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Fabrication of Cutting And Polishing Machine

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ABSTRACT: *The first step in machining most working jobs is to cut the stock to the desired length. This cutting operation should be done in the shortest time possible consistent with the desired quality. Similarly the polishing operation in a metal working job should give the desired surface finish in the quickest time possible. There are many methods by which the cutting operation and the polishing operation can be done. The various methods can be explained below.*

I. INTRODUTION

1.1-Types Of Cutting Operation:

- Sawing
- Flame cutting
- Laser cutting
- Water jet cutting
- Plasma cutting
- Shear cutting

Cutting metal with a saw is similar to cutting wood with a saw. The main difference is that the cutting blade is thinner and the teeth are smaller. The

Fig. no 1.1 sawing operation

blade also moves at a faster rate. Large industrial saws can cut thick blocks of steel and are limited only by the size of the machine.

There are different types of saws such as coping saws, band saws and circular saws. Non-industrial steel saws are designed for thin metals used for such things as shelves and duct work. Metals thicker than 1/8 inch should be cut using other methods.

1.1.2 Flame-Cutting Operation:

Flame from a welding torch melts the metal and pushes it along in the direction of the flame, leaving a cut in the metal. With the flame adjusted to the right temperature, cutting is fast, but the cut edges need grinding down to make a smooth edge.

Fig.no 1.2 Flame cutting operation

Flame-cutting equipment consists of a nozzle connected to hoses that connect to tanks of gas. Most often the gasses are oxygen and acetylene. Regulating the pressure of the gasses using the pressure gauges attached to the tanks adjusts the temperature of the flame. Thicker steel needs a more intense flame to make the cut.

1.1.3 Plasma Cutting Operation:

Plasma cutting starts by clamping a ground cable onto the sheet of metal. Compressed air or a gas such as nitrogen or argon is blown at extreme high speed out of the nozzle of the plasma torch, which contains an electrode. Moving the nozzle close to the metal creates a high-frequency electrical arc that travels through the compressed air, superheating it. The compressed air turns to plasma, a gas that has been energized to the point that some electrons break free. Adding more electricity makes the plasma hotter.

Fig.no 1.3 Plasma cutting operation

Portable plasma torches are used for smaller jobs. The bulk of plasma cutting is left to industrial mass production applied to large plates of steel. A programmed robotic arm moves the nozzle over the steel, making cuts at predetermined points. The edges of a plasma cut need grinding to take off the burrs, which are solidified drops of melted steel.

1.1.4 water-Jet Cutting:

Water jet cutting machines are used in industry for mass production. Water is forced through a pinhole in the end of a diamond or sapphire nozzle at pressures up to 60,000 pounds per square inch. The stream that comes out of the nozzle can cut through materials such as plastic, rubber and fiberglass. Adding a fine abrasive like garnet in the water stream adds more force. which will cut through aluminum, stainless steel and titanium.

Fig.no 1.4 water jet cutting

Cuts are clean and accurate using a waterjet process. The cutting produces no heat to affect the metal, eliminating the need for grinding. Water from the cut is collected underneath, filtered and reused in the cutting process.

1.1.5laser-Cutting Process:

Laser cuts hit the metal with a tightly focused laser beam that heats the metal and forms a melt capillary (a tube with a very small diameter) through the metal. A jet of gas ejects molten metal from the back of the steel during the cuts. Cuts are accurate, with no need for finishing off the edges before welding is done.

Fig.no 1.5 laser cutting operation

Cutting the steel with a laser is accomplished in one of two ways: moving the laser beam over the steel or moving the steel under a fixed-position laser beam. Computer programs control the movement during the cutting process, creating accurate cuts.

1.1.6shear-Cutting:

Shearing is a process of brute force that exceeds the strength of the steel, causing it to separate at the cutting location. A sheet of steel is placed on a table with a blade on the edge. A blade above the steel is thrust down, cutting the steel in a straight line the way a pair of scissors cuts material. There is a small gap between the upper and lower blades to allow for stress on the steel.

Thin sheets of steel like duct work metal can be cut using a foot press shear. Thicker metals need the force of hydraulics. Before the metal separates, it gets bent a little over the bottom die, which leaves a sharp edge that needs

Fig.no 1.6 shear cutting

grinding. Fabrication shops use shears to cut steel down to size before forming it into parts used for products.

1.2 TYPES OF POLISHING OPERATIONS:

- Hand polishing
- Mechanical polishing
- Electro polishing
- Using special cleansers

1.2.1HAND-POLISHING OPERATION:

Those who wish to polish steel at home with household products have several options. First, for mildly stained steel, water may be all that is needed to restore the metal to a natural shine. Soak a clean cloth in warm water and wipe down the fixture that needs polishing. It is important to wipe the water with another clean, dry cloth before the water has time to dry. Microfiber cloths are best for this method.

Fig.no 1.7 hand polishing

Household cleaners such as glass cleaners or ammonia can also help to clean steel. Newspapers or clean cloths are acceptable for wiping the product onto and off the steel. It may be necessary to wipe the chemicals off with warm water and another dry cloth.

A mix of apple cider and vinegar or olive oil and club soda are steel cleaning options for those looking for a more eco-friendly solution. Mixing baking soda and water into a paste, coating the steel, rinsing with warm water and drying with a clean cloth is another effective home polishing method.

1.2.2 Mechanical-Polishing Operation:

For moderately tarnished steel, consider mechanical polishing. A rag wheel or a power buffer gets quick results. Put a coat of special polish on the item, then use the power buffer to lightly apply pressure. When using such equipment, make sure all hair, jewelry, etc., are out of the way. Wearing eye protection is a good idea.

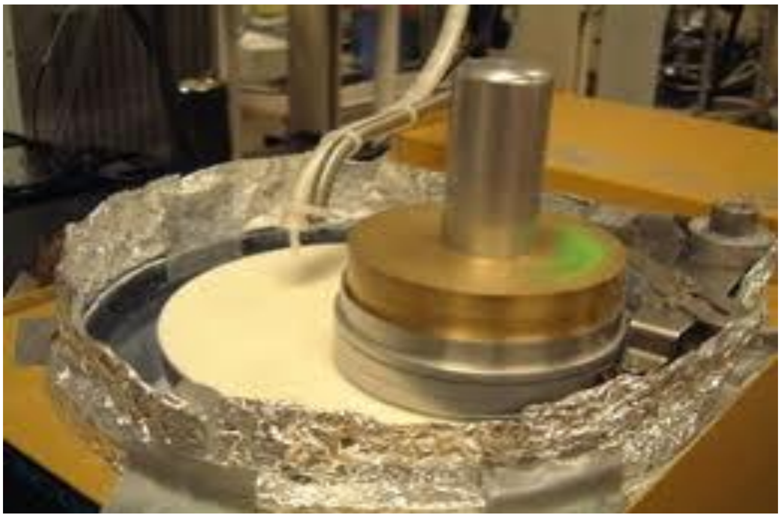

Fig.no 1.8 mechanical polishing

1.2.3 Electro-Polishing:

For products in need of serious attention, electropolishing is a viable option. Electropolishing smooths the surface of a metal object. A surface layer of metal is removed delicately from the object; it is not cleansed or wiped down. The object is immersed in an electrolyte and subjected to an electrical current. The product does not only come out shiny and polished, but smooth.

1.2.4 Using Special Cleansers:

Most commercial products for steel polishing are made for stainless steel. Look for products without chlorine, and avoid using brushes or scrubbing pads, as this could damage steel instead of restore it.
Thus these are the different types of cutting and polishing operations used generally.

II. COMPONENTS USED

2.1motor:

Motor is a device that creates motion. It usually refers to an engine of some kind. The generally used type of motors and its general use is given as follows:

- Electric motor is a machine that converts electricity into a mechanical motion.
- Ac motor is an electric motor that is driven by alternating current
- Synchronous motor is analternating current motor distinguished by a rotor spinning with coils passing magnets at the same rate as the alternating current and resulting magnetic field which drives it.
- Induction motor, also called a squirrel-cage motor, a type of asynchronous alternating current motor where power is supplied to the rotating device by means of electromagnetic induction.
- Dc motor is an electric motor that runs on direct current electricity

Brushed DC electric motor is an internally commutated electric motor designed to be run from a direct current power source. Brushless DC electric motor is a synchronous electric motor which is powered by direct current electricity and has an electronically controlled commutation system, instead of a mechanical commutation system based on brushes. Electrostatic motor is a type of electric motor based on the attraction and repulsion of electric charge.

Engines which are very commonly called "motors.
Starter motor is for starting an internal-combustion engine of a vehicle. Stepper motor is a type of electric motor capable of rotating its output shaft in equally spaced fractions of a full rotation, known as steps.

Internal fan-cooled electric motor is an electric motor that is self cooled by a fan, typically used for motors with a high energy density.

- Actuator is a mechanical device for moving or controlling a mechanism or system
- Hydraulic motor is a machine that converts the energy of pressurized liquid flow into mechanical motion
- Rocket motor usually refers to solid rocket engines.
- Molecular motor the agents of movement in living organisms.
- Synthetic molecular motor, molecular machines capable of rotation under energy input.
- Nanomotor, a molecular device capable of converting energy into movement.
- Pneumatic motor, a machine that converts the energy of compressed air into mechanical motion.

A brief description of the most commonly used type of motors is given as follows:

Dc motors:

A simple DC motor has a coil of wire that can rotate in a magnetic field. The current in the coil is supplied via two brushes that make moving contact with a split ring. The coil lies in a steady magnetic field. The forces exerted on the current-carrying wires create a torque on the coil.

Fig.no 2.1 dc motor

The force F on a wire of length L carrying a current i in a magnetic field B is iLB times the sine of the angle between B and i, which would be 90° if the field were uniformly vertical. The direction of F comes from the right hand rule. The two forces shown here are equal and opposite, but they are displaced vertically, so they exert a torque. The coil can also be considered as a magnetic dipole, or a little electromagnet, as indicated by the arrow SN: curl the fingers of your right hand in the direction of the current, and your thumb is the North pole. In the sketch at right, the electromagnet formed by the coil of the rotor is represented as a permanent magnet, and the same torque (North attracts South) is seen to be that acting to align the central magnet. The angular momentum of the coil carries it past this break point and the current then flows in the opposite direction, which reverses the magnetic dipole. So, after passing the break point, the rotor continues to turn anticlockwise and starts to align in the opposite direction. In the following text, I shall largely use the 'torque on a magnet' picture, but be aware that the use of brushes or of AC current can cause the poles of the electromagnet in question to swap position when the current changes direction.

The torque generated over a cycle varies with the vertical separation of the two forces. It therefore depends on the sine of the angle between the axis of the coil and field. However, because of the split ring, it is always in the same sense. The animation below shows its variation in time, and you can stop it at any stage and check the direction by applying the right hand rule.

Ac Motor:

With AC currents, we can reverse field directions without having to use brushes. This is good news, because we can avoid the arcing, the ozone production and the ohmic loss of energy that brushes can entail. Further, because brushes make contact between moving surfaces, they wear out.

The first thing to do in an AC motor is to create a rotating field. 'Ordinary' AC from a 2 or 3 pin socket is single phase AC--it has a single sinusoidal potential difference generated between only two wires--the active and neutral. With single phase AC, one can produce a rotating field by generating two currents that are out of phase using for example a capacitor. In the example shown, the two currents are 90° out of phase, so the vertical component of the magnetic field is sinusoidal, while the horizontal is cosusoidal, as shown. This gives a field rotating counterclockwise. In this animation, the graphs show the variation in time of the currents in the vertical and horizontal coils. The plot of the field components B_x and B_y shows that the vector sum of these two fields is a rotating field. The main picture shows the rotating field. It also shows the polarity of the magnets: as above, blue represents a North pole and red a South pole.

Fig.no 2.2 ac motor

If we put a permanent magnet in this area of rotating field, or if we put in a coil whose current always runs in the same direction, then this becomes a synchronous motor. Under a wide range of conditions, the motor will turn at the speed of the magnetic field. If we have a lot of stators, instead of just the two pairs shown here, then we could consider it as a stepper motor: each pulse moves the rotor on to the next pair of actuated poles. Please remember my warning about the idealised geometry: real stepper motors have dozens of poles and quite complicated geometries.

Induction Motor:

An induction or asynchronous motor is an AC electric motor in which the electric current in the rotor needed to produce torque is induced by electromagnetic induction from the magnetic field of the stator winding. An induction motor therefore does not require mechanical commutation, separate-excitation or self-excitation for all or part of the energy transferred from stator to rotor, as in universal, DC and large synchronous motors. An induction motor's rotor can be either wound type or squirrel-cage type.

Fig.no 2.3 induction motor

Three phase squirrel cage induction motors are widely used in industrial drives because they are rugged, reliable and economical. Single-phase induction motors are used extensively for smaller loads, such as household appliances like fans. Although traditionally used in fixed-speed service, induction motors are increasingly being used with variable-frequency drives (VFDs) in variable-speed service. VFDs offer especially important energy savings opportunities for existing and prospective induction motors in variable-torque centrifugal fan, pump and compressor load applications. Squirrel cage induction motors are very widely used in both fixed-speed and VFD applications.

2.2bevel Gear:

Two important concepts in gearing are pitch surface and pitch angle. The pitch surface of a gear is the imaginary toothless surface that you would have by averaging out the peaks and valleys of the individual teeth. The pitch surface of an ordinary gear is the shape of a cylinder. The pitch angle of a gear is the angle between the face of the pitch surface and the axis.

The most familiar kinds of bevel gears have pitch angles of less than 90 degrees and therefore are cone-shaped. This type of bevel gear is called external because the gear teeth point outward. The pitch surfaces of meshed external bevel gears are coaxial with the gear shafts; the apexes of the two surfaces are at the point of intersection of the shaft axes.

Fig.no 2.4 bevel gear

Bevel gears that have pitch angles of greater than ninety degrees have teeth that point inward and are called internal bevel gears.

Bevel gears that have pitch angles of exactly 90 degrees have teeth that point outward parallel with the axis and resemble the points on a crown. That's why this type of bevel gear is called a crown gear. Bevel gears are classified in different types according to geometry:

- **Straight bevel gears** have conical pitch surface and teeth are straight and tapering towards apex.
- **Spiral bevel gears** have curved teeth at an angle allowing tooth contact to be gradual and smooth.
- **Zero bevel gears** are very similar to a bevel gear only exception is the teeth are curved: the ends of each tooth are coplanar with the axis, but the middle of each tooth is swept circumferentially around the gear. Zero bevel gears can be thought of as spiral bevel gears (which also have curved teeth) but with a spiral angle of zero (so the ends of the teeth align with the axis).
- **Hypoid bevel gears** are similar to spiral bevel but the pitch surfaces are hyperbolic and not conical. Pinion can be offset above or below the gear centre, thus allowing larger pinion diameter, and longer life and smoother mesh, with additional ratios e.g., 6:1, 8:1, 10:1. In a limiting case of making the "bevel" surface parallel with the axis of rotation, this configuration resembles a worm drive.

Two bevel gears in mesh is known as bevel gearing. In bevel gearing, the pitch cone angles of the pinion and gear are to be determined from the shaft angle, i.e., the angle between the intersecting shafts. The bevel gear has many diverse applications such as locomotives, marine applications, automobiles, printing presses, steel plants, railway track inspection machines, etc.

For examples, see the following articles on:

- Bevel gears are used in differential drives, which can transmit power to two axles spinning at different speeds, such as those on a cornering automobile.
- Bevel gears are used as the main mechanism for a hand drill. As the handle of the drill is turned in a vertical direction, the bevel gears change the rotation of the chuck to a horizontal rotation. The bevel gears in a hand drill have the added advantage of increasing the speed of rotation of the chuck and this makes it possible to drill a range of materials.

Fig 2.5 bevel gear

- The gears in a bevel gear planner permit minor adjustment during assembly and allow for some displacement due to deflection under operating loads without concentrating the load on the end of the tooth.
- Spiral bevel gears are important components on rotocrafts drive systems. In this application, spiral bevel gears are used to redirect the shaft from the horizontal gas turbine engine to the vertical rotor.

The Following Are The Advantages Of A Bevel Gear:

- This gear makes it possible to change the operating angle.
- Differing of the number of teeth (effectively diameter) on each wheel allows mechanical advantage to be changed. By increasing or decreasing the ratio of teeth between the drive and driven wheels one may change the ratio of rotations between the two, meaning that the rotational drive and torque of the second wheel can be changed in relation to the first, with speed increasing and torque decreasing, or speed decreasing and torque increasing.

The following are the disadvantages of using a bevel gear:

- One wheel of such gear is designed to work with its complementary wheel and no other.
- Must be precisely mounted.
- The shaft's bearings must be capable of supporting significant forces

2.3ball Bearing:

The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other.

Ball bearings tend to have lower load capacity for their size than other kinds of rolling-element bearings due to the smaller contact area between the balls and races. However, they can tolerate some misalignment of the inner and outer races.

Although roller bearings had been developed since ancient times, the first modern recorded patent on ball bearings was awarded to Philip Vaughan, aWelsh inventor and ironmaster who created the first design for a ball bearing in Carmarthen in 1794. His was the first modern ball-bearing design, with the ball running along a groove in the axle assembly.

Jules Suriray, a Parisian bicycle mechanic, designed the first radial style ball bearing in 1869, which was then fitted to the winning bicycle ridden byJames Moore in the world's first bicycle road race, Paris-Rouen, in November 1869.

Fig.no 2.5 ball bearing

There are several common designs of ball bearing, each offering various trade-offs. They can be made from many different materials, including: stainless steel, chrome steel, and ceramic (silicon nitride (Si_3N_4)). A hybrid ball bearing is a bearing with ceramic balls and races of metal.

Applications:

In general, ball bearings are used in most applications that involve moving parts. Some of these applications have specific features and requirements:

- Hard drive bearings used to be highly spherical, and were said to be the best spherical manufactured shapes, but this is no longer true, and more and more are being replaced with fluid bearings.
- German ball bearing factories were often a target of allied aerial bombing during World War II such was the importance of the ball bearing to the German war industry.
- In horology, the company Jean Lassale designed a watch movement that used ball bearings to reduce the thickness of the movement. Using 0.20 mm balls, the Calibre 1200 was only 1.2 mm thick, which still is the thinnest mechanical watch movement.
- Aerospace bearings are used in many applications on commercial, private and military aircraft including pulleys, gearboxes and jet engine shafts. Materials include M50 tool steel (AMS6491), Carbon chrome steel (AMS6444), the corrosion resistant AMS5930, 440C stainless steel, silicon nitride (ceramic) and titanium carbide coated 440C.
- Skateboard wheels each contain two bearings, which are subject to both axial and radial time-varying loads. Most commonly bearing 608-2Z is used (a deep groove ball bearing from series 60 with 8 mm bore diameter)
- Yo-Yos there are ball bearings in the center of many new, ranging .

2.4cutting Blade:

Circular saw blades put the power of the saw where it's needed, so the right blade is a key to the success of the project. Just as there are different saws and different project materials, there are different circular saw blades – each suited to a tool and a task.

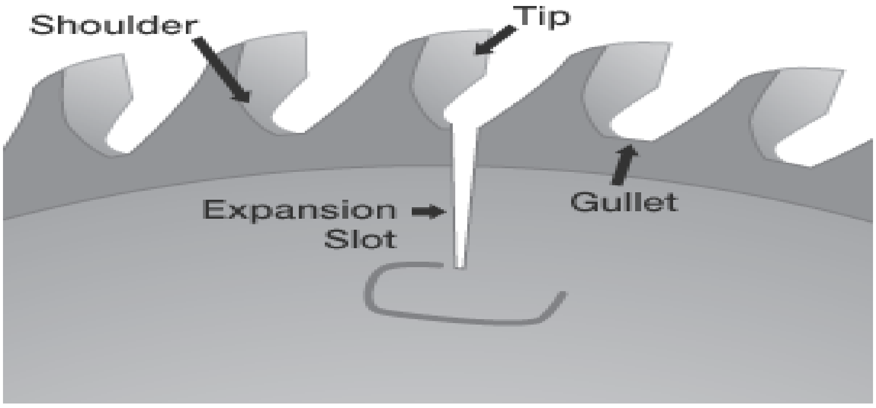

Fig.no 2.6 blade parts

There are four important parts on standard circular saw blades:

- **Tips** bite into the work piece.
- **Shoulders** support the tips
- **Gullets** remove material from the work piece. Deeper gullets remove more material with each pass, while more shallow gullets create a finer cut.
- **Expansion slots** help prevent the blade from warping as it expands and contracts during use. The end result is less vibration and a straighter cut.

Other features you might see on a circular saw blade include heat vents which aid in reducing vibration and an antifriction coating, which decreases buildup on the blade. A blade may also have a diamond knockout you can remove to allow you to use the blade on a saw with a corresponding shaft.

In addition to the standard toothed blades, there are also continuous rim blades that do not have the typical tip / gullet configuration. Blades that cut materials such as concrete, brick and tile often have a continuous rim.

More teeth on a toothed circular saw blade produce a smoother cut, while fewer teeth allow a blade to quickly cut through material

Circular Saw Blade Materials

The materials from which saw blades are manufactured play a significant role in the life and performance of the blade. There are several material types you will commonly see:

- **Steel blades** are inexpensive and work well for cutting softwood, but they dull quickly in hardwood.
- **High-speed steel blades** (HSS) are harder than steel blades and stay sharper longer.
- **Carbide blades** have carbide tips attached to their teeth. They're more expensive than other blades but stay sharp much longer than steel or high-speed steel.
- **Diamond blades** use diamond-tipped teeth designed for cutting ceramic tile, glass and concrete.
- **Abrasive blades** are made of rough material and are for cutting concrete, brick, cinder block and other masonry materials and metals.

Circular Saw Blade Types

Some circular saw blades are suited for stationary tools like table saws and compound miter saws, while others are suited for handheld circular saws. Know which blade your cutting tool will accept and make sure the blade you are considering is correct for the tool you'll be using.

It's also important to know what kind of material you'll be cutting and to match the material to the capability of the blade. In addition, some blades are suitable for dry cutting only while some are suitable only for wet cutting. Others are appropriate for either wet or dry applications.

Some examples of blade types and uses are below. Always follow the saw and blade manufacturers' instructions for use, safety, compatible blade diameter for the saw and materials you can cut with a blade.

Thin Kerf:

This types of blades are used for cutting dimensional or engineered lumber. It has a thin profile for easy cutting and less material waste. This types of blades are used to cut the wooden materials. The blade has a kerf which is sharp and it cuts the materials.the kerf is placed on the tooth at certain angle which facilitates the cutting.

Fig.no 2.7 thin kerf

Abrasive cut-off blades:

Allied's Abrasive Cut-Off Blades are specially formulated for metallurgical sectioning. Aluminum oxide, silicon carbide, diamond or CBN (cubic boron nitride) abrasives are offered in various bond types for sectioning a wide varietyof materials. Choosing the right blade for the right material is crucial inreducing thermal and structural deformation.

Protective arbor inserts are supplied on resin and rubber/resin blades. All blade arbor holes fit BOTH 32 mm and 1-1/4" spindle arbors. All blades are precision ground to slightly less than the stated diameter to universally fit all makes and models of cutting machines. Blotters are supplied to shield vibration from the metal flange and help protect the blade from breaking during use.

Fig.no 2.8 abrasive cut-off blade

Resin bonded blades cut cooler with less resistance and friction and do not emit a burned rubber odor as with the rubber bonded blades. Rubber bonded blades are ideal for production environments where durability and longer life are desired.

Concrete cutting blades:

Circular saw blades are made from all kinds of materials and have different types of teeth and blades. Each combination of material and style yields a blade that is ideal for a certain purpose. For instance, steel circular saw blades are great for slicing through softwood, but they wear our quickly if you try to cut hardwood with them. And the more teeth on the blade, the easier it'll slice through certain materials. To cut plywood, you're better off with 100 or more teeth, but to cut across the grain of regular wood, you can make a smooth cut starting out with just 48 teeth [source: Lowe's]. Plus, your saw may be better for certain tasks depending on where the handle, motor and blade are in relation to each other.

Fig.no 2.9 concrete cutting blade

To cut through concrete, you need a circular saw blade with diamond tips or some other kind of abrasive blade. As with any replacement blade, when you attach an abrasive blade to your saw, you have to make sure that it's the right diameter for your tool. A worm-drive style saw where the motor and blade line up and the handle is toward the back is probably best for a big job like cutting concrete. You also need to make sure your saw is strong enough. The amp rating on a saw tells you how much power the saw uses, but not how much it yields. Oddly enough, the price of a saw may be the best indication of its quality and strength When using a circular saw to cut through concrete, safety should be your first concern. Like in any dangerous task, protective gear for your eyes and ears is a must. Make sure you're using the right type of blade for the task, and only use an abrasive blade if your saw has an aluminum or magnesium guard on the material.

Alumina Powder:

EMS's Alumina Powders are accurately controlled for all specs and particle size distribution, assuring you the best polishing results. The following micron sizes are available: 0.05, 0.3, and 1.0.

Some of the typical applications are

- Precision Optics
- Metallographic Sections
- Electro-Optical Crystals
- Silicone Wafers
- Ferrite Components
- Gem Stones
- Acrylic lenses

Type DX Alumina Powder is specially treated to reduce the number of agglomerates (group of particles in each grade of manufactured alumina). The result is fast polishing and improved quality of the finished products.

III. CONSTRUCTION AND WORKING

3.1construction:

The apparatus is designed to perform the cutting and polishing operation on wood, metal and composites for square and rectangular components. The construction of this apparatus is too simple. The main components used for the construction of this apparatus is:

- Double shaft ac motor
- Welded base
- Shafts
- cutting blades (to cut wood, metal ,tiles and composites)
- Polishing disc
- Bevel gear
- Ball bearings

The whole apparatus is supported by a welded base plate. The double shaft ac motor is placed atop the base plate along its centre to provide enough space for all the components to be placed on the base plate. The shaft to the right side of the motor is fitted to a cutting disc and L angled plate to support the feed to be given to the cutting disc. The cutting disc is fitted to the shaft with the help of a key such that the discs can be changed according to the convenience of the user. The shaft to the right side of the motor is fitted with a bevel gear. The bevel gear is used to aid in upward transmission and so another shaft is connected to the bevel gear in the longitudinal direction. Ball bearings are placed between the longitudinal shaft and the bevel gear in order to prevent wear and tear of the shaft and gear due to friction and also to provide support to the shaft. A polishing disc is attached to the longitudinal shaft that arises from the bevel gear. All the components of the apparatus are welded or bolted to the base metal. The base metal is chosen in such a way as to withstand all the vibrations of the apparatus and also to support the whole apparatus.

3.2working:

The cutting and polishing apparatus uses a motor for the performance of the cutting and polishing operation. The two shafts of the motor aid in performing the cutting and polishing operation of the components. A base metal supports the whole apparatus and the double shaft ac motor is placed along the centre of the base metal. The motor runs at a speed of 1440 rpm. The shaft to the right side of the motor performs the cutting operation and the shaft to the left side of the motor performs the polishing operation.

Cutting Operation:

The shaft to the right side of the motor performs the cutting operation. The shaft is connected to the cutting blades with the help of a key in such a way that the cutting discs can be constantly changed according to the type of component that has to be cut. A L angle plate is welded to the base plate longitudinally to support the shaft and also to support the user give the feed to the cutting discs. The cutting action is performed by introducing the component to the cutting discs manually. Thus the cutting action is performed.

Polishing Action:

The shaft to the left side of the motor performs the polishing action. The shaft is connected to a bevel gear which allows upward transmission. Another shaft is connected to the bevel gear in the upward direction. A polishing disc is fitted to the longitudinal shaft. Between the shaft and the bevel gear, ball bearings are placed which reduce friction between the bevel gear and the shaft and also to support the arrangement. The polishing action is performed by introducing the component to the polishing disc. The constant rubbing of the polishing disc to the components will bring a polished appearance to the components. Thus the polishing action has been performed.

The speciality of this apparatus is that both the cutting and polishing action of the components can be done at the same time. So the time of action is reduced. Thus, this is the working of cutting and polishing apparatus.

3.3cutting Speed And Feed Rate:

Cutting Speed:

Cutting speed may be defined as the rate (or speed) that the material moves past the cutting edge of the tool, irrespective of the machining operation used. Cutting speeds are calculated on the assumption that optimum cutting conditions exist, these include:

- Metal removal rate (finishing cuts that remove a small amount of material may be run at increased speeds).
- Full and constant flow of cutting fluid (adequate cooling and chip flushing).
- Rigidity of the machine and tooling setup (reduction in vibration or chatter).
- Continuity of cut (as compared to an interrupted cut, such as machining square section material in a lathe).
- Condition of material (mill scale, hard spots due o white cast iron forming in castings).

Feed Rate:

Feed rate is the velocity at which the cutter is fed, that is, advanced against the work piece. It is expressed in units of distance per revolution for turning and boring (typically inches per revolution or millimetres per revolution). Feed rate is dependant on the:

- Surface finish desired.
- Power available at the spindle (to prevent stalling of the cutter or work piece).
- Rigidity of the machine and tooling setup (ability to withstand vibration or chatter).
- Strength of the work piece (high feed rates will collapse thin wall tubing).
- Characteristics of the material being cut, chip flow depends on material type and feed rate. The ideal chip shape is small and breaks free early, carrying heat away from the tool and the work.

3.4advantages & Limitations

Advantages:

- Very simple in construction.
- Easy to machine materials.
- Reduce the usage of large conventional machines.
- Can cut hard materials easily.
- It can cut up to very smaller allowance as compared to conventional machines.
- The machining process is simple.
- It is portable and economically cheap

Limitations:

- Very skilled labour is required.
- It does‘nt have any workholding devices.
- High concentration is necessary.
- There is possibilities of damaging of blade in case of improper feeding.
- Only small materials can be machined.

IV. DESIGN CALCULATION

Maximum load = 300kg

Step-1:

Gear ratio $= \frac{z2}{z1} = \frac{16}{10} = 1.6$

Step-2:

Tanδ2 =1.6

$\delta 2 = tan^{-1}$ (1.6)

δ2 = 57.99

δ1+δ2=90°

δ1=90°−δ2

δ1=32°

Step-3:

Mild steel σu =630 N/mm^2

Assume life (N) =20000 hrs

No of cycles =60nT

= 240 x 10^7 cycles

Step-4:

[Mt] = Mt.k.kd

[Mt] = 17.66 x 10^3= $\frac{60*3.7*10^3}{2*\pi*2000}$

[Mt] = 22.96 x 10^3 N.mm   Mt = 17.66 x 10^3 N.mm

Step-5:

From P.S.G data book

Eeq = 2.15 x 10^5 N/mm^2

Step-6:

[σb] =1.4 $\frac{kbl}{nk?}$σ−1

kbl = $\sqrt[9]{\frac{10^7}{N}} = \sqrt[9]{\frac{10^7}{240 \text{ x } 10^7}}$

Kbl = 0.543

N=2 kσ = 1.2(case hardened)

σ−1 =0.45 σu =283.5 N/mm^2

[σb] = $\frac{1.4*0.543}{2*1.2}$ x 283.5

[σb] = 89.79 N/mm^2

Step-7:

[σc] = Cb.HB.Kcl

Cb = 2.5 HB = 350

kcl = $\sqrt[6]{\frac{10^7}{240 \text{ x } 10^7}}$

kcl = 0.401

[σc] = 2.5 x 350 x .401

[σc] = 280.79 N/mm^2

Step-8:

$$R \geq \varphi_y \sqrt{(i^2+1)} \sqrt[3]{(\frac{0.72}{(\varphi_y - 0.5)[s_c]})^2 * \frac{\text{Eeq [Mt]}}{i}}$$

$\varphi_y = 3$

$$R \geq 3\sqrt{1.6^2+1} \sqrt{(\frac{0.72}{(3-0.5)280.79})^2 * \frac{2.5*10^5*22.96*10^5}{1.6}}$$

R ≥ 83.8 mm

Virtual no of teeth

$z_{v1} = \frac{z_1}{\cos d1}$ = 16

$z_{v2} = \frac{z_2}{\cos d2}$ =18

Step-9:

Transverse module

M_t = 8.8

M_t = 8mm

Step-10:

B=$\frac{R}{\varphi_y} = \frac{83.8}{3}$ =27.93

$m_{av} = m_t - \frac{b \sin d1}{z_1}$

$= 8 - \frac{(27.93 \sin 32°)}{10}$

m_{av} = 6.5

m_{av}(std) = 6mm

d_{av} m_{av} x z_1 = 60mm

Step-11:

v = $\frac{\pi * d_{av} * N_1}{60}$

v =4.71 m/s

$\varphi_y = \frac{b}{d_{av}} = \frac{27.93}{60}$

φ_y =0.4655

R = 0.5 $m_t\sqrt{{z_1}^2 + {z_2}^2}$

= 0.5 x 8 x $\sqrt{16^2 + 10^2}$

R = 75.47 mm ⟶ corrected cone distance

Step-12:

Checking

$$\sigma b = \frac{R\sqrt{i^2+1}}{(R-0.5b)^2 * b * y_{v1} * m_t}$$

$$= \frac{75.47\sqrt{i^2+1}}{(75.47-(0.5*29.93))^2 * 29.93 * 8 * 0.355}$$

σb =10.89 N/mm^2

$\sigma b < [\sigma b]$

The design is safe.

Step-13:

Checking

$$\sigma c = \frac{0.72}{(R-0.5b)}\left[\frac{\sqrt{i^2+1}}{ib} * E_{eq} * [M_t]\right]^{\frac{1}{2}}$$

$$= \frac{0.72}{(75.47-(0.5*27.93))}\left[\frac{\sqrt{1.6^2+1}}{1.6*27.73} * 2.15 * 10^5 * 22.96 * 10^3\right]^{\frac{1}{2}}$$

σc = 169 N/mm^2

$\sigma c < [\sigma c]$

Hence the bevel gear has been designed safely

V. COST ESTIMATION

Two shaft motor	3,500
Bevel gear	750
Cutting blades	550
Grinding wheel	80
Poloishing wheels	75
Mild steel base	1,191
L channel	574
Ball bearing	150
Machining cost	1,200
Welding cost	1,150
Transportation cost	1,300
Other allowances	1,500
Total	12,020

Assembled View

VI. CONCLUSION
VII.

Thus we have developed a project on "**FABRICATION OF CUTTING AND POLISHING MACHINE**" which helps to know how to achieve low cost automation. The capacity of our cutting machine is to cut all the materials by changing the blades. This machine also facilitates for polishing the materials which had been cut. The polishing operation is very simple as compared to other conventional machines.

This machine would boom the mass reduction in industries having large conventional machines for cutting heavy materials. The commercial production of this project is feasible economically.

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