MANUFACTURING PROCESSES

LABORATORY MANUAL

DEPARTMENT OF MECHANICAL ENGINEERING

LAB INCHARGE:

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LIST OF EXPERIMENTS:

Title
To prepare a green sand mold from the given pattern with and without core.
To perform sand Casting using a single mold cavity with core.
To perform sand Casting using a single mold cavity without core
To perform sand Casting with multi cavity mold.
To Study different parts of Universal lathe Machine.
To perform different lathe operations such as facing, turning and etc. on a given workpiece material.
To perform machining on flat surfaces of a given workpiece material by using shaper Machine.
To perform grinding on flat surfaces of a given workpiece material by using NC Surface Grinding Machine
To perform slotting & facing operations on a given Work piece material using Vertical Milling Machine.
To investigate the effects of varying voltage and current on spot welded specimen

Experiment 01:

Objective:

To prepare a green sand mold from the given pattern with and without core.

Problem Statement:

In a foundry industry, a fresh engineer is asked to perform casting. There may be the chances of disaster results if he is not well aware of mold preparation technique and has not practiced it enough. So, this experiment is being performed. Discuss your concluding remarks at the end of this experiment.

Theory:

In casting, a solid is melted, treated to proper temperature and then poured into a cavity called mold, which contains it in proper shape during solidification. Simple or complex shapes can be made from any metal that can be melted.

Advantages of Casting:

It is used in;

- production of complex shapes
- parts having hollow sections or internal cavities
- parts that contain irregular curved surfaces
- parts made from metals which are difficult to machine

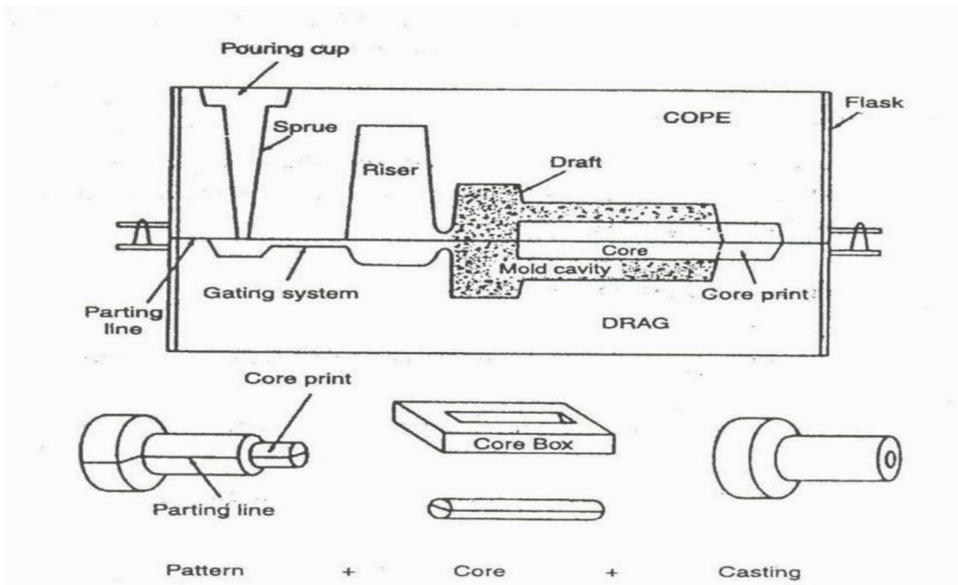
Sand Casting:

Sand casting, also known as sand-mold casting, consists of;

- pouring molten metal into a sand mold
- allowing the metal to solidify
- breaking up the mold to remove the casting

The casting must then be cleaned and inspected. The cavity in the sand mold is formed by packing sand around a pattern (an approximate duplicate of the part to be cast), and then removing the pattern by separating the mold into two halves. Since the mold is sacrificed to remove the casting, a new sand mold must be made for each part that is produced.

Sand casting includes not only the casting operation itself, but also the fabrication of the pattern and the making of the mold. Sand is one of the cheaper, fairly refractory materials and hence commonly used for making mold cavities. Sand basically, contains grains of silica (SiO_2) and some impurities. For mold making purposes sand is mixed with a binder material such as clay, molasses, oil, resin etc.



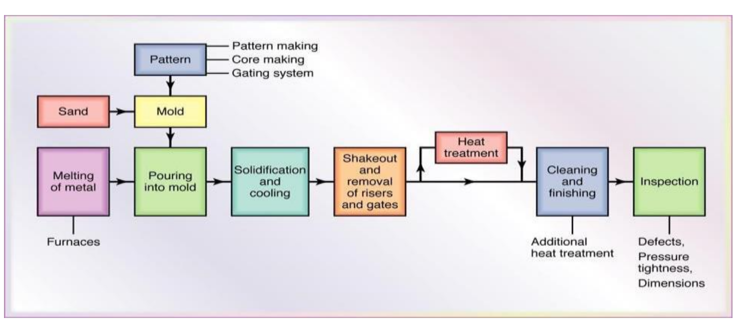
Green Sand Molding:

In green sand molding process;

- clay (a silicate material) along with water (to activate clay) is used as binder
- The mold making essentially consists of preparing a cavity having the same shape as the part to be cast

There are many ways to obtain such a cavity or mold, and in this demonstration, you will learn to make it using a pattern, metal ‘flasks’ and ‘green-sand’ as mold material.

A pattern is a reusable form having approximately the same shape and size as the part to be cast. A pattern can be made out of wood, metal or plastic; wood being the most common material. Green



sand refers to an intimate mixture of sand (usually river sand), bentonite clay (3-7 percent by weight of sand, to provide bonding or adhesion between sand grains), and water (3-6 percent by weight of sand, necessary to activate the bonding action of the clay).

Mixing the above ingredients in a sand muller best provides the intimate mixing action. In practice, a major part of this sand mixture consists of ‘return sand’, i.e. the reusable portion of the sand left after the solidified metal casting has been removed from the mold. Molding flasks are rectangular frames with open ends, which serve as containers in which the mold is prepared. Normally a pair of flasks is used; the upper flask is referred to as ‘Cope’ and the lower one as ‘drag’. A riddle is a relatively coarse sieve. Riddling the green sand helps in breaking the lump and aerates the sand. Sometimes the casting itself must have a hole or cavity in or on it. In that case the liquid metal must be prevented from filling certain portions of the mold. A ‘core’ is used to block-off portions of the mold from being filled by the liquid metal. A core is normally made using sand with a suitable binder like molasses. Core is prepared by filling the core-box with core sand to get the desired shape and the baking this sand core in an oven at suitable temperature. During mold making a suitable ‘gating system’ and a riser’ is also provided. The gating system is the network of channels used to deliver the molten metal from outside the mold into the mold cavity. The various components of the gating system are pouring cup, sprue, runners and gates. Riser or feeder head is a small cavity attached to the casting cavity and the liquid metal of the riser serves to compensate the shrinkage in the casting during solidification.

Types of Patterns:

- Single piece pattern.
- Two-piece pattern.
- Gated pattern.
- Multi piece pattern.
- Match plate pattern.
- Skeleton pattern.
- Sweep pattern.
- Lose piece pattern.

Procedure:

- Place a pattern in sand to create a mold.
- Incorporate the pattern and sand in a gating system.
- Remove the pattern.
- Fill the mold cavity with molten metal.
- Allow the metal to cool.
- Break away the sand mold and remove the casting.

Mold Making:

- Place the drag part of the molding flask and riddle molding green sand to a depth of 2 cm in the drag.
- Place the pattern at the center of the drag (flask)
- Pack the sand carefully around the pattern with figures. Heap more molding sand in the drag and ram with rammer carefully
- Place the core/ half of the pattern over the drag pattern matching the guide pins and also place the gating system with sprue and riser in proper positions.
- Complete the cope half by repeating steps 3. Remove the extra sprue and riser pins and make a pouring basin.

Applications:

Sand casting is used for a variety of applications to produce a wide range of parts including:

- Air compressor pistons.
- Bearings.
- Blowers & impellers.
- Bushings.
- Cams.
- Electronic equipment.
- Engine crankcases.
- Engine oil pans.

Comments:

- The pattern made have some defects
- The mold is not of good strength
- The pattern provided is rusted

Experiment 02&03:

Objectives:

To perform sand Casting using a single mold cavity without core.

Problem Statement:

An engineer working in foundry industry should understand molding, casting and melting practically. This experiment is being performed to serve this purpose. Discuss your concluding remarks at the end of this experiment.

Equipment:

Green sand mold, melting furnace, Pouring ladle, Reamer

Theory:

When the pattern is withdrawn, its imprint provides the mold cavity. This cavity is filled with metal to become the casting. - If the casting is to be hollow, additional patterns called 'cores', are used to form these cavities. Cores are placed into a mold cavity to form the interior surfaces of castings.

Defects in Casting:

Pinholes:

Pinholes, also sometimes referred to as *porosities*, are very tiny holes (about 2 mm) usually found in the cope (upper) part of the mold, in poorly vented pockets. They usually appear in large numbers together, either at the surface or just below the surface of the casting. They are always visible to the naked eye and don’t require equipment to identify.

Subsurface Blowholes:

Blowholes, or simply blows, are larger cavities than pinholes. A subsurface blowhole appears on the inside of a cast and usually isn’t visible until after machining.

Subsurface blowholes can be difficult to detect before machining, requiring harmonic, ultrasonic, magnetic or x-ray analysis.

Open Holes:

These blowholes appear on the surface of the cast and are easier to detect than subsurface blowholes.

Open Shrinkage:

These are open to the atmosphere. Air compensated as the shrinkage cavity forms. Pipes are open shrinkage defects that form at the surface and burrow into the casting. Caved surfaces are shallow, open shrinkage defects that form across the surface of the casting.

Closed Shrinkage:

Also known as shrinkage porosity, closed shrinkage defects form within the casting. Macro shrinkage can be viewed with the naked eye, but micro shrinkage cannot. Closed shrinkage defects usually appear at the top of hot spots, or isolated pools of hot liquid.

Cuts & Washes:

Cuts and washes are areas of excess metal. These appear when the molten metal erodes the molding sand. A cut appears as a low projection along the surface of the drag face, decreasing in height

Fusions:

Fusion occurs when sand grains fuse with molten metal. It appears as a thin crust with a brittle, glassy appearance firmly adhered to the casting.

Run Outs:

Run out is when liquid metal leaks out of the mold, leading to an incomplete or missing casting.

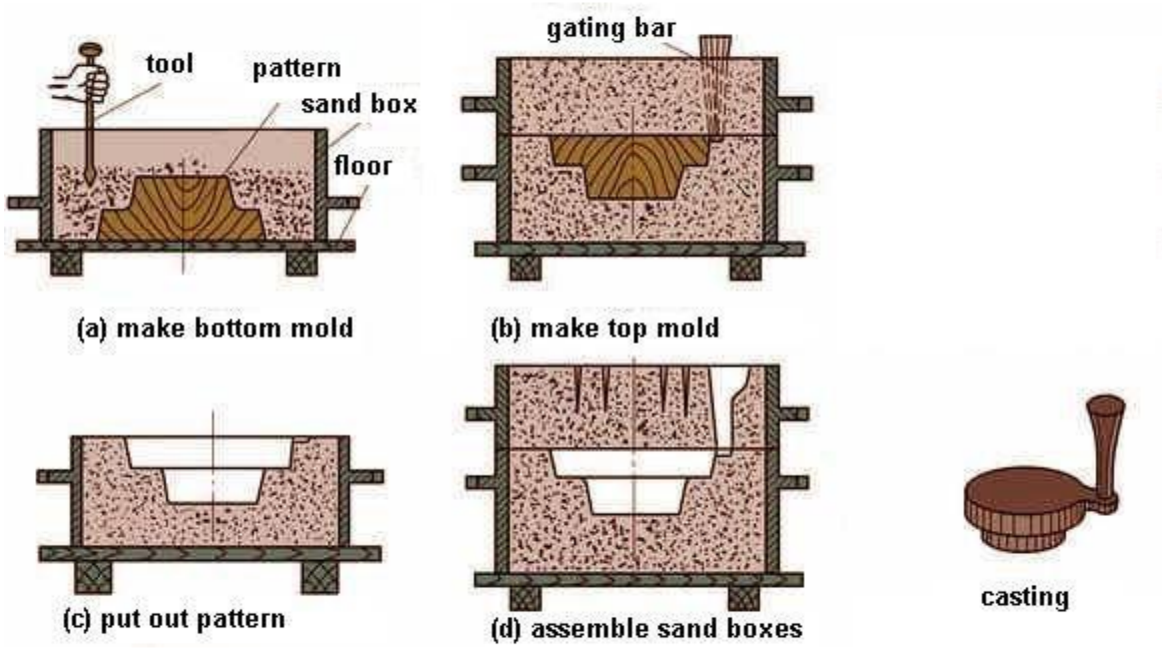
Swells:

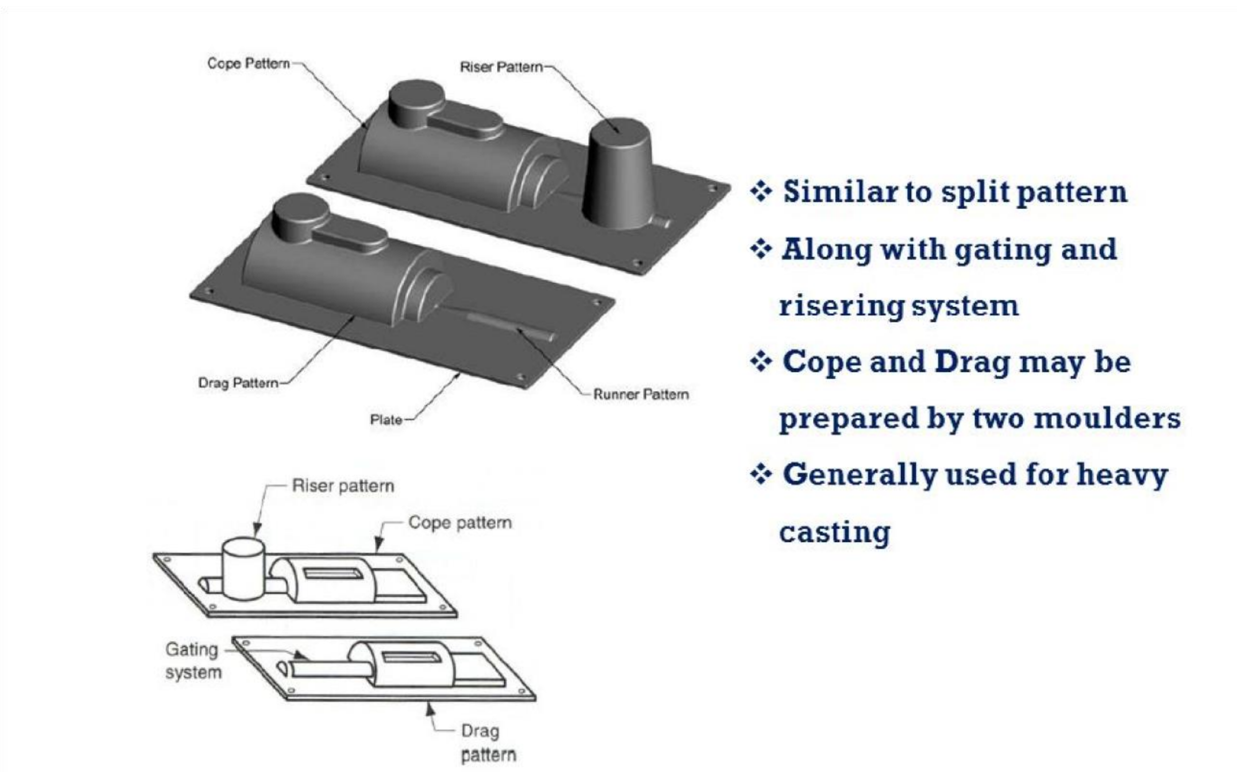
Swells are an enlargement of the casting. Swells typically take on the shape of a slight, smooth bulge on the vertical face of castings

Drops:

Drops occur when pieces of sand fall into metal casting when it’s still liquid. Drops appear as an irregularly shaped projection on the cope (top) surface of a casting.

Diagram:





Procedure:

- Melt the metal in the furnace. Use appropriate fluxes at proper stages and measure metal temperature from time to time.

- Pour the molten metal into the pouring ladle at a higher temperature than the pouring temperature. As soon as the desired pouring temperature is reached, pour the liquid metal into the mold in a steady stream with ladle close to the pouring basin of the mold. Do not allow any dross or slag to go in.

- Allow sufficient time for the metal to solidify in the mold. Break the mold carefully and remove the casting.

- Cut-off the riser and gating system from the casting and clean it for any sand etc.

- Inspect the casting visually and record any surface and dimensional defects observe.

Applications:

casting is used for a variety of applications to produce a wide range of parts including:

- Air compressor pistons.
- Bearings.
- Blowers & impellers.
- Bushings.
- Cams.
- Electronic equipment.
- Engine crankcases. Engine oil pans.

Comments:

- When placing core, the mold often damaged.
- Due to less strength of the mold the part may contain defects.
- The core may not properly shaped.

Experiment 04:

Objective:

Casting with multi cavity mold.

Problem Statement:

When castings are to be produced at a higher production rate, then multi cavity molds are used. This experiment is performed to provide students the understanding of this process

Equipment & Materials:

Patterns, molding flasks, molding tools, sand Muller, riddle, sand, melting furnace, pouring ladle.

Theory:

Production Rate:

Production rate is defined as the amount of non-defective parts produced by a manufacturing process within a set time. Typically, the production rate is given as the number of parts per hour.

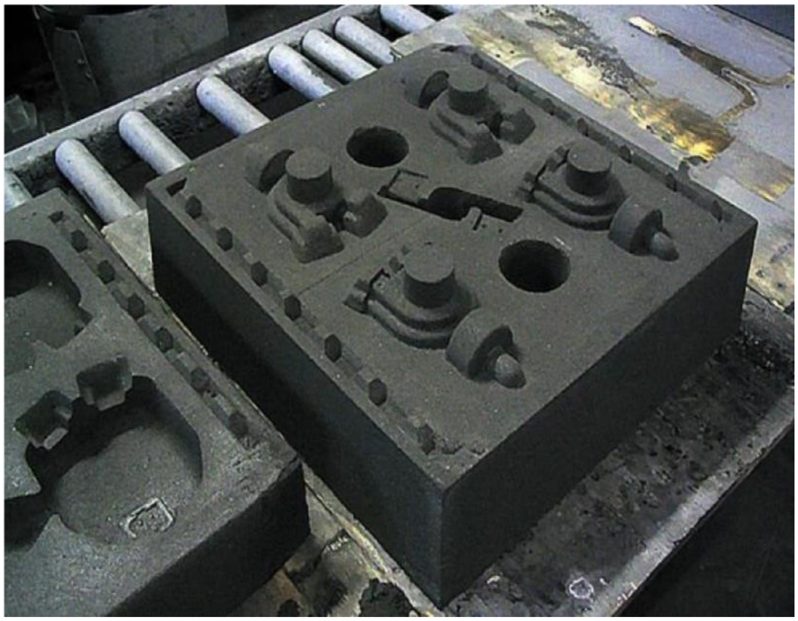
Multi Cavity Mold:

Multi cavity mold, as the name shows, has more than one cavities, so, produces two or more castings at the same time. Mold making is a time-consuming process. Producing two or more cavities in the same mold saves time and material, which in turn increases production rate and reduces cost of producing the mold.

Types of Molds in sand casting:

Sand casting is a process that utilizes non-reusable sand molds to form metal castings. Sand molds can be formed to create castings with fine exterior detail, inner cores, and other shapes. Nearly any metal alloy can be sand cast.

Hollows are made in moistened sand, filled with molten metal, and left to cool.



Greensand mold

Greensand mold - Greensand molds use a mixture of sand, water, and a clay or binder. Typical composition of the mixture is 90% sand, 3% water, and 7% clay or binder. Greensand molds are the least expensive and most widely used.

Procedure:

- Place a pattern in sand to create a mold.
- Incorporate the pattern and sand in a gating system.
- Remove the pattern.
- Fill the mold cavity with molten metal.
- Allow the metal to cool.
- Break away the sand mold and remove the casting.

Mold Making:

- Place the drag part of molding flask on the molding board.
- Place the patterns at the center of the drag.
- Sprinkle the chalk powder and fill the drag with green sand and ram it with rammer.
- Level the sand using strike-off bar and turn the drag.

- Place the core half of the pattern over the drag pattern matching the guide pins and place the gating system with sprue and riser in proper positions.
- Complete the cope half by repeating steps 3. Remove the extra sprue and riser pins and make a pouring basin.

Melting and Pouring:

- Melt the metal in the furnace. Use appropriate fluxes at proper stages and measure metal temperature from time to time.
- Pour the molten metal into the pouring ladle at a higher temperature than the pouring temperature. As soon as the desired pouring temperature is reached, pour the liquid metal into the mold in a steady stream with ladle close to the pouring basin of the mold. Do not allow any dross or slag to go in.
- Allow sufficient time for the metal to solidify in the mold. Break the mold carefully and remove the casting.
- Cut-off the riser and gating system from the casting and clean it for any sand etc.
- Inspect the casting visually and record any surface and dimensional defects observe.

Applications:

Sand casting is used for a variety of applications to produce a wide range of parts including:

- Air compressor pistons.
- Bearings.
- Blowers & impellers.
- Bushings.
- Cams.
- Electronic equipment.
- Engine crankcases.
- Engine oil pans.

Comments:

- Green sand mold depends on the mixture of material we used
- Mold damaged due to more liquidity
- Mold contain defects due to contamination

Experiment 05:

Objective:

After performing this lab session, students will be able to select different settings on the spot welding and perform the welding process.

Problem statement:

Spot welding is commonly used welding process for joining of sheet metals e.g. car bodies. Engineers should understand different process parameters of spot welding. This experiment is designed to serve this purpose.

Equipment and Materials:

Spot Welding Machine, Specimen, sand paper.

Theory:

In resistance welding (RW) a low voltage and high current is passed through the joint for a very short time (typically 0.25 s). This high amperage heats the joint, due to the contact resistance of the joint and melts it. The pressure on the joint is continuously maintained and the metal fuses together under this pressure.

The heat generated in resistance welding can be expressed as H = k i2 R t

Where H = the total heat generated in the work, J

I = electric current, A

t = time for which the electric current is passing through the joint, s R =

the resistance of the joint, ohms

And k = a constant to account for the heat losses from the welded joint.

- The resistance of the joint, R is a complex factor to know because it is composed of
- The resistance of the electrodes,
- The contact resistance between the electrode and the work piece, The contact resistance between the two work piece plates, The resistance of the work piece plates.

The amount of heat released is directly proportional to the resistance. It is likely to be released at all of the above-mentioned points, but the only place where a large amount of heat is to be generated to have an effective fusion is at the interface between the two work piece plates. Therefore, the rest of the component resistances should be made as small as possible, since the heat released at those places would not aid in the welding.

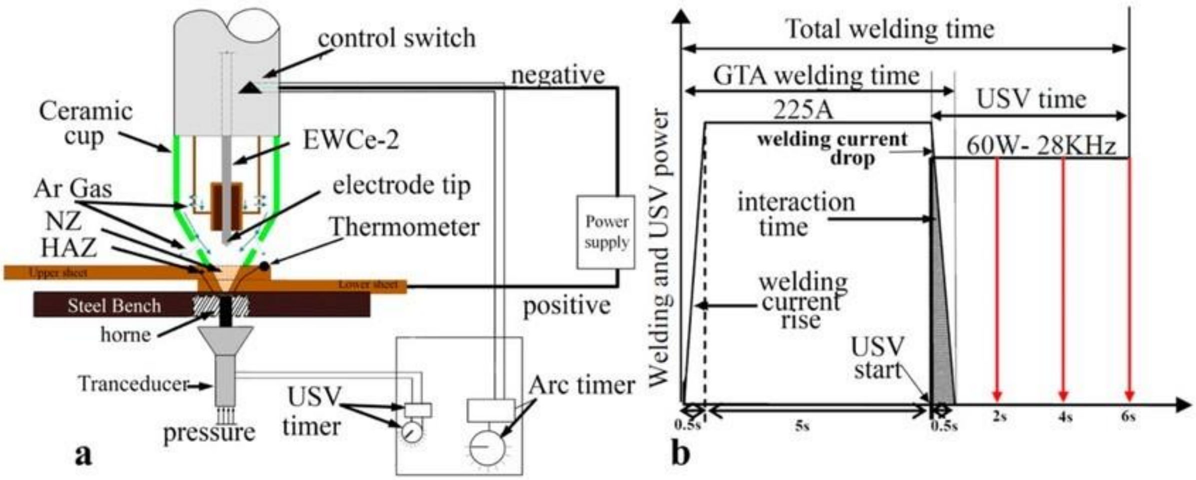
The main requirement of the process is the low voltage and high current power supply. This is obtained by means of a step-down transformer with a provision to have different tapings on the primary side, as required for different materials. The secondary windings are connected to the electrodes which are made of copper to reduce their electrical resistance.

The time of the electric supply needs to be closely controlled so that the heat released is just

enough to melt the joint and the subsequent fusion takes place due to the force (forge welding) on the joint. The force required can be provided either mechanically, hydraulically or pneumatically. The critical variable in a resistance welding process is the contact resistance between the two work piece plates and their resistances themselves. The contact resistance is affected by the surface finish on the plates, since the rougher surfaces have higher contact resistance. The contact resistance also will be affected by the cleanliness of the surface. Oxides or other contaminants if present should be removed before attempting resistance welding.

Procedure:

- Receive the specimens and sand paper from the lab assistant.
- Remove the rust from the specimens by using sand paper.
- Wear gloves and goggles.
- Turn on the spot-welding machine and select the voltage as instructed.
- Place the specimens between the electrodes to form a lap joint.
- Press the foot pedal to lower the upper electrode to start welding process.



- Remove your foot from the pedal as soon as the weld forms (typical time= 0.25 Sec) Wait for the cooling of the specimen.
- Submit the specimen to the teacher along with a one-page report of the experiment.

Application:

- Spot welding is used in automobiles, battery manufacturing and electronics applications.
- Skilled workers such as dentists also use spot welding in orthodontics field.
- Besides this, fabrication and repair shots extensively use spot welding.
- For effective joineries and applications, make sure to select OR Laser.

Comments:

- It is difficult to make grip on things while wearing the welding gloves.
- We are unable to see the object we have to weld after wearing the welding helmet.
- Due to poor ventilation system the smoke gathered in the room causing suffocation.

Experiment 06:

Objective:

After performing this lab session, students will be able to select different settings on the Arc welding and perform the welding process.

Problem statement:

Arc welding is commonly used welding process for joining of different objects. Engineers should understand different process parameters of arc welding. This experiment is designed to serve this purpose.

Equipment and Materials:

Arc Welding Machine, Specimen, Filler Stick.

Theory:

Terminology:

Following are the given terminologies;

Electrode:

A rod that is used in arc welding to carry a current through a work piece to fuse two pieces together. In some welding processes, the electrode may also act as the filler metal.

Filler metal:

Metal deposited into the weld to add strength and mass to the welded joint.

Flux:

A chemical cleaning agent that is applied to a joint just prior to the welding process to clean and protect the metal surface from surface oxides that form as a result of heating.

Porosity:

The appearance of tiny bubbles on a weld bead as a result of gas entrapment; excessive porosity can weaken a weld.

Root opening:

The separation at the joint root between the base metals.

Shielding Gas:

Inert or semi-inert gas that is used to protect the weld puddle and arc from reacting negatively with the atmosphere.

Slag:

Cooled flux that forms over the top of the weld; slag protects the cooling metal and is then chipped off.

Spatter:

Liquid metal droplets expelled from the welding process.

Weldability:

The ability of a material to be welded under prescribed conditions and to perform as intended.

Background Information:

Safety is a critical consideration for any welding application. Arc welding is a safe occupation when proper precautions are taken. If safety awareness is not a priority, welders face an array of hazards that can be potentially dangerous, including electric shock, fumes, fire, explosions, and more. Knowing how to avoid the most common welding hazards ensures a safe, productive work environment.

Electric Shock:

Electric shock is one of the most serious and immediate risks facing a welder. Electric shock can lead to severe injury or death, either from the shock itself or from a fall caused by the reaction to a shock.

Electric shock in welding can come from two sources. Welding machines connected to primary voltages of typically 120V, 230V or 460V pose the greatest threat. Connection and maintenance of the primary system should only be done by qualified personnel. Inside the machine, primary voltages are transformed to the secondary voltages and currents required for the welding arc. Once energized, many components of the welding operation are electrically “hot” including the electrode holder, gun or torch, the wire feeder, and the spool or coil of wire.

An electrical circuit exists between these and the work connection. If welders insert themselves into this circuit, shock will occur. Care should be taken to wear the proper personal protective equipment (PPE) and assure that they are in good repair. Even heavy welding gloves, if wet, can cause shock to the welder. Welding equipment electrical systems should only be installed and repaired by qualified personnel.

Eye and Face Protection:

The proper eye and face protection for welding safety varies depending on the welding process, its heat or current, and other factors. Helmets, hand shields, goggles, safety glasses, or a combination of these may be required based on the application. Arc welding requires the proper filter lens shade based on process and current settings.

According to OSHA 29 CFR 1910.252, "Helmets and hand shields shall protect the face, forehead, neck and ears to a vertical line in back of the ears, from the arc direct radiant energy and weld spatter."

OSHA requires that when arc cutting or arc welding with open arc, helmets or hand shields with filter lenses and cover plates be used by welders and welding operators. Anyone in the area welding should be shielded from the arc or be wearing proper eye protection. Safety glasses with a Shade 2 lens are recommended for general-purpose protection for distant workers who may inadvertently view the arc.

Protective Clothing:

The ANSI standard requires all welders and cutters to wear protective flame-resistant gloves, such as leather welder's gloves, which provide the heat resistance needed for welding. Gloves should have cuffs long enough to cover any exposed skin and should be insulated enough to keep the heat from reaching the welder's hands.

Fumes and Gases:

Many welding operations produce fumes from the base metal and its coatings and from the burning of the welding consumable. It is always important to keep your head out of the fumes. Ventilation, either natural or mechanical, is required to reduce exposure to the harmful metal oxides produced in the welding operation.

Safety data sheets are available from consumable manufacturers outlining the specific potential health effects which relate to that product.

Arc Welding:

Background Information:

Shielded metal arc welding (SMAW), also called "stick welding," or in many other countries manual metal arc (MMA), is an arc welding process that uses a solid rod coated with flux. This rod or electrode can be made from a variety of metals and flux components, making the process one of the most versatile in welding many materials.

The rod carries electric current from a power supply to create an arc that melts both the base metal and the rod. As the weld is deposited, the flux coating of the electrode provides both a shielding gas (by burning of flux components) and a slag layer that protects the molten metal from the atmosphere.

Significance and Use:

- SMAW dominates other welding processes in the maintenance and repair industry.
- Although flux-cored arc welding is growing in popularity, SMAW continues to be used extensively in the construction of steel structures and in industrial fabrication.
- The process is used primarily to weld iron and steels
- This is also including stainless steel, but most alloys can be welded with this method.

Procedure:

- The electrode is placed in an electrode holder, which is connected to one lug of a constant current welding power supply.
- This power supply can be operated on alternating current (AC), direct current electrode positive (DCEP),
- This can also be work on direct current electrode negative (DCEN) depending on the type of electrode being used.

- A cable connected to the work is attached to the other lug.
- The machine is energized and the electrode is lightly touched to the work
- The arc is then initiated.
- The welder then manually moves the electrode along the weld joint.

Advantages:

- Wide variety of metals welded due to wide choice of electrodes
- Simple and portable equipment
- Low cost
- Adaptable to confined spaces and remote locations
- Suitable for out-of-position welding

Applications:

- Shipbuilding.

- Industrial piping.
- Railroads. • Maintenance and repair.

Comments:

- Slag is trapped in the weld
- Relatively high metal wastage (electrode stubs)
- Frequent stop/starts to change electrode

Experiment 07:

Objective:

After performing this lab session, students will be able to select different settings on the Oxy – acetylene welding and perform the welding process.

Problem statement:

Gas welding is commonly used welding process for joining of different objects. Engineers should understand different process parameters of gas welding. This experiment is designed to serve this purpose.

Equipment and Materials:

Oxy – acetylene Gas Welding Machine, MS sheets 150x50x1mm.

Tools Required:

Wire brush, hand gloves, and chipping hammer, spark lighter.

Theory:

Introduction:

Gas welding has been around for many years and when it is carried out by a skilled operator, it can be useful in welding a wide range of materials. It has, however, been largely superseded by more modern welding methods yet it remains a desirable base skill for welding and associated trades.

Gas welding process overview:

Oxygen and acetylene together in a flame provide the heat necessary to melt most metals. This combined with a neutral welding atmosphere and suitable filler material allows a skilled operator to weld most metals. Other fuel gases such as LPG or propane produce a reactive secondary flame that interferes with the molten metal, making them unsuitable for welding. These and other fuel gases are suitable for heating and cutting purposes.

- Personal safety for oxygen-fuel gas plant use, including:
- What you should wear when using an oxygen-fuel gas plant
- Personal safety for oxygen-fuel gas plant operators
- Ventilation
- Fire prevention
- Eye protection
- Safety when oxygen-fuel gas cutting and welding.

Personal safety for oxygen-fuel gas plant use:

It is important that you always wear the proper safety clothing when you are working with any oxy-fuel gas equipment or electrical welding equipment. For general fabrication or welding, or when working near machinery or on scaffolding, it is essential that you wear heavy-duty clothes which do not have lots of pockets or loose material which can easily get caught up in moving parts or equipment.

Loose-fitting shirts or old baggy windcheaters with floppy sleeves could put your life in danger. It is important to make sure that the trousers you wear do not have cuffs as these have been the cause of many a trip to hospital because of fire and burns. In some factories, cuffs have even collected explosive or poisonous dust. It is better to wear short sleeves rather than rolled-up sleeves. However, if you are engaged in gas cutting or electric welding operations, long sleeves should be worn with the recommended protective clothing. Remove wristwatches and rings as these too can get caught up in the machinery.

Do not wear old worn shoes or boots. Loose laces and ragged soles or heels can cause serious falls. Wear sound, sturdy, safe shoes or safety boots. Remember that if the job requires special protective clothing, you must wear it, even if it causes you a bit of inconvenience. It could save you from death or from serious injury. Unrestrained hair hanging down has been the cause of many scalping accidents.

Always wear a hat, a beret or a hairnet when working near moving machinery.

The operator should wear:

- A long-sleeved cotton shirt (non-flammable)
- Sleeves rolled down and buttoned
- Hard-wearing trousers without cuffs (fire resistant)
- Sturdy leather shoes or work boots (spark resistant, steel toe cap)
- An apron (leather)
- gloves (leather)
- Cats (leather)

- Caps (non-flammable)
- A leather cape or jacket
- Eye protection
- Ear protection

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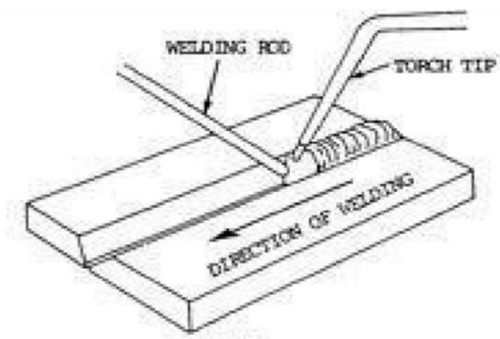


NOTE
TORCH AND ROD ANGLES ARE 45 DEG AS VIEWED BY THE OPERATOR AND PERPENDICULAR (90 DEG) TO THE WORK SURFACE AS VIEWED FROM THE END OF THE WORKPIECE.

Figure 11-4. Forehand welding.

Procedure:

- Acetylene valve on the torch is opened slightly and lightened with the help of a spark lighter.
- Now acetylene valve is opened to get required the flow of acetylene.
- Oxygen valve is opened till the intermediate flame feather reduces into inner cone to get a neutral flame.
- The torch tip is to be positioned above the plates so that white cone is at a distance of 1.5mm to 3mm from the plates.
- Torch is to be held at an angle of 300 to 450 to the horizontal plane. Now filler rod is to be held at a distance of 10mm from the flame and 1.5 mm to 3 mm from the surface of the weld pool.
- As the backward welding allows better penetration, back ward welding is to be used.

After the completion of welding, slag is to be removed by means of chipping hammer, wire brush

Applications:

- Repair works is one of the most common applications of gas welding is for repair works.
- Fabrication of sheet metal is the application Thin to medium sheet metals are easily weld using gas welding.
- Aircraft industry is also the area in which Oxy-Acetylene welding is used in joining various aircraft parts

Comments:

- Dangerous to Work on such a high temperature

Weld lines are much rougher in appearance than other kinds of welds

Experiment No. 8

Title:

To perform grinding on flat surfaces of a given workpiece material by using NC Surface Grinding Machine.

Objective:

After performing this lab session, students will be able to understand the basics of NC Surface Grinding Machine and its operations.

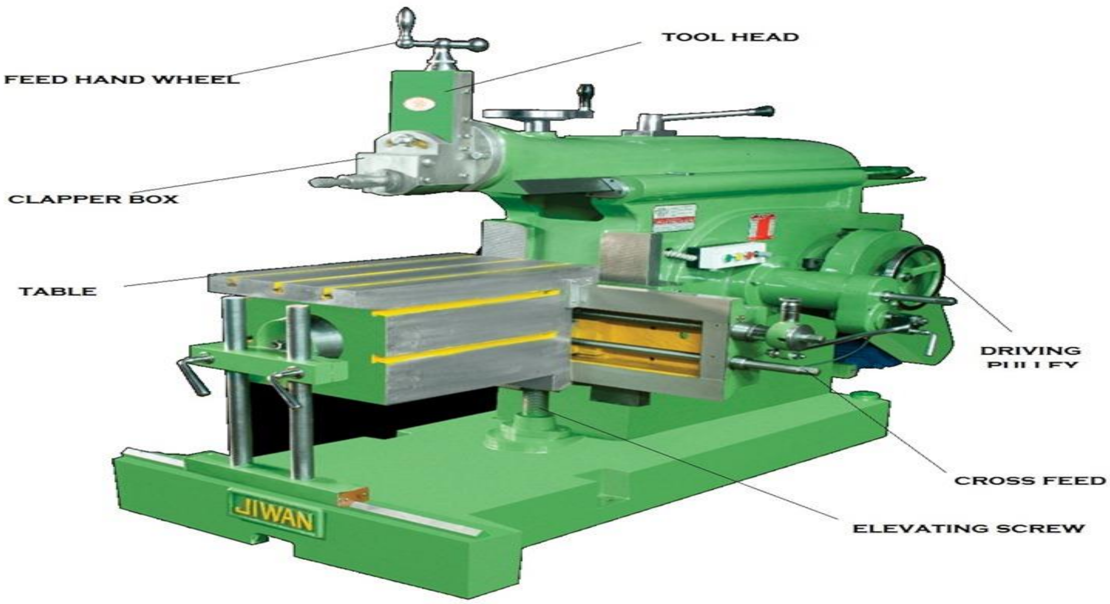
Problem statement:

In a manufacturing industry, an engineer is asked to work on the Grinding machine without any kind of training. There may be the chances of disaster results in the form of workpiece or cutting tool damage or injury due to improper clamping. That's why, this experiment is being performed. Discuss your concluding remarks at the end of this experiment.

Equipment and Materials:

Alumina Abrasive wheel, Iron workpiece, Magnetic Plate, Table Stopper, Cross slide stopper, Clutch lever, Grinding wheel control lever, Digital read out, Co-ordinate Measuring machine.

Theory: Introduction to NC Surface Grinder Machine:



PARTS OF SHAPER MACHINE

Grinding is a process of removing material by the abrasive action of a revolving wheel on the surface of a work-piece, in order to bring it to the required size and shape. The wheel used for performing the grinding operation is known as grinding wheel. It consists of sharp crystals, called abrasives, held together by a binding material or bond. The wheel may be a single piece or solid type or may be composed of several segments of abrasive blocks joined together.

Procedure:

1: Clamp the workpiece in the magnetic plate.

2: Adjust the table movement by table stopper and cross slide movement by cross slide stopper.

3Adjust the reference point by grinding wheel control lever.

3: Adjust the number of strokes and depth of cut by digital read out.

4: Perform the required grinding operation in microns.

5: Measure the dimensions of the workpiece.

6: De-magnetize the workpiece and in this way, the experiment is completed.

Questions:

How many axis An NC grinder Machine has?

What are the elements of a Grinding Machine responsible for the movement of grinding wheel?

Differentiate between surface and cylindrical grinding?

Comments:

Experiment No.9

Objective:

To perform slotting & facing operations on a given Work piece material using Vertical Milling Machine.

Problem Statement:

In industry, a fresh engineer is assigned to work on Vertical Milling Machine without any training on commands and hand on experience. There may be chances of severe conditions. That's why, this experiment is being performed. Comment on this decision on the basis of your results.

Apparatus:

Milling machine, Mild steel plate, End Mill

Theory:

Milling Machine:

A milling machine is a machine tool used for the shaping of metal and other solid material. Unlike a drill press, in which the work piece is held stationary and the drill is moved vertically to penetrate the material, milling also involves movement of the work piece against the rotating cutter, the latter which is able to cut on its flanks as well as its tip. Milling machines may be manually operated, mechanically automated, or digitally automated via computer numerical control (CNC).

Types of Milling Machines:

1. Horizontal 2. Vertical

Horizontal milling machine:

Horizontal mill has the same sort of *x–y* table, but the cutters are mounted on a horizontal arbor across the table. While end mills and the other types of tools available to a vertical mill may be used in a horizontal mill, their real advantage lies in arbor-mounted cutters, called side and face mills, which have a cross section rather like a circular saw, but are generally wider and smaller in diameter.

Uses:

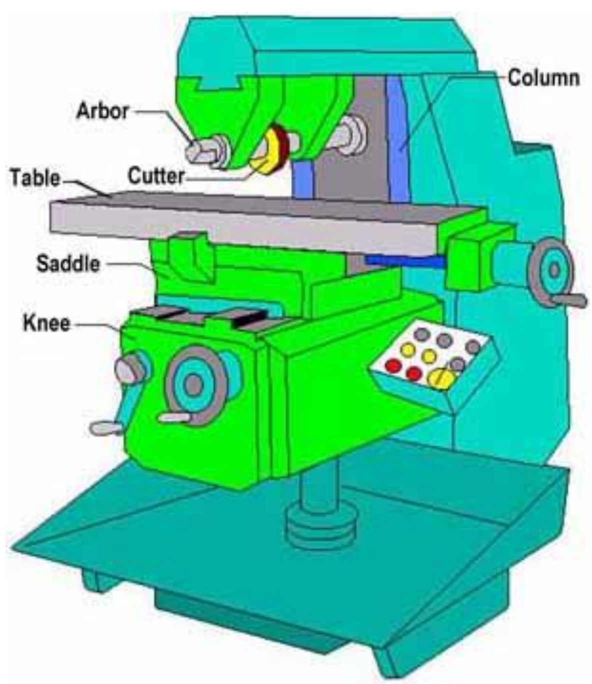
These are used to mill grooves and slots. Plain mills are used to shape flat surfaces. Several cutters may be ganged together on the arbor to mill a complex shape of slots and planes. Special cutters can also cut grooves, bevels, radii, or indeed any section desired. These specialty cutters tend to be expensive. Simplex mills have one spindle, and duplex mills have two. It is also easier to cut gears on a horizontal mill.

Vertical milling machine:

Vertical milling machine is so named because spindle is at right angle to the surface of the table.

Parts of Vertical Milling Machine:

The vertical knee mill is the most common milling machine found in machine shops today. Therefore it will be used as an example to describe the general parts of all mills.



Head:

The head (drive) is that part of the drive system that transforms electrical power from a motor to mechanical power in the spindle. The drive system also allows the machinist to change the speed of the spindle (RPM) and therefore the cutting tool. The quill moves vertically in the head and contains the spindle in which cutting tools are installed.

Column:

The column is the most important part which is mounted on the base and acts as a support and holding device for all the other parts of a milling machine. It acts as a support for table and all feed mechanisms. The column should be rigid enough to sustain all the forces produced due to the drilling action of the tool. The head and worktable are mounted with column.

Work table:

It gives the motion in X-direction.

Saddle:

It gives the motion in Y-direction

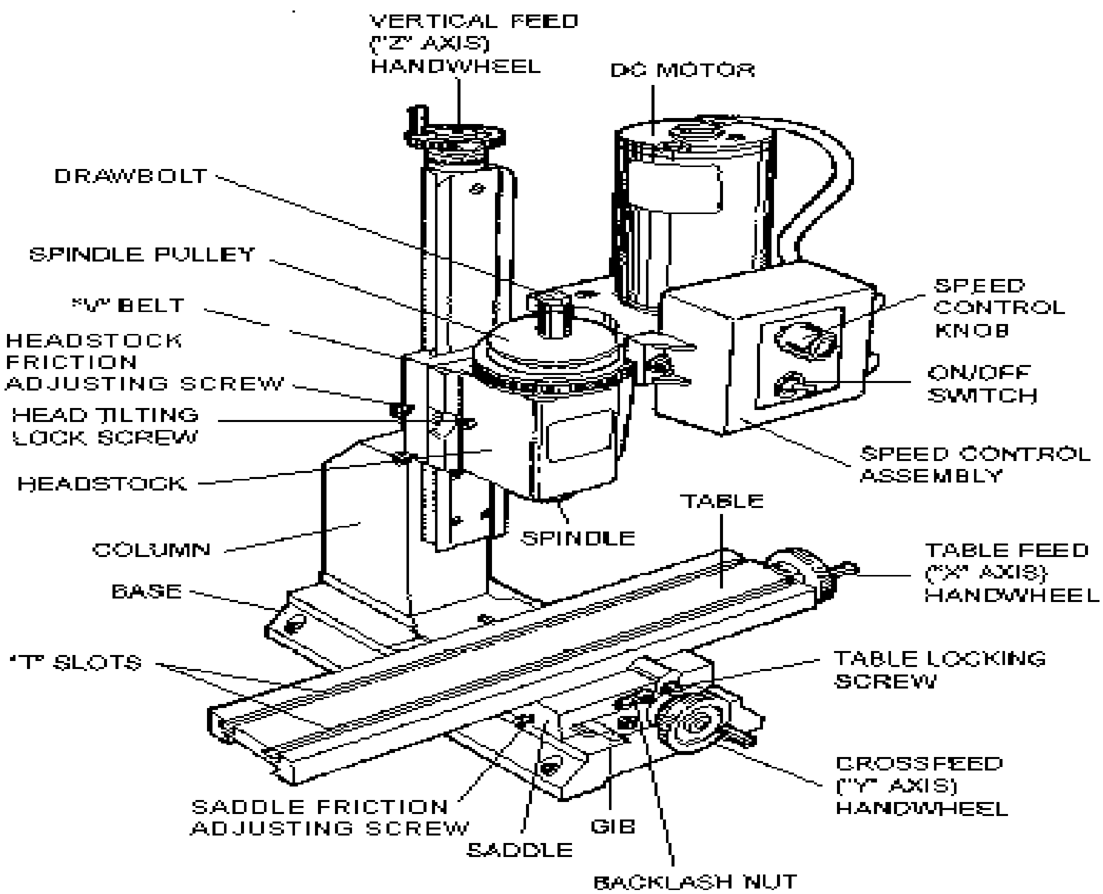


Fig. 10.1 The complete description of parts as shown in diagram

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Knee:

It gives the motion in Z-direction. The saddle sits on the knee and allows translation of the worktable. Sitting on the base is the column whose main function is to hold the turret. The turret allows the milling head to be rotated around the column's center. The over arm (ram) slides on the turret and allows the milling head to be repositioned over the table.

Base:

The whole machine is mounted on this part. The base is that part of a machine on which the column is mounted. In the belt driven milling machines both the fast and loose pulley and cone pulley are also mounted on the base. In general the base is of a circular cross section when viewed from top. The base also has T-slots on it facilitating holding of large pieces for machining.

Procedure:

1: Clamp the work piece in vice.

2: Mount the end mill cutter in collet chuck.

3: Adjust the rpm of tool and feed.

4: Take a reference point

5: Take a depth of cut

6: Perform the slotting operations with help of end mill.

7: Unclamp the work piece when the required operations have been completed.

Questions:

1. **How many motion axis are present in milling machine in your lab. Also tell the type of Milling Machine?**

2. **Differentiate between up milling and down milling?**

3. **Write down some methods to increase the production rate in case of machining thousands of parts on a milling machine?**

Comments:

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Experiment No.10

Title: To investigate the effects of varying voltage and current on spot welded specimen

Objective:

After performing this lab session, students will be able to select different settings on the spot welding and perform the welding process.

Problem statement:

Spot welding is commonly used welding process for joining of sheet metals e.g. car bodies. Engineers should understand different process parameters of spot welding. This experiment is designed to serve this purpose.

Equipment and Materials:

Spot Welding Machine, Specimen, Sand Paper.

Theory:

In resistance welding (RW) a low voltage and high current is passed through the joint for a very short time (typically 0.25 s). This high amperage heats the joint, due to the contact resistance of the joint and melts it. The pressure on the joint is continuously maintained and the metal fuses together under this pressure. The heat generated in resistance welding can be expressed as

$H = k\, i^2\, R\, t$

Where H = the total heat generated in the work, J

i = electric current, A

t = time for which the electric current is passing through the joint, s

R = the resistance of the joint, ohms

and k = a constant to account for the heat losses from the welded joint.

The resistance of the joint, R is a complex factor to know because it is composed of

i. The resistance of the electrodes,
ii. The contact resistance between the electrode and the work piece,
iii. The contact resistance between the two work piece plates,
iv. The resistance of the work piece plates.

The amount of heat released is directly proportional to the resistance. It is likely to be released at all of the above-mentioned points, but the only place where a large amount of heat is to be generated to have an effective fusion is at the interface between the two work piece plates. Therefore, the rest of the component resistances should be made as small as possible, since the heat released at those places would not aid in the welding.

The main requirement of the process is the low voltage and high current power supply. This is obtained by means of a step down transformer with a provision to have different tappings on the primary side, as required for different materials. The secondary windings are connected to the electrodes which are made of copper to reduce their electrical resistance. The time of the electric supply needs to be closely controlled so that the heat released is just enough to melt the joint and the subsequent fusion takes place due to the force (forge welding) on the joint. The force required can be provided either mechanically, hydraulically or pneumatically. The critical variable in a resistance welding process is the contact resistance between the two work piece plates and their resistances themselves. The contact resistance is affected by the surface finish on the plates, since the rougher surfaces have higher contact resistance. The contact resistance also will be affected by the cleanliness of the surface. Oxides or other contaminants if present should be removed before attempting resistance welding.

Students are requested to insert a labelled picture of spot welding equipment in their lab

reports.

Procedure

i. Receive the specimens and sand paper from the lab assistant.
ii. Remove the rust from the specimens by using sand paper.
iii. Wear gloves and goggles.
iv. Turn on the spot welding machine and select the voltage as instructed.
v. Place the specimens between the electrodes to form a lap joint.
vi. Press the foot pedal to lower the upper electrode to start welding process.
vii. Remove your foot from the pedal as soon as the weld forms (typical time= 0.25 Sec)
viii. Wait for the cooling of the specimen.
ix. Submit the specimen to the teacher along with a one-page report of the experiment.

Observations

Students are requested to insert table of their observations along with picture of the specimen.

Safety Precautions

Students are requested to write safety precautions as instructed during the lab session.

Comments:

(Also discuss your concluding remarks as a fresh engineer on problem statement)