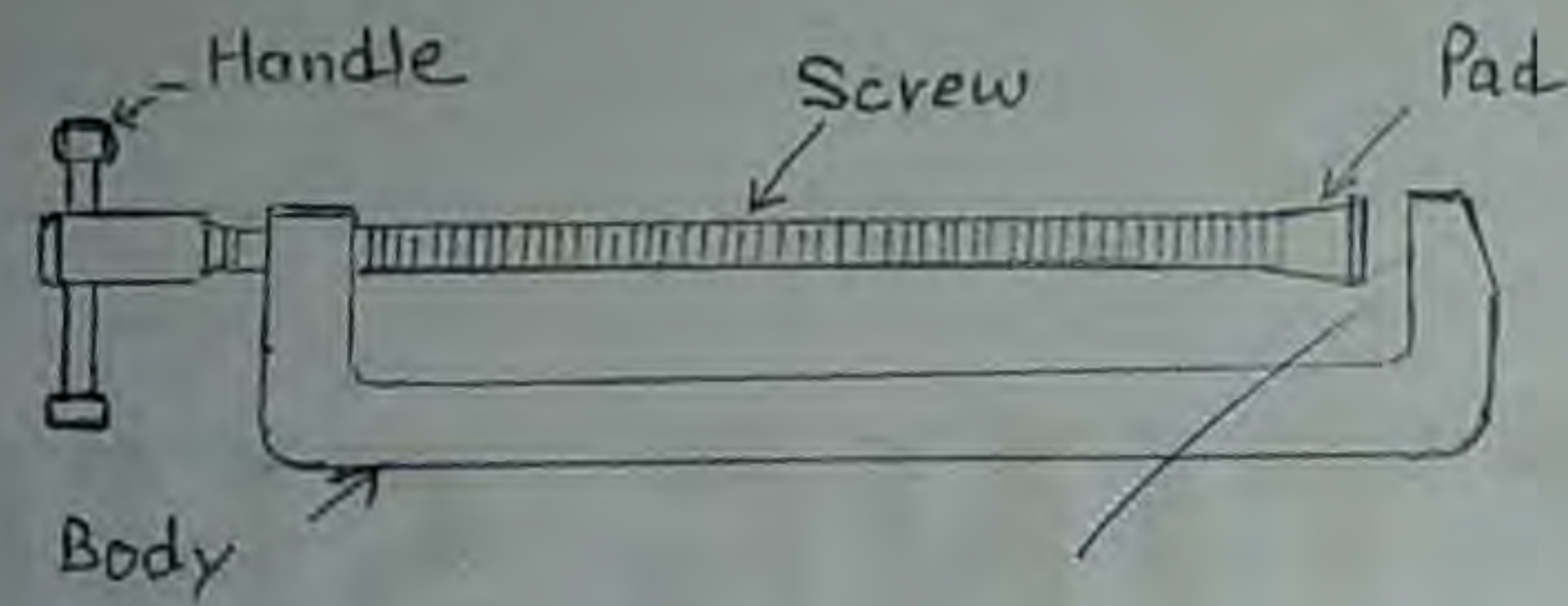




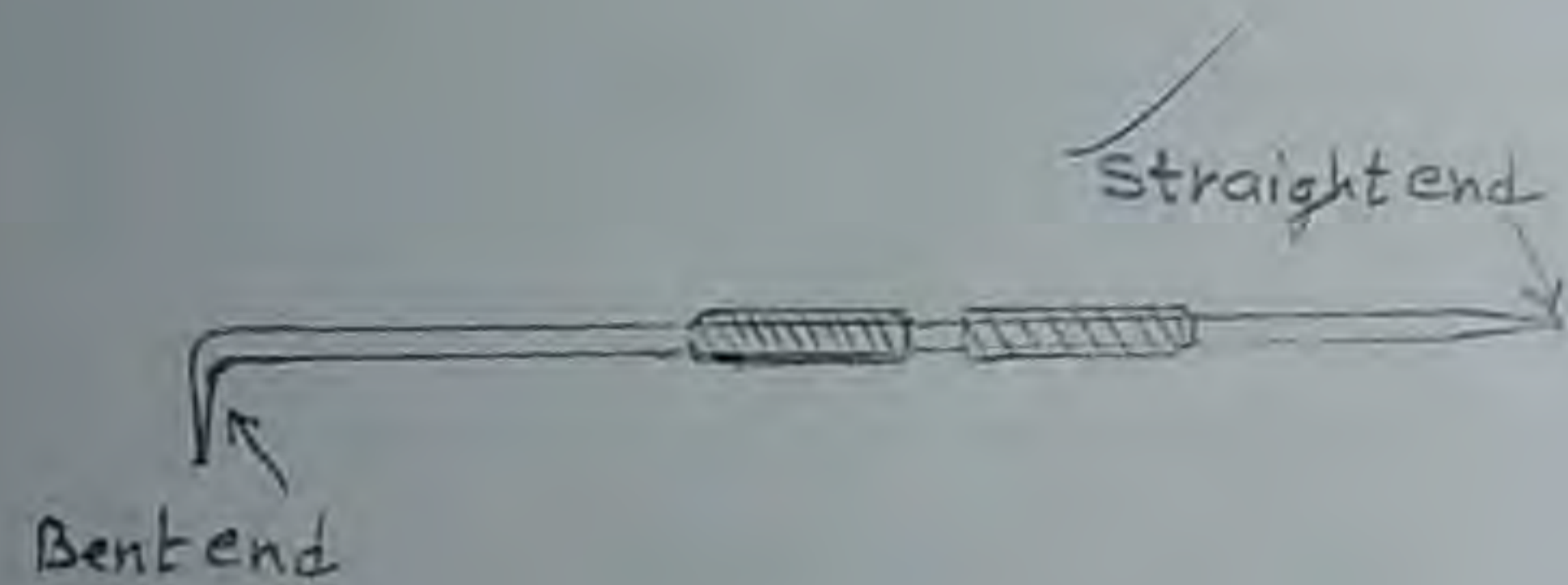
Workshop Practice Manual

Devang Shaurya Pratap Singh

B. Tech (I year)



C-Clamp



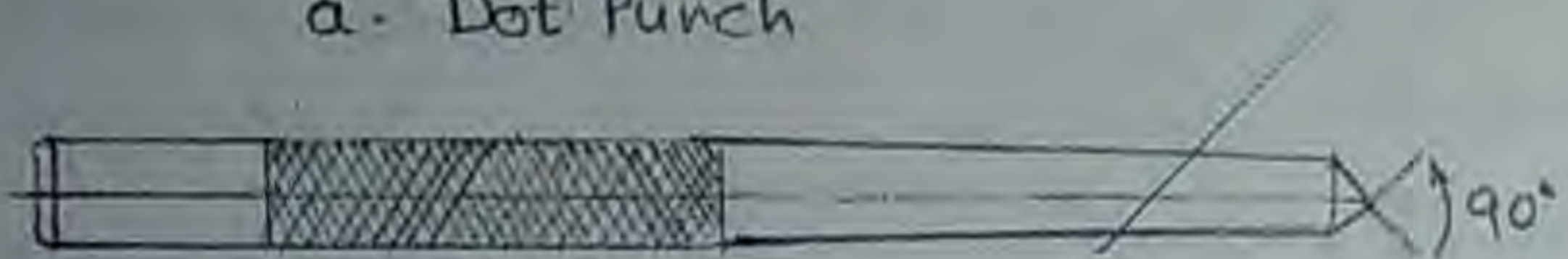
Scriber

FITTING SHOP

1. **C-Clamp:** This is used to hold work against an angle plate or v-block or any other surface, when gripping is require. Its fixed jaw is shaped like english alphabet 'C' and the movable jaw is round in shape and directly fitted to the threaded screw at the end.
2. **Scriber:** It is a slender steel tool, used to scribe or mark lines on metal work pieces. It is made up of hardened and tempered High Carbon Steel. The tip of the scriber is generally ground at 12° to 15° . It is generally available in lengths ranging from 125 mm to 250 mm.
3. **Try Square:** It is measuring and marking tool for 90° angle. It is used for checking the squareness of many types of small works when extreme accuracy is not required. The blade of the Try square is made of hardened steel and the stock of cast iron or steel.
4. **Odd Leg Caliper:** This is also called 'Jenny Caliper' or Normaphodite. This is used for making parallel lines from a finished edge and also for locating the center of round bars. It has one leg pointed like a divider and the other leg bent like a caliper. It is specified by the length of the leg up to the hinge point.



a. Dot Punch



b. Centre Punch

Punches



Ball Peen Hammer

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

6. Steel Ruler: It is a simple measuring instrument consisting of a long, thin metal strip with a marked scale of unit divisions. It is an important tool for linear measurement.

7. Punches: These are used for making indentations on the scribed lines, to make them visible clearly. These are made of high carbon steel. It is specified by its length and diameter. It consists of a knurled body, which is flain for some length at the top of it. At the other end, it is ground to a point.

Dot punch: It is used to lightly indent along the layout lines. Its conical point's angle is 60° .

Center punch: Its conical point's angle is 90° . It is used to mark the location of the holes to be drilled.

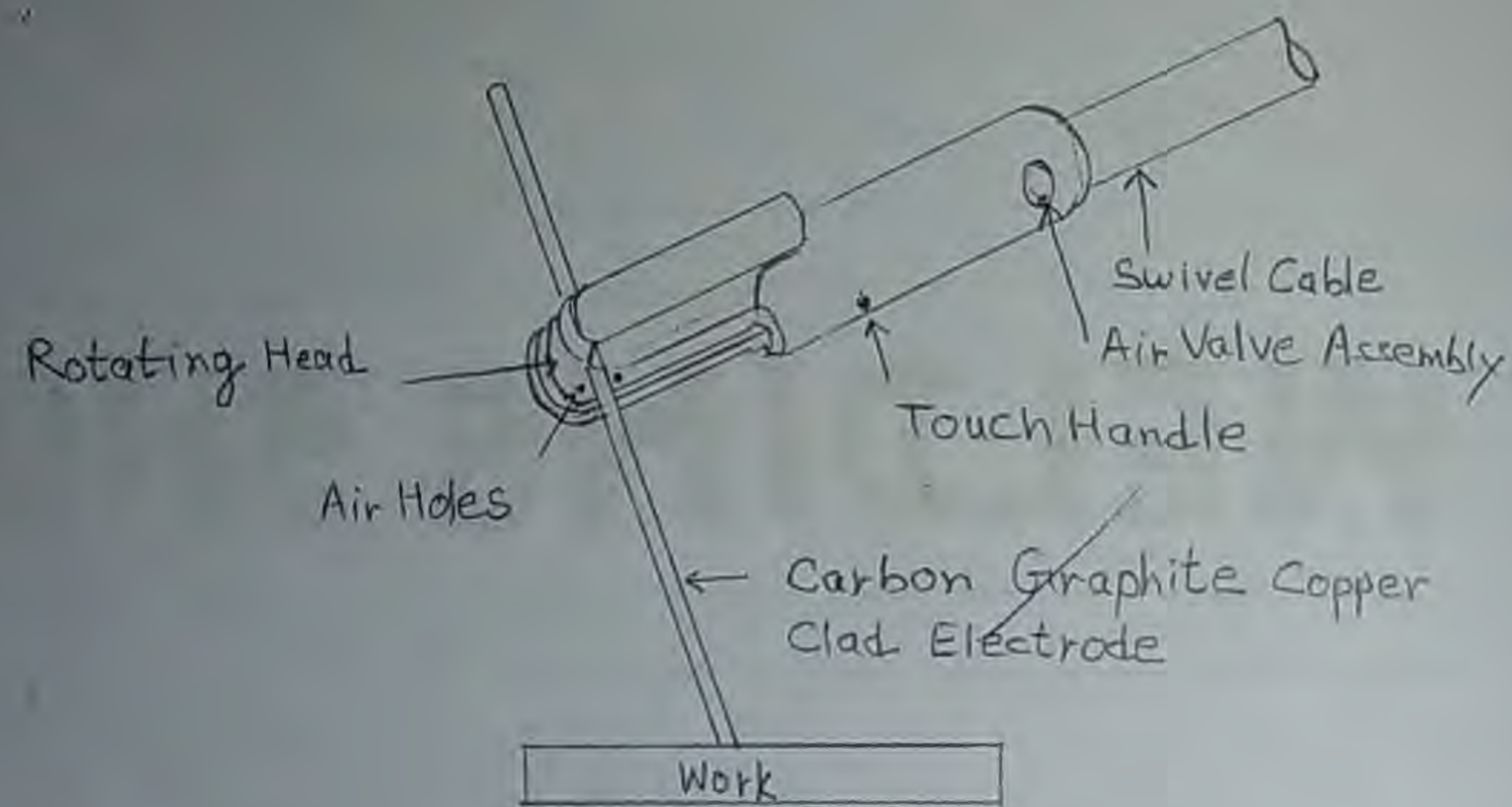
8. Ball-peen Hammer: This tool is named according to its shape and material and specified by their weight. It has a flat face which is used for general work and a ball end, particularly used for riveting.



Flat Chisel

9. Files: It is a hardened steel tool, having small parallel rows of cutting edges or teeth on its surface.
- On the face, the teeth are usually diagonal to edge. One end of the file is shaped to fit into a wooden handle.
 - The hand file is parallel in width and tapering slightly in thickness, towards the tip.
 - There are double cut teeth on its faces, and single cut on one edge and no teeth on other edge (safe edge).

10. Chisels: These are used for removing surplus metal or for cutting thin sheets. These tools are made from 0.9% to 1.0% carbon steel of octagonal or hexagonal section. These are annealed, hardened and tempered to produce a tough shank and hard cutting edge. Cutting angle for general purpose is 60° .



Electrode holder



Spanner

WELDING SHOP

1. **Transformer:** The function of a transformer is to generate a low voltage (10 to 50V) and high ampere range (50A to 300A) electric current. The current be A.C or D.C. It converts electrical energy into heat energy which is required for the welding process.
2. **Electrode Holder:** The electrode holder is connected to the end of the welding cable and holds the electrode. It should be light strong and easy to handle and should not become hot while in operation. Shows one type of electrode holder. The jaws of the holder are insulated offering protection from electric shock.
3. **Clamps:** Welding clamps are sheets of metals that temporarily hold two parts of material tightly together. Welding clamps permit you to securely hold your workpiece, so the operator will produce tighter joint.
4. **Spanner:** These are generally used for tightening or loosening various fasteners. These are designed with drop-forged steel or carbon steel. But in welding, a double-ended spanner is used for tightening and opening the nuts of the welding apparatus and job.

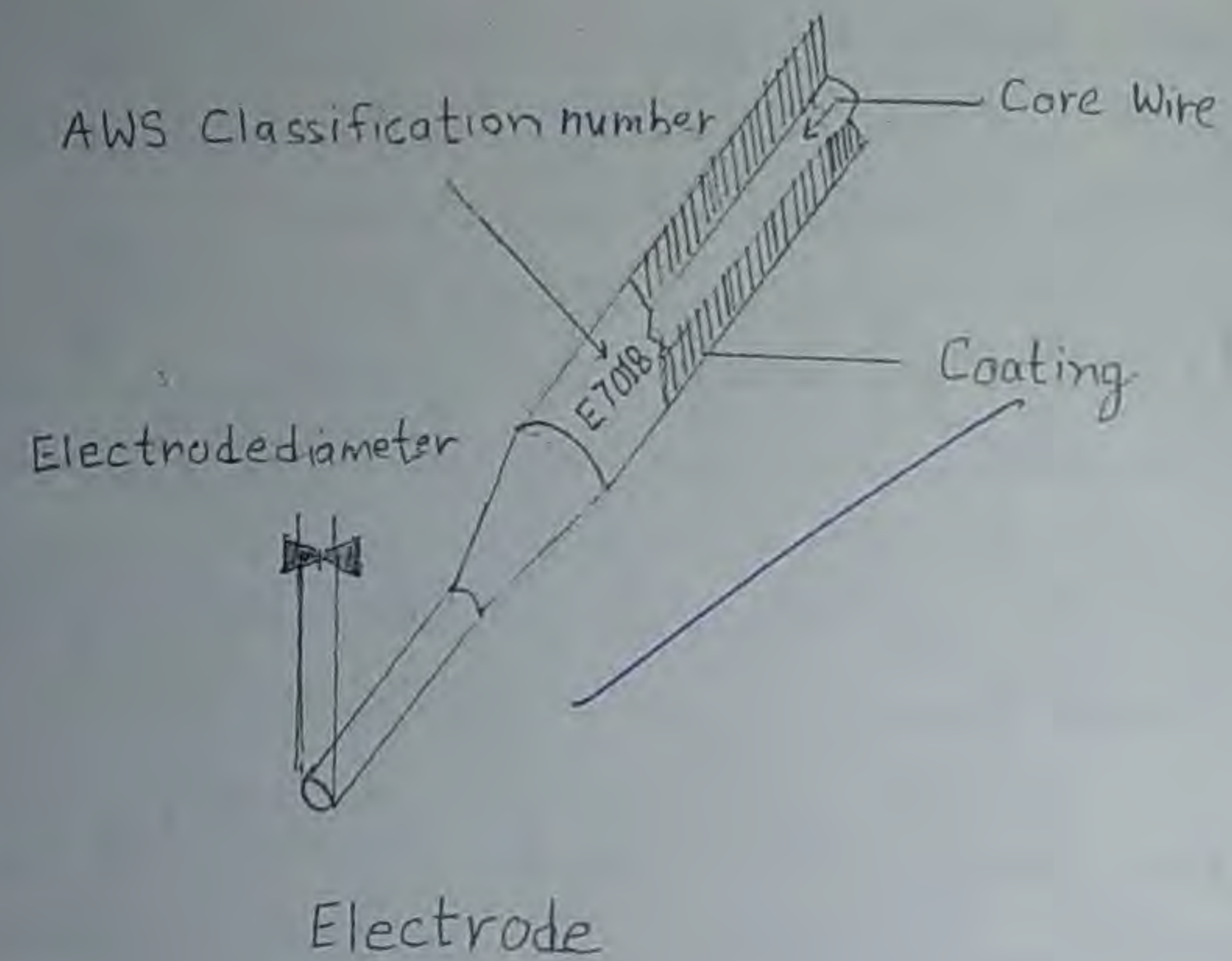


Welding Goggles



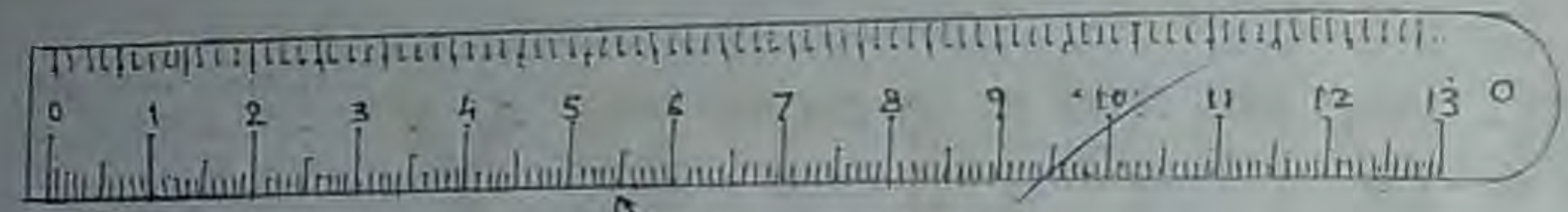
Welding Gloves

5. **Welding Cables:** These cables are required for conduction of current from the power source, to electrode holder, to the arc, then the work piece, and finally back to the welding power source.
6. **Ground (Earthing) clamp:** It is connected to the end of the ground cable and is clamped to the work or welding table to complete the electric circuit. It should be strong and durable, and should also provide a low resistance.
7. **Goggles:** Goggles are used for the protection of eyes against any possible bad effect of the gas flame. Green or blue glasses are used in the goggles which are capable to protect the eyes from UV and IR radiation of the high-temperature gas flame.
8. **Chipping Hammer:** It is a hammer used to remove the slag from the welded metal piece. After chipping the metal is allowed to cool. Chipping hammer is also called a scaling hammer.
9. **Hand gloves and leather gloves:** In the welding process, the risk of burns from heat and spark is significant. To prevent them, welders wear protective clothing in the form of heavy leather gloves and protective long sleeve jackets.

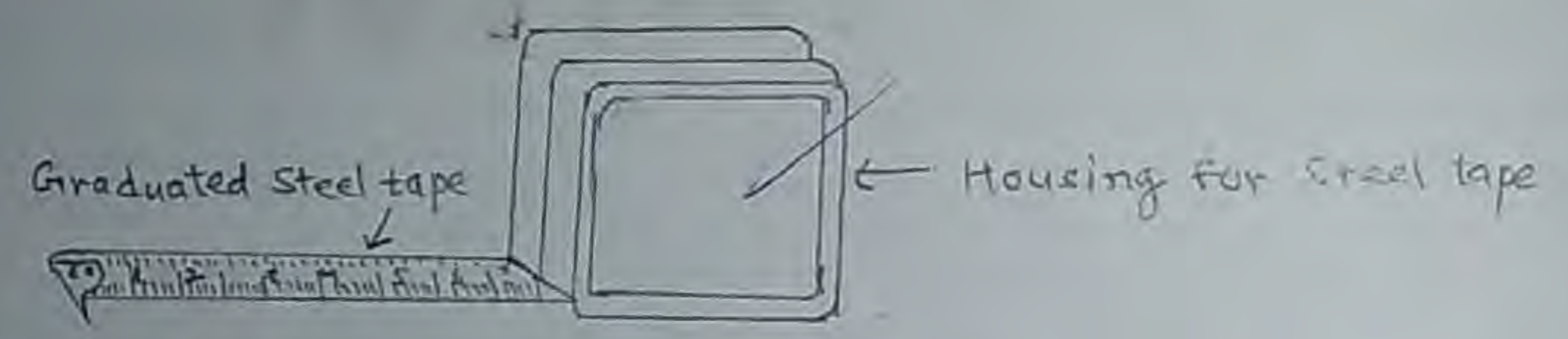


10. Electrode: In arc welding, an electrode is used to conduct current through a workpiece to fuse two pieces together. Depending upon the process, electrode is either consumable, as in the case of gas metal arc welding. For a direct current system, the weld rod or stick may be a cathode, for filling type weld ~~an anode~~ an anode may be used.

CARPENTRY SHOP



Steel Rule



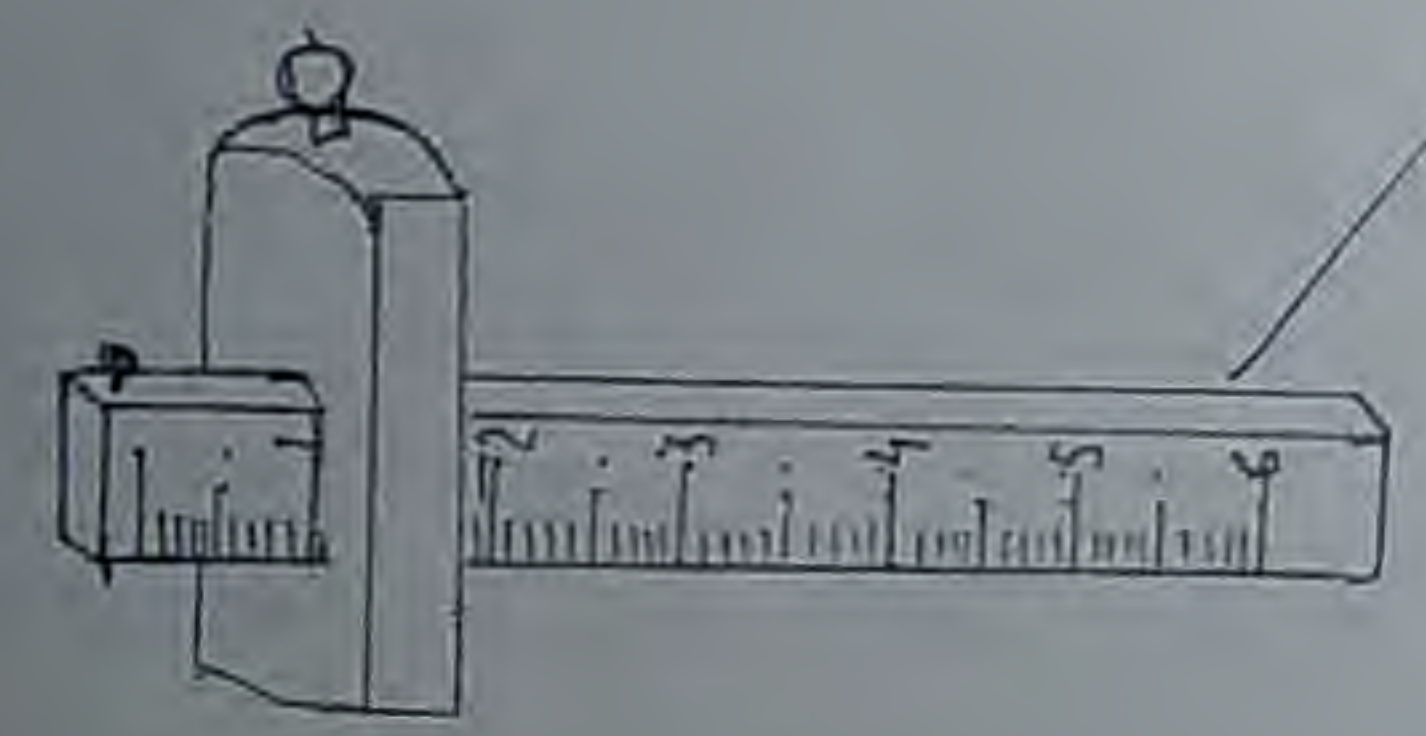
Steel Rule and Steel Tape

1. **Steel Rule and Steel Tape.** Steel rule is a simple measuring instrument consisting of a long, thin metal strip with a marked scale of unit divisions. It is an important tool for linear measurement. Steel tape is used for large measurements, such as marking on boards and checking the overall dimensions of the work.

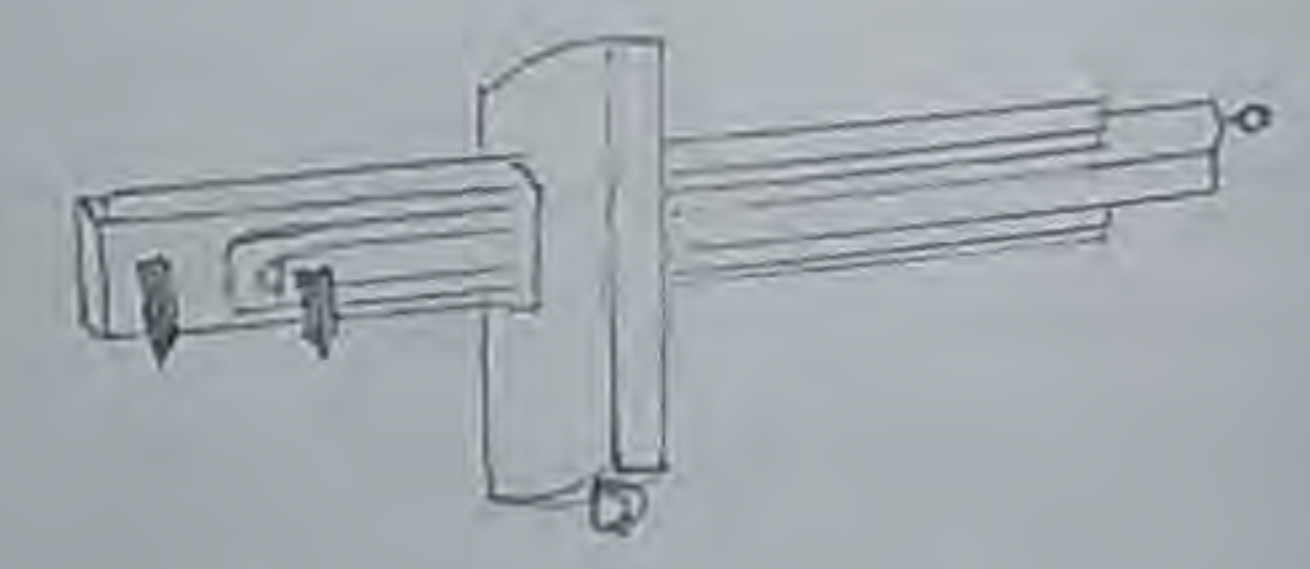
2. **Marking Gauge:** It is a tool used to mark lines parallel to the edge of a wooden piece. It consists of a square wooden stem with a sliding wooden stock (head) on it. On the stem there is a fitted marking pin, made of steel. The stock is set at any desired distance from the marking point and fixed in position by a screw.

A mortise gauge consist of two pins, in this it is possible to adjust the distance between the pins, to draw two parallel lines on the stock

3. **Try square:** It is used for making and testing the squareness and straightness of planed surfaces. It consists of a steel blade, fitted in cast iron stock. It is also used for checking the planed surfaces in flatness. It is less accurate when compared to the try square used in the fitting shop.

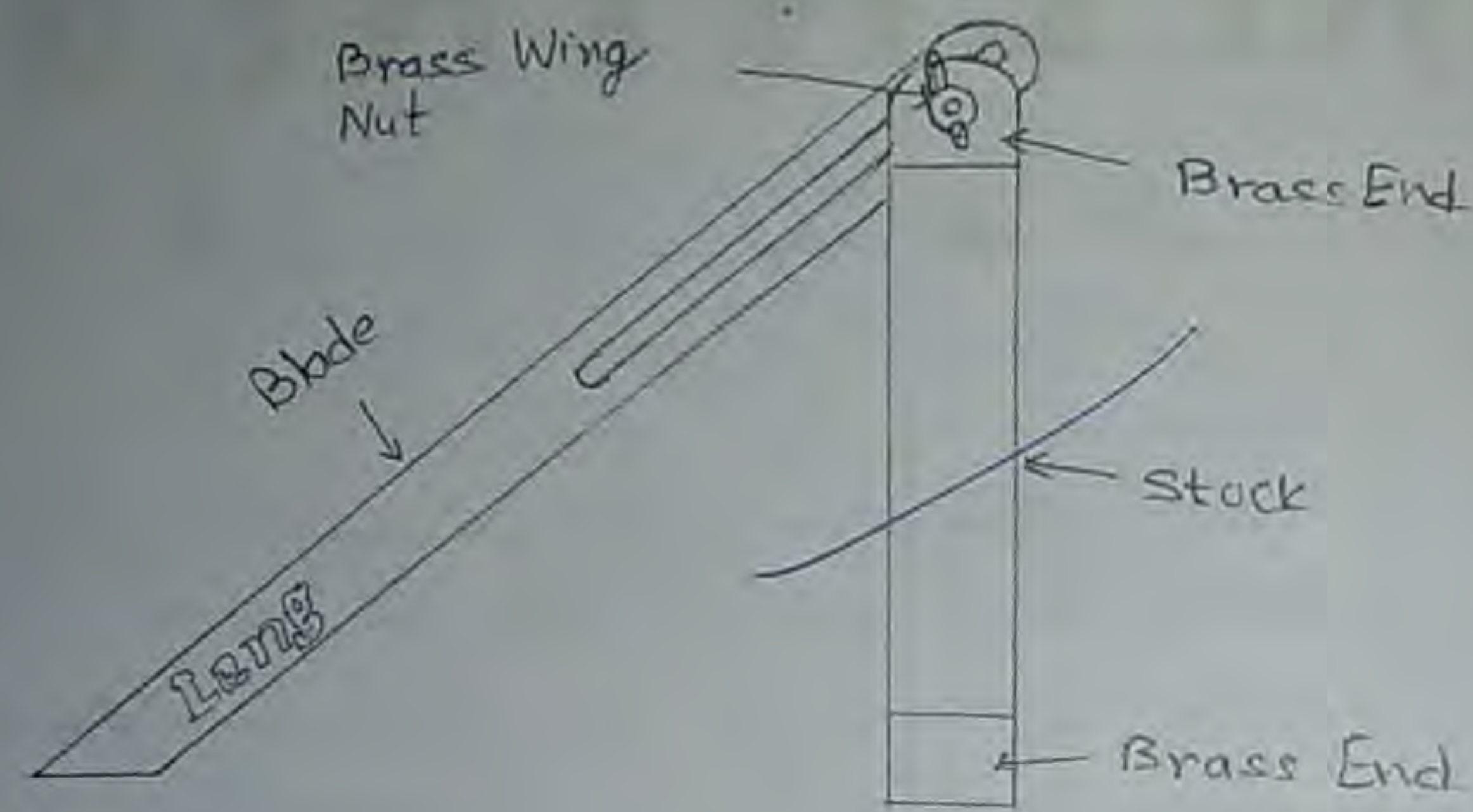


Marking gauge

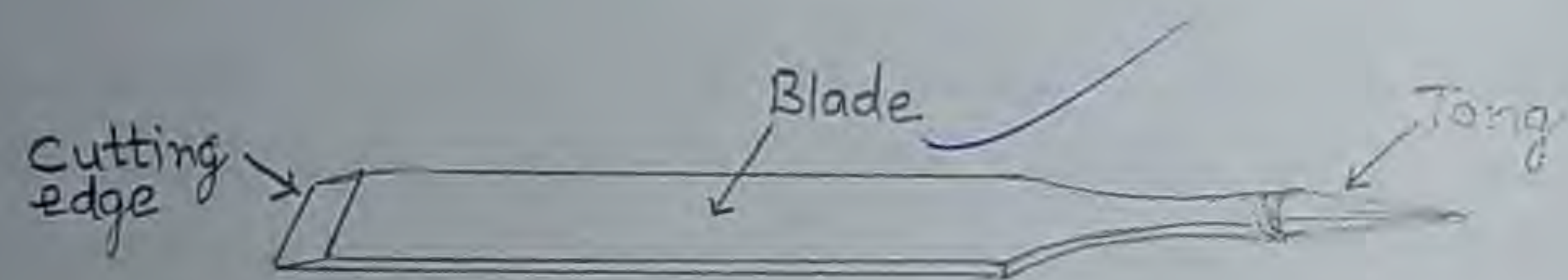


Mortise gauge

Marking Gauges



Bevel Square

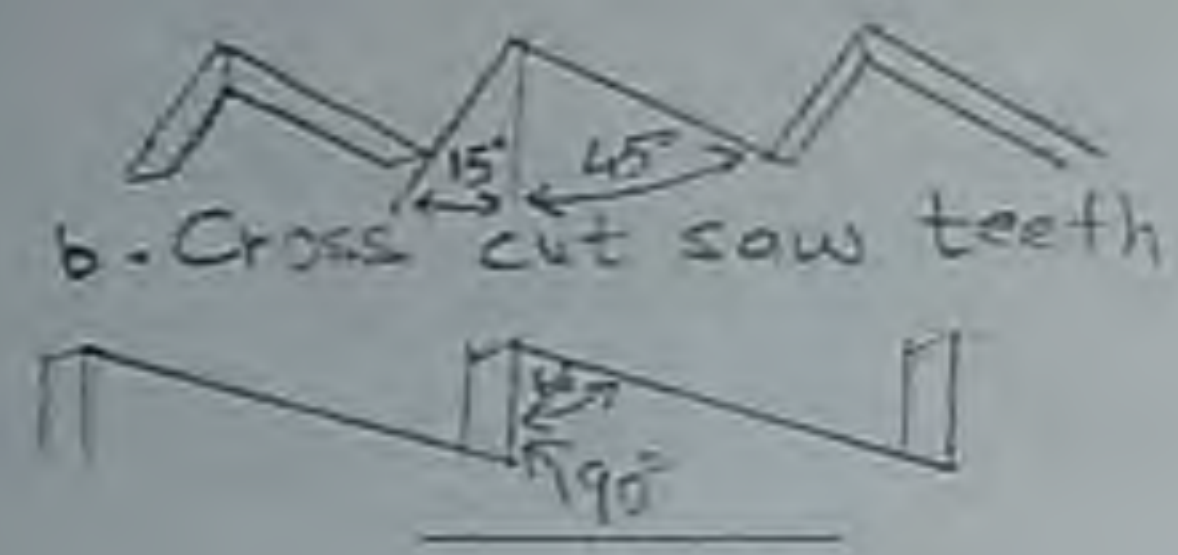


Chisel

4. **Bevel Square:** It is used for laying out and checking angles. The blade of the bevel is adjustable and may be held in place by a thumb screw. After it is set to desired angle, it can be used in the same way as a try square. A good way to set it to the required angle is to mark the angle on a surface and then adjust the blade to fit the angle.
5. **Carpenter's vice:** It is used as a work holding device in a carpenter shop. Its one jaw is fixed to the side of the table while the other is movable by means of a screw and a handle. The carpenter's vice jaws are lined with hard wooden jaws.
6. **Mallet:** It is a kind of hammer, made of wood, with a relatively large head. It is usually used in carpentry to knock wooden pieces together or to drive dowels or chisels. A wooden mallet will not deform the striking end of a metal body as most metal hammers would, but it also reduces the force available to drive the cutting edge of a chisel.
7. **Chisels:** These are used for cutting and shaping wood accurately. Wood chisels are made in various blade widths ranging from 3 to 50 mm. These are made of forged steel or tool steel blades.



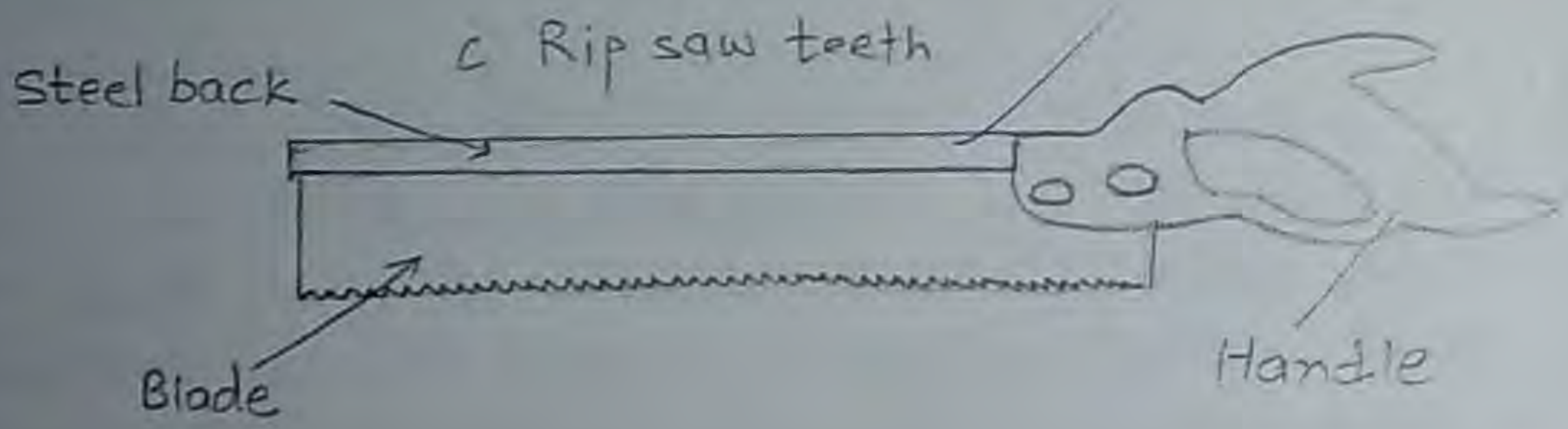
a - Cross cut saw



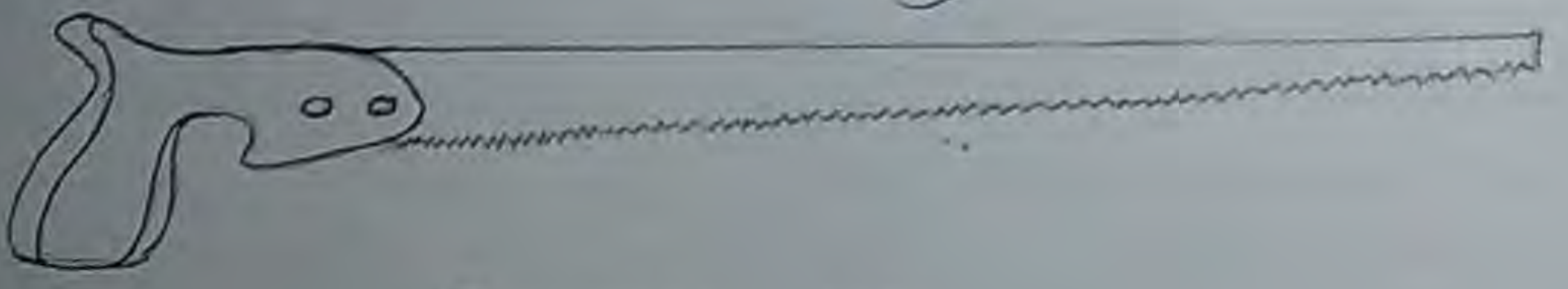
b - Cross cut saw teeth



c Rip saw teeth



Tenon saw



Compass saw

8. Jack Plane: Plane is a hand tool used to produce flat surfaces of wood. The blade of a plane is fitted in a wooded or metallic block at an angle. Jack plane is about 35cm long. The cutting iron (blade) should have a slight curvature. Used for quick removal of material.

9(a) Rebate Plane: Used to make a rebate. Rebate is a recess along the edge of a piece of wood, which is generally used for positioning glass in frames and doors.

(b) Plough Plane: Used to cut grooves, which are used to fix panels in a door.

10. Saws: It is used to cut wood into pieces.

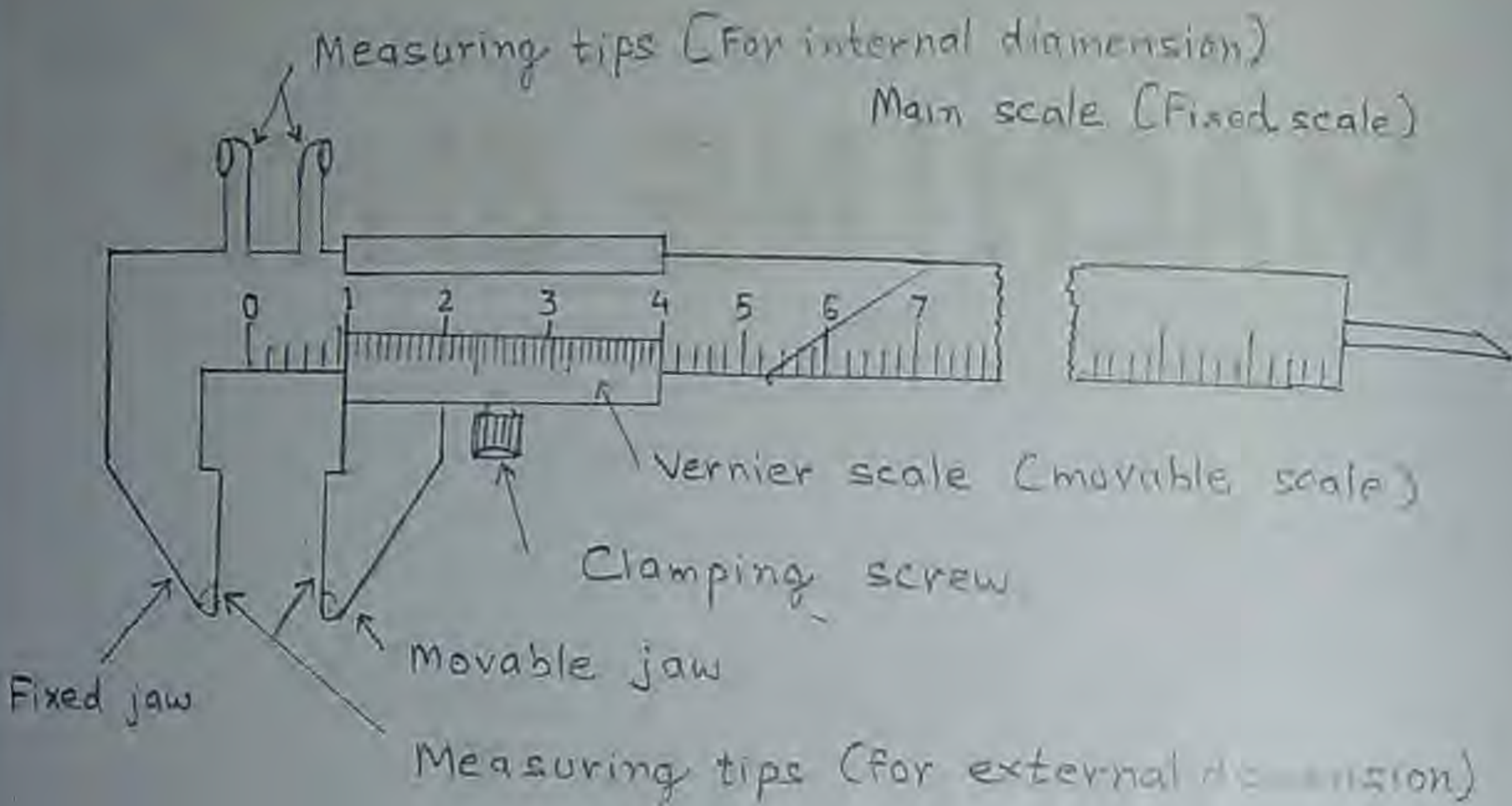
(a) Cross-cut saw or Hand Saw: It is used to cut across the grains of the stock. The teeth are so set that the saw kerf will be wider than the blade thickness, allowing the blade to move freely in the cut.

(b) Tenon Saw: Used to cut the stock along or across the grain. Used for cutting tenons and in fine cabinet work. It is also called as back-saw.

(c) Compass saw: It has a narrow, longer and stronger tapering blade, which is used for heavy works.

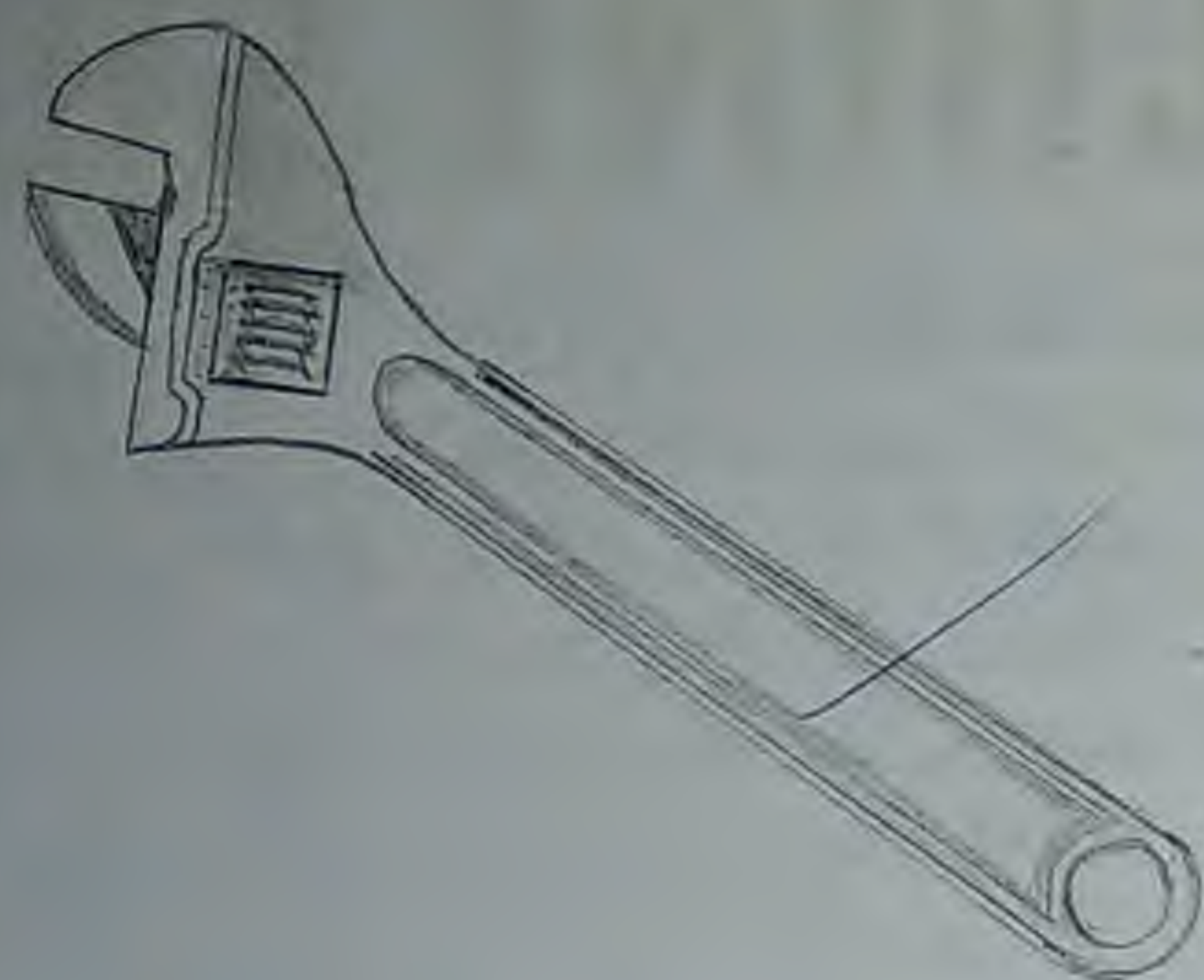
MACHINE SHOP

- Calipers:** It is an essential machinists tool used to measure the accurate distance between two opposite sides of an object. To measure the object, adjust the caliper tip to fit the point to be measured, then remove the caliper and measure the distance between the tips using a ruler. Many types of calipers allow measurements to be read on a ruled scale, a dial, or a digital display.
- Dial Indicator:** It is a type of gauges, also known as dial gauge. It provides a dial display with clock hands similar to a clock face, used to measure small linear distances. Dial Indicator is a versatile tool with a multitude of uses, such as to measure deck clearances, crankshaft thrust and straightness, lift travel or square your vice with the machine axis.
- Edge finder:** It is also known as wiggler, wobbler, center-finder, etc. It is used in or on a machine like a mill to accurately align the machining tool with the center, edges, layout markings, or already machined features of the workpiece during the set-up phase during machining or other operations. It is also acting well in zero setting on CNC machine.
- Deburring Tool:** It is used to remove burrs and other defects from the inner and outer surface, hole edges, corners of narrow slots, and more areas formed in the machining and cutting process, it is

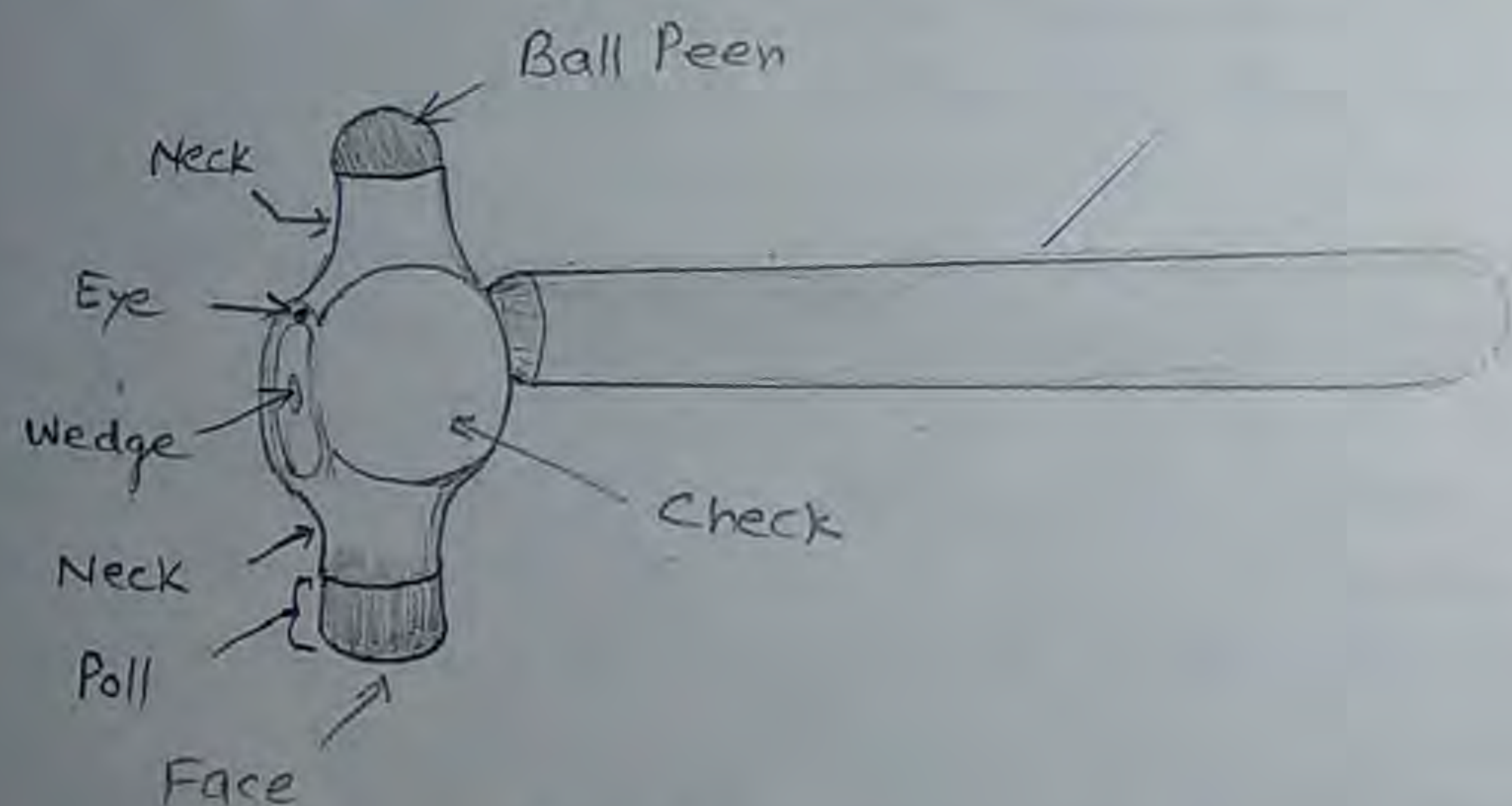


Vernier calipers





Adjustable Wrench



Ball Peen Hammer

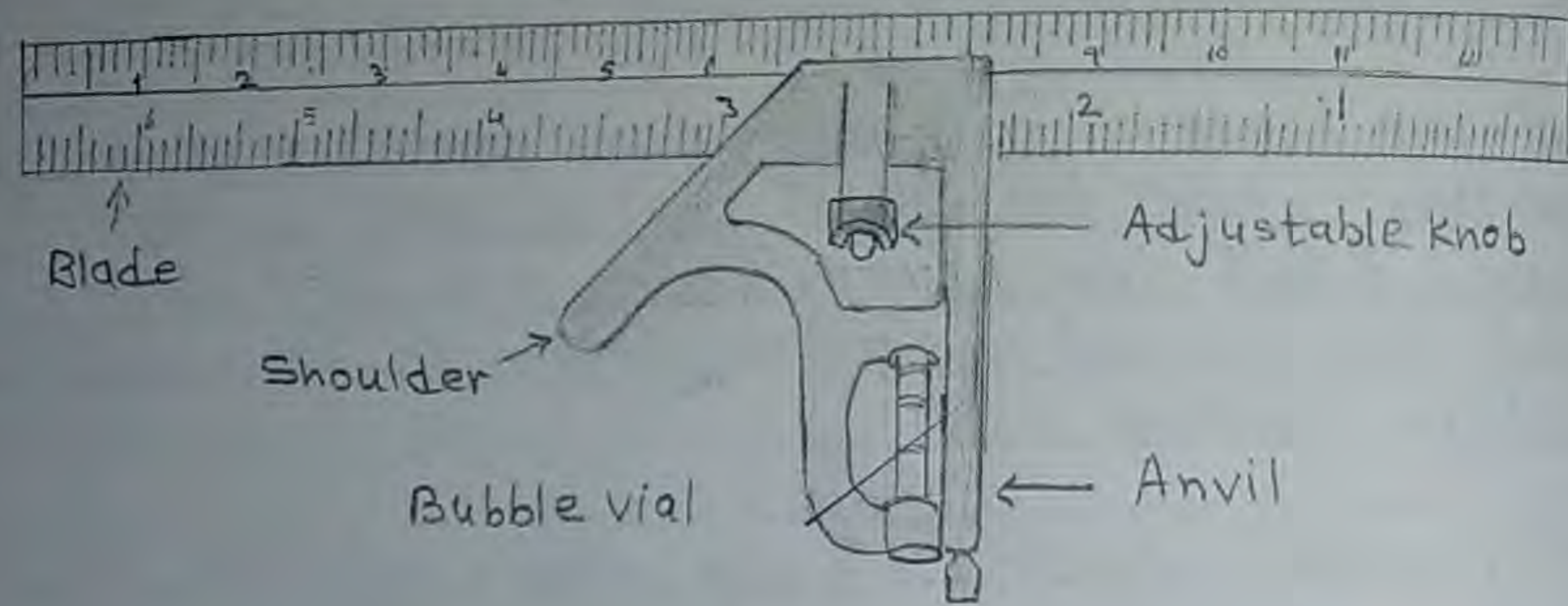
also useful when rounding out rough edges and removing chatter marks, more convenient and faster than using a file.

5. Calculator with sine, cosine & Tangent: Scientific calculator also comes handy to a machinists. It is most used for trigonometry and working out your feeds and speeds.

6. Ball-peen hammer: These hammers are named, depending upon their shape and material and specified by their weight. A ball-peen hammer has a flat face which is used for general work and ball end, particularly used for riveting.

7. 12" Adjustable Wrench: It is also called a adjustable spanner. It has a movable jaw and a fixed jaw, the fixed jaw allows it to be used with different sizes of fastener head (nut, bolt) rather than just one fastener size as with a conventional fixed spanner.

8. Micrometer: It is also known as screw gauge, It is a device using a calibrated screw widely used for accurate measurement of mechanical engineering and CNC machining components, including the diameters, thickness, length and other dimensions.



Combination square set

9. Combination Square set: It is a measuring tool designed to measure angles and lengths. It is composed of a ruler and one or more interchangeable heads that may be affixed to it. The commonly used head is the standard or square head, which is used to lay out or check 90° and 45° angles. It can also be used to find the center on the ends of shafts.

10. 6" steel (Ruler)

10. End Mill Starter Set: It is a type of milling cutter used for the milling process. It is different from the drill bit in its application, geometry and manufacturing. It can be used to make various shapes and holes in varying sizes, as well as profiling, contouring, slotting, drilling, reaming, etc.



Riddle



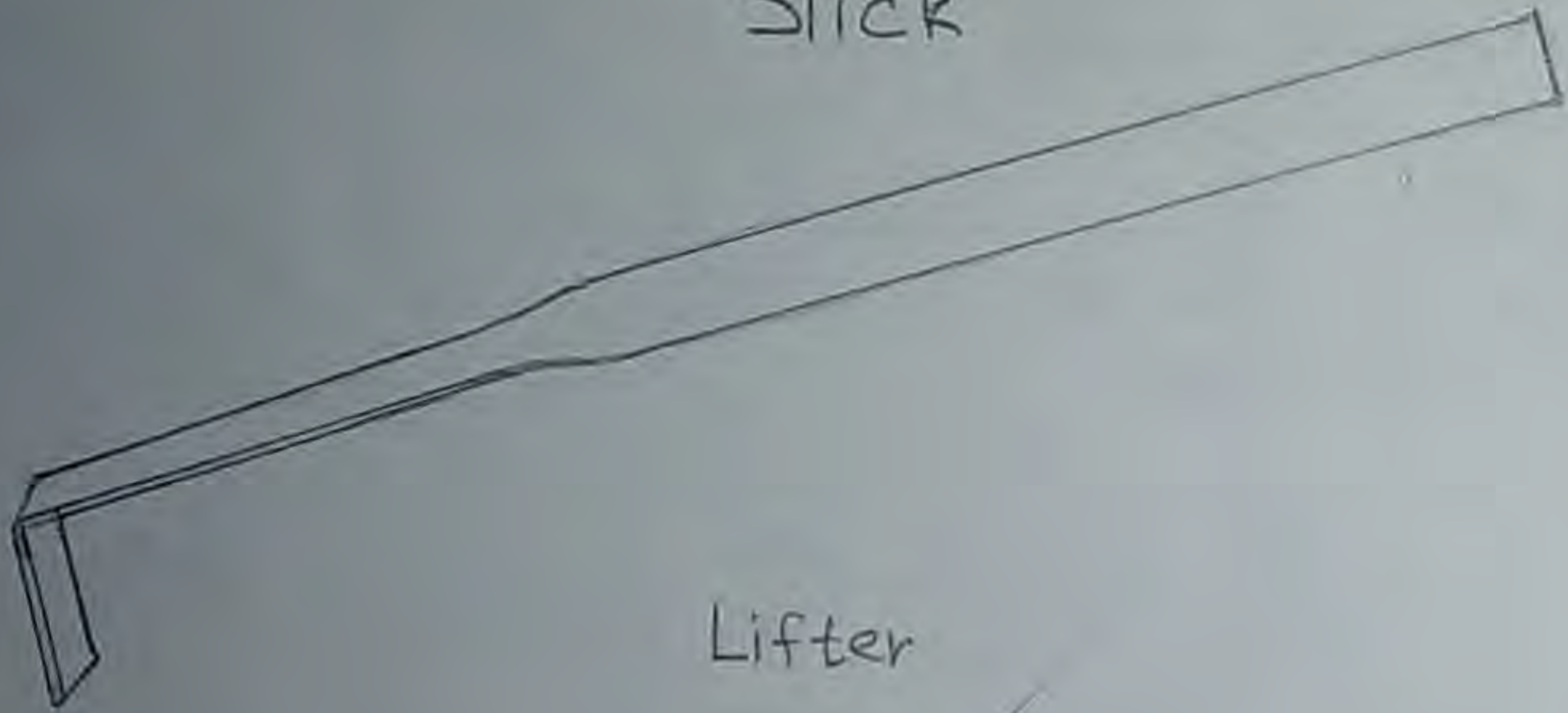
Shovel

FOUNDARY SHOP

1. **Molding Board:** A molding board is a smooth wooden board on which the flask and pattern are placed when the mould is being made.
2. **Molding Boxes:** Sand moulds are prepared in specially constructed boxes called flasks. The purpose of flask is to impart the necessary rigidity and strength to the sand in molding. They are usually made in two parts, held in alignment by dowel pins. The top part is called the cope and the lower part the drag. These flasks can be made by wood or metal depending upon the size required and the purpose the flask must serve.
3. **Riddle:** A riddle sometimes called a screen consists of a circular or square wooden frame fitted with a standard wire mesh at the bottom. It is used to remove coarse sand particles and other foreign material from the foundry sand.
4. **Shovel:** It is used for mixing and tempering molding sand and for moving the sand from the pile to the flask.
5. **Sprue pin:** It is tapered wooden pin. It is used to make a hole in the ~~the~~ cope through which the molten metal is poured into the mould.



Slick



Lifter

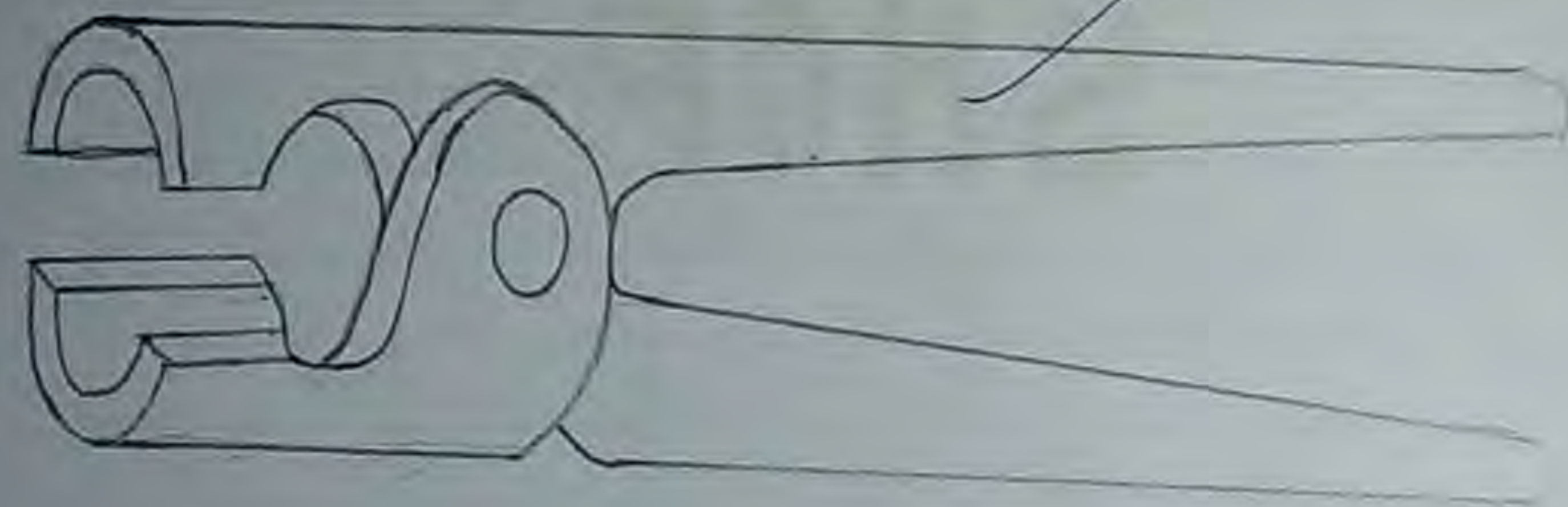


Draw screw

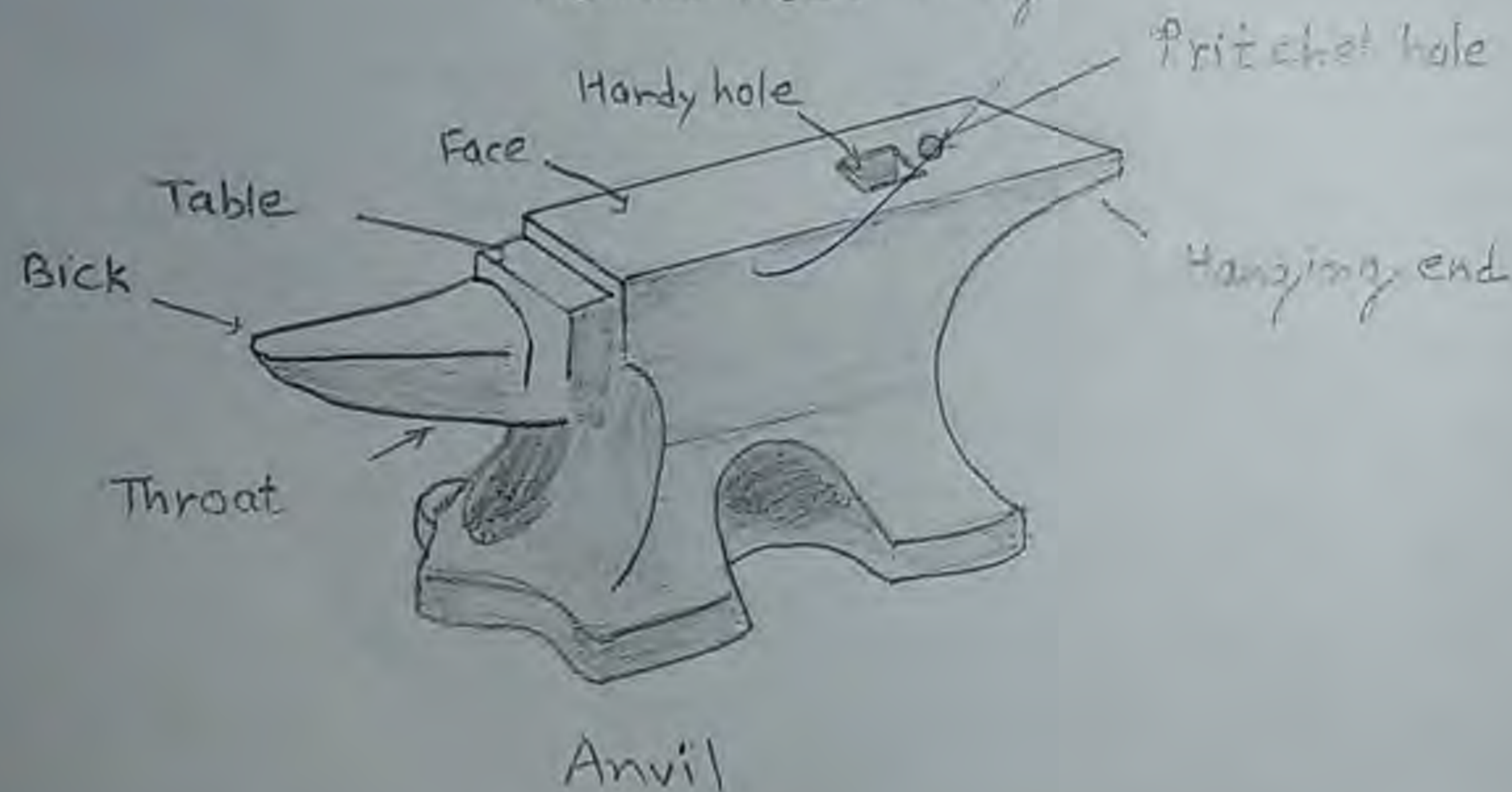
6. Riser pin: It is a straight wooden pin used to make a hole in the cope over the mold cavity for the molten metal to rise in and feed the casting to compensate the shrinkage that take place during solidification.
7. Slick: It is a small double ended tool having a flat on one end and a spoon on the other end. These are used for repairing and finishing small surfaces of the mould.
8. Gate cutters: It is small piece of tin plate shape. This serves as a tool for cutting gates and runners in the mould.
9. Lifter: Lifters are made of thin sections of steel of various widths and lengths with one end bent at right angles. They are used to clean and finish the bottom and sides of deep, narrow openings in moulds.
10. Draw spike or screw: The draw spike is appointed steel rod, with a loop at one end, It is used to rap & draw patterns from the sand. It is threaded on the end to engage metal patterns.



Flat or Square Tong

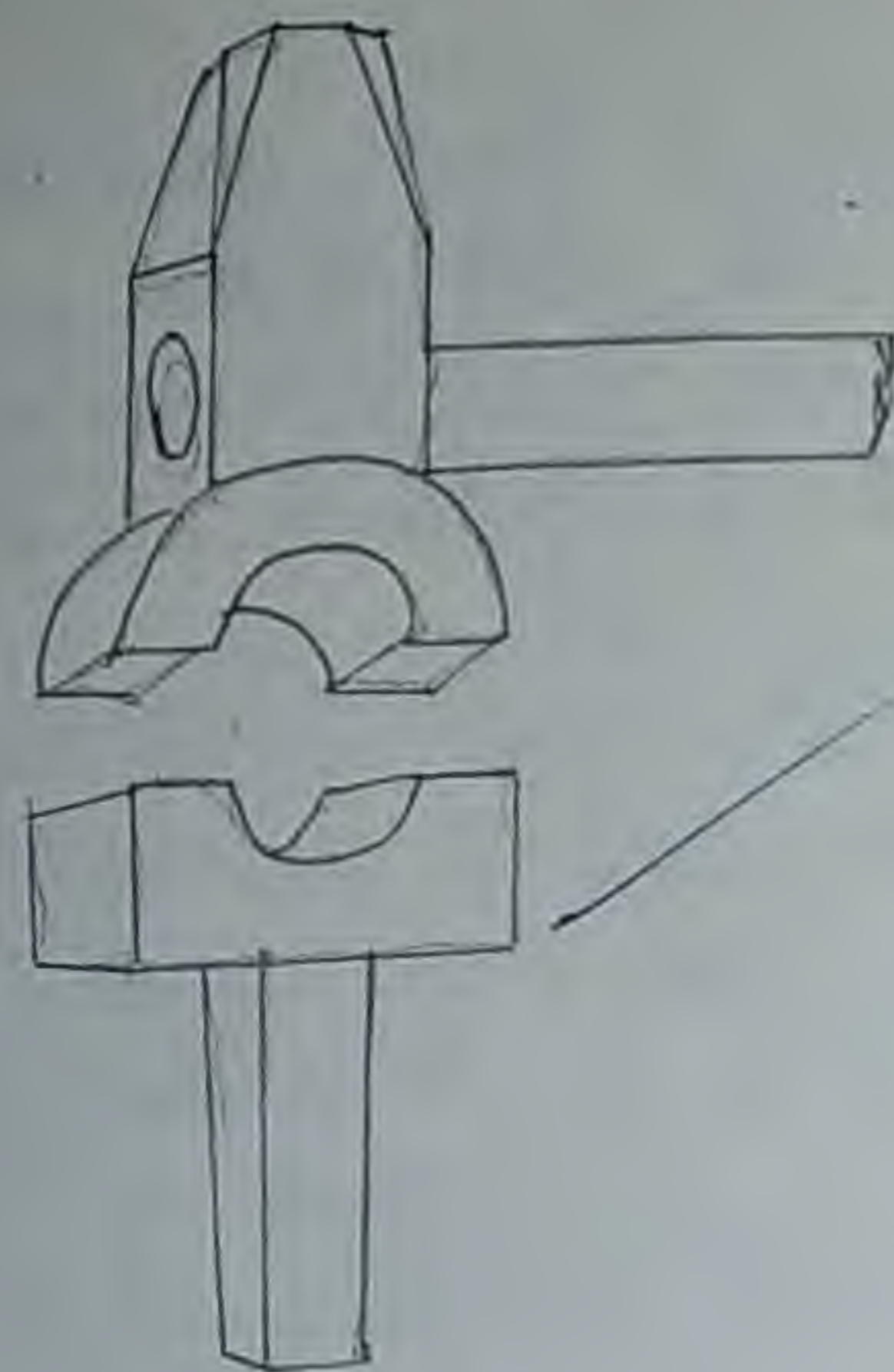


Hollow Nose Tong



BLACK SMITH SHOP

1. Forge:- It is a type of hearth used for heating metals. The forge is used by the smith to heat a piece of metal to a temp. at which it becomes easier to shape by forging, or to the point at which work hardening no longer occurs.
2. Tongs:- Tongs are great blacksmithing tools that allow us to easily move and grasp our workpieces without having to directly grab them with our hands. There are also many different shapes of tongs to accommodate parts of different shapes and even aspect ratios. It helps us to manipulate a scalding workpiece at its deformation temperature.
3. Anvil: An anvil is a most commonly used tool in forging shop. It acts as a support for blacksmith's work during hammering. The body of the anvil is made up of mild steel with a tool steel face welded on the body, but the beak or horn used for bending curves, is not steel faced.
4. Apron: Many blacksmiths wear aprons to protect themselves. Blacksmithing aprons are typically made of leather and cover a large portion of the body to prevent serious burns and damage to clothing. Some aprons have very practical features, such as pockets for holding blacksmithing tools, which can come in very handy when working with multiple tools on a specific project.



Swages (A pair)



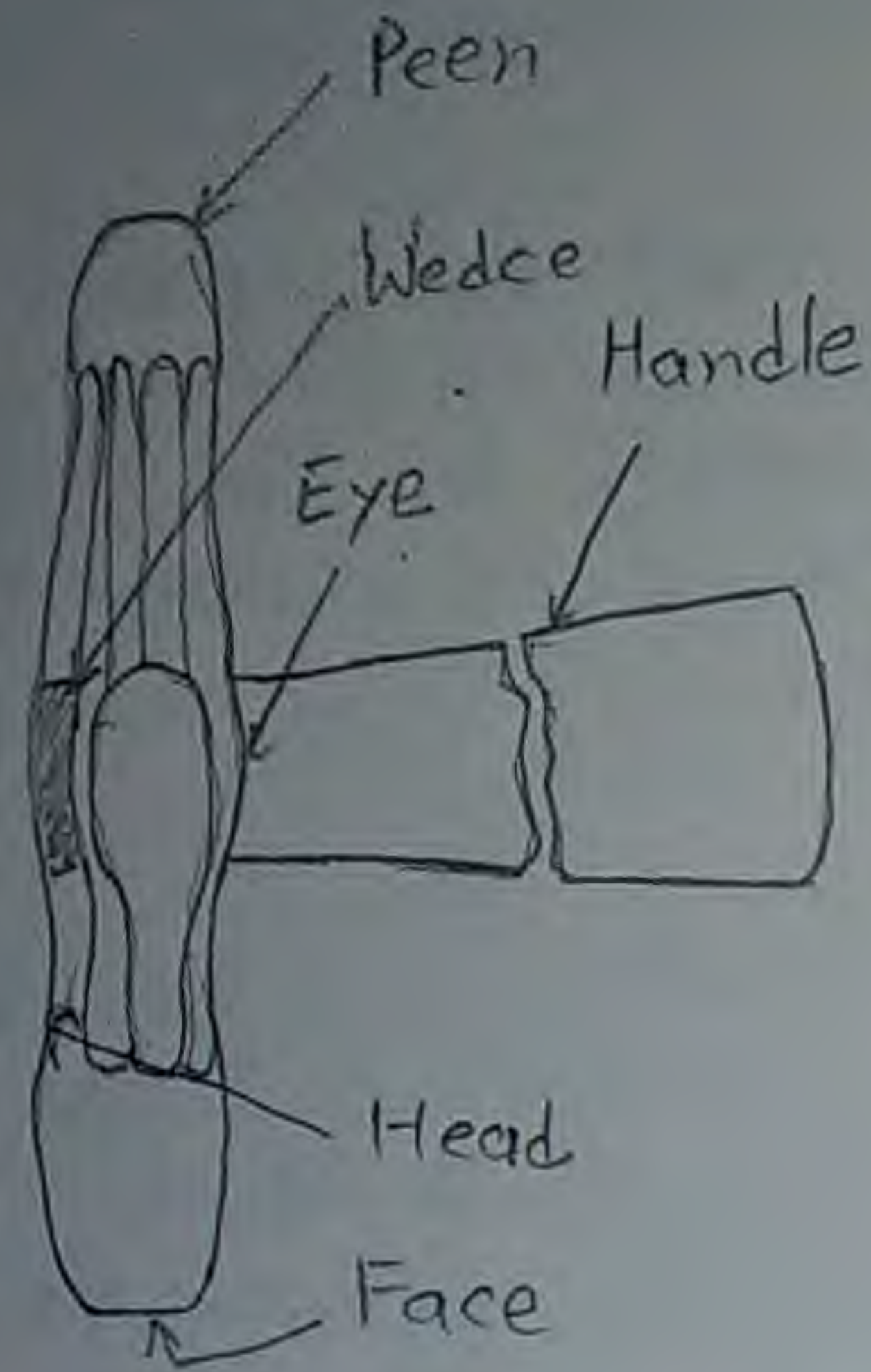
Drifts

5. Wire brushes: These are block wire brushes that can be used on hot surfaces. Hand brushes are often used by blacksmiths to brush away excess material from the workpiece and leave a nice finish on the forging. The excess material that is scraped off by hand brushes is known as scale.

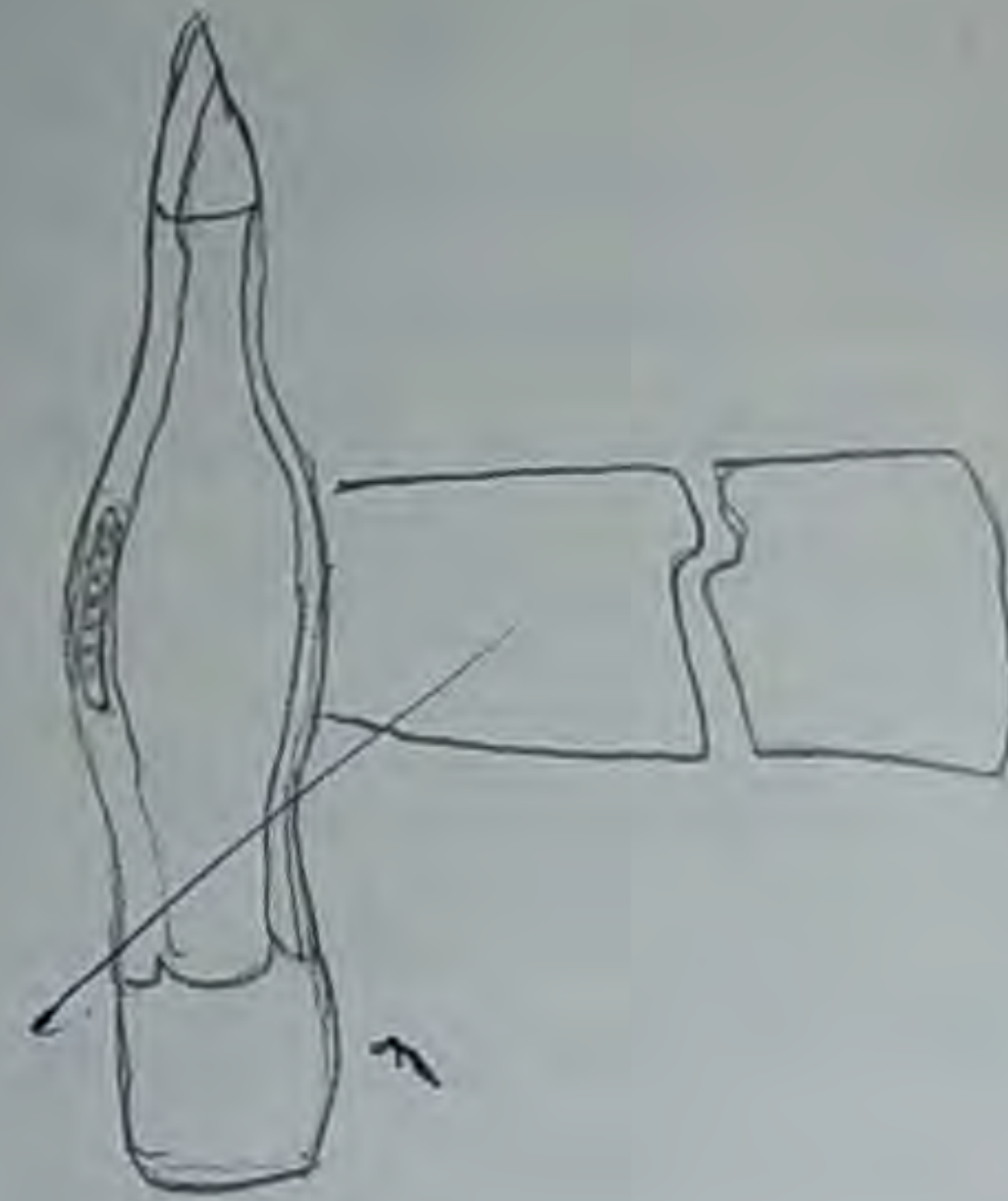
6. Swages: These are made up of dies that form the metal workpiece into the shape that is hollowed out in the die. Spring swages are actually made up of both the top and bottom die blocks, working together to shape a heated workpiece.

7. Drifts: Drifts are also referred as a drift punch or drift pin. It looks like a tapered rod. The main use of this tool is to enlarge holes. The larger face of the rod can be struck by a hammer to drive the drift into a hole. The tapered shape of the drift causes a heated metal workpiece to be displaced when the drift is driven into it.

8. Chisels: Chisels are used for cutting metals and for nicking prior to breaking. They may be hot or cold depending on whether the metal to be cut is hot or cold. A hot chisel generally used in forging shop is shown in figure.



Ball peen hammer



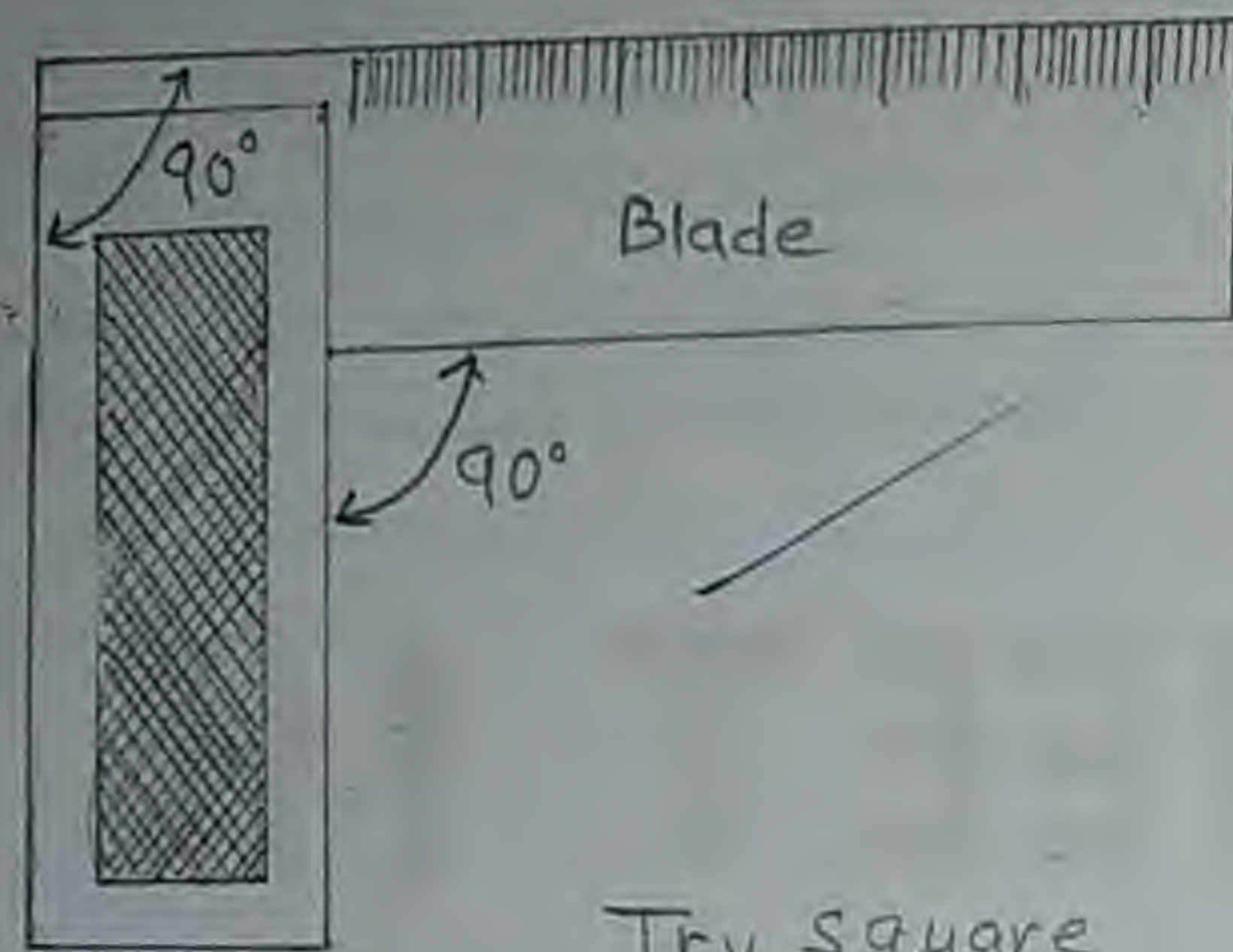
Cross peen hammer



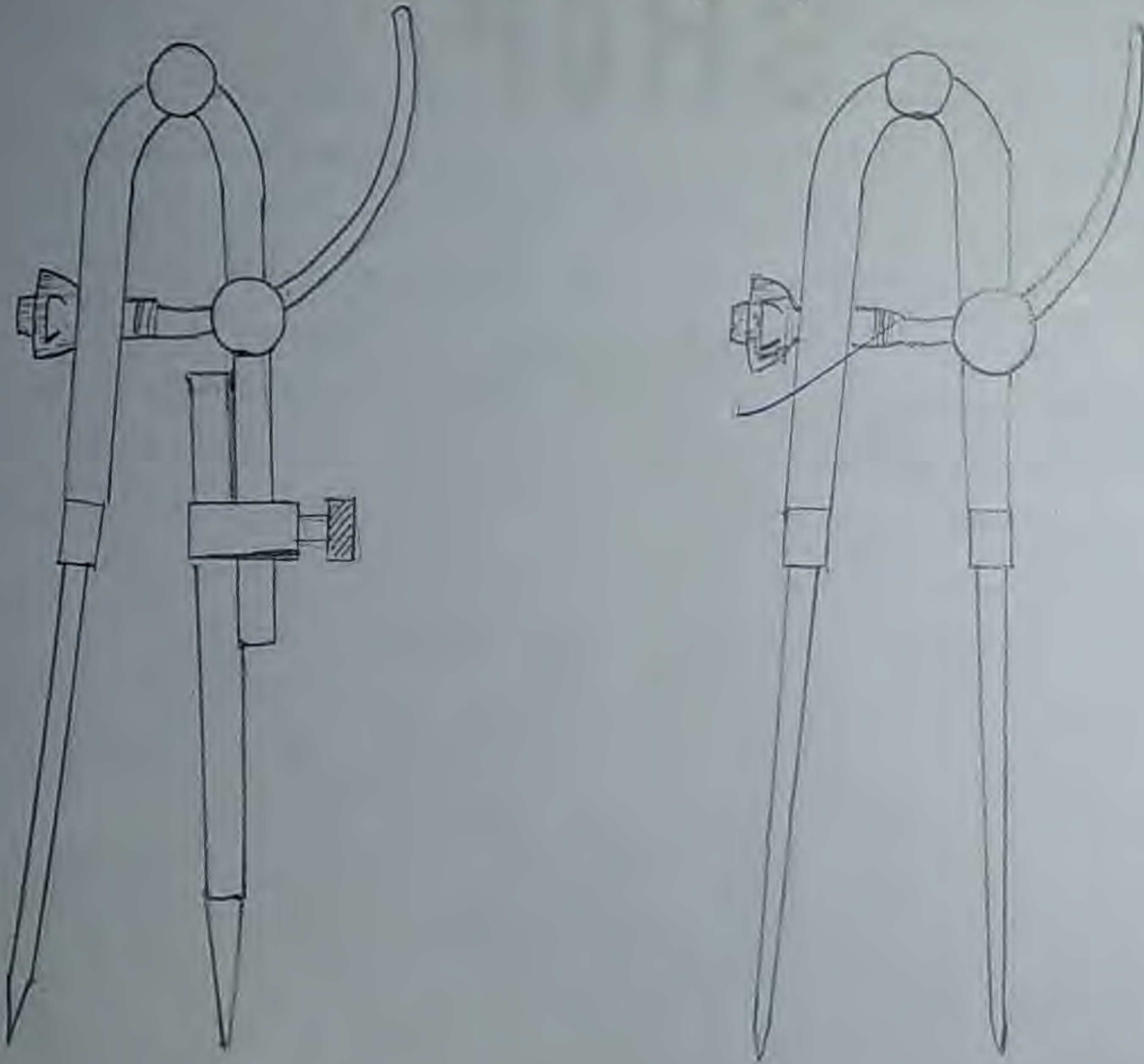
Straight peen hammer

9. Twisting Tools: Twisting wrenches can be used in conjunction with vise to twist a heated workpiece into the desired shape. These wrenches can have different styles. Some twisting wrenches are adjustable and other have characteristic "Z" shape. There are also different kinds of twisting machines available to achieve different types of twists.

10. Hammers: Hammers acts as a powerful extension of our arms to facilitate the shaping of a workpiece. A good hammer or mallet can allow a blacksmith to efficiently achieve a desired workpiece shape without requiring the blacksmith to use excess force.



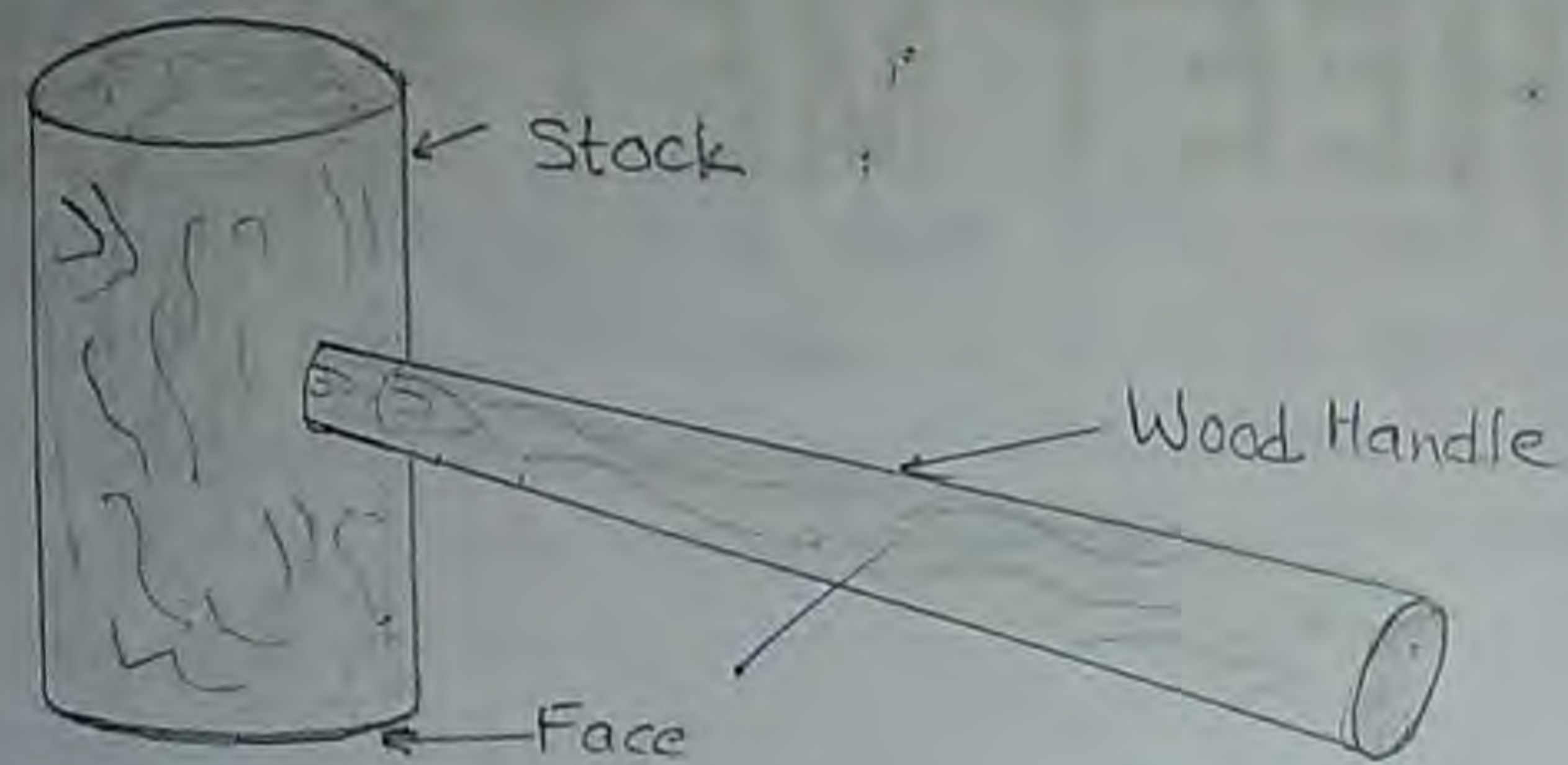
Try square



Compass and Divider

SHEET METAL SHOP

1. **Steel Rule:** Steel Rule is a simple measuring instrument consisting of a long, thin metal strip with a marked scale of unit divisions. It is an important tool for linear measurements.
2. **Try square:** It is measuring and marking tool for 90° angle. In practice, it is used for checking the squareness of many types of small works when extreme accuracy is not required. The blade of the Try square is made of hardened steel and the stock of cast Iron or steel.
3. **Compass and divider:** Compass and divider, are used for making arcs and circles on the planed surfaces of the GI sheets.
4. **Bench Shear:** It is a type of hand cutting machine, the sheet is cut by shearing action. The force is applied through compound lever. The machine is able to cut the sheet metal upto 2 mm thick. The bench shears also contains a chopping hole in the chopping blade which can shear a mild steel rod upto 10 mm diameter.



Mallet



Straight Snip



Double Snip

5. Stakes: Stakes are supporting tools used in sheet metal work. These are used to form, seam, bend or rivet the sheet metal objects. Stakes are made of wrought iron, faced with steel. Its working face is well machined and polished to prevent harmful effect to sheet while doing the hammering process.

6. Mallet: It is generally made of wood or plastic. It is used whenever slight blows are required. Wooden hammer is most commonly used because it does not damage the work surface. The simple mallet used in tin smithy is shown in figure.

7. Straight snip: Snips are hand shears. Straight snip has a straight blade and is used for cutting along straight lines and for trimming the edges.

8. Double snip: Double shears are used for cutting thin cylinders, stove pipes and for cutting holes and light gauge metals.

9. Raising hammer: It is used for making depressions on a flat sheet, and it is adapted for making trays, bowls, etc.

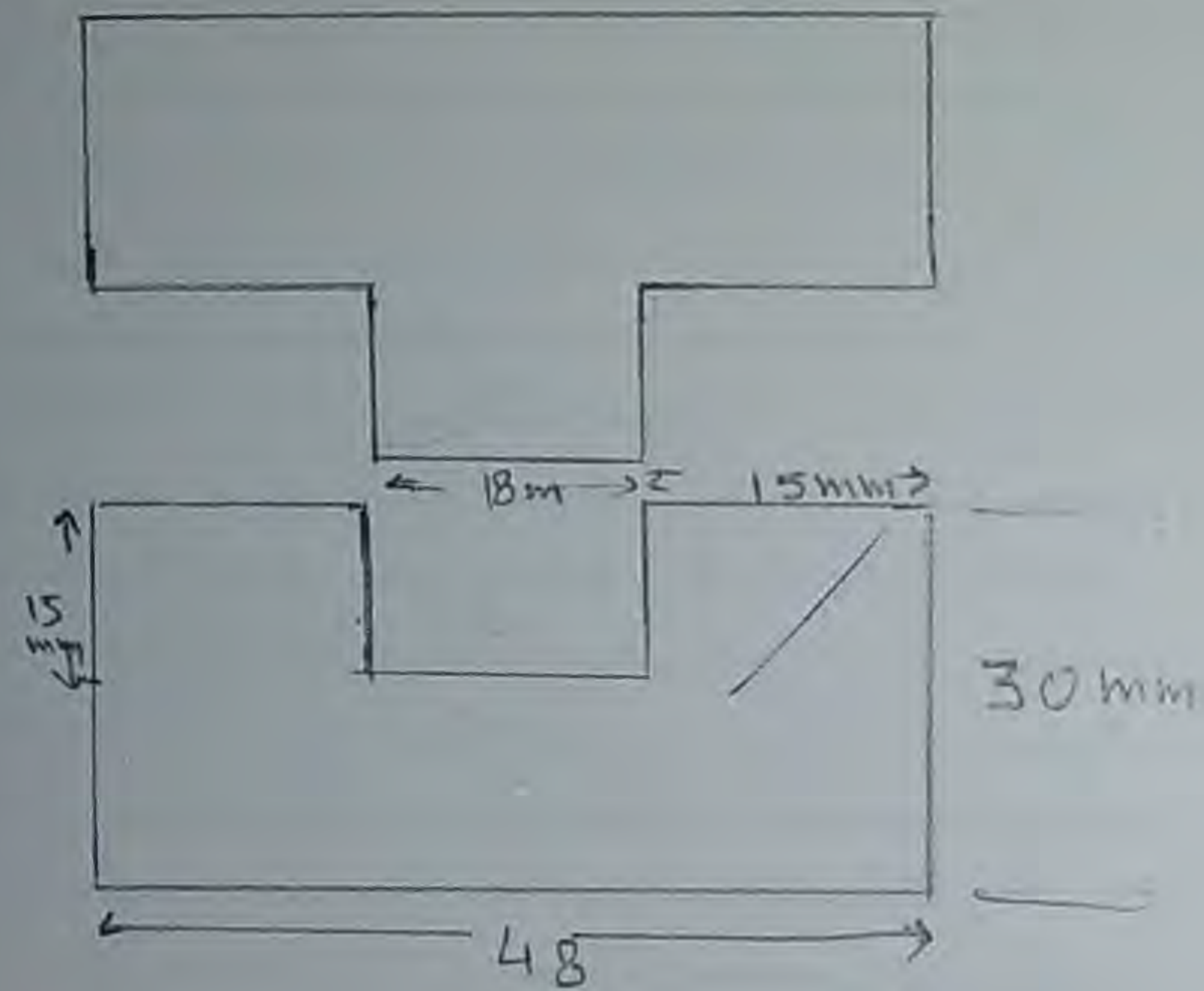
10. Riveting hammer: It has a square slightly curved face and its face is tapered. It is used for riveting.

Workshop Safety Precautions

1. Always wear tight clothes. Loose clothing or long hair will bring danger.
2. Wear covered footwear (shoes). Never use sandals or chappals.
3. Never use files, screwdrivers without a handle. Do not use a hammer without the wedge.
4. Never operate a machine unless otherwise you thoroughly know its mechanism.
5. Wear goggles while chipping, ~~cutting~~ welding or grinding.
6. Always wear safety hand gloves, an apron or dungaree and leather shoes in the Workshop.
7. Never touch overhead lines unless you are sure that it is properly earthed and dead.
8. Don't touch/operate power tools without aid from instructors.
9. Do not throw water on the equipment. It will be harmful since water is a good conductor of electricity.
10. Do not touch electrical circuits of welding machine.

Teacher's Signature: _____


6/11/23



Male Female Joint

Job No. 1

Aim: To make a male female joint in fitting shop as per given diagram.

Raw material: Two pieces of soft iron of dimensions (50x25x10mm)

Tools Required: Bench vice, try-square, ball-pen hammer, dot punch, scriber, files, surface plate, hack saw with blade and flat chisel.

Procedure:

1. Dimensions of the given pieces are checked with the help of steel Rule.
2. The pieces are clamped in the vice and the outer edges are filed using files.
3. The pieces are then checked for their flatness with the help of try square.
4. The side edge of the two pieces are filed such that, they are at right angle to each other, and the required dimensions are obtained.
5. Chalk is then applied on the surface of the two pieces.
6. The given dimensions of the ~~pieces~~ fitting are marked by using steel rule, scriber and surface plate.

7. Using dot punch, dots are punched along the above scribbled lines.
8. Using the hacksaw, the unwanted portions are removed.
9. And the remaining portion of U shaped piece is removed using flat chisel.
10. The corners of the surfaces are filed by using a square or triangular file to get the sharp corners.
11. The pieces are fitted together and the mating is checked for the correctness of the fit. Any defects noticed are rectified by filing with a smooth file.

Precautions:

- Care should be taken while marking.
- Care should be taken while hack sawing.
- Use cleaning brush while removing chips.



Half Lap Joint

Job No-2

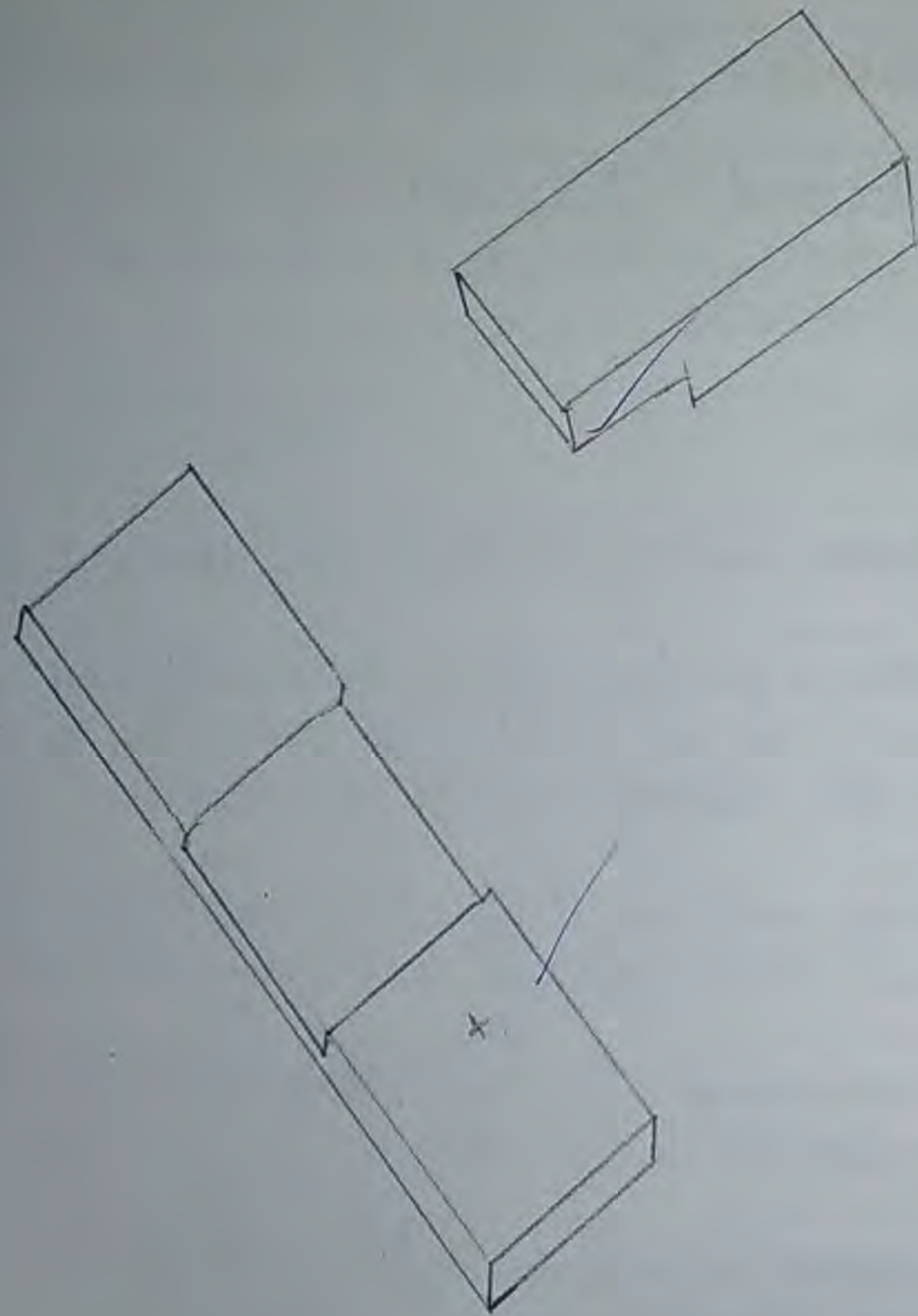
Aim: To make a half lap joint in carpentry shop as per given drawing.

Raw Material:- One piece of Kall wood measuring $305 \times 55 \times 27$ mm.

Tools Required:- Carpenter's vice, steel rule, jack plane, try-square, marking gauge, cross-cut saw, tenon saw, scribes and mallet.

Procedure:-

1. The given material is checked to ensure its correct size.
2. The material is firmly clamped in the carpenter's vice and any two adjacent faces are planed by the jack plane and the two faces are checked for squareness with the try square.
3. Marking gauge is set and lines are drawn at 30 and 40 mm, to mark the thickness and width of the member respectively.
4. The excess material is first chiselled out with firmer chisel and then planed to correct size.
5. The mating dimensions of the parts X and Y are then marked using scribe and marking gauge.

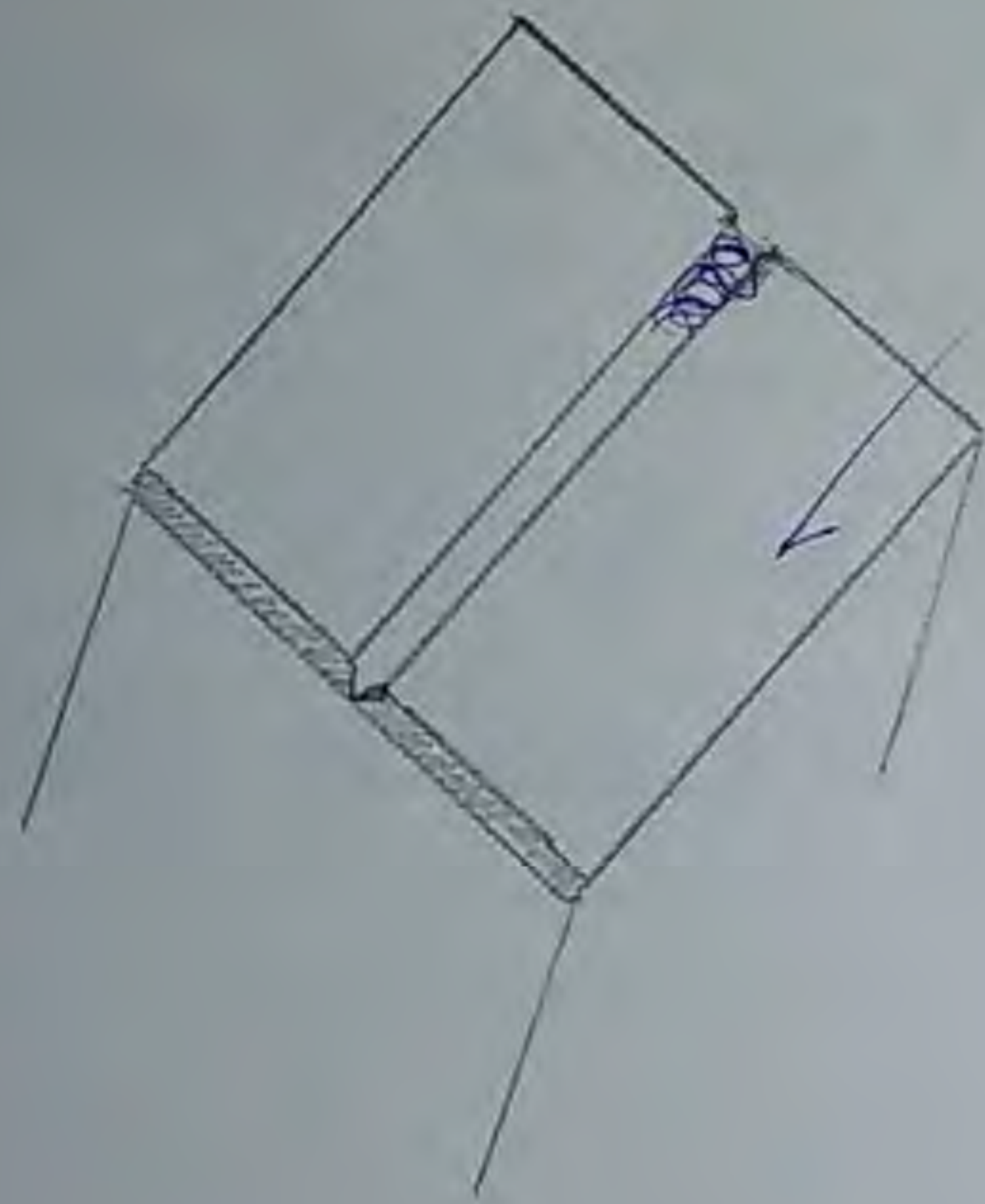


T-Lap Joint

6. Using the cross-cut saw, the portions to be removed are cut in both the pieces, followed by chiseling out also.
7. Ends of the both the parts are chiseled to the exact lengths.
8. A fine finishing is given to the parts, if required so that, proper fitting is obtained.
9. The parts are fitted to obtain a slightly tight joint.

Precautions:

- Care should be taken while marking
- Care should be taken while cutting the wooden piece with chisel



Single 'V' Butt joint

Job No. 3

Aim:- To make a single V Butt joint in welding shop as per given drawing.

Raw material:- Mild steel plate of size $75 \times 35 \times 5\text{mm}$.

Tools Required:- Rough and smooth files, protractor, Arc welding machine (transformer type), Mild steel electrode and electrode holder, Ground clamp, Tongs, Face shield, Apron, Chipping hammer.

Sequence:- Marking, Cutting, Edge preparation (Removal of Rust, scale) by filing, Try square leveling, Tacking, welding, cooling, chipping, cleaning.

Procedure:-

1. The given M.S. pieces are thoroughly cleaned of rust and scale.
2. One edge of each piece is beveled, to an angle of 30° , leaving nearly $\frac{1}{4}$ th of the flat thickness at one end.
3. The two pieces are positioned on the welding table such that, they are separated slightly for better penetration of the weld.
4. The electrode is fitted in the electrode holder and the welding current is set to be a proper value.

5. The ground clamp is fastened to the welding table.
6. Wearing the apron and using the face shield, the arc is struck and holding the two pieces together, first run of the weld is done to fill the root gap.
7. Second run of the weld is done with proper beaming and with uniform movement. During the process of welding, the electrode is kept at 15° to 25° from vertical and in the direction of welding.
8. The scale formation on the welds is removed by using the chipping hammer.
9. Filing is done to remove any spatter around the weld.

Safety Precautions:-

- Inspect welding equipment and electrode holder before proceeding to work.
- Welders should not touch the metal parts of the electrode holder with skin or wet cloth.



Lap Joint

Job No. 4

Aim:- To make a lap joint, using the given two M.S. pieces in arc welding shop as per given drawing.

Raw Material:- Mild steel plate of size $75 \times 75 \times 3$ mm.

Tools Required:- Rough and smooth files, Protractor, Arc welding machine (transformer type), Mild steel electrode and electrode holder, ground clamp, Tongs, face shield, Apron, Chipping Hammer.

Sequence:- Marking, Cutting, Edge preparation (Removal of rust, scale, etc.) by filing, Try square leveling, Tacking, Welding, cooling, chipping, cleaning.

Procedure.

1. The given M.S. piece are thoroughly cleaned of rust and scale.
2. The two pieces are positioned on the welding table such that, the two pieces overlapped one over the other as shown in drawing.
3. The electrode is fitted in the electrode holder and the welding current is set to be a proper value.
4. The ground clamp is fastened to the welding table.
5. Wearing the apron and using the face shield, the arc is struck and the work pieces are tack welded at both the end and at the centre of

the joint.

6. The alignment of the lap joint is checked and the tack-welded pieces which are required are obtained.
7. The scale formation on the welds is removed by using the chipping hammer.
8. Filing is done to remove any spatter around the weld.

Precautions:-

- Welding appropriate PPE like welding helmet and goggles to protect workers' eyes and head from hot slag, sparks, intense light, and chemical fumes.
- Welders should not touch the metal parts of the electrode holder with skin or wet clothing.

~~23/11/23~~