
6. List-out the commonly used pipe fittings.
7. When, a union is used in pipe layout?

8. Name the various valves used in a pipe line, to control the fluid flow
9. When, a monkey wrench is preferred in place of ordinary pipe wrench?
10. List-out the steps to be followed while joining PVC pipes.
11. What are the steps to be followed while threading a metallic pipe?
12. Name the commonly used types of steel trusses.
13. Define the following terms, as applied to door shutters :i) stile, ii) rail and iii) mullion
14. Name the various furniture joints used in practice.

EXPERIMENT -3

Aim: Plumbing of bath water shower and line water tap as per layout using GI /PVC and relevant fitting.



Material required:

1) PVC /GI Pipe size 1/2”
2) Gate valve (1/2”)
3) GI Tee ½”
4) GI elbow 90^0 -1/2”
5) GI coupling ½”
6) Nipple ½” X 4” L
7) Water tap ½” plastic / brass /CI
8) Cotton thread or sealing tape
9) Dummy plug ½”
10) Control cock
11) Shower fitting

Tools required:

1) pipe vice
2) pipe cutter or hack saw
3) pipe die with die stock & handle
4) oil can
5) Pipe wrench
6) Steel rule

Sequence of operations:
Length marking
Cutting to required lengths
Threading with pipe die and checking thread quality
Assembly of pipes and pipe fitting as per layout
Fix water tap

Procedure:
1. Measure the length of the given pipe
2. Mark the required lengths of pipe
3. Hold the pipe in pipe vice, cut the pipe to different lengths required.
4. Hold the pipes one by one in pipe vice in position adjust die set screw to form half the thread depth cut external threads on end.
5. Increase the depth of cut by adjusting die set screw and finish cut threads till one thread projects through the die.
6. Finally fix water tap and shower fitting

Precautions :
1. Clamp the pipe securely in the pipe vice
2. For GI pipes once the threading is started apply cutting oil.
3. While threading turn the die stock handle back and forth frequently to loosen the chips.
4. For PVC pipes application of cutting oil is not necessary while threading.
5. In cutting pipe to length, the portion of the pipe that will screw into the fittings, must be taken.
6. To avoid damaging valve or a tap with wrench marks, it is advised to use nonkey wrench with smooth jaws.

Result :

Applications :

Viva Questions :

1. With what kind of work, the term “plumbing”, deals?
2. Name the various plumbing tools
3. What for the jaws of a pipe wrench are seperated inside?
4. When, a pipe cutter is used instead of a hacksaw, for cutting pipes?
5. What is a pipe die?
6. List-out the commonly used pipe fittings.
7. When, a union is used in pipe layout?
8. Name the various valves used in a pipe line, to control the fluid flow
9. When, a monkey wrench is preferred in place of ordinary pipe wrench?

10. List-out the steps to be followed while joining PVC pipes.
11. What are the steps to be followed while threading a metallic pipe?
12. Name the commonly used types of steel trusses.
13. Define the following terms, as applied to door shutters :i) stile, ii) rail and iii) mullion
14. Name the various furniture joints used in practice.

METAL CUTTING (Water Plasma)

1. INTRODUCTION

Plasma may be defined as charged particles which are close together so that, each particle influences many charged particle, rather than just interacting with nearby particle. Plasma is typically an ionized gas and it is considered to the distinct state of matter, because of its unique properties. It is 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 ad –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 exit, 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 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.

2. 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 K. 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 future industrial power installations. The use of water as a source of energy will solve many environmental problems in the planet.

2.1 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 fluxed 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.

3. CONSTRUCTION OF PLASMA TORCH

(Fig: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 (220 V, AC, 50 Hz) through a grounded power outlet.

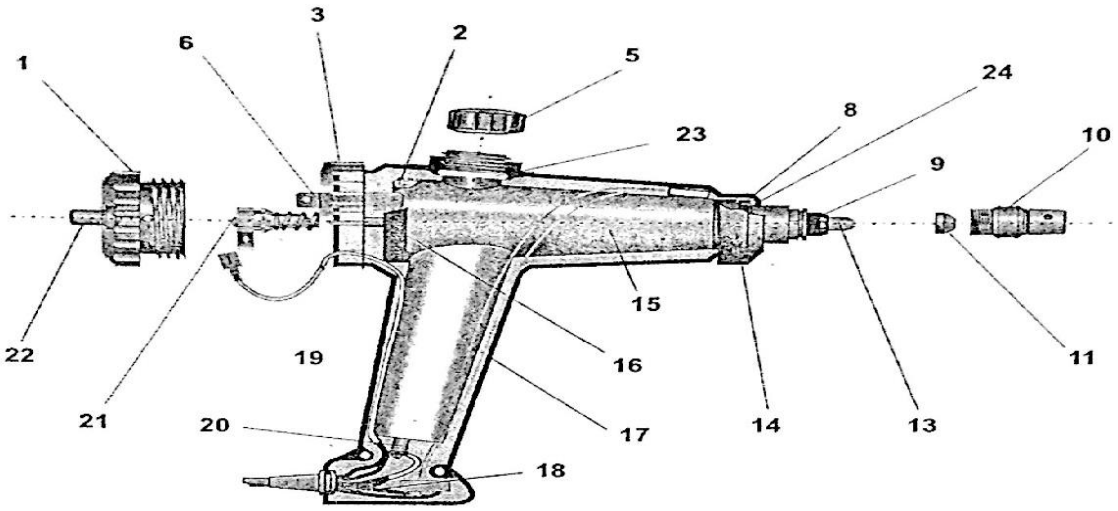


Fig 1: Plasma Torch

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

Fig 1: Plasma Torch

1. Cathode Adjusting Cap
2. Sealing Bush
3. Ring
5. Filling Plug
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10. Spout
11. Nozzle-ANODE
13. CATHODE
14. Torch body tightening nut
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.

3.1 Principle of operation of plasma tool

(Fig:2) illustrates the principle of plasma tool operation. Brief pressing of the torch activating knob activities 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 are occurs between the cathode tip and nozzle-anode.

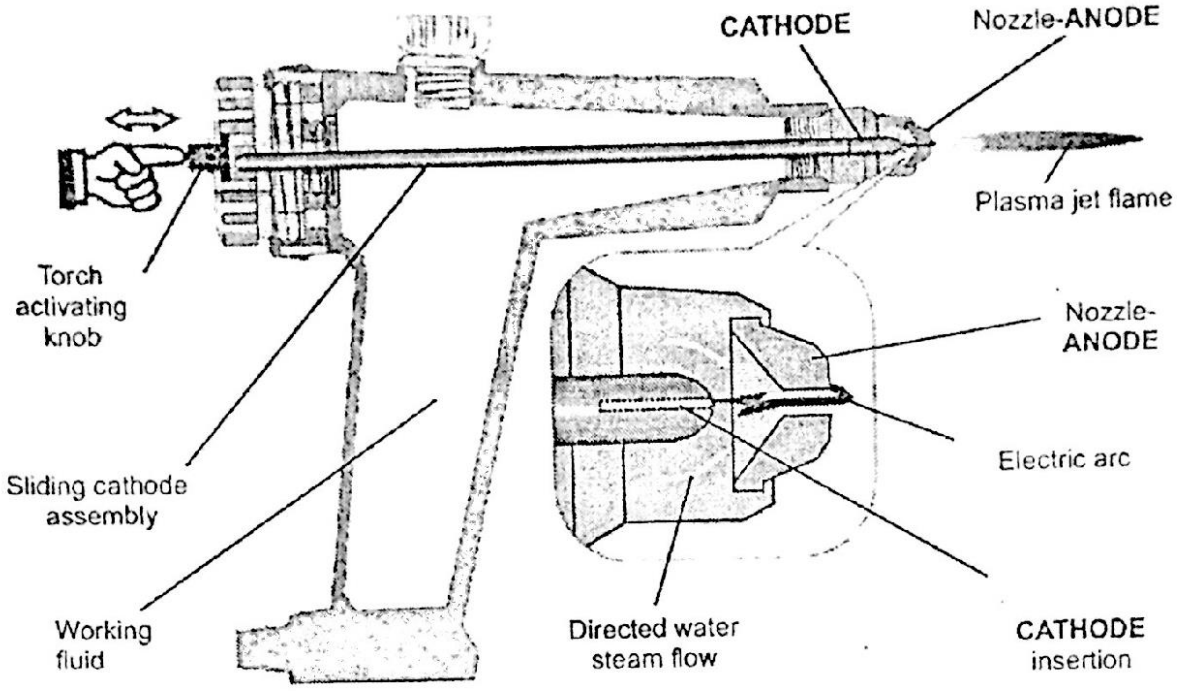


Fig 2: Plasma tool operation

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 are, part of the steam turns into the fourth state of matter-plasma with the temperature upto 8000 C, 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 is also widely used in the nuclear industry. Ware may be used as a working fluid for cutting and 40 % water-alcohol solution for welding, soldering and brazing.

The device operates with a 200 V socket connector and does not require a high voltage connection. The device can be carried to the worksite in a small bag with a total weight of only 6 kg.

NOTE: Multiplaz-2500 device, which produces and uses water plasma for both welding and cutting, is marketed by Bharadwaj e-technologies Pvt. Ltd, Hyderabad.

4. ADVANTAGES OF PLASMA TOOL

1. Cost effective
2. Can be carried to the worksite in a small bag.
3. Less power consumption
4. Does not require lighting as the flame produces effective illumination
5. No thermal strains in the material that is being operated upon, due to the narrow heat penetration area.
6. In case of welding, the weld does not rust as a stainless oxide film forms on the welded area.
7. The device can be operated 24 hours a day and 365 days in a year at its maximum capacity rate.
8. When this device is used, the working room is additionally enriched with oxygen. Hence, it is possible to perform operations in enclosed spaces without aeration.

5. PRECAUTIONS

1. It is advisable to use minimum work current to extend the lifetime of the electrode.

2. The torch should not be started without the working fluid filled; as otherwise, it may damage the electrodes.
3. It is advisable to avoid the usage of the operating modes when the flame becomes greenish.
4. While working outdoors with temperatures below zero, fill the torch just before the use, to avoid water freezing inside the torch.

6. SAFETY RULES

1. Fire-Project the work area, by providing sand, fire extinguishers, bucket of water or internal fire hydrants.
2. Ensure that the local exhaust ventilation is operational.
3. Avoid contact of molten metal and torch flame with non-fire proof materials and power supply unit.
4. Wear gas welder's mask for "plasma-arc" mode to prevent eye injury.
5. Do not use the appliance without grounded power outlet.
6. Do not weld, cut, solder or braze freshly painted parts until the paint dries out completely.
7. Do not activate the plasma torch near inflammable materials and liquids.
8. Do not wear clothes with spots of oil, grease, gasoline or any other combustible liquids.
9. Disconnect power supply unit from the power outlet before disassembling the torch.
10. Never pour working fluid into the torch with voltage applied
11. Do not immerse the torch into water when output voltage is applied.
12. Never bring the torch close to your face.

Viva Questions

1. Define the term, ' plasma'
2. What is meant by 'plasma density'?
3. What is meant by 'degree of ionization' of plasma?
4. Differentiate between hot plasma and cold plasma
5. What is meant by water plasma?
6. What are the various applications of water plasma?
7. Describe the plasma torch, used for producing plasma.

8. Describe the principle of operation of plasma tool?
9. Why the welds made by plasma tool do not rust?
10. What are the advantages of using plasma tool?
11. What are the precautions to be followed while working with a plasma tool?
12. List out the safety rules to be followed while using a plasma tool.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY

WORKSHOP RECORD

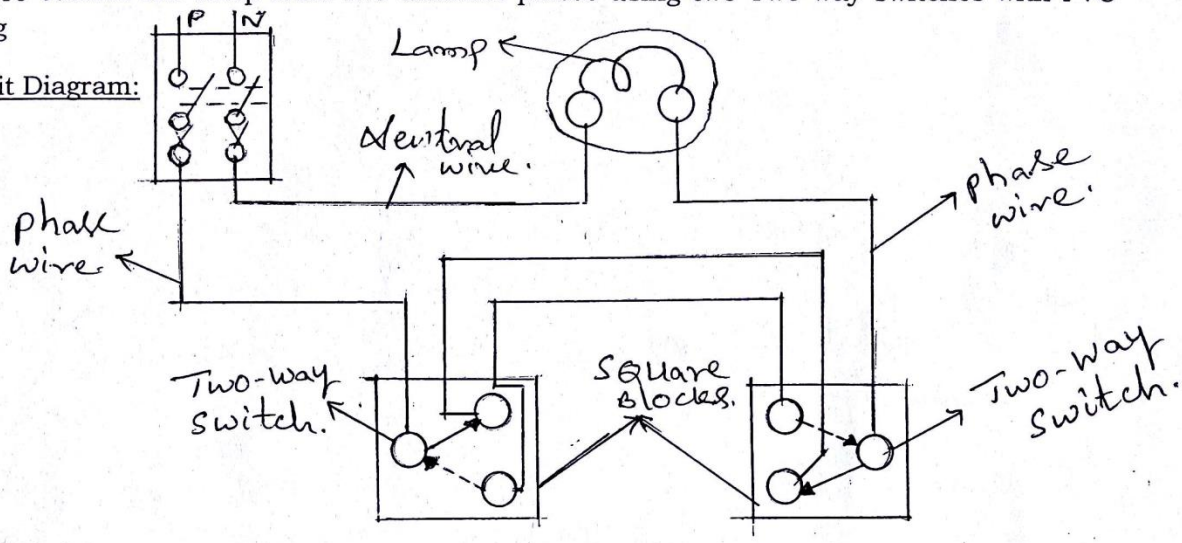
HOUSE WIRING

EXPERIMENT – 2

STAIRCASE WIRING

Aim: To control one lamp from two different places using two Two-way switches with PVC wiring

Circuit Diagram:



Tools Required:

1) Screw drivers - sizes (10", 8" , 6")
2) Side cutting plier
3) Combination cutting plier
4) Nose plier
5) Tester (Neon)
6) Insulation remover (or) wire stripper
7) Poker
8) Wooden mallet

Material requirement:

1) ¾" PVC Pipe
2) ¾" PVC 3-way junction boxes & Elbow
3) PVC wire (1/8 SWG)
4) Saddles
5) Wooden Square box (4/4")
6) Wooden Screws (2")
7) Soft Screws or Metal Screws (½")
8) Batten holder - 1 No
9) Two-way switches – 2 No.
10) Bulbs

Procedure

1. The PVC pipes are arranged as per the circuit diagram.
2. The phase wire is connected to middle terminal of first two-way switch. The neutral wire is connected to one terminal of lamp holder.
3. The other terminal of lamp holder and the middle terminal of second two-way switch are connected using as phase wire.
4. The first terminal of the two-wire switches and the last terminals of the 2 two-way switches are connected using two different loop wires. Thus the connections are made.

Precautions

1. All the connections should be made tightly.
2. Don't touch the phase wire of live wire directly without insulation.
3. Should not touch phase and neutral wire each other to avoid short circuit.

Applications

It is used for general used in stair case wiring .

Result and Discussion

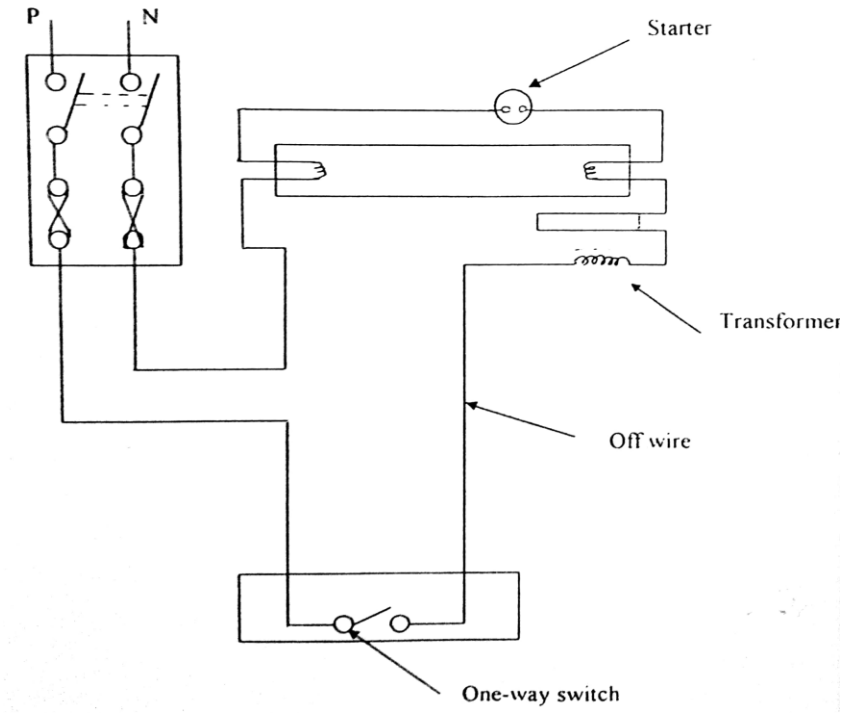
The stair case wiring was given power supply and observed that one lamp glows from two different places using two-way switches.

HOUSE WIRING

EXPERIMENT-1

Aim To control Fluorescent lamp(or Tube light) using one –way switch with PVC wiring.

Circuit diagram



Tools : Screw drivers 10" 8" & 6" – 1 No.
Side cutting player -1 No.
Combination cutting player -1 No.
Nose player -1 No.
Tester (Neon) – 1 No
Hand drill machine – 1 No
Ball pen hammer – 1 No.
Insulation remover (or) stripper -1 No.
Poser
Hack saw
Wooden mallet

Material requirement

¾" PVC pipe 1.5m length
¾" 3 way junction box- 1 No.
PVC wire 1/8" standard wire gauge – 3 m
¾" saddles – 5 Nos.
¾" and 2" screws required
4/4" square block – 1 No.
1 way switch – 1 No.

Ceiling rose – 1 No.
Wooden round block – 1 no.
Fluorescent lamp – 1 No.
Flexible wire – 1 m

Procedure

1. The PVC pipes are arranged and fixed on the board. Wires are arranged as per the circuit diagram.
2. The phase wire is connected to the one terminal of the switch.
3. The neutral wire is connected to the first filament and from that point connection is made to starter and second filament a short wire called as the loop wire. It becomes neutral wire to the second filament.
4. The remaining terminal of switch and transformer are connected using an off wire.
5. Thus the connections are made as per the circuit diagram.

Precautions

1. All the connections should be made tightly.
2. Don't touch the phase wire of live wire directly without insulation.
3. Should not touch phase and neutral wire each other to avoid short circuit.

ApplicationsIt is used for general house wiring or lighting purpose at anywhere.

Result and Discussion

The Fluorescent lamp was given power supply and observed that Fluorescent lamp glow with one switch.

Viva voce questions

1) What do you mean by wiring?

2) State the ohm's law

3) What is the difference between electrical power and electrical energy?

4) What do mean by 1 Kwh?

5) What is the function of fuse wire? And name the materials of fuse wire

6) What is the purpose of earthing or grounding?

7) What is the difference between conductor and insulators with examples?

8) How does a phase wire differ from a neutral wire?

9) Differentiate between a fuse and a circuit breaker.

10) What for a lamp holder is used in an electric circuit?

11) What for a ceiling rose is used?

12) What is meant by an electric circuit?

CARPENTRY

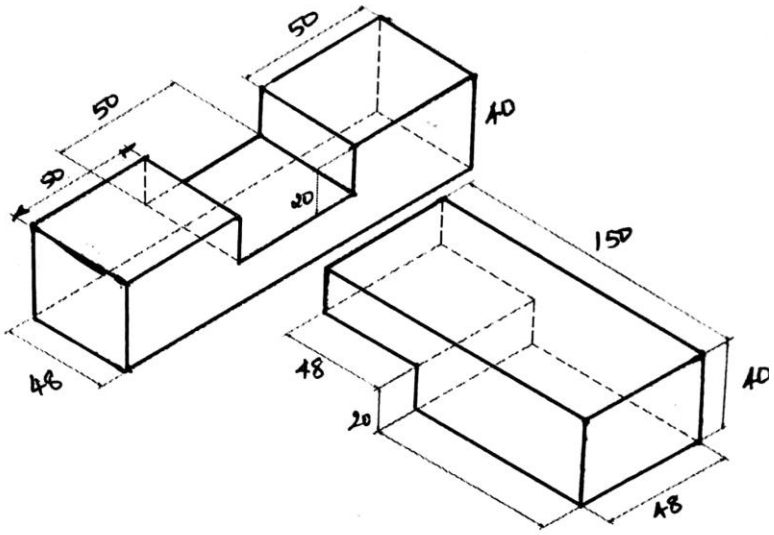
EXPERIMENT -1

Aim: To make a T- lap joint.

Materials required: Teak wood of 150mm X 48mm X 40mm

Tools and equipment used:

1. Metal Jack plane
2. Try square
3. Marking gauge
4. Steel rule
5. Crosscut hand saw
6. Tenon saw
7. Firmer chisel
8. Mortise chisel
9. Wooden mallet
10. Carpentry vice



Operations to be carried out:

1. Planning
2. Marking
3. Sawing
4. Chiseling
5. Finishing

Procedure:

1. The given reaper is checked for dimensions and one side of it is planed with metal jack plane and checked for straightness.
2. The adjacent side is also planned and checked for squareness with a try square marking gauge.
3. Take one of the wooden block mark the dimension 50mm from either side of length 150mm with the help of a marker and
4. Mark 20mm line parallel to the top surface in total thickness of 40mm on either side of width 48mm.Extend 50mm lines in 90^0 with the help of try square,such that it will cut 20mm lines as shown in figure.
5. Take the second wooden block mark the dimension 48mm parallel from one of its side of length 150mm. Mark 20mm lines in thickness 40mm on either side of width 48mm. Extend the 48mm line in $90^0$with the help of try square, such that it will cut 20mm lines as shown in figure.
6. Along the markings the wood is sawed off with the help of cross cut saw and chisel in both the wooden blocks.

7. The excess material is then chiseled to finish the job.

Precautions:

1. Reaper should be free from moisture
2. Marking is done without parallax error
3. Care should be taken while chiseling

Applications:

- Internal cabinet frames
- Simple framing and bracing.

Results and Discussion:

Required T-Lap Joint is obtained

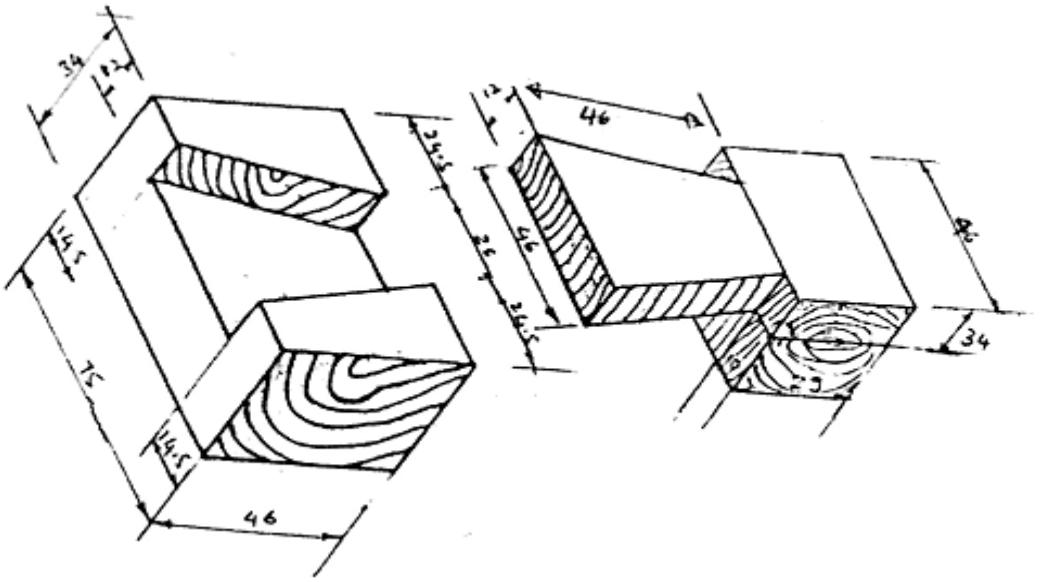
Viva Voce Questions:

1. What do you mean by carpentry?
2. How are wood working tools classified according to their use?
3. How does a hand saw differ from a tenon saw?
4. Give a neat sketch of a firmer chisel and name its different parts
5. How do you classify chisels used in wood work?
6. With the help of suitable sketch, explain the construction and working of carpentry vice?
7. Name the different planes used in woodworking
8. What are the general safety precautions necessary in carpentry?
9. What are the different joints used in woodworking?
10. How do you classify the different operations done in wood working?
11. Give a list of marking and measuring tools?

CARPENTRY

EXPERIMENT – 2

Aim: To obtain **Dove tail joint** with the given wooden piece as shown in the figure.



Materials required: Teak wood block of dimensions 150mm x46 mm x34 mm

Tools and Equipment required:

1. Metal Jack plane
2. Try square
3. Marking gauge
4. Steel rule
5. Crosscut hand saw
6. Tenon saw
7. Firmer chisel
8. Mortise chisel
9. Wooden mallet
10. Carpentry vice

Operations to be carried out:

1. Planning
2. Marking
3. Cutting
4. Chiseling
5. Finishing

Procedure:

1. The given wooden piece is made plane and the adjacent two sides are made perpendicular and it is tested with the help of a try square and the dimensions are to be marked carefully with the help of pencil and then it is cut into two halves along length.
2. Now one of the wooden blocks is taken and from one edge on 75 mm x 46 mm side 46 mm line is drawn at a distance of 46 mm. In the perpendicular direction, centering is done and on either side as distance of 13 mm two parallel 75 mm edge at a distance of 12 mm lines are drawn using marking gauge. Now along the markings, the wood is sawed off with the help of a cross cut saw and chisel.
3. The second block is taken and on two sides with 34 mm x 75 mm dimensions parallel to 75 mm edge and at a distance of 12 mm lines are drawn with gauge. Centering is done along 75 mm length on 75 mm x 46 mm side and on one either side of this line at a distance of 13 mm and 23 mm four lines are drawn using try square. Along the marking the is sawed off and then chopped-off with the chisel. Then chiseling is done to finish the job.

Precautions:

1. Marking must be done accurately.
2. Care must be taken while chiseling so that the required material is not removed.

Applications:

Dovetail joint is used for making the box and drawer joints.

Results & Discussion:

Dovetail joint is obtained.

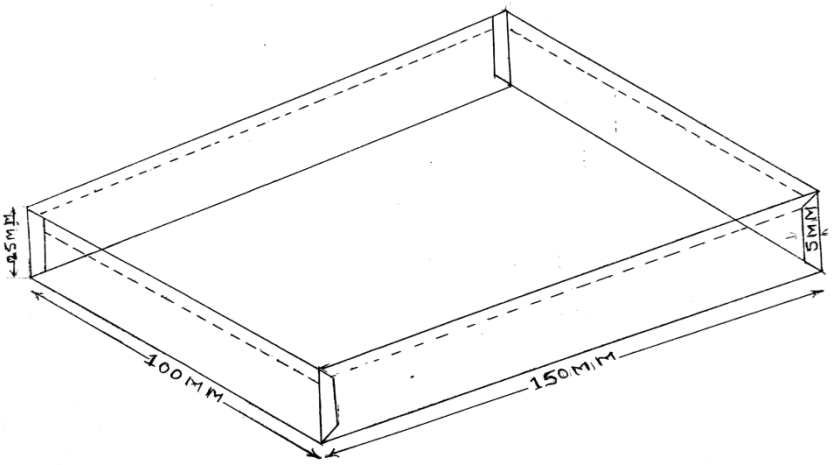
Viva Voce questions:

1. What do you mean by carpentry?
2. How are the wood working tools classified according to their use?
3. How does a hand saw differ from a tenon saw?
4. Give a neat sketch of a firmer chisel and name its different parts.
5. How do you classify chisels used in woodwork?
6. With the help of suitable sketch, explain the construction and working of carpentry Vice.
7. Name the different planes used in woodworking
8. What general safety precautions are necessary in carpentry?
9. What are the different joints used in woodworking?
10. How do you classify the different operations done in wood working?
11. Give a list of marking and measuring tools

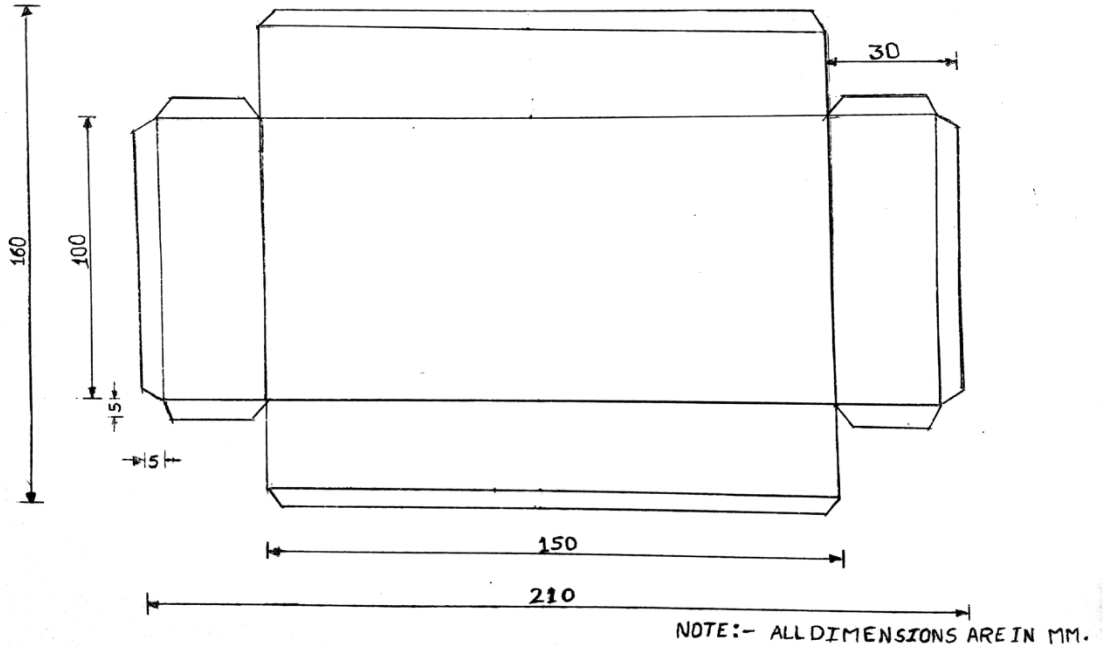
TIN SMITHY

EXPERIMENT- 1

Aim: To make a Rectangular Tray using GI-sheet(Galvanized Iron sheet)



Development



Materials required with dimensions: G.I. Sheet 30 Gauge (210 x 160 mm) and lead

Tools and Equipment used:

Steel rule, Scriber, Straight Snip, Try square, Mallet, Electrical Soldering Iron, Stakes and Shearing M/c

Operations to be carried out:

1. Measuring

2. Marking
3. Folding and Bending
4. Hammering
5. Soldering
6. Finishing

Procedure:

1. Draw the development of surface of the required work piece i.e., rectangular tray of required dimensions.
2. Take a sheet of dimensions 210 X 160 mm and marking has to be done as per dimension in the development of surface with the help of steel rule, scriber and try square.
3. Mark a square of 30x30 mm using a steel rule with the scriber.
4. Mark 5 mm distance at every edge, as shown in figure.
5. Cut 5 mm marked line using a straight snip. Bent each side onto the inside so as to form a tray.
6. Now bending has to be done to get required shape with the help of mallet and stake.
7. Finally soldering has to be done in the required places with the help of soldering iron, flux tin and lead.

Precautions:

1. Utmost care has to be taken while handling sheet to protect our hands and other body parts from sharp edges/corners of the sheet
2. Dimension has to be marked carefully
3. Soldering iron is handled carefully to avoid short circuit

Result: Rectangular Tray is obtained.

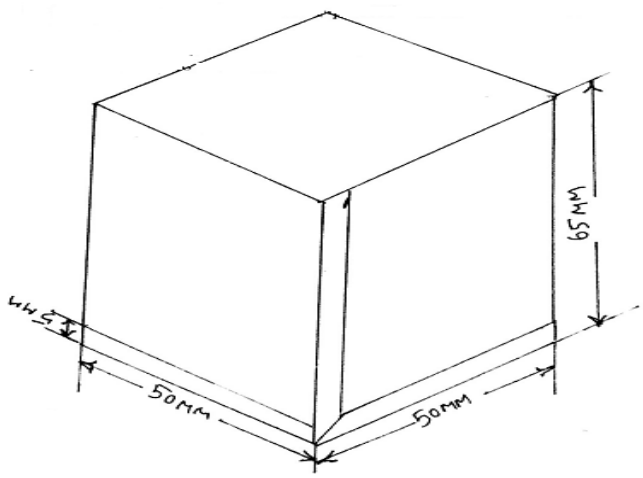
Viva voce questions

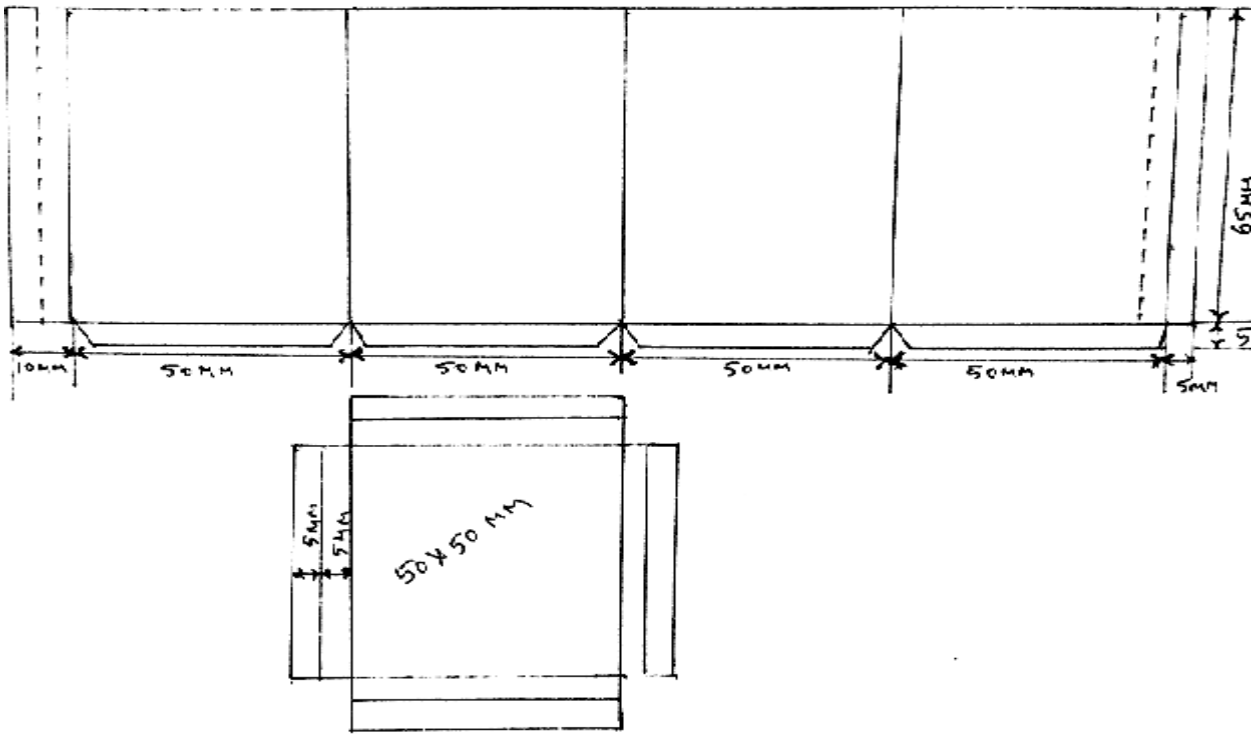
1. What is the importance of sheet metal work?
2. What are the materials used in Tin smithy?
3. List out the hand tools used in Tin smithy
4. Name the measuring tools and draw the neat sketches
5. What do you mean by S.W.G? And its importance?
6. Write any four marking tools used in Tin Smithy with the help of neat sketches
7. Sketch different types of stakes used in sheet metal work ,stating their applications
8. List out the different folded joints used in fabrication of sheet metal
9. What are the operations are to be carried out in sheet metal work?
10. List out the straight flat joints used in Tin Smithy.
11. What are the precautions should be taken while conducting the experiments?
12. How to classify the snips?
13. G.I stands for_____

TIN SMITHY

EXPERIMENT- 1

Aim: To make a Square Tin





Materials required with dimensions: G.I. Sheets 30 Gauge 215 x 70 mm & 70 x 70 mm.

Tools and Equipment used:
Steel rule, Scriber, Straight Snip, Try square, Mallet, Stakes, Shearing M/c

Operations to be carried out:

1. Measuring
2. Marking

3. Cutting
4. Folding
5. Bending
6. Hammering

Procedure:

1. Draw the development of surface of the required work piece i.e., Square Tin of required dimensions
2. Take two sheets of dimensions (i) 215 X 70 mm (ii) 70 X 70 mm and marking has to be done as per dimension in the development of surface drawing drawn before with the help of steel rule, scriber and try square.
3. After completion of marking unwanted material is removed with the help of steel snip.
4. Now bending has to be done by placing sheet on the stakes. After completing the bending as per requirement two pieces are assembled and joined firmly with the help of stakes and mallet.
5. Finally Square tin is obtained.

Precautions:

1. Utmost care has to be taken while handling sheet to protect our hands and other body. parts from sharp edges/corners of the sheet.
2. Dimension has to be marked carefully.
3. Soldering iron is handled carefully to avoid short circuit.

Result: Square Tin is obtained

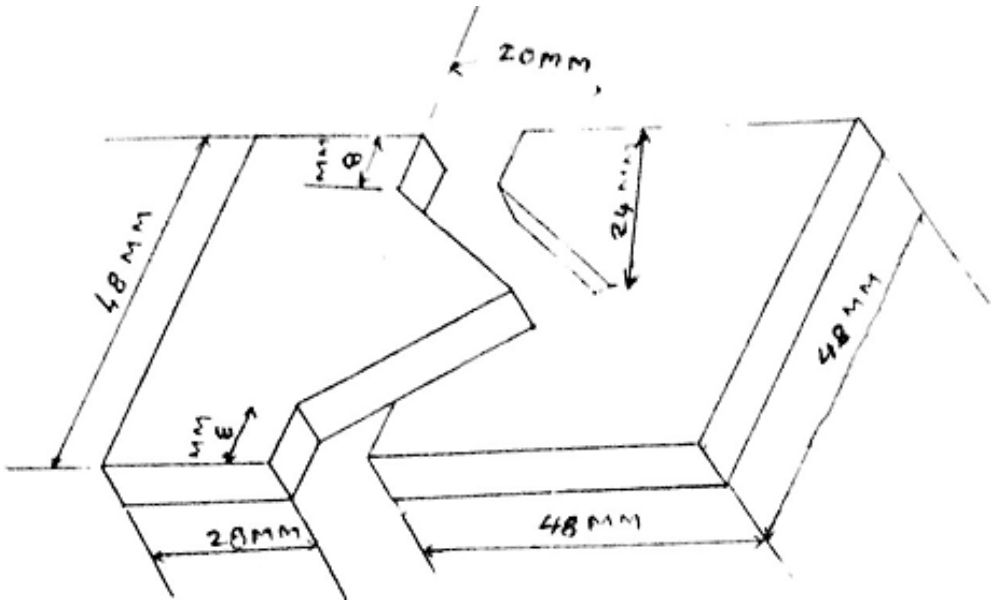
Viva voce questions

1. What is the importance of sheet metal work?
2. What are the materials used in Tin smithy?
3. List out the hand tools used in Tin smithy
4. Name the measuring tools and draw the neat sketches
5. What do you mean by S.W.G? And its importance?
6. Write any four marking tools used in Tin Smithy with the help of neat sketches
7. Sketch different types of stakes used in sheet metal work ,stating their applications
8. List out the different folded joints used in fabrication of sheet metal
9. What are the operations are to be carried out in sheet metal work?
10. List out the straight flat joints used in Tin Smithy.
11. What are the precautions should be taken while conducting the experiments?
12. How to classify the snips?
13. G.I stands for_____

FITTING

EXPERIMENT – 1

Aim: To produce ' **V** ' fitting from the given work piece as shown in figure.



Material required: Mild steel material of dimensions 100 mm x 50 mm x 5 mm.

Tools & equipment used: Bench vice, flat rough file, smooth file, try square, dot punch, hammer, hacksaw, vernier calipers, vernier height gauge, surface plate and angle plate.

Sequence of operations:-

1. Filing, 2. Marking 3. Punching, 4.Sawing 5. Finishing 6. Fitting

Procedure:

1. Filing is done on the edges of the work piece with rough flat file to remove surface material & finishing is done with smooth flat file.
2. The right angles to the edges and the straightness of the edges are checked with try square..
3. After applying chalk on the surface, given dimensions are marked on the work piece with the vernier height gauge.
4. Dots are punched along the marked lines using dot punch & ball peen hammer.
5. Excess material is removed with sawing using hacksaw
6. Finishing of all edges is done with smooth flat file.
7. All dimensions are checked with Vernier calipers.
8. Both the pieces are fitted together to form 'V' fitting.

Precautions:

- Work piece must be held in the bench vice firmly.
- Do not bend the hacksaw while cutting.

Results & Discussion:

"V" fitting is obtained

Applications:

Lathe tail stock moved over the lathe guide ways

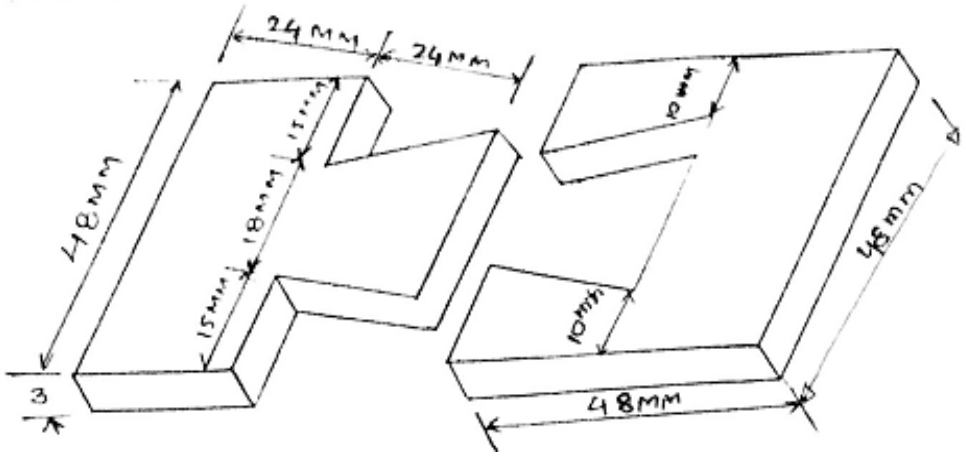
Viva Voce questions:

1. Define fitting
2. What are the different types of tools used in fitting?
3. Sketch and describe the engineer's try square.
4. What is the importance of surface plate?
5. Explain the different parts of a combination set and their uses.
6. How are the files classified?
7. Name and explain various types of files.
8. How to specify the file?
9. What are the different types of chisels used in fitting work?
10. Describe the marking tools used in fitting
11. Sketch and describe the inside and outside calipers
12. What are the precautions should be taken while conducting the experiments?
13. List out the sequence of operations are to be conducted in fitting work.
14. With the help of neat sketch explain the construction and working of bench vice
15. What are the different processes done in bench work?
16. Name the material of the specimen.

FITTING

EXPERIMENT – 2

Aim: To produce ' **Dovetail** ' fitting from the given work piece as shown in figure.



Material required: Mild steel material of dimensions 100 mm x 50 mm x 5 mm.

Tools & equipment used: Bench vice, flat rough file, smooth file, try square, dot punch, hammer, hacksaw, vernier calipers, vernier height gauge, surface plate and angle plate.

Sequence of operations:

1.Filing 2. Marking 3. Punching 4. Sawing 5. Finishing 6. Fitting

Procedure:

1. Filing is done on the edges of the work piece with rough flat file to remove surface material & finishing is done with smooth flat file.
2. The right angles to the edges and the straightness of the edges are checked with try square..
3. After applying chalk well on the surface, given dimensions are marked on the work piece with the help of vernier height gauge.
4. Dots are punched along the marked lines using dot punch & all peen hammer.
5. Excess material is removed by sawing using hacksaw. While sawing cutting is done slightly away from the marked line.
6. The marked line which is in side, cannot be cut by handsaw is cut by drilling holes using drilling machine.
7. Using flat chisel the chipping is done to remove the excess material from the work piece.
8. Filing is done with triangular file after the excess material removed.
9. Dimensions are checked with Vernier calipers.
10. Both the pieces are fitted to form 'Dovertail' fitting.

Precautions:

- Work piece must be held in the bench vice firmly.
- Do not bend the hacksaw while cutting.

Results & Discussion:

Required dove tail fitting is obtained

Applications:

Loaded guide ways and lifting purpose

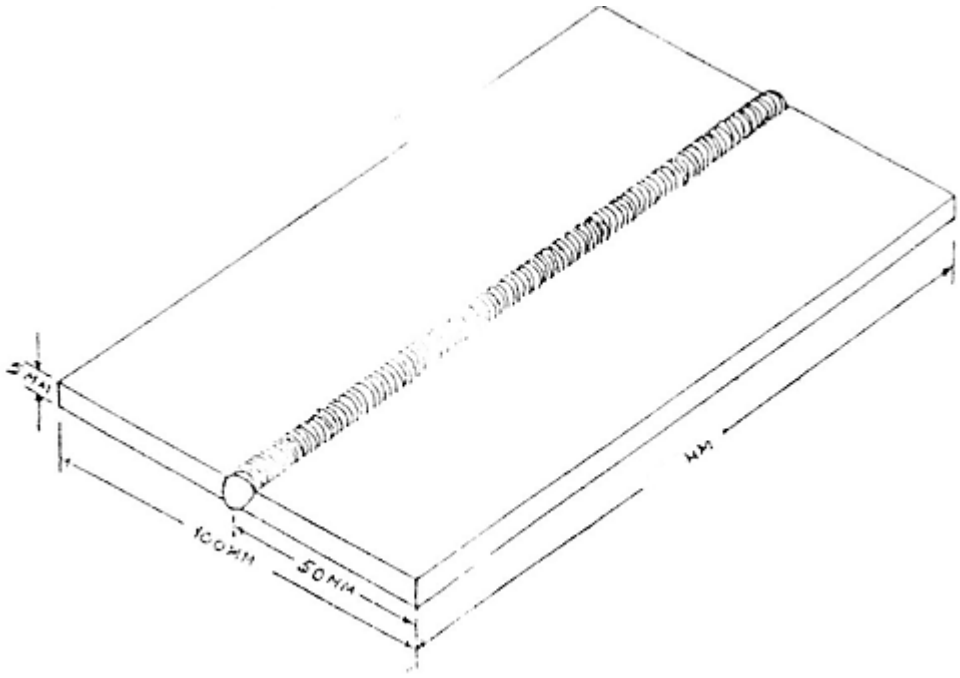
Viva Voce questions:

1. Define fitting
2. What are the different types of tools used in fitting?
3. Sketch and describe the engineer's try square.
4. What is the importance of surface plate?
5. Explain the different parts of a combination set and their uses.
6. How are the files classified?
7. Name and explain various types of files.
8. How to specify the file?
9. What are the different types of chisels used in fitting work?
10. Describe the marking tools used in fitting
11. Sketch and describe the inside and outside calipers
12. What are the precautions should be taken while conducting the experiments?
13. List out the sequence of operations are to be conducted in fitting work.
14. With the help of neat sketch explain the construction and working of bench vice
15. What are the different processes done in bench work?
16. Name the material of the specimen.

WELDING

EXPERIMENT-1

Aim: To make a **Butt joint**, with the given work piece.



Material required:

Two M.S Flat pieces (120 mm x 50mmx5mm) and 3.2mm or 10 gauge M.S electrodes (90 to 110 amperes)

Tools & Equipment:

A.C Transformer with devices, work bench, steel rule, Welding screen, Apron, Hand gloves, goggles, Chipping hammer, Wire brush, Iron tong, Flat file, and Anvil.

Sequence of operations to be carried out:

- Cleaning
- Edge Preparation
- Welding
- Chipping
- Cleaning
- Cooling and Finishing

Procedure:

Clean the surface to be welded by wire brush to remove rust. The two work pieces are kept one adjacent to the other such that the edges are welded in the same plane with each other. During the process of welding the electrode is kept at inclined to the vertical and in the direction of welding. Welding is done with uniform speed maintaining medium arc length. Chipping is done to remove slag and spatters on the weld metal with the help of chipping hammer by holding the work piece by a with an iron tong. Cleaning is done on the surface of the workpiece by wire brush. The work piece is cooled by dipping in water.

Precautions:

1. Ensure good electrical contact before starting the operation
2. Use leather apron and gloves to protect the body from the heat and spatters.
3. While welding , hold the welding screen to protect eyes and face from U.V rays.
4. The hot metal should be kept away from the body while chipping.

Applications:

For making Reactors, tanks and Cylinders etc.

Results & Discussion:

Required "butt joint" is obtained.

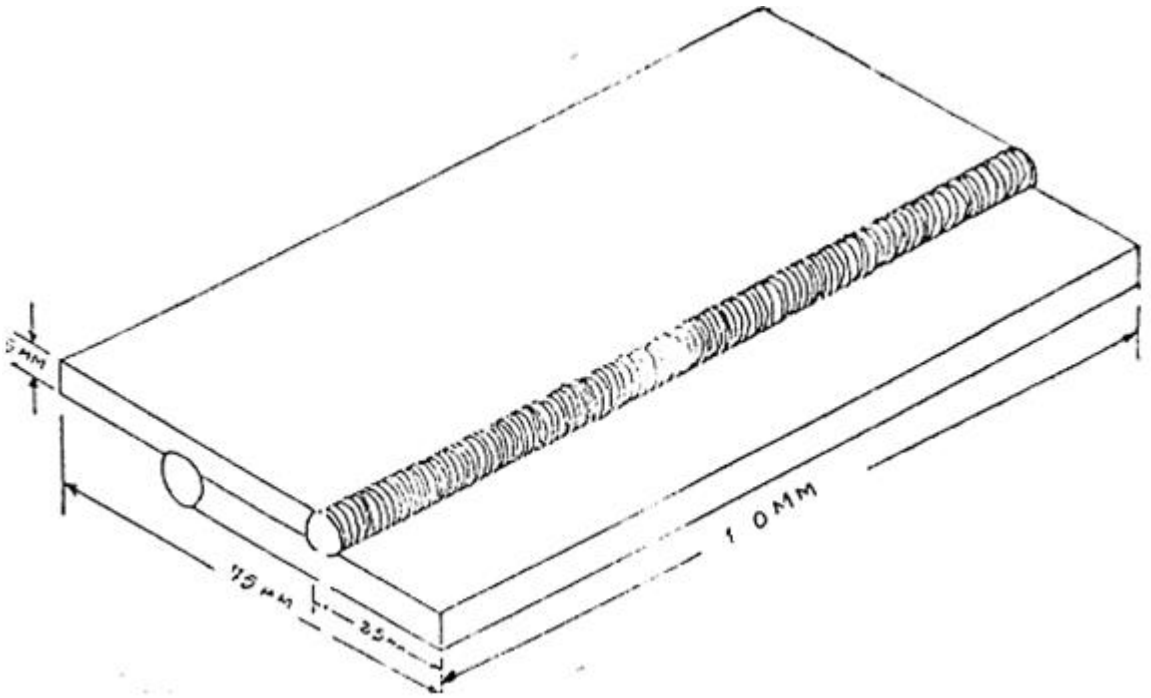
Viva Voce questions:

1. Define welding.
2. How do you classify the welding process?
3. How many methods of arc welding do you know?
4. Differentiate between A.C and D.C arc welding.
5. State the functions of flux coating.
6. What do you understand by Gas welding?
7. What are the electrodes used in arc welding made of?
8. What are the functions of coated electrode?
9. Differentiate between soldering and welding.
10. What are advantages of gas welding?
11. Differentiate between soldering and Brazing.
12. How is an electrode specified? What factors govern the selection of an electrode?
13. What tools required while conducting the experiment?
14. What are the safety precautions required in the welding lab?
15. What are the equipments required while conducting the experiment in the welding lab?

WELDING

EXPERIMENT-2

Aim: To make **'Lap joint'** with the given work piece.



Material required:

Two M.S Flat pieces (120 mm x 50mmx5mm) and 3.2mm or 10 gauge M.S electrodes (90 to 110 amperes)

Tools & Equipment:

A.C Transformer with devices, work bench, steel rule, Welding screen, Apron, Hand gloves, goggles, Chipping hammer, Wire brush, Iron tong, Flat file, and Anvil.

Sequence of operations to be carried out:

- Cleaning
- Edge Preparation
- Welding
- Chipping
- Cleaning
- Cooling and Finishing

Procedure:

Clean the surface to be welded by wire brush to remove rust. The two work pieces are kept one over the other such that each work piece is over lapped at half the width from the end. Tack welding is done on both side of the lapped ends. Holdings the electrode at inclined to the surface to be welded. Welding is done with uniform speed maintaining medium arc length. Chipping is done to remove slag and spatters on the weld metal with the help of chipping hammer by holding the work piece by a wire brush. The work piece is cooled by dipping in water.

Precautions:

1. Ensure good electrical contact before starting the operation
2. Use leather apron and gloves to protect the body from the heat and spatters.
3. While welding , hold the welding screen to protect eyes and face from U.V rays.
4. The hot metal should be kept away from the body while chipping.

Applications:

For making machine beds and column beds etc..

Results & Discussion:

Required " Lap joint" is obtained.

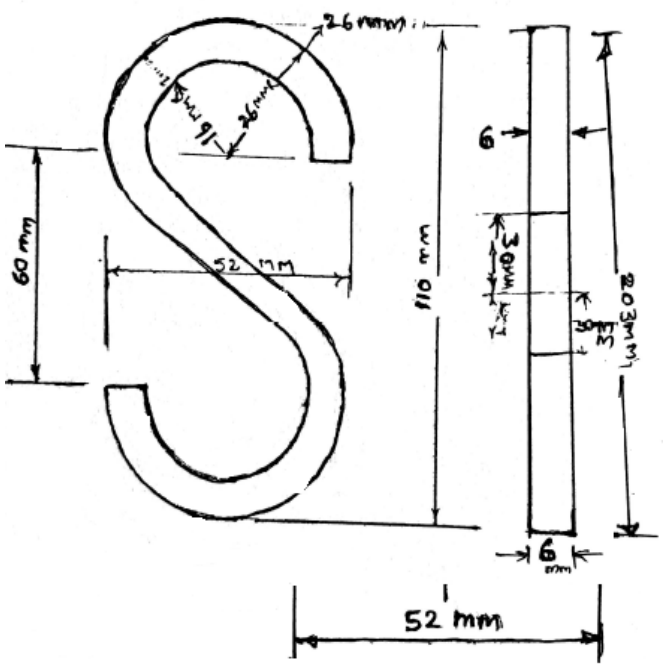
Viva Voce questions:

1. Define welding.
2. How do you classify the welding process?
3. How many methods of arc welding do you know?
4. Differentiate between A.C and D.C arc welding.
5. State the functions of flux coating.
6. What do you understand by Gas welding?
7. What are the electrodes used in arc welding made of?
8. What are the functions of coated electrode?
9. Differentiate between soldering and welding.
10. What are advantages of gas welding?
11. Differentiate between soldering and Brazing.
12. How is an electrode specified? What factors govern the selection of an electrode?
13. What tools required while conducting the experiment?
14. What are the safety precautions required in the welding lab?
15. What are the equipments required while conducting the experiment in the welding lab?

BLACK SMITHY

EXPERIMENT – 1

Aim: To make **"S"** Shape with the given work piece.



Material required: Mild steel square rod of thickness is 6x6x203mm length and char coal.

Tools & equipment used: Sledge hammer, flat tong, steel rule, Anvil, flatter, poker, showel, chisel, smithy furnace, and electrical air blower with motor (2.5HP, 1500 rpm).

Sequence of operations:

1.Marking 2. Heating 3. Striking 4. Bending 5.Stretching 6. Finishing and cooling.

Procedure:

1. The given work piece of square rod is 6mm is heated to red hot (900-1000^0C) in smithy furnace.
2. When it is red hot take it out with the help of flat tong and it is placed on the beak of the anvil.
3. It is Striked with the help of flatter and hammer to get required shape.
4. After getting S shape , the job piece is flatted with the help of flatter and hammer then work piece is cooled in air.

Precautions:

- The workpiece should not be overheated..
- The hot rod should be handled carefully. Heated it below the melting point.
- Hammering should be done carefully without slipping the work piece.

Applications: It is used for lifting purpose.

Black smithy

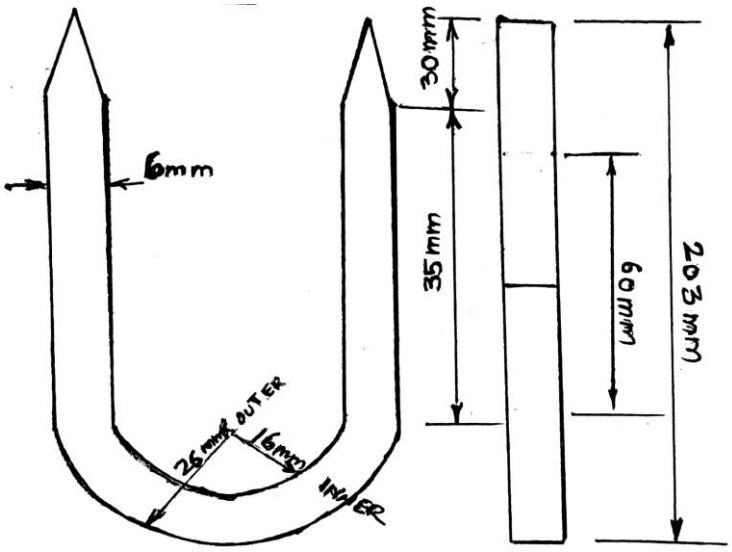
Viva Voce questions

1. Differentiate between Smithy and forging
2. How to clarify the heating devices?
3. Sketch and describe the black smithy striking tools
4. Describe with neat sketch of the anvil used in smithy.
5. What operations are performed in a black smithy?
6. List out the holding tools used in smithy shop.
7. What do you understand from 'open fire' and stock fire?
8. Name the common materials used for forging.
9. Give the forging temperatures of some common forgeable materials.
10. Why blowers are used in block smithy?
11. List out the merits and demerits of forging.
12. State the applications of forging.
13. What general safety precautions are necessary in a black smithy?

BLACK SMITHY

EXPERIMENT – 2

Aim: To make a "Fan hook" with the given work piece.



Material required: Mild steel square rod (203mmx6mmx6mm) and coal

Tools required: Anvil(100 to 150 Kg), flat tong, steel rule, sledge hammer, poker, flatter, shovel and chisel.

Equipment required: Electrical air blower with motor (2.5 H.P, 1500 r.p.m) and smithy furnace

Sequence of operations

- Marking
- Heating
- Striking
- Supporting
- Bending
- Finishing
- Cooling

Procedure:

1. The given work piece of square rod is 6mm is heated to red hot (900- 1000^0C) in smithy furnace.
2. When it is red hot take it out with the help of flat tong and it is placed on the beak of the anvil.
3. It is Striked with the help of flatter and hammer to get required shape.
4. Sharpen the two ends of work piece with the help of a flatter and hammer.

5. After getting Fan hook shape, the job piece is flatted with the help of flatter and hammer then work

piece is cooled in air.

Precautions:

- The work piece should not be overheated..
- The hot rod should be handled carefully. Heated it below the melting point.
- Hammering should be done carefully without slipping the work piece.

Application: Purpose for clamping and fixing the fan.

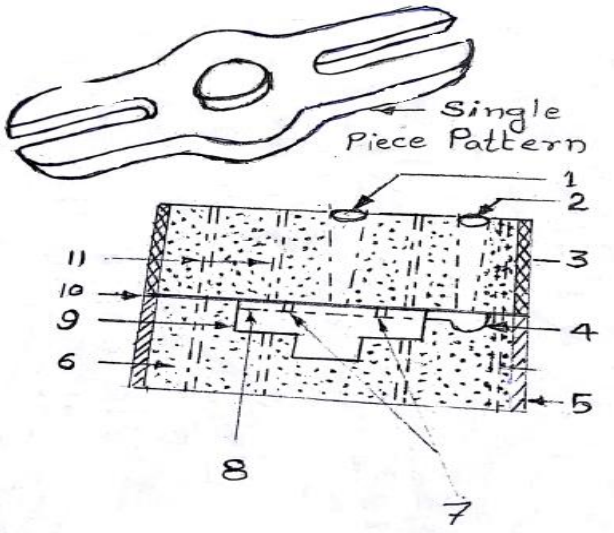
Viva Voce questions

1. Differentiate between Smithy and forging
2. How to clarify the heating devices?
3. Sketch and describe the black smithy striking tools
4. Describe with neat sketch of the anvil used in smithy.
5. What operations are performed in a black smithy?
6. List out the holding tools used in smithy shop.
7. What do you understand from 'open fire' and stock fire?
8. Name the common materials used for forging.
9. Give the forging temperatures of some common forgeable materials.
10. Why blowers are used in block smithy?
11. List out the merits and demerits of forging.
12. State the applications of forging.
13. What general safety precautions are necessary in a black smithy?

FOUNDRY

EXPERIMENT-1

Aim: To prepare sand mould for **Single piece pattern**.



1. Riser hole
2. Sprue hole
3. cope box
4. Sprue basin
5. Drag box
6. Moulding Sand
7. Gates
8. Runner
9. Mould cavity
10. Parting line
11. Venting holes

Tools required: Moulding boxes, shovel, peen rammer(10”), butt rammer(10”), strike off bar(18”), finishing trowel, runner pipe(1”dia), lifter, gate cutter, vent rod(12”), riser pipe(1” dia, 12” long).

Procedure:

1. Keep the pattern on moulding board
2. Keep the drag box around the pattern
3. Place the moulding sand around the pattern
4. Pack ,ram,and squeeze the moulding sand and level by strike off bar
5. Reverse the box and spray parting sand
6. Place the cope box above the drag box
7. Pack the sand and ram it by peen and butt rammer after spraying parting sand
8. Take out the cope box
9. Serarate pattern form mould box
10. Provide gate plug, riser plug
11. Provide ingate in drag box and connect to mould cavity
12. Place the cope over drag box

Precautions:

1. Ramming is to be done properly not to spoil the pattern
2. Leveling is to done correctly with strike off bar
3. Parting sand is to be sprayed properly
4. Gate and riser plugs should be made properly

Results:

Required single piece pattern mould is obtained

Application:

This joint is used for the machine swivel vise wage

Foundry

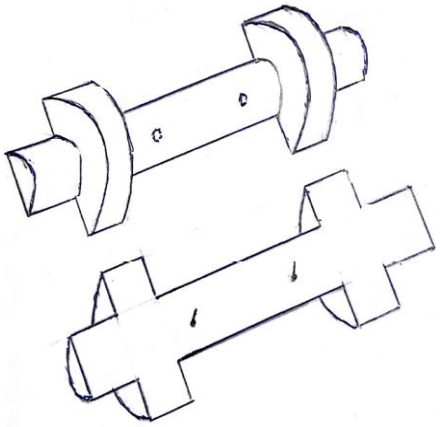
Viva Voce questions

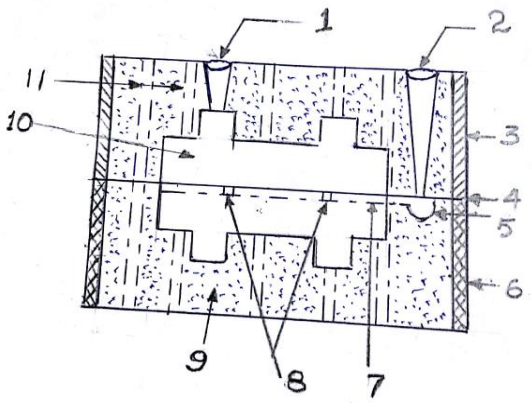
1. Define foundry
2. Define pattern. Explain various types of pattern materials used.
3. Sketch and explain different types of patterns used in a foundry
4. What are the properties of good moulding sand?
5. What do you mean by casting? List out the sequence of steps involved in casting.
6. How are the patterns classified?
7. What considerations are necessary while designing a pattern?
8. What are the tools are required while conducting the experiment in pattern making?
9. What are the safety precautions should be taken while conducting the experiments?
10. How do you classify the different tools used in foundry?
11. How are the different mould materials classified?
12. What are the main characteristics, which a good moulding sand should possess?
13. What are the main constituents of moulding sand?

FOUNDRY

EXPERIMENT-2

Aim: To prepare sand mould for **Split piece pattern** (pipe)





1. RISER HOLE
2. SPRUE HOLE
3. COPE BOX
4. PARTING LINE
5. SPRUE BASIN
6. DRAG
7. RUNNER
8. GATES
9. MOULDINGSAND
10. MOULD CAVITY
11. VENTING HOLES

Tools required: Moulding boxes, shovel, peen rammer(10”), butt rammer, strike off bar(18”), finishing trowel, runner pipe(1: dia.),lifter, gate cutter, vent rod (12”), riser pipe(1”dia, 12” long).

Procedure:

1. keep the pattern on moulding board .
2. Keep the drag box around the pattern.
3. Place the moulding sand around the pattern.
4. Pack ,ram, and squeeze the moulding sand and level by strike off bar.
5. Reverse the box and spray parting sand.
6. Place the cope box above the drag box.
7. Pack the sand and ram it by peen and butt rammer after spraying parting sand.
8. Take out the cope box.
9. Separate pattern from mould box .
10. Vent holes are made with vent rod.

Precautions:

1. Ramming is to be done properly not to spoil the pattern.

2. Leveling is to be done correctly with strike off bar.
3. Parting sand is to be sprayed properly.
4. Gate and riser plugs should be made properly.

Results:
Required split piece pattern mould is obtained.

Application:
This joint is used for the symmetric parts about any axis.

Foundry

Viva Voce questions

1. Define foundry
2. Define pattern. Explain various types of pattern materials used.
3. Sketch and explain different types of patterns used in a foundry
4. What are the properties of good moulding sand?
5. What do you mean by casting? List out the sequence of steps involved in casting.
6. How are the patterns classified?
7. What considerations are necessary while designing a pattern?
8. What are the tools are required while conducting the experiment in pattern making?
9. What are the safety precautions should be taken while conducting the experiments?
10. How do you classify the different tools used in foundry?
11. How are the different mould materials classified?
12. What are the main characteristics, which a good moulding sand should possess?
13. What are the main constituents of moulding sand?