

**Department of
Mechanical Engineering**

LAB MANUAL

MP-2 LAB

B.Tech– IV Semester



**KCT College OF ENGG AND TECH.
VILLAGE FATEHGARH
DISTT.SANGRUR**

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Experiment No. 1

Aim: To study the composition of moulding sand and core sand.

Apparatus: Sample of foundry sand

Theory: Moulding sand composition

The main ingredients of molding sand are the silica sand grains. Clay act as binder and moisture activates the clay to provide plasticity.

1) Silica sand

The sand which forms the major portion of the molding sand i.e. up to 96% is essentially silica grains rest being the other oxides such as alumina, sodium and magnesium oxides. These impurities must be below 2% as they affect the fusion point of the sand. The main source of the silica sand is the river sand which is used with or without washing. Ideally fusion point of sand should be about 1450°C for-cast iron and 1550C for steels.

2) Clay

Clays are most generally used binding agents. These are used widely for their low cost. The most popular clay types are Kaolinite or fire clay ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$) and Bentonite ($Al_2O_3 \cdot 4SiO_2 \cdot nH_2O$)

Kaolinite has melting point of 1750°C to 1787°C and bentonite has a melting range of 1250°C to 1300°C of the two clays beatonite can absorb more water which increases the binding power. The clay also contain some impurities that tend to reduce the refractoriness of the clay.

3) Water

Clay is activated by water so that it develops the necessary plasticity and Strength. The amount of water should be properly controlled. This is because a part of water absorbed by the clay helps in binding while the remaining part helps in improving plasticity but more water would decrease the strength and malleability. The normal percentage of water used is from 2 to 8 percent.

4) Additives

A number of materials are added

i) Sea Coal

This is ground bituminous coal marketed in various grades. Its basic use is to improve the finish, by reducing burning in, creating a reducing atmosphere. The correct amount depends upon the base sand and weight of casting being produced. When the correct amount is used it produces excellent results.

ii) Cereal

This is both a bonding material and a cushion material. The most widely used in the foundry is corn Flour produced from wet milling of corn starch. The effectiveness of corn flour depends entirely, as with other sand additives, on how it is used. In synthetic sands it works well from 4i percent to 2% percent by weight. It is widely used in steel sands.

iii) Pitch

This material is used to produce dry and hot strength along with good hot deformation and as an expansion control. Also used as a binder for dry sand work and black sand cores, it is a

baking type of binder. Most prepared black core binders sold today under various trade

names are usually a mixture of pitch, dexhin, li & sulphite, and resin and in order to use these correctly you should know the percentage of pitch

iv) WoodFlour

All wood floors are not the same; foundry wood flours should be a wood flour with the largest portion of resinous material removed, and possessing a low ash content. The normal percentages used is

v) Iron oxide

Fine iron oxide is used in small percentages in certain mixtures of sand to obtain hot strength

vi) Silica Flour

Pulvenized silica liner 200 mesh is called silica flour. It May be used in amounts up to 350/o for the purpose of increasing hot strength of the sand. It also increases the density of the sand for resistance against to the metal penetration.

vii) Dextrin and Molasses

Molasses containing 60-70% sugar solids may be used for increasing dry strength and edge hardness of the moulds. Dextrin is used for the same purpose.

Core sands

The core sand should contain sand grains, binders and other additives to provide specific properties.

1 Silica sand. The silica sand which is completely devoid of the clay is generally used for making cores. Course silica sand is used in steel foundries for their high refractoriness while fine sands are used in cast iron and non ferrous foundries

2. Binders. Core sands need to be stronger than the molding sands. Thus clay as a binder is not sufficient so some better binders are used. These binders are organic in nature.

The binders generally used are linseed oil, core oil, resins, dextrin etc. core: oils are mixture of linseed, fish and petroleum oils and coal tar.

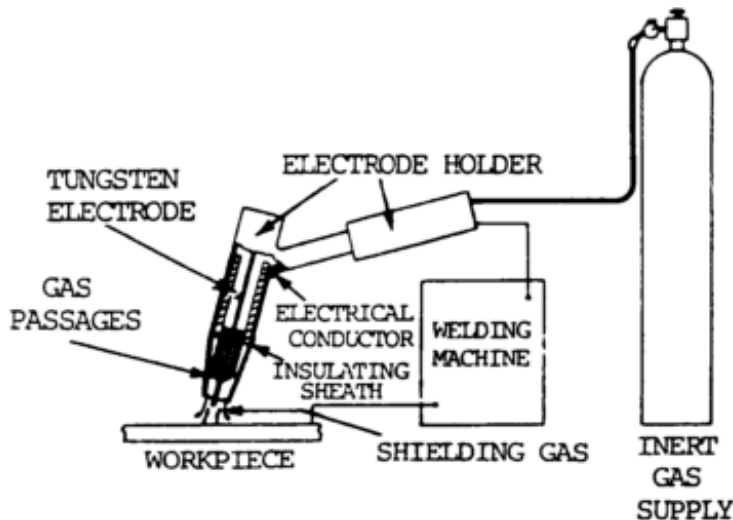
Conclusion: Deciding the ratio of different constituents of sand is a demanding task. It requires thorough knowledge and experience oil the part of the foundry me to decide the ratio of various components to get sand of desired quality.

Experiment No. 2

Aim: To study Tungsten Inert Gas (TIG) Shielded Arc Welding

Apparatus: Apparatus for tungsten inert gas welding

Theory: The set up for tungsten inert gas welding is shown in the following figure



Characteristics:

- (1) This is a welding process in which coalescence is produced by heating with an electric arc between a metal electrode and the work. Shielding of the arc and the molten metal is obtained through the use of an inert gas. A tungsten electrode is used because of its high melting point, and in the presence of the inert gas the electrode is practically no consuming.
- (2) Filler metal, if used, is added to the weld in the same manner as in oxyacetylene welding. A cleaning action that is beneficial when welding aluminum, magnesium, beryllium, copper, and some alloys containing additions of aluminum or beryllium which form refractory oxides.
- (3) With the tungsten inert welding process, welds can be made in all positions, and in practically all metals, without the use of flux. No significant amount of oxide is formed; therefore, fluxes are not required.
- (4) Either direct current (dc) or alternating current (ac) electricity can be used to perform inert gas arc welding operations, depending on the type metal to be welded. When welding aluminum with this welding process, the use of alternating current is preferred. The use of alternating current produces an oxide cleaning action, resulting in a better weld in aluminum. Direct current, reverse polarity (dcrp) i.e. electrode positive, is used for welding these metals in very thin sections.

Type of Inert Gas Used:

- (1) Argon is the type of inert gas most commonly used because it affords better control of the molten metal pool and of the arc. The argon gas also forms an envelope which protects the molten metal from contact with the air. The results are that the weld metal remains brighter, is less cloudy, and produces a better quality weld which is free of contamination.

(2) Helium gas is used in cases where more intense heat or deep penetration into the base metal is required. Therefore, helium is used only when performing high speed welding, or when welding or cutting thicker metal.

Tungsten Electrodes:

(1) Tungsten can withstand higher temperatures than the normal electrode used in arc welding. But it can also be consumed if the temperature of the arc is too hot. Therefore, there is a limit to the current carrying capacity of tungsten electrodes. This limit, together with the beating characteristics of the work in terms of polarity, has led to the use of alternating current for almost all tungsten arc welding.

The size of the electrode is determined by the current which, in turn, is a function of the material thickness. Non consuming electrodes for TIG welding are of four types: pure tungsten, tungsten containing 1 or 2 percent thorium, and tungsten containing 0.3 to 0.5 percent zirconium. Each type of tungsten electrode can be identified by painted end marks, as follows:

(a) Green - pure tungsten.

(b) Yellow - 1 percent thorium.

(c) Red - 2 percent thorium.

(d) Brown - 0.3 to 0.5 percent zirconium.

(3) Pure tungsten (99.5 percent tungsten) electrodes are generally used on less critical welding operations rather than the tungstens which are alloyed. This type of electrode has a relatively low current carrying capacity and a low resistance to contamination.

(4) Thoriated tungsten electrodes (1 - or 2 percent thorium) are superior to pure tungsten electrodes because of their higher electron output, better arc-starting and arc stability, high current-carrying capacity, longer life, and greater resistance to contamination.

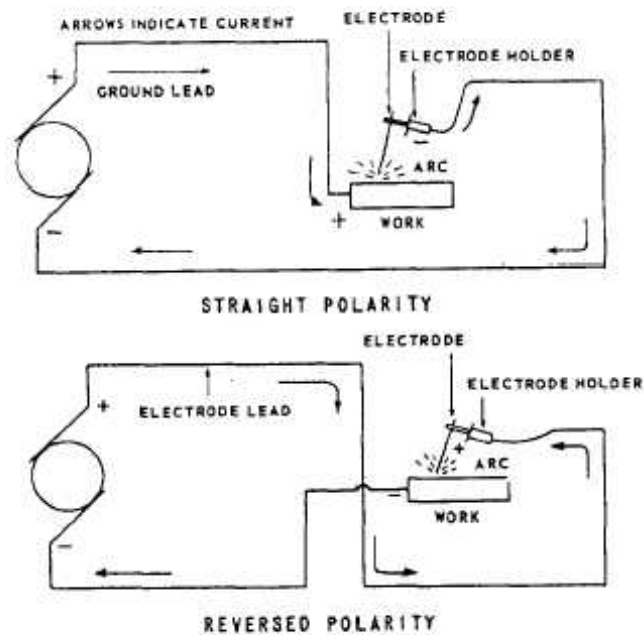
(5) Tungsten electrodes containing 0.3 to 0.5 percent zirconium generally fall between pure tungsten electrodes and thoriated tungsten electrodes in terms of performance.

(6) Welding Current:

Standard alternating current welding transformers, with 100 volts or less open circuit potential, are used in this method of welding. These transformers usually require a superimposed high frequency voltage for starting and maintaining the arc. The polarity to be used with a specific type of electrode is established by the manufacturer.

Direct Current Welding:

(a) In direct current welding, the welding current circuit may be hooked up as either straight polarity (dosp) or reverse polarity (dcrp). For dosp, the machine connections are electrode negative and workpiece positive as shown in the figure. The electron flow in the circuit formed by this connection is from the electrode to the workpiece (base metal plate). For dcrp, the welding machine connections are electrode positive, and work piece negative, as shown in figure the electron flow in this circuit is from the work piece to the electrode.

**Advantages:**

The TIG shielded arc welding process has certain advantages over other welding processes as described in the following subparagraphs.

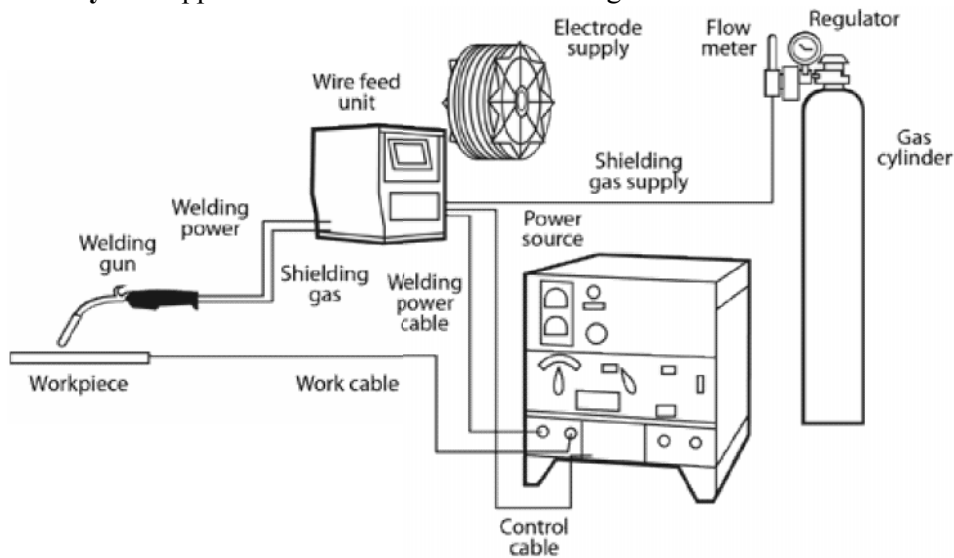
- (1) It provides freedom from the need for using a flux, either on the work or on the filler rod, thus eliminating the flux removal problem.
- (2) It permits visual control while welding in any position.
- (3) It produces distortion in the base metal.

Experiment No. 3

Aim:To study metal gas welding or shielded arc welding

Apparatus:Set up for metal inert gas welding (MIG)

Theory:The apparatus for MIG is shown in the figure below:



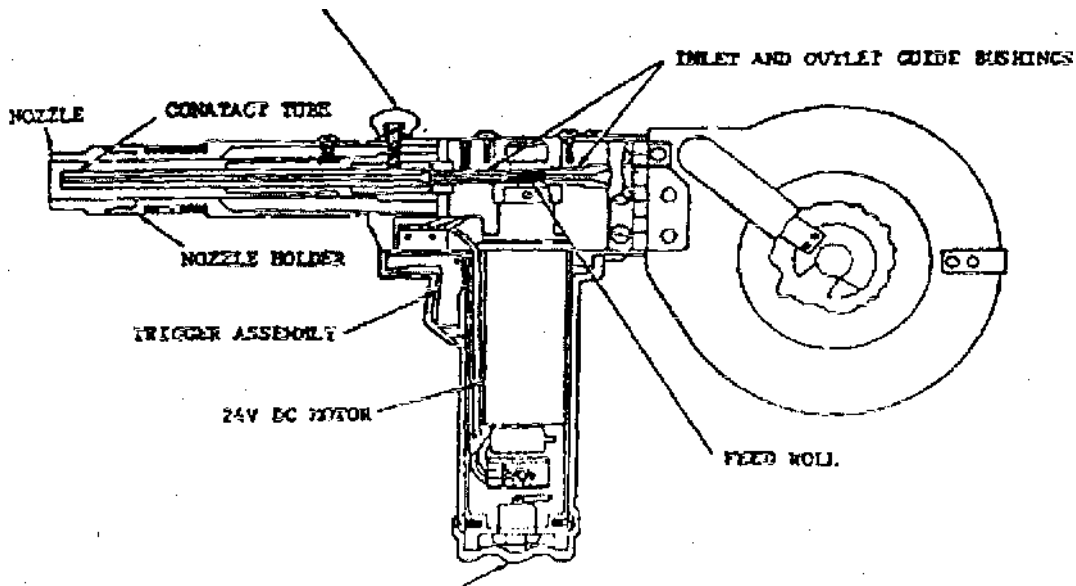
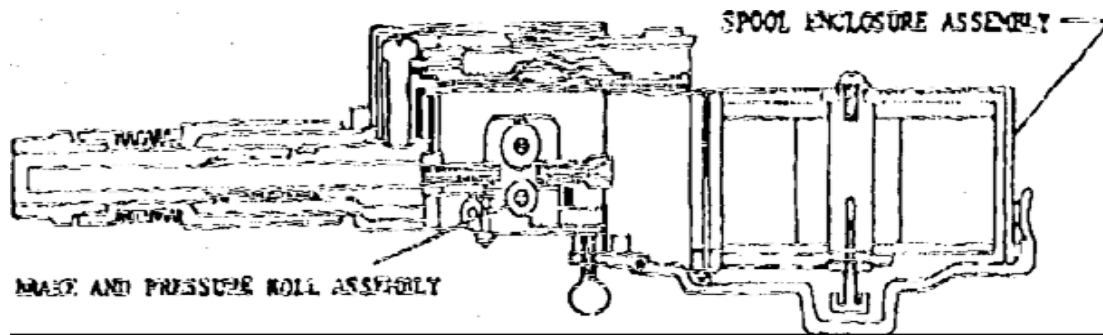
(1) This welding process is relatively new and only recently has been adopted for use by the U.S. Army in the field. Much use of this welding process will be made in the repair of aluminum hull tracked vehicles.

(2) Gas metal-arc (MIG) welding is process in which a consumable, bare wire electrode, is fed into a weld at a controlled rate of speed. A blanket of inert gas (argon, helium, or a mixture of the two as used in TIG welding) shields the weld zone from contamination. This process produces high welds without the use of fluxes or the necessity of post cleaning the weld.

(3) The MIG welding unit is designed for manual welding with small diameter wire electrodes using a spool-on-gun torch as shown in figure on the following page. (There are MIG welding systems that have the spool located away from the torch gun, but the principle operation is the same as for the type system discussed here. The complete system consisting of the torch, a voltage control box, and a welding contactor are shown in figure. The torch handle contains a complete motor and gear reduction unit that pulls the welding wire electrode from a 4 inch diameter spool containing one pound of wire electrode; mounted in the rear of the torch.

Three basic sizes of wire electrode may be used: 3/32 inch; 3/64 inch; and 1/16 inch. Any type of metal may be welded, provided the welding wire electrode is of the same composition as the base metal.

(4) The unit is designed for use with an ac-dc conventional, constant current type welding power Supply.



MIG Welding Equipment Components.

(1) **Contact Tube.** This tube is made of copper with a hole 0.01 to 0.02 inch larger than the electrode. The contact tube and guide bushings must be changed when changing the size of the electrode. Electric power is transmitted through the contact tube to the electrode.

(2) **Nozzle and Holder.** The nozzle is made of copper to dissipate heat and chrome-plated to reflect the heat. The holder is made of stainless steel and is connected to an insulating material which prevents an arc from being drawn between the nozzle and ground in case the gun comes in contact with the work.

(3) **Inlet and Outlet Guide Bushings.** The bushings are made of nylon for longer wear. They must be changed to suit the wire electrode size when the electrode size is changed.

(4) **Pressure Roll Assembly.** This is a smooth roller, under spring tension, which pushes the wire electrode against the Feed and allows the wire to be pulled from the spool. A thumbscrew applies tension as required.

(5) **Motor.** When the inch button is depressed, the current for running the motor comes from the 110 volt ac-dc source, and the motor pulls the wire electrode from the spool at the required rate of feed. The current for this motor is supplied by the welding generator.

(6) Spool Enclosure Assembly. This assembly is made of plastic which prevents arc spatter from jamming the wire electrode on the spool. A small window allows the operator to visually check the amount of wire electrode remaining on the spool.

- Insulate yourself from work and ground.
- Do not touch live electrical parts.
- Keep all panels and covers securely in place
- Keep your head out of the fumes.
- Ventilate area, or use breathing device.
- Do not weld near flammable material.
- Watch for fire; keep extinguisher nearby
- Wear welding helmet with correct shade of filter.
- Wear correct eye, ear, and body protection.
- Allow cooling period before touching welded metal

Experiment No. 4

Aim:To study different arc welding processes

Apparatus: Different arc welding setups.

Theory:Arc welding is one of several fusion processes for joining metals. In arc welding the intense heat needed to melt the metal is produced by an electric arc between the work piece and electrode. The electrode is guided manually or mechanically along the joint. Electrode can be consumable or non-consumable type.

Basic welding circuit:The basic arc welding circuit is shown in figure. An A.C. or D.C. power source is connected across the electrode and work piece through cable. The arc is created across gap when the energized electrode tip JS just touched slightly with work piece and withdrawn maintaining a proper gap.

Different arc welding processes are as follows:

- | | |
|---------------------------|-------------------------------|
| 1. Carbon arc welding, | 2. Shielded metal arc welding |
| 3. Submerged arc welding | 4. Gas tungsten arc welding |
| 5. Gas metal arc welding | 6. Plasma arc welding |
| 7. Flux cored arc welding | 8. Stud arc welding |

1) Carbon arc welding: this process is the oldest of all the arc welding processes and is considered to be the beginning of arc welding process. It is the process which produces joints of metal by heating them with an arc between two carbon electrodes or between electrode and the work piece. Pressure and filler metal may or may not be used.

2) Shielded metal arc welding: This is the process of arc welding which produces coalesce of metals by heating them with arc between a covered metal electrode and the work piece. Shielding is obtained from deposition of electro covering.

3) Submerged arc welding: It is an arc welding process which produces coalesce of metals by heating them with an arc between base metal and electrode. Pressure is not used, filler metal is obtained from the electrode. Welding zone is completely covered by means of large amount of granulated flux which is delivered ahead of the welding electrode by means of flux fed tube. Power source used in this welding can be AC or DC. Both constant current and voltage machines can be used.

4) Gas tungsten arc welding: This is a welding process in which coalescence is produced by heating with an electric arc between a metal electrode and the work. Shielding of the arc and the molten metal is obtained through the use of an inert gas. A tungsten electrode is used because of its high melting point, and in the presence of the inert gas the electrode is practically no consuming.

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5) Gas metal arc welding

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Gas metal-arc (MIG) welding is process in which a consumable, bare wire electrode, is led into a weld at a controlled rate of speed. A blanket of inert gas (argon, helium, or a mixture of the two as used in TIG welding) shields the weld zone from contamination. This process produces high welds without the use of fluxes or the necessity of post cleaning the weld.

The MIG welding unit is designed for manual welding with small diameter wire electrodes using a spool-on-gun torch as shown in figure on the following page. (There are MIG welding systems that have the spool located away from the torch gun, but the principle of operation is the same as for the type system discussed here.) The complete system consisting of the torch, a voltage control box, and a welding contactor are shown in figure. The torch handle contains a complete motor and gear reduction unit that pulls the welding wire electrode from a 4 inch diameter spool containing one pound of wire electrode mounted in the rear of the torch.

Three basic sizes of wire electrode may be used: 3/32 inch; 3/64 inch; and 1/16 inch. Any type of metal may be welded, provided the welding wire electrode is of the same composition as the base metal. The unit is designed for use with an ac-dc conventional, constant current type welding power supply.

6) Plasma arc welding

An arc welding process which produces coalesces of metal by heating them with constrained plasma arc. The electrode used here is that of tungsten. A small amount of pure argon gas flow is allowed through the inner orifice surrounding the tungsten electrode to form plasma gas. Because of the squeezing action of the constraining nozzle, the arc in PAW is concentrated and straight. This constriction increases the heat contained per unit volume of the plasma. Thus arc temperatures of the order of 11000°C are not unusual in PAW.

7) Flux cored arc welding

It is an arc welding process which produces coalesce of metals by heating them with an arc between continuous filler metal electrode and the work piece. Shielding is provided by flux contained in the tubelet electrode

8) Stud arc welding

This process is defined as the arc welding process, which produces coalesce of metal by heating them with an arc between a metal stud or similar part and the work piece. Then the surface is to be joined is properly heated and are brought in contact under pressure partial sealing may he obtained by use of ceramic material surrounding the stud.

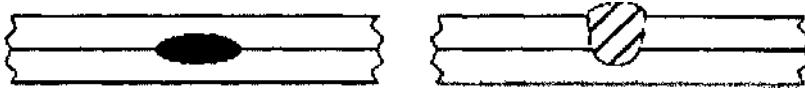
Experiment No. 5

Aim: To study resistance welding techniques.

Apparatus: Set up for resistance welding

Theory: Principle

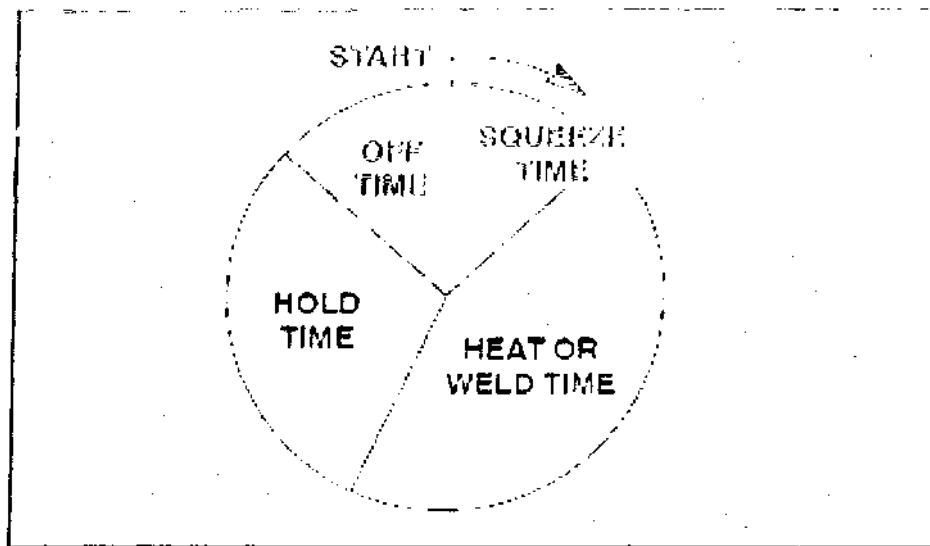
Resistance welding is accomplished when current is caused to flow through electrode tips and the separate pieces of metal to be joined. The resistance of the base metal to electrical current flow causes localized heating in the joint and the weld is made. The resistance spot weld is unique because the actual weld nugget is formed



The gas tungsten-arc spot is made from one side only. The resistance spot weld is normally made with electrodes on each side of the work piece. Resistance spot welds may be made with the work piece in any position. When current is passed through a conductor the electrical resistance of the conductor to current flow will cause heat to be generated. The basic formula for heat generation may be stated:

$$H = I^2 R$$

where H = Heat, I² = Welding Current Squared and R = Resistance The cycle for resistance welding is Given in the figure below:



SQUEEZE TIME – Time between pressure application and weld.

HEAT OR WELD TIME – Weld time.

HOLD TIME – Time that pressure is maintained after weld is made.

OFF TIME -- Electrodes separated to permit moving of material for next spot.

There are six major points of resistance in the work area. They are as follows:

The contact point between the electrode and top work piece.

The top work piece.

The interface of the top and bottom work pieces.

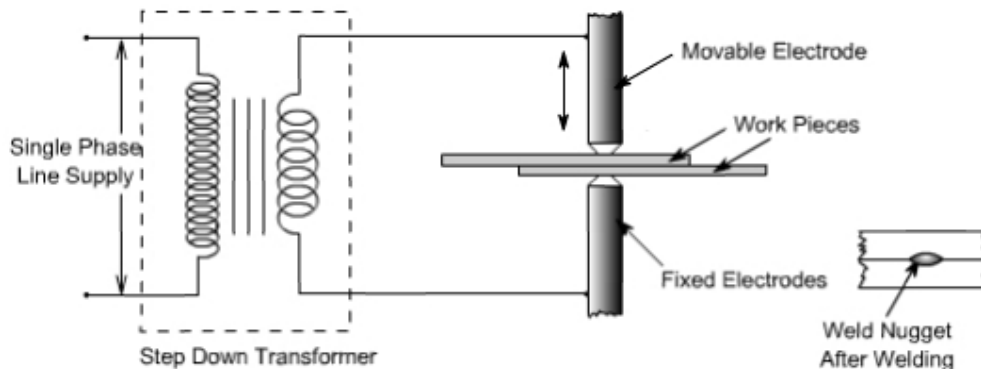
The bottom work piece.

The contact point between the bottom work piece and the electrode.

Resistance of electrode tips.

The resistances are in series, and each point of resistance will retard current flow.

The amount of resistance at point 3, the interface of the work pieces, will depend on the heat transfer capabilities of the material, its electrical resistance, and the combined thickness of the materials at the weld



TONGS

Electrode Tips

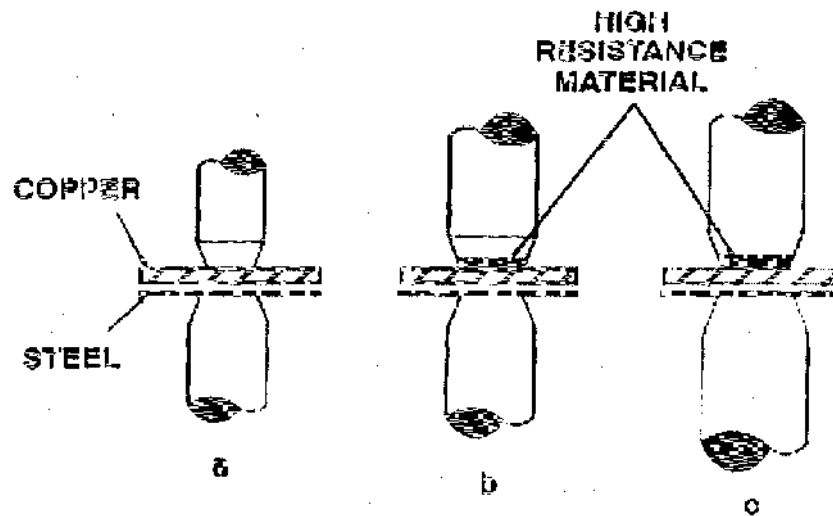
Copper is the base metal normally used for resistance spot welding tongs and tips. The purpose of the electrode tips is to conduct the welding current to the workpiece, to be the focal point of the pressure applied to the weld joint, to conduct heat from the work surface, and to maintain their integrity of shape and characteristics of thermal and electrical conductivity under working conditions. Electrode tips are made of copper alloys and other materials.

Heat balance,

There is no particular problem of heat balance when the materials to be welded are of equal type and thickness. The heat balance, in such cases, is automatically correct if the electrode tips are of equal diameter, type, etc. Heat balance may be defined as the conditions of welding in which the fusion zone of the pieces to be joined are subjected to equal heat and pressure. When the well-meant has parts of unequal thermal characteristics, such as copper and steel, a poor weld may result for several reasons. The metals may not alloy properly at the interface of the joint. There may be a greater amount of localized heating in the steel than in the copper. The reason would be because copper has low electrical resistance and high thermal transfer characteristics, while steel has high electrical resistance and low thermal transfer characteristics.

Correct heat balance may be obtained in a weldment of this type by one of several methods. The following Figure illustrates three possible solutions to the problem. In the following figure (a) shows the use of a smaller electrode tip area for the copper side of the Joint to equalize the fusion characteristics by varying the current density in the dissimilar

materials. In the figure (b) shows the use of an electrode tip with high electrical resistance material, such as tungsten or molybdenum, at the contact point. The result is to create approximately the same fusion zone in the copper as in the steel. A combination of the two methods is shown in Figure (c).



Types of resistance welding processes

- a) Spot welding
- b) Seam welding
- c) Projection Welding
- d) Upset welding
- e) Flash welding

a) Spot welding: The principle has already been explained above.

b) Seam welding: the principle is similar to spot welding except that in this process the spot weld tips are replaced by continuous revolving wheel type electrode. The current is switched on and metal pieces are pushed together to travel between the revolving electrode wheels. The metal between the electrodes get heated up to the welding temperature and a weld is obtained under contact pressure of rotating electrodes.

c) Projection Welding: this process is the similar to the spot welding but differs the latter in that the spots at which the welding take place are previously defined by providing the projection at the desired location on the surface of the work piece.

d) Upset welding: In the upset or butt welding bars or rods of same cross section are welded. They are brought in contact forming a butt joint and are held tightly against each other and current is applied so that heat is generated through the contact area between the two pieces.

e) Flash Welding: in this method first the current is switched on and then the ends of the pieces are brought in contact and then moved back, and there is an arc created between the two pieces. The ends of the two pieces melt due to the heat of the arc. They are again brought in contact and supply is switched off and the joint is formed.

Experiment No. 6

Aim:To study gas welding process and equipment (oxy-acetylene)

Apparatus:Apparatus for oxy-acetylene welding.

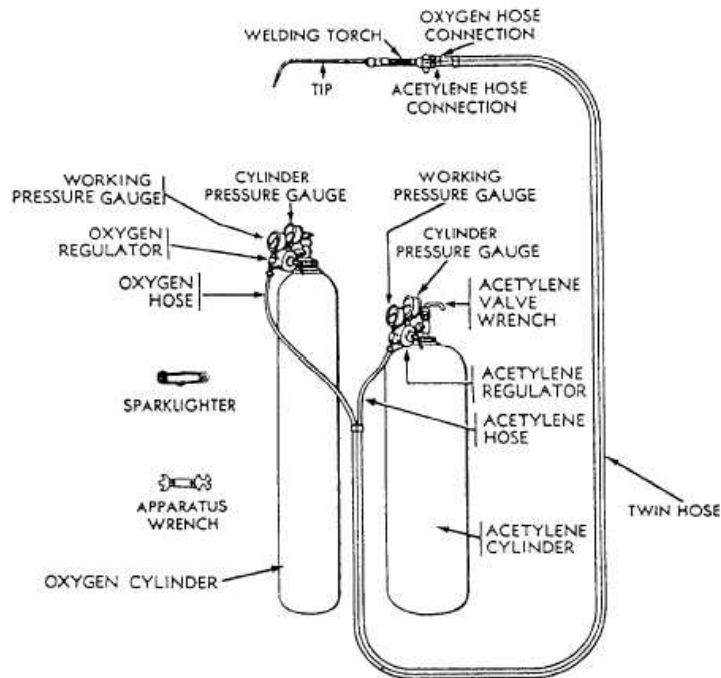
Theory:The use of gas welding dates back to the middle 1800's where a mixture of Oxygen and Hydrogen were used to produce a hot flame that was used in the making of jewelry. It wasn't until the late 1890's when the gas Acetylene became available that gas welding developed into the process that we know today. Acetylene is it gas that is manufactured by mixing Calcium Carbide, (a byproduct of the electric furnace steel making process) with water. Acetylene when burned alone can produce a flame temperature of about 4000 deg. F. With the addition of Oxygen a flame temperature in excess of 6000 deg. F. can be achieved, making Acetylene ideal for welding and cutting. An Oxy-Acetylene outfit is portable, less expensive and more versatile than a electric welding set up. By using the proper tips, rods and fluxes, almost any metal can be welded, heated or cut using the Oxy-Acetylene process. Acetylene is the most commonly used fuel gas. Acetylene is very flammable and hazardous and can ignite at a wide range of concentrations. Oxygen won't burn or explode, but it helps other objects burn a greater rates

Oxygen and Acetylene are stored under pressure in steel cylinders. They are sized by the cult. of either Oxygen or Acetylene that they hold.

Cylinders should be tested regularly with the date of the last test stamped on the top of the cylinder. Cylinders should always be secured and used in the upright position. When a cylinder is not being used, the valve cap should always be in place.

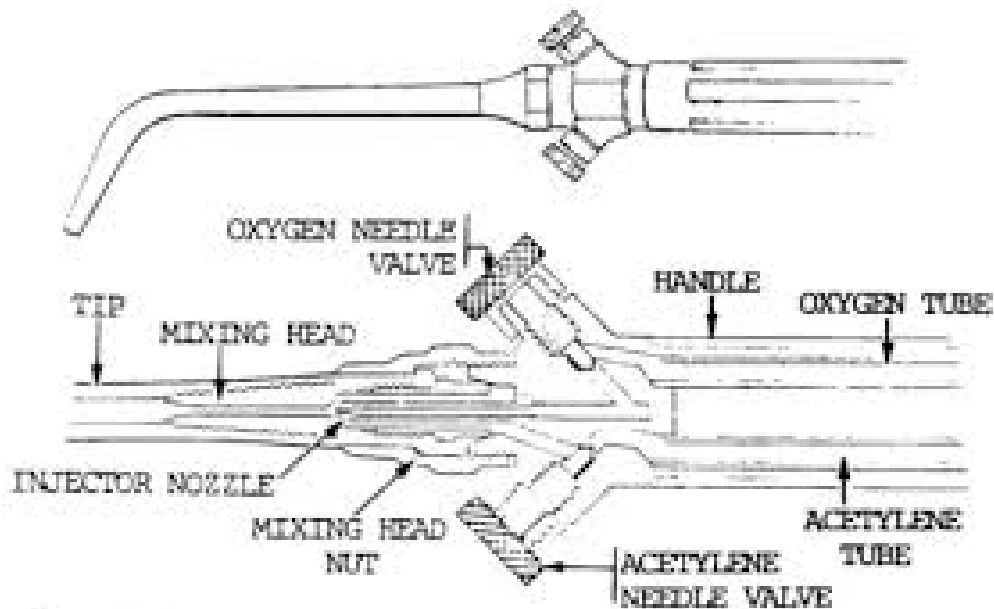
Regulators:

Basically, regulators work by admitting the high cylinder pressure through a valve which is operated by a flexible diaphragm. By turning the regulator adjusting knob or screw in or out causes a spring in the regulator to operate the diaphragm which opens or closes a valve in the regulator. This in turn regulates the outlet pressure and flow. By turning the adjusting knob in .you increase the flow and pressure, out decreases the flow and pressure. Most regulators have two gauges. One shows the inlet pressure from the cylinder (the high pressure gauge) and the other (low pressure gauge) shows the working pressure being supplied from the regulator. There are regulators that are made for heavy duty or rough service that are not equipped with gauges, (referred to as gauge less) and have a settle ill the regulator body that is used to make pressure adjustments. Tile setup for the welding is shown in (lie following figure.



Torch assembly:

The torch assembly consists of the handle, oxygen and fuel gas valves and mixing chamber. Welding tips or a cutting attachment can be used with the handle allowing it to be used for welding, heating and cutting operations. Oxygen and fuel gas flow through tubes inside the handle which blend in the mixing chamber or tip. It is at the tip that the mixed gases are ignited.



Oxy-acetylene torch

There are two basic mixer types, the equal or medium pressure type (also known as balance or positive pressure type) and the injector type. The equal pressure type is the most common and is used with fuel gas pressures that are above 1 psi. Oxygen and fuel gas enter the torch

at almost equal pressures. The injector type is used when fuel gas pressures are less than 1 psi. In this type, Oxygen at high pressure pulls the fuel gas into the mixing chamber. The welding tip is mounted on the end of the torch handle and through it the oxygen and fuel gas mixture feed the flame. Tips are available in a variety of shapes and sizes to fit most any welding job and are identified by number. Larger the number the larger the hole in the tip and the thicker the metal that can be welded or cut. Welding tips have one hole and cutting tips have a centrally located hole with a number of smaller holes located around it in a circular pattern. The cutting Oxygen comes from the center hole with the preheat flame coming from the holes around it. Many factors determine the size tip to use, but mainly the thickness of the metal to be welded or cut determines which tip size to use. The attachments at the end of this article will serve as a guide to tip selection

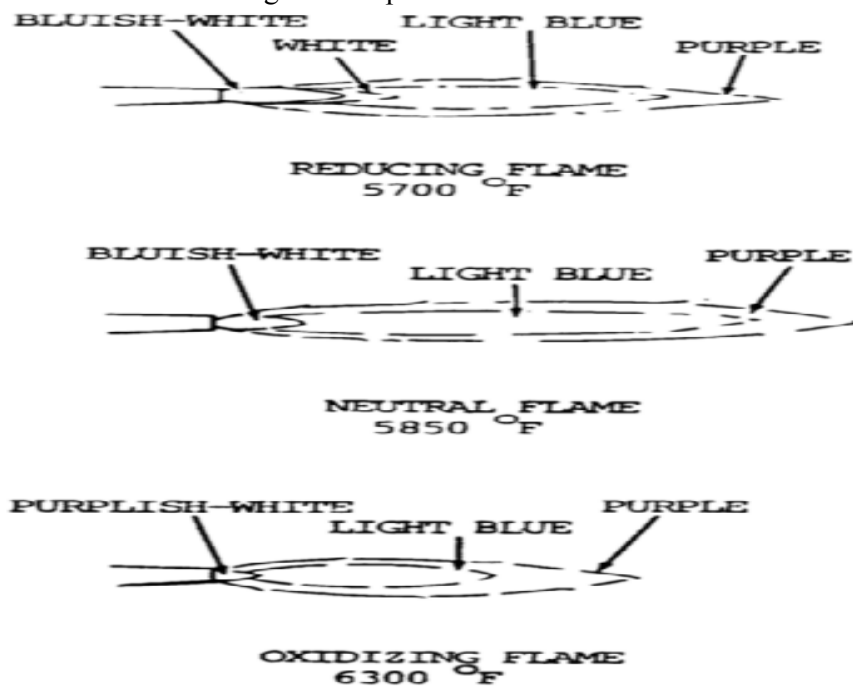


Figure 11-2. Oxyacetylene flames.

Advantages of Oxy-Acetylene Welding :

- It's easy to learn.
- The equipment is cheaper than most other types of welding rigs (e.g. 'FIG welding)
- The equipment is more portable than most other types of welding rigs (e.g. TIG welding)
- OA equipment can also be used to “flame-cut” large pieces of material.

Disadvantages of Oxy-Acetylene Welding:

- OA weld lines are much rougher in appearance than other kinds of welds, and require more finishing if neatness is required.
- OA welds have large heat affected zones (areas around the weld line that have had their mechanical properties adversely affected by the welding process)

General Gas Welding Safety Tips

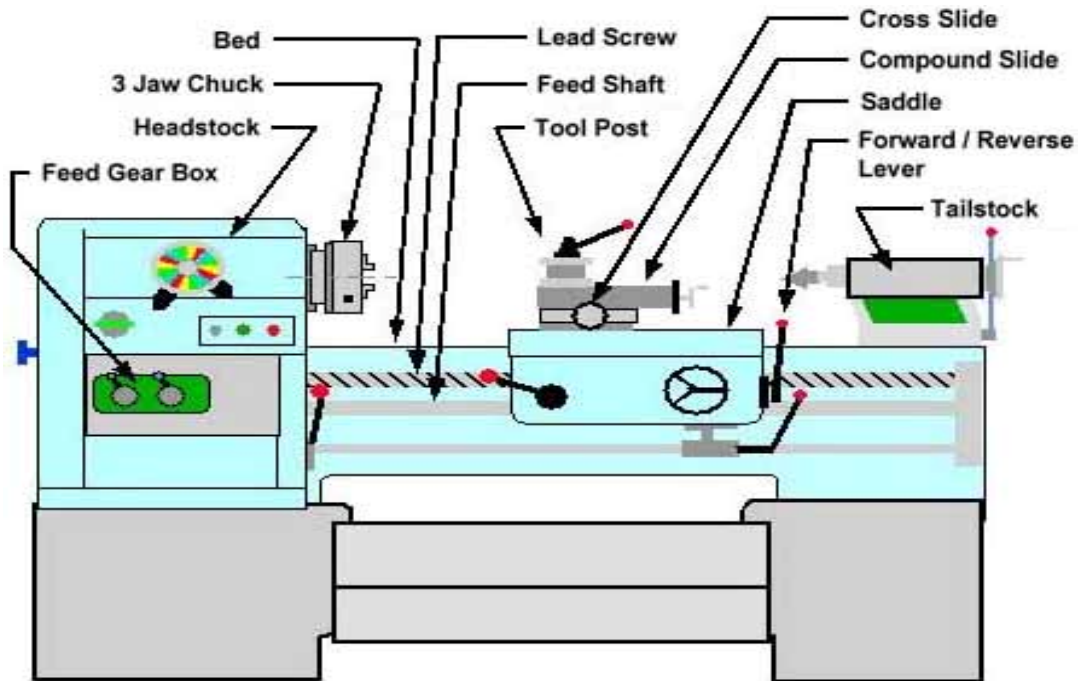
- Inspect equipment for leaks at all connections using approved leak-test solution.

- Inspect hoses for leaks and worn places.
- Replace bad hoses.
- Protect hoses and cylinders from sparks, flames and hot metal.
- Use a flint lighter to ignite the flame.
- Stand to the side (away from the regulators) when opening cylinder valves.
- Open cylinder valves very slowly to keep sudden high pressures from exploding the regulators.
- When finished, close cylinder valves, bleed the lines to take pressure off regulators, neatly coil hoses and replace equipment.

Experiment No. 7

Aim: - To study the constructional features of the lathe machine through drawing.

Theory The function of lathe is to remove metal from a piece of work to give it the required shape and size. This is accomplished by holding the work securely and rigidly on the machine and turning it against cutting tool which will remove metal in the form of chips. To cut the material properly the tool should be harder than material of work piece. The part to be machined can be held between two rigid supports called centre or by some other device such as chuck or face.



Principal parts of lathe: -

1. **Bed:** - the bed of lathe consists of two heavy parallel sides having ways or Vs over it. It is held rigidly by cross griths supported by cast iron supports.
2. **Head stock:** - It is situated at left hand end of bed. It consists of head stock casing and supports the spindle and driving arrangement. The steel spindle is hollow so that bars can be passed through it is necessary. The spindle nose of spindle is threaded to hold the chuck of face plate by screwing it on.
3. **Tail stock:** - This is counter part of head stock and is located opposite it on the ways of bed. It consists of tapered hole adjusting screw and hand wheel. It is used for supporting and feeding drills, reamers and centres.
4. **Carriage:** - the carriage is a moving part that slide over the ways between head stock and tail stock. It consists of a saddle and apron and also carries the compound slide. Saddle carries the cross slide and tool rest to provide various kinds of motion to tools. Compound slide is used to support the tool post and cutting tool in various positions. The base of compound slide is graduated and the tool post can be swiveled to various angular positions for different turning operations. Apron contains the gears and clutches for transmitting motion from feed rod to the carriage. Tool post is used to hold various tools and tool holders to create convenient working conditions.

Size of a lathe machine

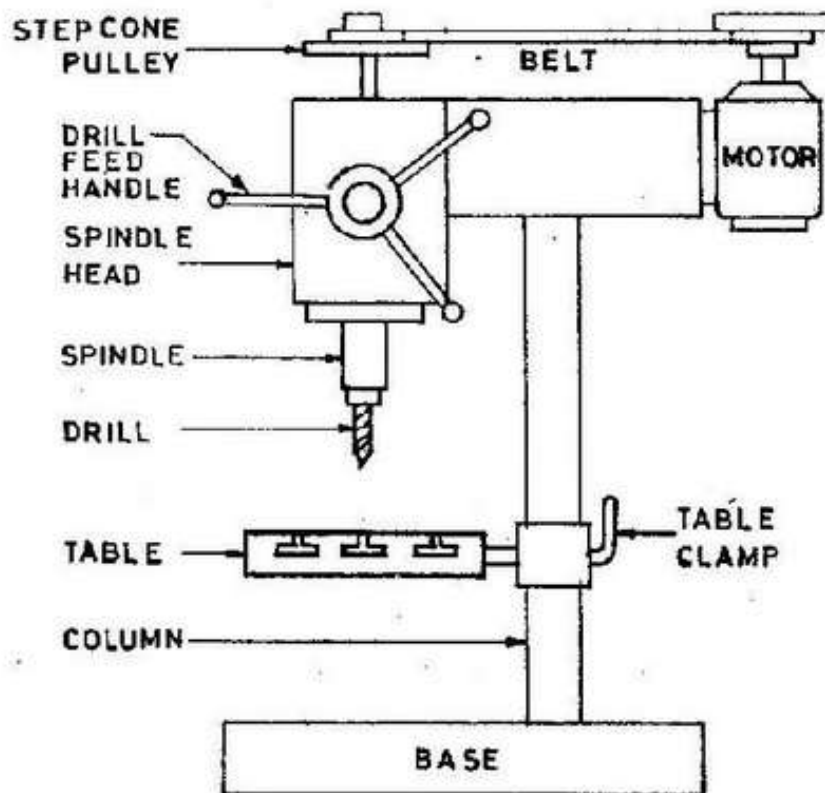
The size of the lathe is specified by

- (a) Height of the centres measured from lathe bed
- (b) Swing diameter over bed
- (c) Length between centre
- (d) Swing diameter over carriage
- (e) Maximum bar diameter
- (f) Length of the bed.

Experiment No. 8

Aim: To study the constructional features of the Radial drilling machine through drawing.

Theory: Radial drilling machine is intended for drilling medium to large and heavy workpieces. The machine consists of a heavy, round, vertical column mounted on a large case the column supports a radial arm which can be raised and lowered to accommodate work pieces of different heights. The arm may be swung around to any position over the work bed. The radial arm can be moved horizontally on the guide—ways and clamped at any desired position. These three movements in a radial drilling machine when combined together permit the drill to be located at any desired point on a large workpiece for drilling the hole... The work may be mounted on the table or when the work is very large it may be placed on the floor.



Principle parts of Radial drilling machine

1. Base: - the base of a radial drilling machine is a large rectangular casting that is finished on its top support a column on its one end and to hold the work table at the other end.

2. Column: - the column is a cylindrical casting that is mounted vertically at one end of the base. It supports the radial arm which may slide up or down on its face. An electric motor is mounted on the top of the column which imparts vertical adjustment of the arm by rotating a screw passing through a nut attached to the arm.

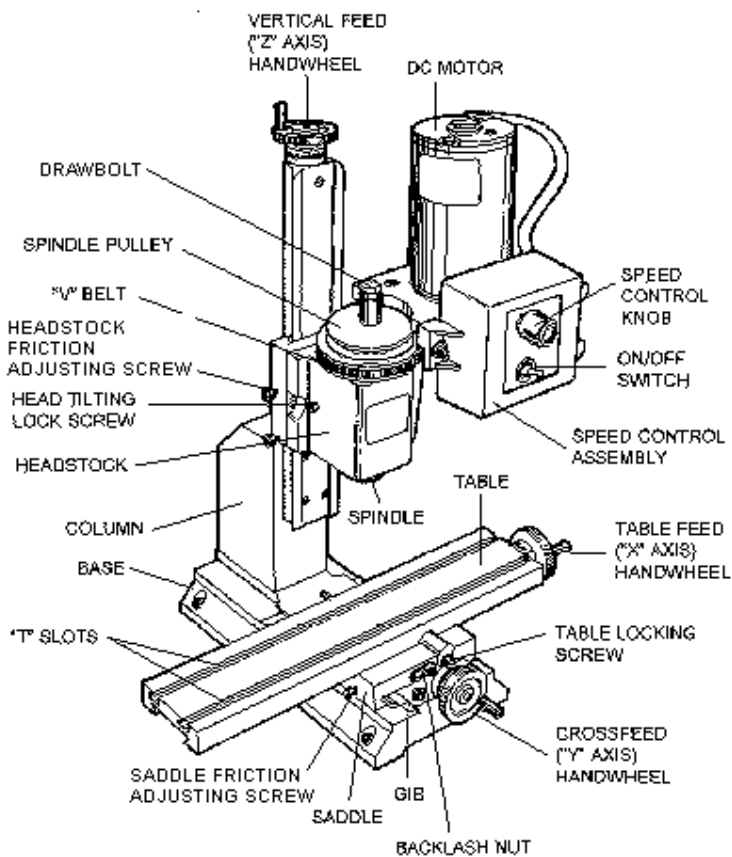
3. Radial arm: - the radial arm that is mounted on the column extends horizontally over the base. The arm may be swung round the column. In some machines this movement is controlled by a separate motor.

4. Drill head: - the drill head is mounted on the radial arm and drives the drill spindle. It encloses all the mechanism, for driving the drill at multiple speeds and at different feed.

Experiment No. 9

Aim: To study the constructional features of the universal milling machine through drawings.

Theory: A milling machine is a machine tool that removes the metal as the work is fed against a rotating multiple point cutter. The cutter rotates at high speed and because of multiple cutting, edges it removes metal at very fast rate. a Universal milling machine can be distinguished from a plain milling machine in that the table of universal milling machine is mounted on a circular swiveling base has degree graduations, and the table can be swiveled to any angle up to 45 degree on either side of normal position. The table can be swiveled about a vertical axis and set an angle other than right angles to the spindle. Thus in universal mil, l1m, machine in addition to three movement as incorporated in plain milling machine, the table may have a fourth movement when its fed at an angle to the Milling cutter. This additional feature enables it to perform helical milling operation which cannot be done on plain milling machine. The capacity of universal milling machine is considerably increased by use of special attachment such as dividing head or index head, vertical milling attachment, rotary attachment etc.



Principle parts of universal milling machine

1. **Base :** base of machine is grey iron casting accurately machined on its top & bottom surface & serves as foundation member for all other parts which rests upon it .it carries the column on its one end.
2. **Column:** it is supporting frame mounted vertically on the base .The column is box shaped, heavily ribbed inside & houses all the driving mechanism for spindle & table feed.

3. **Knee:** it is rigid grey iron casting that's slides up and down on the vertical ways of the column face. The adjustment of the height is effected by an elevating screw mounted on the hale that also supports the knee. The knee houses the feed mechanism of the table and different controls to operate it.

4. **Table:** table rests on the ways on the saddle and travel longitudinally. Top of the table is accurately finished and T- slots are provided for clamping the work and other Fixtures on it. A lead screw under the table engages a nut on the saddle to move the table horizontally by hand or power. In universal machine the table may also be swiveled horizontally.

5. **Spindle:** spindle of the machine is located in upper part of column and receives power from motor to belts, gears, clutches and transmit it to the arbor. Front end of spindle just projects from column face and is provided with tapered hole into which various suiting tools and arbors may be inserted.

6. **Arbor:** arbor may be considered as extension of machine spindle on which milling are securely mounted and rotated. Arbors are made with taper shanks for proper alignments with machine spindle having tapers hole at their nose.

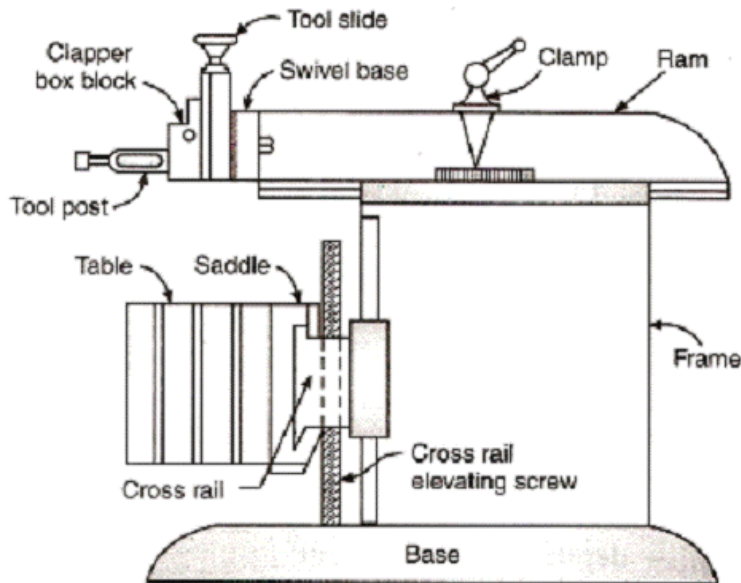
Milling machine size

The size of milling machine is designated by dimensions of working surface of table and its maximum length of longitudinal cross and vertical travel of table. In additions to above dimensions no. of spindle speed, no. of feed, nose taper, power available, net weight and floor space required etc. should also be stated in order to specify the machine fully.

Experiment No. 10

Aim: - To study the constructional features of the Shaper through drawing

Theory Shaper is a versatile machine which is primarily intended for producing flat surfaces. These surfaces may be horizontal, vertical or inclined. This machine involves the use of single point tool held in a properly designed tool box mounted on a reciprocating ram. The main significance of this machine lies in its great flexibility on account of ease in work holding, quick adjustment and use of tools of relatively simple design.



Principle parts of shaper

1. **Base:** it is heavy and robust cast iron body which acts as a support for all parts of machine which are mounted over it.
2. **Column:** it is mounted on the base and acts as housing for all the operating mechanisms of machine and the electricals. It also acts as a support for other parts of the machine such as cross rail and ram etc.
3. **Cross-rail:** it is heavy cast iron construction attached to the column. It carries two mechanisms, one for elevating the table and other for cross transverse of the table.
 1. **Table:** it is made of cast iron and has a box type construction. It holds and supports the work during the operation and slides along the cross rail to provide feed to the work.
 2. **Ram:** it is semi-circular in shape and provided with a ribbed construction inside for rigidity and strength. It carries the tool head and travels in ram ways to provide a straight line motion to the tool.
 6. **Vice:** It is a job holding device and is mounted on the table. It holds and supports the work during the operation. Alternatively, the job can be directly clamped to the machine table.

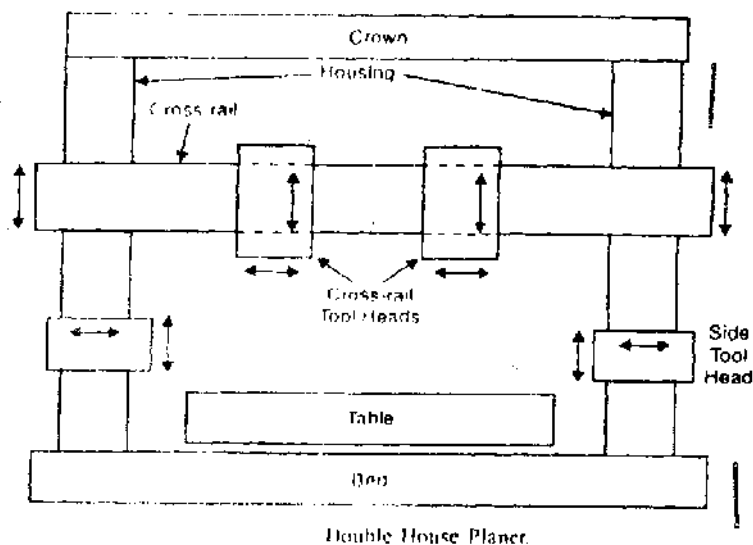
Size of shaper

Size of shaper is determined by maximum length of cut or stroke it can make. Maximum horizontal travel, vertical travel of the table, length and width of table top, no. of ram cycles per minute, maximum vice opening, net weight and floor space requirements etc. should also be stated in order to specify the machine fully.

Experiment No.11

Aim: - To study the constructional features of the Planer through drawing.

Theory: A planer is a large machine tool used for machining flat surfaces by means of single point cutting tool. The work to be machined is fastened securely to the planer table with suitable holding devices. This table has a reciprocating movement and the length of the stroke is three to five centimeter longer than the length of surfaces to be planed. The cutting operation on a planer is carried out by stationary cutting tool against the reciprocating. Job.



Principal parts of planer

1. **Bed:** The bed is large rigid box like casting that acts as the foundation of a machine. It supports the column and all other moving parts of the planer. The length of bed is slightly more than twice the length of table so that full length of table can move in it.
 2. **Table:** Table of planer is large rectangular thick cast plate that moves over the bed on sliding V-ways. The upper surface of the table has T-slots to facilitate the clamping of the workpieces, special fixture and vices with T-bolts. Its main function is to hold the workpieces and reciprocate on guide ways to impart motion to the job for a planning operation.
 3. **Housing:** The housing is a vertical casting that straddles the table and the bed of a planer. It acts as a support for the mechanism of tool head operations.
- Cross-rail:** the mechanism that acts as a guide for the transverse travel of the saddle is known as cross rail. Its supports the tool heads by means of feed screws. The cross rail can be move up and down by means of feed screws. Cross rails are rigidly connected to castings for accurate operations.
4. **Saddle:** the unit fitted to the ways of the cross-rail is known as saddle. The front of saddle is provided with ways to hold the tool head and feed screws. The saddle can be move in the crosswise direction over the table.

5. Tool head: the tool head of a planer is the part attached to the saddle that contains the tool post. In turn tool post holds the cutting tool. The tool post is so hinged to the head that the cutting tool is raised during the idle stroke. This saves the cutting edge of the tool. A planer may be fitted with two or more tool heads to perform more than one operation.

Size of planer

The size of standard planer is specified by the size of largest rectangular solid that can reciprocate under the tool. The size of largest solid is known by the distance between two housing, the height from top of table to cross rail in its upper most position and the maximum length of table travel.

Experiment No.12

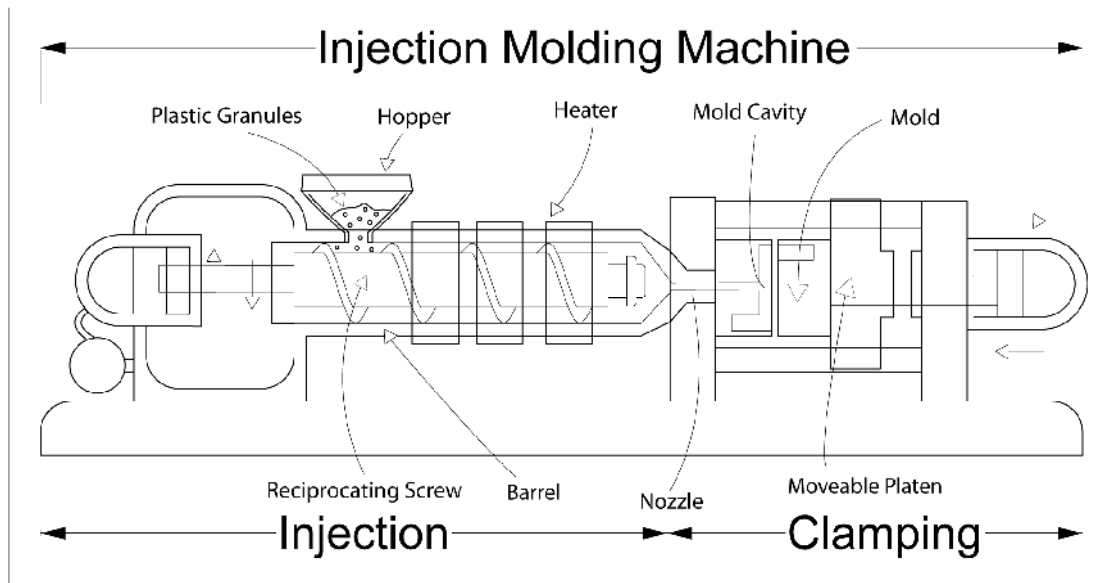
Aim: - To study the constructional features of the Plastic molding machines through drawing.

Theory

Molding machines are used to give a definite shape to the compounds. These machines impart various thermoplastic resins, thermoset polymers or metal injection molding (MINI) compounds into finished shapes. Current day molding machines are controlled by computer systems that act upon information that is provided by the sensors. After receiving the information, the automated system controls each action of the molding machine and ensures consistency in the output and quality of the end product. This reduction of the manual interference increases the chances of accuracy and also enhances the speed of entire process.

Depending on the input material, molding machines can be:

- Plastic injection molding machines
- Metal injection molding machines



Plastic molding machines are used to manufacture different plastic parts of any product, parts using the blow molding process. Depending on the requirement of the end product, different molding processes can be used. During plastic molding process, force is applied to the plastic material during and after it enters the mold. The product is released from the mold, as soon as it hardens.

- An injection unit, which melts the plastic and injects the plastic into the mold
- The clamping unit which holds the mold. The injection molding unit clamps the mold in a closed position during injection, opens the mold after cooling and ejects the finished part.

Plastic Injection molding is mainly used for producing complex shapes of various sizes having very fine details. The parts produced by using this method have greater dimensional control and can produce the products in bulk

Plastic Injection molding process's efficiency varies by the number of parts you plan to produce. For a small quantity, such as 10 parts, it may be less expensive to simply machine the desired part utilizing a CNC milling machine. On the other hand, if several thousand parts

have to be made, injection molding is ideal.

Some of the materials that are best suited for producing parts using Plastic Injection Molding are:

- ABS Acrylic Polycarbonate
- High Density Polyethylene
- Polyvinyl chloride
- Acetyl Polyamide
- Low Density Polyethylene
- Polypropylene Filled and Blended Plastics

Plastic molding is widely used for many applications, such as:

- Aerospace
- Hydraulics and Pneumatics Packaging
- Architecture Appliances
- Fiber Optics
- Medical and Dental
- Power Tools
- Agriculture
- Measuring Instruments

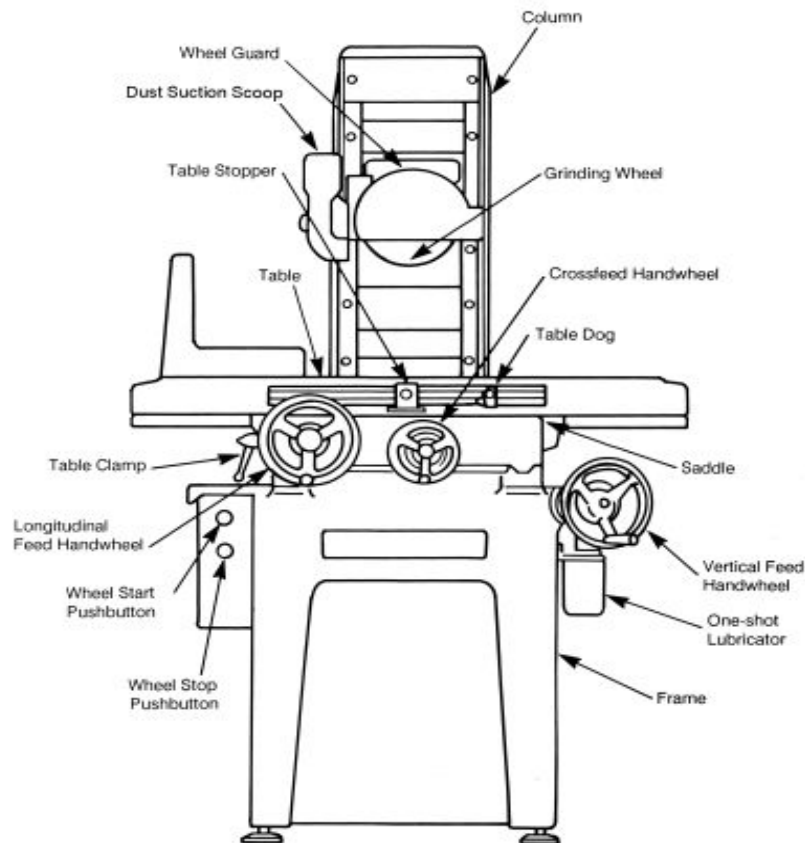
Experiment No. 13

Aim: - To study the constructional features of the Surface grinding machines through drawing.

Theory: Surface grinding machines are employed to finish plain or flat surfaces. They are also capable of grinding irregular, curved, convex and concave surfaces. There are basically four types of machines depending upon spindle direction and the table motion.

- Horizontal spindle and rotating table.
- Vertical spindle and rotating table.
- Horizontal spindle and reciprocating table.
- Vertical spindle and reciprocating table.

The majority of surface grinders are of horizontal table type. In the horizontal type of Machine grinding is done on the periphery of wheel. The area of contact is small and speed is uniform over the grinding surface. In the vertical type the surface grinders apply the face or side of wheel and cupped, cylindrical wheels are used.



Principal parts of Surface Grinder

- 1. Base:** the base has a column at the back for supporting wheel head. The base also ----as the drive mechanism.
- 2. Table:** the table is fitted to the saddle on carefully machined ways. It reciprocates along ways to provide the longitudinal feed. T-slots are provided in the table surface for clamping work pieces directly on table or for clamping grinding fixtures or magnetic chuck.

3- Wheel head: the wheel head is mounted on the column. It has ways for vertical slide can be raised or lowered with the grinding wheel only manually by rotating a hand wheel to accommodate workpieces of different heights.

Size of surface Grinder

Size of surface grinders are specified by the size of rectangular table, maximum distance from grinding wheel spindle to the table surface, grinding wheel diameter and speed, automatic cross feed rate and vertical feed rate, longitudinal feed of table, grinding wheel drive motor power and overall dimensions of machine.