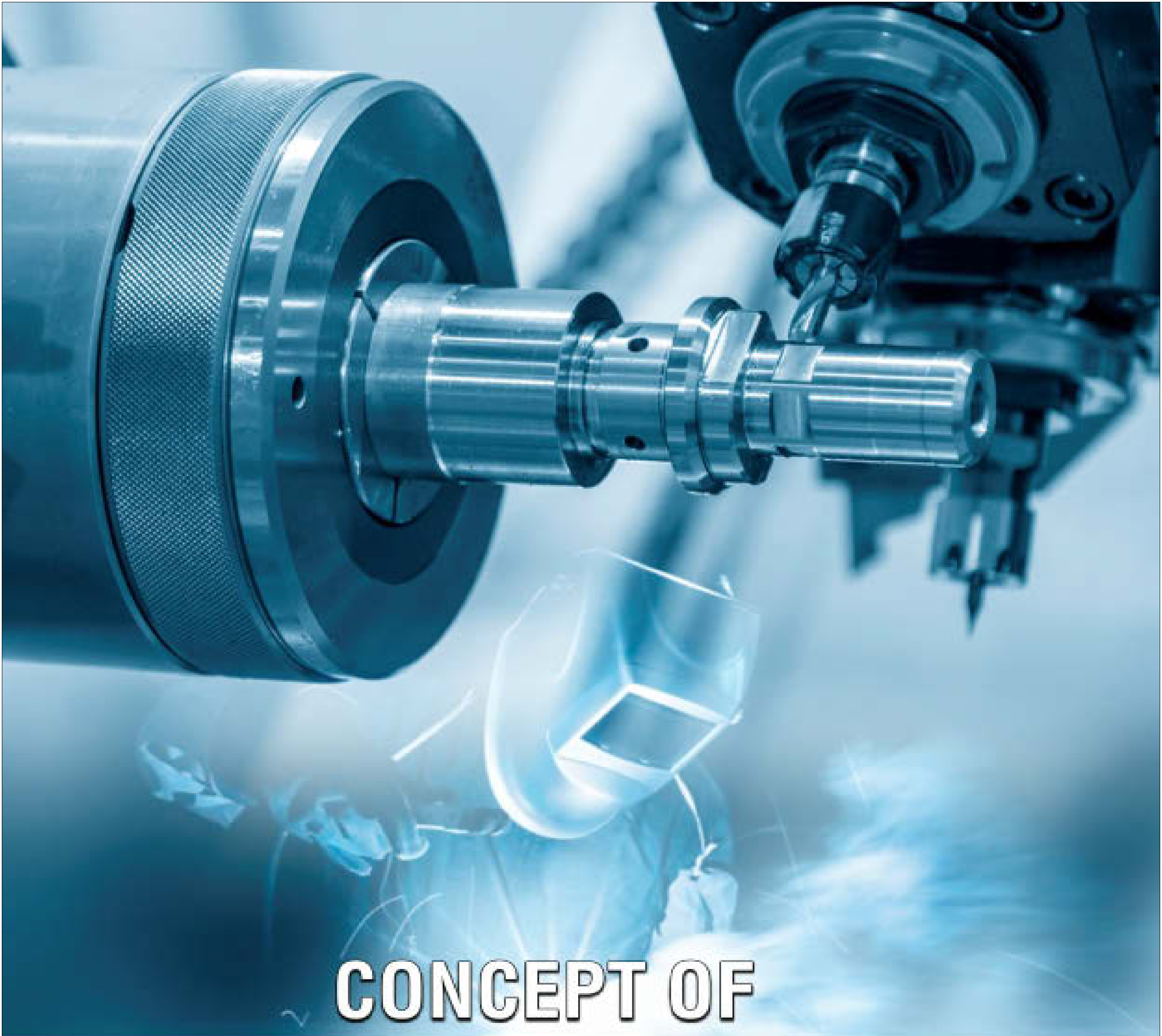

CONCEPT OF LATHE MACHINE AND WELDING TECHNIQUES

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CHAPTER 1

Introduction to Lathe Machine

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A lathe machine is a piece of machinery used to remove metal from a workpiece to shape and size it as needed. Lathe machines are used in glass blowing, metal spinning, wood turning, and parts recycling. Other tasks that can be completed using a lathe machine include turning, facing, taper turning, grooving, thread cutting, cutting, knurling, and drilling, among others. The purpose of a lathe is to remove metal from a piece of work in the form of chips by mounting the work solidly on a machine spindle and rotating at the necessary speed. The cutting tool is fed against the work either longitudinally or transverse to create the desired shape and size.The lathe is a highly useful tool that is crucial to understand how to use[1]. A cylindrical item is rotated by this machine in opposition to a tool that the user controls. The lathe is the first machine tool ever created. As the cutting tool is moved along the intended cut line, the work is retained and rotated on its axis. One of the most useful machine tools in industry is the lathe. The lather may be used for turning, tapering, form turning, screw cut, facing, dulling, drilling, and spinning, grinding, and polishing operations with the right attachments. Cutting operations are carried out using a cutting tool that is fed parallel to or at an angle to the work axis. For the purpose of machining taper and angles, the cutting tool may also be fed at an angle with respect to the work's axis. The tailstock of a lathe does not revolve. Instead, the stock's holding spindle revolves. Spindle may support retaining collets, centers, three jaw chucks, and other work-holding accessories. Tools for drilling, threading, reaming, or cutting tapers can be stored in the tailstock. Additionally, it may be changed to accommodate various workpiece lengths and support the workpiece's end using a center[2].

Lathe Machine History: Around 1751, Jacques de Vaucanson created the lathe.An old tool is the lathe machine. Around 1300 BC, when this machine was in its very early stages of development, just the headstock and tailstock had been created. But as a result of the industrial revolution, metalworking lathes became bulkier, more rigid machines.Line shafting is replaced by an electric motor as a power source between the 19th and 20th centuries.Later, in 1950, a Direct Numerical Drive machine was used to control lathes and other machine tools using the servomechanism. The Lathe is the machine tool standard with the widest range of applications[3].

Lathe Machine Types:

1. Engine Lathe

2. Capstan and Turret Lathe
3. CNC Lathe Machine
4. All Geared Lathe Machine

The basic operation of a lathe machine is to hold the work between two sturdy rotating supports known as centres or chucks. The machine's main spindle is where the chuck is placed. The cutting tool is fed against the rotating job while being tightly supported in the tool post. The task revolves around the axis, and a cylindrical, tapered, square, or spherical surface is formed by moving the tool either parallel to or at an angle to the axis. The hexagonal cutting on the lathe machine is now being introduced. The device we're referring about is a 14" prototype lathe that uses three single position cutting tools to feed round pipes and generate hexagonal cuts. The cutting implements rotate about their own axes. The mechanism we employed in this is a gear system that aids in the rotation of the chuck and the cutting tools, as well as a motor that aids in providing the necessary power to operate the entire machine. The casting, pattern-making, and machining processes are used to create the entire product. A stand (or legs) that rests on the floor and raises the lathe bed to a working height may or may not be present on a lathe. Some lathes are compact, without a support, and rest on a workbench or table[4]. Although CNC lathes sometimes include an inclined or vertical beam for a bed to guarantee that chips fall clear of the bed, almost all lathes have a bed, which is (always) a horizontally beam. Large bowl woodturning lathes frequently lack a bed or tail stock in favor of just a free-standing headstock and a cantilevered tool rest.

A headstock is located at one end of the bed, which is nearly always on the left when the operator faces the lathe. High-precision spinning bearings are included in the headstock. A spindle, or horizontal axle with an axis parallel to the bed, is rotating within the bearing. Spindles are frequently hollow and contain inner Morse taper or exterior threads on the "inboard" that may be used to attach work-holding devices to the spindle. Spindles may also feature inside taper, external threads, a hand-wheel, or other supplementary mechanism on their "outboard" end, among other things [5]. Spindles provide the work piece motion since they are motorized. The spindle is powered, either by belt or gear drive to a power source or by foot force from a flywheel. The power source in the majority of contemporary lathes is an integrated electric motor, which is frequently located in the headstock, to the left of the headstock, or underneath the headstock, hidden in the stand.

Principle: Although this machine is a hexagonal cutting lathe machine, its operating principle is the same as that of a standard lathe machine since it is the prototype for lathe machines. Its structure or design is based on a lathe machine. A spindle serves as the tool's center, and spur gears rotate the centers. The name of this machine is due to its specific cutting purpose, namely hexagonal cutting, which is accomplished by the synchronization of tool and work piece speed. Tool is fixed parallel to the center where the job must be fixed. By turning two gears in the same direction and one gear in the opposite way, synchronization is achieved. Utilized a single point cutting tool with rounded front forms to make the unique cuts on two small and one big gear. This cutting cannot be done on any standard lathe machine, making it a revolutionary stride in human history thus far. It is a hexagonal cutting lathe machine for this reason[6].

The lathe is a machine tool that clamps the workpiece between two solid, rigid supports, known as centers, or in a rotating chuck or face plate. A tool post that is fed up against the rotating work firmly holds and supports the cutting tool. One of the most crucial machine tools in the metalworking sector is the lathe machine. A spinning work piece and a fixed cutting tool are its basic operating principles. The workpiece is fed with the cutting tool, which spins around its own axis to give the workpiece the required shape.

1. Mechanism for reversing the tumbler gear
2. Quick-change transmission.
3. Quick-change gearbox for tumbler gear[7].

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CHAPTER 2

Classification of Lathe Machine

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The main purpose of the machining tool known as a lathe is to shape metal. It operates by having the workpiece revolve around a cutting tool that is fixed. The primary function is to eliminate the material's undesirable portions, leaving behind a neatly formed workpiece. Figure 1 depicts the lathe machine's schematic design and essential components[1].

➢ **Parts of the Lathe Machine and their functions:**

Headstock: The drive mechanism and electrical mechanism of a lathe machine tool are housed in the head stock, which is located on the left side of the lathe bed.It retains the task on its spindle nose, which has exterior screw holes and an internal Morse taper for keeping the lathe center [2]. It rotates at a varied speed thanks to a cone pulley or a fully geared drive. For working with lengthy bars, the spindle has holes all throughout. The feed rod, lead screw, and thread cutting mechanism are all powered by the spindle through the head stock. Two more items are installed on the headstock spindle: a three- and four-jaw chuck.

- Lathe dog and the center lathe
- Chuck Collect
- Faceplate
- Magnet chuck

Below the headstock is a separate speed change gearbox that is used to slow down the speed in order to have various feed rates for threading and automated carriage lateral movement. Most turning actions are performed using the feed rod, while thread cutting activities are performed using the lead screw[3].

Bed: It is the machine's foundation. It is comprised of a single semi-steel casting (Chilled Cast Iron). The bed is made of two long, heavy metal slides with ways or "V" shapes on them and stiff cross girths supporting them.

- It maintains the headstock, tailstock, carriage, and other parts of the lathe machine.
- It is suitably robust and has strong damping ability to absorb vibration.
- It prevents bending brought on by cutting forces.

Tail Stock: Above the lathe bed on the right side is where the tail stock is located.It's employed for:

- Maintain the long end of the job to keep it in place and reduce drooping.
- It keeps the equipment needed to carry out tasks like drilling, reaming, tapping, etc.
- And simply shifting the tailstock, it may also be utilized for a tiny bit of taper on a lengthy job.

Carriage: When the machining is finished, the carriage is utilized to support, direct, and guide the tool against the work.It provides stiff supports to the tool during operations, holds it, moves it, and controls it.Through an apron mechanism used for longitudinal cross-feeding, power is transferred from the feed rod to the cutting tool.By using a lead screw and half nut mechanism, it streamlines the thread cutting process [4].It is made up of:

A. A saddle
B. The cross-slide
C. Apron
D. Compound rest
E. Tool post

It offers the tool three different movements:

A. Movement of the longitudinal feed-through carriage
B. Cross feed-through and cross slide motion
C. Angle-fed top sliding action

Saddle: Typically, it is a casting in an "H" form with a flat guide and a "V" guide for attachment on the lathe bed guideways.

Cross-slide: On the top of the saddle, it is assembled. T-slots are present on the cross-upper slide's surface.

Compound rest: This rest holds the cutting tool post and blade in multiple positions. It may be rotated in the horizontal plane to any desired position. It is required for drilling short tapers and turning angles.

Apron: The feed mechanism's home is an apron. It is attached to the hangover front of the bed and the saddle [5].

Lead screw: A lead screw is sometimes referred to as a translating screw or a power screw. The motion is changed from rotational to linear. In a lathe machine tool, a lead screw is utilized for the thread cutting process.

Feed Rod: The carriage may be moved from the left to the right as well as from right to the left using the feed rod.

Chuck: Chuck is used to firmly grasping the workpiece. There are primarily two categories of chucks:

1. 3 jaw self-centering chuck
2. 4 jaw independent chuck

Main Spindle: The spindle is a hollow, cylindrical shaft that may accommodate large projects. Because to its excellent design, the spindle is not deflected by the cutting tool's push.

Leg: Legs are transferring to the ground while carrying the full weight of a lathe machine tool. The foundation bolt firmly fastens the legs to the ground.

Tool post: Located at the top of the carriage, it is used to carry different cutting tools or tool holders. The component on a lathe that firmly retains the cutting tool during machining processes is called a tool post. Afterward, the post is fastened to the complex rest using a standard hex or Allen head bolt.Various kinds of tool posts include:

1. Four Way Tool Post Index
2. Post for Quick Release Tools
3. Tool Post with Pillars
4. Tool Post of the Clamp Type[6].

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CHAPTER 3

Operations on Lathe Machine

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A popular instrument used in several industries is a lathe machine. It is used to mould and shape a variety of materials. A lathe machine is made up of several components, each of which has a crucial function. The bar stock is attached on the machine in various ways to complete several operations using certain tools, to generate varied characteristics. A lathe is a machine that is nearly always present in all machine shops for providing CNC turning services. The several sorts of fundamental CNC lathe machining operations. The main components of a turning lathe are a headstock, spindle, and chuck, and tool post, compound rest, cross slide, tailstock, hand wheel, guideway, bed, lead screw, saddle, feed rod, leg, carriage, apron, and chip pan. Lathe machines are a type of adaptable machine tool utilized in CNC services [1].

Turning: The most frequent action carried out on a lathe machine is also one of the most often used machining techniques to produce CNC turning components. In a turning process, the cutter will remove extra material from the surface of the work piece on the bar stock to produce a cylindrical component with the correct form and dimension. The feed lowers the dimension of the cylindrical component by moving it along the chuck's axis of rotation. The turned pieces' exterior diameters may vary across various portions. Step, taper, chamfer, and contour are only a few topological characteristics that might be present where two surfaces with differing diameters meet. Multiple passes at a shallow radial depth of cut could be required to achieve these characteristics [2].

Step Turning: Step turning produces two surfaces that abruptly differ in diameter from one another. The last element is shaped like a step.

Taper Turning: Due to the angled motion between the workpiece and a cutting tool during taper turning, two surfaces with different diameters transition between each other in a ramp pattern.

Chamfer Turning: In a manner similar to step turning, chamfer turning produces an angled transition of a normally square edge between two surfaces with various turned diameters.

Contour Turning: When turning a contour, the cutting tool travels axially along a route with a predetermined shape. To give the workpiece the appropriate curves, a contouring tool must make many passes. The identical contour shape may, however, be created with form tools with only one pass.

Facing: In the machining process known as facing, material is removed from the workpiece's ends to create flat surfaces. Feeding the tool perpendicular to the chuck's axis of rotation is how this procedure is carried out.

Boring: A single-point cutting tool is used to bore holes in a workpiece in order to remove material from the existing hole and expand it. Before beginning the boring procedure, holes should have already been bored.

Drilling: Making holes in the material using a drill that is held in the tailstock while drilling is called drilling. Drilling is accomplished by moving the small device against the stock while spinning the tailstock handle.

Knurling: By pressing the knurling tool against the workpiece to carry out the knurling operation, a recess (or sharp depression) is created on the edge of the workpiece. A greater grasp on the task may be offered by the knurling procedure.

Chamfering: To eliminate burrs, protect the end of the item from damage, and improve the appearance, chamfering is the process of beveling a workpiece's extreme ends.

Divorcing: Cutting or splitting the work after it has been manufactured to the desired form and size is known as "parting off." Security is crucial since parting off is typically one of the final procedures to be completed on the part.

Grooving: The technique of generating a shallow slot or hollow on a cylinder, cone, or face of the component is called grooving, also known as recessing or necking. The groove form, or a sizable portion of it, will be in the shape of the grooving tool.

Forming: Forming is the process of using a forming tool that has the necessary shape for use in carrying out a forming operation to create a convex, concave, or other uneven surface on the workpiece [3].

Taper Turning: In the process of "taper turning," a conical form is created on the component, and the feed is angled toward the component. From one end to the other, the diameter of taper turning components varies consistently.

Threading: Making threading on a cylindrical item is called threading, and the procedure results in a helical ridge with a consistent section. On the lathe, threading is accomplished by making sequential cuts using a threading tool that matches the desired thread form in shape.

Reaming: Reaming is the process of enlarging the hole using a rotating cutting tool called a reamer. There are two types of reamers: non-precision reamers, which are used for basic hole enlargement or burr removal, and precision mandrels, which are designed to enlarge the formed hole's size by a small amount while doing so with high accuracy to achieve a specified radius and leave a smooth finish. Reaming differs from boring in that its primary goals are to increase tolerance and surface quality.

Tapping: Tapping is the process of creating a thread within a hole so that a cap screw, bolt, or nut may be threaded into the hole. Threading produces exterior threads, whereas tapping creates internal threads, hence this is the difference between the two operations [4].

Lathe's main components

A lathe machine's bed, headstock, carriage, and tailstock are its essential components. Le Blond lathe could feature a raised head or detachable ways, depending on its model and period. Levers, gears, bearings, and shafts are just a few of the numerous moving elements found in a headstock. The spindle speed is determined by the arrangement of these components, which are powered by the main motor. The saddles, cross slide, compound rest, and apron make up the carriage. The cross slide is the sole component that travels along the X-Axis, although the entire assembly moves longitudinally (Z-Axis) along the bed. The operator may adjust the cut angle necessary for their application thanks to the swivel of the compound rest[5]. When necessary for the application, the tailstock offers additional support, and it enables the operator to execute tasks like drilling and reaming.

Benefits of Lathe Machine Parts

- For the best cutting precision, the lathe bed must be solid and steady.
- Depending on the material you're working, you may tailor your project utilizing the headstock's numerous speeds.
- The bed is smoothly moved by the carriage as it goes comfortably along it.
- The workpiece is stabilized and supported by the tailstock [6].

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CHAPTER 4

Engine Lathe Machine

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The words "center lathe," "engine lathe," and "bench lathe" all refer to a fundamental kind of lathe, which may be thought of as the archetypical class of metalworking lathes most frequently employed by the ordinary machinist or machining enthusiast. The term "bench lathe" refers to a size of this type that may be installed on a workbench. The construction of a center lathe is described above, although even these lathes can differ significantly across models based on the year of manufacturing, size, price range, or desired features. The term "engine lathe" refers to a typical lathe from the late 19th or early 20th century having automated feed to the cutting tool, as opposed to early lathes that employed hand-held tools or lathes with manual feed exclusively. Here, the word "engine" refers to a mechanical device rather than a primary mover, like in the days when steam engines were the go-to industrial power source. There would be a single huge steam engine at the plant that would power every machine with a belt system called a line shaft[1].

Early engine lathes were therefore often "cone heads," in that the spindle typically had a multi-step pulley called a cone pulley attached to it that was made to receive a flat belt. By adjusting the flat belt's stride on the cone pulley, varied spindle speeds may be achieved. As opposed to direct belt drive, cone-head lathes often included a countershaft (lay shaft) on the rear side of the cone that could be engaged to offer a reduced range of speeds[2]. They were referred to as back gears. A further lower set of speeds might be provided by shifting the two-speed rear gears on larger lathes. Many cone-head lathes were changed over to electric power as electric motors became more prevalent in the early 20th century. At the same time, the state of the art in gear and bearing practice was improving to the point where producers started creating fully geared headstocks, using gearboxes similar to those found in automobile transmissions to achieve different spindle speeds and feed rates while transferring the higher quantities of torque required to fully utilize high-speed steel tools[3].

In the 1970s, man-made carbides were extensively used by general industry and marked the beginning of cutting tools' latest evolution. Initially, carbides were brazed into tool holders' machined "nests," which served as a means of attaching them to tool holders. Later developments made it possible for tips to be interchangeable and multifunctional, allowing for reuse. Carbides may be machined at significantly greater rates without wearing out. Because of this, machining times have decreased, which has increased productivity. The trajectory of lathe development was governed by the need for quicker and more powerful lathes. By enabling constantly changing motor speed from the maximum down to virtually zero RPM, the accessibility of affordable electronics has once again altered how speed control may be used. This was attempted in the late 19th century, but at the time it was not deemed adequate. Electric circuitry advancements later have restored its viability.

Additionally, it has the ability to create things like prints, foundry pattern core boxes, and forge burner nozzles. The construction of many modern tools is made possible by engine lathes, which are a wonderful tool. It is simple to make gadgets at home or in a shop for everyone who has an engine lathe. Because it can produce a variety of goods, an engine lathe is often referred to as a reproducing machine. Gears, a stepped pulley to control spindle speeds, a tailstock, and a carriage are the main components of an engine lathe. The transport, which supports the cutting tools, is powered by the gears. A tailstock will help with spindle hole drilling. Shaping tools can be moved by hand or by using gears. For angle and crosscutting, a traditional engine lathe will additionally have a compound rest and cross-slide. The waggon would collect dirt and dust in the days of a 19th-century blacksmith, which could be cleaned afterwards. Today's carriage is self-oiling at both the front and back, making machinists' jobs easier. The carriage is also designed to shield the machine from the scrap from the components it makes[4].

Look no farther than Machinery Resource International if you or your company is seeking for the highest quality engine lathes for sale. MRI is a full-service machinery dealer with offices in Los Angeles, Chicago, and Toronto that provides the manufacturing sector with high-quality used machines. With over 60 years of combined expertise, Machinery Resources has benefited from both local and international commerce. Only the greatest and most recent versions with expensive CNC and enormous capacity are the focus of MRI. Devices including Blanchard grinders, CNC lasers, traditional milling and turning equipment, metal fabrication tools, and even hard-to-find machinery. MRI mainly serves the medical, automotive, small component, aerospace, and defense sectors.Each component of an engine lathe machine is included, including the bed, saddles, headstock, and tailstock. An engine lathe has a rigid headstock and a movable tailstock that is used to support operations like knurling. With the aid of feed mechanisms, it may readily feed the cutting tool in both longitudinal and lateral orientations[5]. The gear mechanism or pulley mechanism powers engine lathe equipment. It has three different driven mechanism types:

1. Gearhead:
2. Motor
3. Belt-Driven

One of the most beneficial and essential tools in a shop is the engine lathe. A rotating work piece can be altered in size, shape, or finish using a variety of cutting tools on an engine lathe. The most common lathes in shops have a headstock, tailstock, carriage, and bed.

- The spindle and motor, as well as any gears and pulleys required to modify the spindle speed and feed rate, are all housed inside the headstock.
- The tailstock is used for centering, drilling, reaming, tapping, and threading components. The majority of drill chucks contain a tang that enables the chuck to be positioned in the tailstock.

- Levers, clutches, and gears on the carriage allow for manual or electrical power feed movement control. There is a lengthy flat bar underneath the carriage. This bar can be used as an emergency brake to halt the spindle's revolution.
- The bed, which is joined to the headstock, supports the carriage and tailstock[6].

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CHAPTER 5

CNC Lathe Machine

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Computerized numerically controlled is referred to as CNC. Because of its quick and precise operation, this is a lathe that is frequently employed in the present. It is one of the most sophisticated varieties.In order to operate the machine tool, computer programs are used. After being inserted into the Computer starts operating at a very high speed and precision in accordance with the program. Even a pre-planned, programmed machine exists, and once the code is put up for the different activities, it may run without the need to change it again. After initial setup, a semi-skilled individual may readily run this.Although there is no programmed feeding system, these lathes are employed for mass manufacturing just as capstan and turret[1]. These lathes produce components with extremely precise dimensional tolerances.CNC Lathes are machine tools that operate using Computer Numerical Control (CNC) systems and come with exact design instructions. The material or part is clamped and turned by the main spindle, while the cutting tool that works on the material is attached and moved in multiple axes. The majority of the time, CNC lathes are used to machine items, such as shafts and pipes, where the material or part is clamped and rotated while the cutting tool is stationary attached. They are most suited for components with same symmetry around an axis that might be tossed up (i.e. radially clamped) in the spindles. A basic CNC lathe has two axes of motion and an 8–24 station turret where the tool is fixed in place. Certain varieties of CNC lathes are referred to as CNC turning machines because the rotating motion of the component is referred to as "turning."

Boring, tapping, and milling (where the cutting tool travels around a stationary workpiece) tools are often operated by different drive systems inside the turret. The life tools, or active tools, are positioned for either axial or radial operative directions depending on the purpose. Both 3-axis CNC lathes and CNC turning machines may have them. Turning centers are the usual name for lathes that include extra features like Y-axis, sub-spindles, or specifically chosen choices for automation. These advanced machine tools may accomplish complicated component fabrication in one configuration by including milling, drilling, and tapping operations in addition to normal OD and ID turning operations. Such all-in-one machine tools greatly increase production by transforming an item from a raw component to a completed product[2].

CNC Lathe Types A machine that rotates material around a central spindle and a fixed cutting tool is a computer numerical control lathe. Instead of using physical labor, a computer is provided with coded instructions that control the movement of your material[3]. Multiple processes may be set simultaneously, preventing the need for your material to leave the lathe among manufacturing processes and ensuring accurate cut placement. A straightforward CNC lathe rotates the material it is cutting while using two axes of motion. You may hear people refer to CNC lathes as CNC turning machines since the rotation of the material is sometimes referred to as "turning." It's more likely that lathe machines having more than two axes, such as those with an extra Y-axis or sub-spindle, will be referred to as CNC turning centers.

The number of axes a CNC lathe has determines the sort of lathe it is. They can generate more complicated pieces without manually moving between machines or equipment since they come with a variety of axes. The various axes have an impact on how the tool or machined item may be approached, turned, and positioned throughout the machining process[4].

- **2-Axis CNC Lathe:**This basic CNC lathe machine includes two linear axes that may be used for facing operations, such as drilling and tapping at the center of the component, and outer diameter/inner diameter operations, which are essentially cylindrical machining. It does not support milling and just has an X and Z axis.
- **3-Axis CNC Lathe:**A C axis and life tool system are added to a 3-axis CNC lathe, enabling the workpiece to be positioned for common milling operations like boring and tapping. It is feasible to do helical milling operations that call for the workpiece to rotate slowly in sync.
- **4-Axis CNC Lathe:** An additional Y-axis is added to a 4-axis machine to enable off-center machining operations. When turning more complicated and irregular shapes, the fourth axis is useful.
- **5-Axis CNC Lathe:**A second turret is added to a 3-axis CNC lathe in 5-axis lathes. These machines would then feature the C-axis on the revolving spindle in addition to two axes at each upper and lower turret. Due to the ability to operate two tools simultaneously on the component, machining speed is dramatically increased.
- **6 Or More Axis CNC Lathe:** The permutation may comprise any of the following with more than five axes: Two C-axes with a primary and secondary spindle, two turrets with an upper and lower turret and two linear axes each, one Y-axis at the higher turret, and a secondary spindle that may travel in the direction of the primary spindle to pick up the component are all included. Even machines with more axes than eight exist. 8-axis lathes, on the other hand, are extremely complicated and high-tech devices that are rarely used for routine industrial tasks[5]–[7].

Benefits from a CNC Lathe: Purchasing a computer numerical control lathe rather than a manual one has several advantages. First off, because their movement is controlled by code, computer-operated lathes are highly exact. Extra accuracy throughout the production process results in fewer errors, less expensive operation, and less material waste. When turning, manual lathes are susceptible to human mistake.Additionally, a single operator may control numerous CNC lathes simultaneously, whereas manual lathes take more care! Though initially more expensive, CNC lathes end up being less expensive to operate in terms of staffing for supervision. As a result of the dependability of computer numerical control, production periods are shorter, more CNC machines are operating simultaneously, and all goods produced are almost identical.

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CHAPTER 6

Capstan and Turret Lathe

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A modified variant of the engine lathe machine, the capstan and turret lathe machine is used for mass production (big quantities). This machine is utilized in situations when the workpiece is subjected to their sequence of operations; alternate operations are not carried out on this machine. These machines used a hexagonal turret head in place of a tailstock, allowing numerous operations (turning, facing, boring, and reaming) to be completed sequentially without the need to change the tool manually. The turret rotated after each operation. Additionally, it has three tool posts. In comparison to other lathe machines, it takes up more floor space. Capstan and turret lathes are only used for big projects. Even less experienced operators can use capstan and turret lathes, which is their principal benefit[1].

The development of engine and center lathes is the capstan and turret lathe, which replaces the tailstock with a hexagonal tool head with six distinct tools and rotates the turret tool during each operation in accordance with the needs of the process. These are utilized for mass manufacturing in less time with the highest accuracy and precision. They are also used to make a huge number of similar parts. These lathes are semi-automatic, which means that all machining operations, such as boring, digging, thread cutting, facing, and turning, among others, will be carried out automatically without the need for tool changes, while manual tasks, such as setting the tools, clamping the workpiece, and cooling the process, will be required for other operations. These machines are more expensive than engine lathes due to their complicated structure and their ability to handle tiny to big workpieces. Despite having a similar appearance at first glance, capstans and turret lathes differ in numerous ways, including their sizes, modes of operation, and structure. So let's now discuss how they differ from one another [2].

A production lathe is one with a capstan and turret. It is used to produce any quantity of identical components in the shortest amount of time. Machine operations are carried out automatically in semi-automatic lathes. Other from machining, manual tasks include work loading and unloading, tool placement, and coolant operations. The ram with the turret head placed on it has turret slides running lengthwise on the saddle. A hexagonal block with six sides serves as the turret head and features a bore for mounting six or more tools simultaneously. These faces have a threaded hole that is used to hold the tools. A hexagonal turret is positioned on a short slide or ram that is connected with a capstan in the case of a capstan lathe. The saddle can be adjusted in accordance with the bed's directions and, if required, attached to the bed. Specially designed for duties like those in bars. Nevertheless, the hexagonal pattern used on the Turret Lathe immediately installed on the saddle turret. The saddle is movable along the bed rails. Turret lathes are typically employed for chucking-related tasks [3].

Components of a Capstan and Turret Lathe:

The turret is the only component that differs significantly between the engine and turret lathes. It also has a sophisticated mechanism built into it to make it ideal for use in mass manufacturing. The components of a capstan and turret lathe are as follows:

Bed: The bed is a long, box-like casting with precise guideways on which the carriage and turret saddle are fixed. Under heavy load services, the bed is developed to provide strength, stiffness, and permanent alignment.

Headstock: Large castings make comprise the headstock. It is at the end of the bed on the left. The following are the many headstock designs used in capstan and turret lathes:

- Headstock with a step cone pulley drive.
- Headstock with direct electric motor driving.
- Whole headstock in gear
- Headstock that is preemptive or preselected.

Saddle and Cross-Slide: Small capstan lathes employ hand-operated cross slides that are clamped at the necessary location on the lathe bed. Larger lathes and heavy-duty turret lathes often have two different carriage configurations.

- Traditional style of carriage
- The side-hung carriage

Auxiliary Slide and Turret Saddle: The turret saddle spans the space between two bed-ways in a capstan lathe. And a bearing area for the auxiliary slide is provided by precisely milling the top face. On the lathe bed ways, the saddle is adjusted and fixed in place. The auxiliary slide is where the hexagonal turret is placed. A turret's movement is immediately influenced by the saddle's movement since the saddle is directly attached on top of the turret. The turret may be moved manually or mechanically. The turret is a tool storage with a hexagonal form designed to accommodate six or more instruments [4].

Brief working:

- Chucks or collects that are actuated hydraulically or pneumatically are holding the work item. All of the tools are secured in their appropriate holes on the turret head.
- According to the order of action, the tool is being moved by the turret head.
- On the turret head, drilling, boring, turning, reaming, and threading equipment is mounted.
- The front of the turret is mounted with tools for forming, chamfering, and knurling.
- The Parting tool is mounted on the back of the turret in an upside-down position.
- After finishing each action that automatically indexes the tools, the turret head moves back to its starting location[5].

Advantages

- The rate of output is high.
- Different speed ranges can be attained.
- Tools of all kinds can be accommodated.
- Because fewer skilled workers are needed, labor costs are reduced.
- Greater stiffness to support high weights[6].

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CHAPTER 7

Quadra Index Tool Post

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It also goes by the name "square tool post." This sort of tool post can hold four fixed tools, and any one of them may be moved into the operational position to complete the job. The handle lever is used to clamp the square head[1]. The following tool may be indexed and moved into the operational position by loosening the handle lever. As seen in Figure 1, the indexing is manually controlled using a turret lock. This tool post is manufactured of Mild Steel IS 2062, has slots on all four sides, and can accommodate four tool shanks at once. This tool post's slot is 30 mm wide and can accommodate 20 mm shanks with great stability[2].

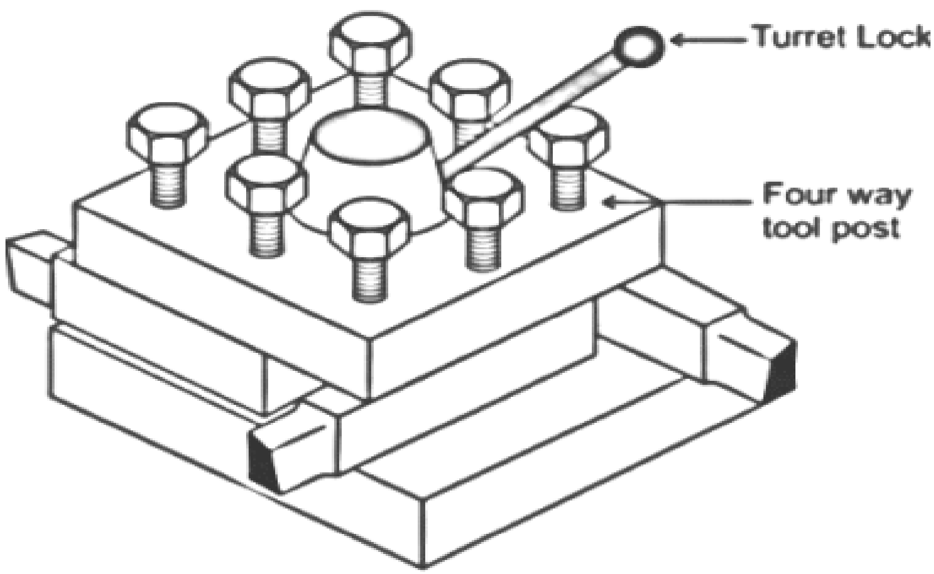

Figure 1: Representation of the Quadra index tool post.

Quadra Index tool post disadvantages: The primary disadvantage of this tool post is that it is challenging to line the dead center of the tail stock with the tool tip. If the tool shank is inserted into the tool post slot without the use of additional shims or slips, it will not do so. Shims are needed to be positioned below the shank for each operation in order to align the tool's center with the workpiece, and this adds time to the operation that should be avoided[3]. The Quadra index tool post with shims is shown in Figure 2.

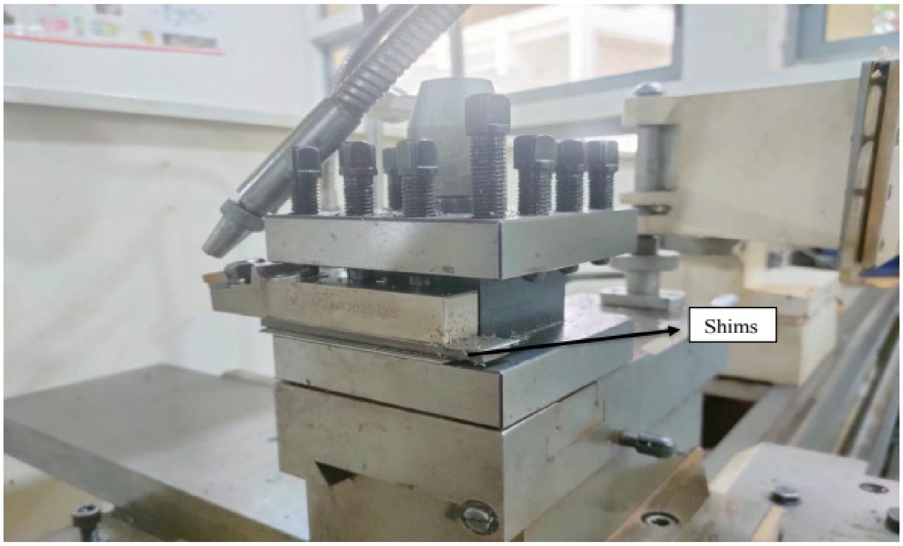

Figure 2: Depicts the Shim-Equipped Quadra Index Tool Post.

These kinds of tool posts are included with contemporary lathes: The tool holder, in which the tool is fastened, is modified as opposed to the actual tools. The original 4-way tool post on our lathe will be swapped out by this quick-change tool post[4]. The Quick release tool post of the lathe machine is shown in Figure 3.

Figure 3: Depicts the Lathe's Quick Release Tool Post.

Cast iron is used to construct this tool post: It consists of two parts: the tool holder, which is attached to the main component via a slotting mechanism, and the main body section. It includes four bolts to secure the tool shank, and it also has an adjustable bolt that enables vertical movement of the tool holder on the core element up and down[5]. The tool tip may be adjusted to the dead center or work job center by tightening the bolt. Therefore, with this form of tool post, shims or slips are not required to align the tool tip to dead center. To hold the tool, it has just one slot[6].

Quick release tool after drawbacks include:

- Although there is no requirement for shims or slips, the adjustable bolt, which has a complicated design, is the primary flaw of this tool post. Beginners find it difficult and time-consuming to position the tool tip to the dead center due to the intricate design.
- Because there are more pieces, it is more difficult to adjust and fix the tool post because the tool has to be fixed to the tool holder, the tool holder needs to be fastened to the tool post, and the tool post needs to be connected to the lathe machine.
- Develop the notion to create a tool post that is user-friendly for new users after realizing these drawbacks. Figure 4 lists the components used in the Quick release tool post[7].

Figure 4: The Components Utilized in the Quick Release Tool Post are Listed.

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CHAPTER 8

Introduction to Welding

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Metals are frequently joined by welding, which has many different applications. Welding takes place in a variety of environments, including indoor spaces like factories and workshops as well as outdoor settings like construction sites and rural farms. Welding Processes are quite easy to comprehend, and fundamental approaches are rapidly mastered. Metals are joined at the molecular level during welding. A weld is a homogenous connection among two or more metal pieces when the welded joint's strength is greater than that of the base metal pieces[1]. In its most basic form, welding requires the use of four materials: metals, a heating element, filler metal, and some sort of air barrier. The metals are heated till they melt while being protected[2].

While being protected from the air, the metals are heated to their melting points. Next, a filler metal is introduced to the heated region to create a single individual piece of metal. You can carry it out or without with or without pressure.In the fabrication and manufacturing sectors, the terms "automation" and "automation" refer to the performance of particular tasks or stages by mechanical, electrical, or hybrid equipment. The degree of automation varies since certain functions could encompass all processes or just a portion of them. Such welding procedures are frequently described using the phrases automated and mechanized. Although there are legitimate concerns against the use of the name AI to suggest that the device is capable of self-learning, which is not the case, the motions of the welding process are simply mechanized and not many of the electronics are controlled by artificial intelligence (AI)[3].

The existing system is essentially a system with computations and kinematic algorithms already coded in. In contrast, the word "automatic" is used in a variety of ways; it implies that some form of artificial intelligence (AI) is used to control the mechanical arms that could assist in moving the welding head (torch) along the weld line or locating itself to challenging welding ranks as the welding progresses. In more advanced models, it may manage the current and weld travel speed within a predetermined range of parameter constraints. It may also consist of considerably more intricate controls that are programmed into the system rather than being controlled by operators[4]. To perform welding most efficiently, it may comprise a variety of parameter controls, the welding head, and task manipulation.

The capacity to mount a welding head on a machine with an electronically articulated or mechanical arm is only one aspect of welding automation; other aspects include planning, coordinating, and monitoring the manufacturing process. It entails selecting which of those humanly operated operations to employ and to what extent they need to be automated after carefully evaluating the welding/producing process, processes, production phases, and controls. Since most welding tasks require the welder's judgment, an automation decision must be made based on determining which task can be automated without relying on the welder's judgment; the machine in question might use a sophisticated electronic control system, and straightforward mechanical movements to simulate manual welding or any combination [5].

It could mimic human welding with basic mechanical motions, or it might combine the two automation strives to lower manufacturing costs by boosting productivity. It also aims to raise production quality by converting routine tasks from manual to mechanical methods. The level of sophistication simply depends on how well these fundamental objectives are accomplished.

Mechanized welding, also known as machine welding, and is performed by welding equipment while being closely supervised by a welding operator. The welding process can be carried out with the item stationary and the weld head moving around the weld line to complete the welding, or it can be done with the object stationary and the weld head moving along the weld line. The equipment might or might not be able to load and unload the job to the welding station in such a configuration.

In contrast to the machine welding that was previously explained, automatic welding is carried out using machinery that completes the full welding process without any changes or supervision from a welding operator. Although a welding operator is not necessary for the equipment to operate, their skill set is considerably strengthened in this area since they must make sure the electromechanical functioning of the system is in good working condition. Understanding the machine's electronic system and functioning is necessary for this. The system may or may not be able to load and unload the work at the welding station on its own[6]. Automatic welding incorporates the machine welding components that were previously explained. In each weld, the weld preparation is a crucial component.

The weld treatment is a crucial component of every high-quality weld, but for automated welding to be effective, there is a strict requirement for more exact weld preparation. The heating cycle controller is a crucial component in automated welding. This regulates the welding process as well as the necessary features and material handling tools. The controller precisely schedules these actions and different phases to enable good welding and a quick manufacturing process.

Robotic technologies make it feasible to automate welding successfully; a robot is simply a mechanical device that can be programmed to carry out certain duties, such as manipulating the weld head and placing work at the weld station. These robots can be utilized with computerized numerical control technology to handle job-work fluctuations (learn more about robotics in the next paragraphs). This enables the welding software to be modified to cater to a varied set of welding requirements. This automated welding system's use of robots and computer numeric control (CNC) programming enables comparatively smaller work orders to be finished quickly and with high-quality results[7].

A set of instructions for each future job of the same kind are stored in robots and their computer memory. Robotic arms are frequently equipped with sensory eyes to check that the weld joint fitting is within the necessary limits, which strengthens the production process's quality control efforts.

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CHAPTER 9

Welding Forms

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Types of Welding:

There are several types of Welding such as:

- Arc Welding
- Gas Welding
- Resistance Welding
- Energy Beam Welding
- Solid-State Welding

Arc Welding:

To melt metals at the welding site, an electric arc is produced and maintained between an electrode and the base material using a welding power source. The power supply for these welding procedures might be either AC or DC, the electrode is either edible or not, and a filler substance may or may not be included. The metal at the link between the two workpieces melts because of the power supply's extreme heat of around 6500°F. The electrode either simply conducts the current or conducts the current and dissolves into the weld pool at the same time to give filler metal to the join the arc can be automatically or manually steered along the line of the join[1].

A protective shielding gas or slag is employed to reduce the contact of the molten metal with the air because the metals, when heated to high temperatures by the arc, chemically react to oxygen and nitrogen in the air. Upon cooling, the molten Metallurgical bonds are created when metals solidify[2].

Gas Welding:

This process involves melting the work parts (and filler) together using a focused, high-temperature flame produced by gas combustion. The most popular kind of gas welding is called oxygen-fuel welding, in which acetylene burns in oxygen weld using gas By heating metals with a flame produced by the interaction of fuel gas and oxygen, the welding process known as "gas welding" melts and unites metals. Due to the high flame temperature of oxyacetylene welding, it is the most widely used technique. The weld metal can be cleaned and deoxidized using flux. On the metal that results from the weld, the flux melts, solidifies, and creates a slag skin. Oxyacetylene welding melts metal by heating it with oxygen and a fuel gas until it is molten.Oxyacetylene uses a fuel gas and oxygen to melt metal until it is molten, then it uses that heat to fuse many pieces of metal. Both with and without a filler rod are excellent for joining metals of different compositions[2].

Resistance Welding:

By exerting pressure and running a powerful electric charge through the metal combination to heat it, resistance welding, also known as electric resistance welding (ERW), allows metals to be welded together. Metals are joined together through forging and welding. Resistance welding is typically used to connect two pieces of simple metalwork. Weld electrodes give an electric current to the metal plates (or any other workpieces being connected), applying force to the sheets as a result. Heat is created by this force. The metal is heated to the point where it joins the point of "resistance" between the faying surfaces, melting it there. The electrode then draws heat from the hot spot to create a weld.The liquid weld region is then heated by the electrode, and when it cools and hardens, a weld nugget is created. Before, during, and following the passage of a stream, a force is applied, so limiting the contact area[3].

Energy Beam Welding:

In this technique, the work components are melted and then joined together using a focused high-energy beam (such as a laser or an electron beam). An electron gun produces electrons during the fusion welding process known as an electron beam (EB). Using electrical fields, a pistol was accelerated to great speeds. Magnetic fields are used to concentrate this fast-moving electron stream as it is delivered to the materials that will be bonded. As the electron beam collides with the work components, kinetic heat is produced, forcing the parts to melt and fuse[4]. Due to the possibility of the beam scattering in the presence of gas, electron beam welding is only accomplished in a vacuum environment. This welding is difficult since it uses high voltages and a vacuum process.This welding process is highly mechanized and computer-controlled due to the vacuum process and the high voltages employed. Therefore, unique fittings and CNC tables are utilized inside the welding vacuum chamber, to move the work components[5].

Solid-State Welding:

The connecting of the workpiece occurs in the solid state during solid-state welding procedures, which do not need any external heat. These welding procedures don't employ filler metal and don't involve a Base or filler material in a molten condition. The intermolecular diffusion process, in which the interface molecules of the workpieces travel from high concentration zone to low concentration region owing to applied pressure, is what causes the weld to develop. Heat is generated using a variety of techniques, which quickens the diffusion at mating surfaces. These welding techniques are frequently utilized in industrial applications since they don't alter the physical or mechanical characteristics of the parent material. These are the best connecting methods for heat-sensitive materials[6].

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CHAPTER 10

Components Used in Welding Process

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The Following Components are used:

- DC MOTOR
- BEARINGS
- TRANSFORMER
- COPPER ALLOY ELECTRODE
- SQUARE ROD AND ANGLE ROD
- SCREW ROD AND GUIDE ROD
- MICRO CONTROLLER

DC MOTOR:

An electrical device known as a DC motor transforms electrical energy into mechanical energy. A current-carrying conductor receives a mechanical force anytime it is in the magnetic field; this is the fundamental operating principle of a DC motor. A DC any of a group of rotating electric motors that use direct current electricity to create mechanical energy is referred to as a motor. The majority of kinds rely on the magnetic field's forces. For a portion of the motor's current to sometimes shift direction, almost all types of DC motors contain an internal mechanism that is either electromechanical or electronic[1].By converting the high voltage (HV) and low current from the primary side of the transformer to the low voltage (LV) and high current value on the secondary side of the transformer, a step-down transformer transforms the primary side's HV and low current into the secondary side's LV and LV[2].

BEARINGS:

A bearing is a component of a machine that limits relative movement to only that motion that is intended and lessens friction between moving elements. For instance, the bearing's design can provide unrestricted rotation or linear motion of the moving portion on a fixed axis, or by regulating the vectors of the normal forces acting on the moving pieces, it may stop motion. Most bearings reduce friction to enable the required motion. According to the kind of operation, the movements permitted, or the directions of the loads (forces) supplied to the components, bearings can be widely classified[3].The copper alloy electrodes are used to hold the sheets (work components) together while also concentrating welding current into a compact "spot." Electrodes apply pressure to hold workpieces together.

TRANSFORMER:

A device that steps up or steps down the voltage as it transmits electrical energy from one alternating-current circuit to one or more other circuits. Transformers are used for a broad range of functions, including raising the voltage from electric generators to enable long-distance transmission of electricity and lowering the voltage of traditional power circuits to run low-voltage devices like doorbells and toy electric trains[4].

Transformers work by inducing current in a second coil known as the secondary as the magnetic lines of force (flux lines) build up and contract in response to variations in current flowing through the primary coil. The number of turns in the secondary coil divided by the number of turns in the primary coil, known as the turn ratio, is multiplied by the primary voltage to determine the secondary voltage.

COPPER ALLOY ELECTRODE:

For use in the transistor, Chemical Vapor Deposition (CVD), and Physical Vapor Deposition (PVD) processes such as Thermal and Particle Frame Evaporation, Cooling Organic Moisture, Atomic Layer Deposition (ALD), Metallic-Organic, and Chemical Vapor, American Elements specializes in producing highly pure uniform shaped Copper Electrodes with the highest density and smallest average grain sizes (MOCVD).

Highly pure copper electrodes are produced by American Elements and may be used for demonstrations as well as chemistry and physics studies involving mass and heat conductivity. Crystallization, solid state, and other ultra-high purity procedures like sublimation are used to make materials[5].

SQUARE ROD AND ANGLE ROD:

The versatile steel piece known as square rod often referred to as square steel, squares, and square metal bar, is mostly used for maintenance and production. Our light and re-rolled segment include general-purpose square bars, which are appropriate for routine commercial applications.Square rods, often known as square rods, are units of measurement for small areas of land. Equivalent to a square with sides that are one rod long equivalent to 1/160 acre or 3014 square yards[6].

SCREW ROD AND GUIDE ROD:

A large drill bit that is attached to and has the same diameter as the core barrel it is used with. It increases the core barrel's stiffness and aids in preventing borehole deflection. Oversize rod is another name for core-barrel rod for comparison, see drill collar.A threaded rod, also known as a stud or a rod of variable length, is a rod that has threads arranged in a helical pattern. The threading wraps around and along the rod and resembles a screw to provide rotational motions[7].

MICROCONTROLLER:

A microprocessor is a microchip-based open-source microcontroller board. A microcontroller board called Arduino Uno is based on the ATmega328P. There are 14 digital input/output pins in total. A 16 MHz ceramic resonator, 6 analog inputs, a USB port, a power connector, an ICSP header, and a reset button are all included. It comes with everything required to operate the microprocessor; to get started, just plug in a USB cable, an AC-to-DC converter, or a battery.

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CHAPTER 11

Fabrication Process

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Any process that involves cutting, shaping or molding material into a finished good is referred to as "metal fabrication" in the broadest sense. Fabrication develops a finished version from raw or semi-finished materials as opposed to assembling it from pre-made components. Manufacturing procedures for fabrication come in a wide variety. Both bespoke and off-the-shelf items require metal manufacturing. The majority of bespoke metal goods are made from a variety of widely used metals and alloys. To make a new product, metal fabricators frequently start with standard metal elements such as sheet metal, steel rods, metal steel bars, and metal bars[1].

Fabrication shops are businesses that specialize in metal fabrication. Metal fabricator work on a range of projects for contractors, equipment makers, and resellers. Many metal fabricators submit designs as part of their bids for work, and if they get the deal, they construct the project. Metal fabricators start the planning process as soon as a contract is granted by placing the appropriate material orders and having an expert programmer in CNC machines for the job. To produce a finished product, fabrication facilities may employ several procedures. They could also offer the product finishing services like deboning, polishing, coating, and painting. Finishing is different from metal processing in that it is an additional technique used to treat the product's exterior rather than shaping it or producing something entirely new[2].

Types of Fabrication Process

Casting:

Casting is the process of pouring hot metal into a mold or die, allowing it to cool, solidify, and take the desired shape. The mass manufacture of parts using the same mold repeatedly to produce similar goods is suitable for the metal fabrication process. There are several casting variations. Die-casting is the process of forcing liquid metal into a die rather than a mold, where the pressure retains the metal in place as it solidifies. The fast applications that this approach provides are its main selling point. The molten metal is poured into a mold during permanent mold casting. There are several different casting methods. This procedure occasionally also involves the use of a vacuum. Die casting can produce weaker castings than permanent mold casting[3].

Semi-permanent mold castings are also offered as a result. These molds' replaceable cores make them easier to handle and less expensive to remove. Sand casting is the last casting technique. Sand casting involves pressing a design into a fine sand mixture to create casts. This creates a mold into which the molten metal may be poured. Despite being slow, this casting method is typically more affordable. Additionally, it works well for big metal production projects or when elaborate patterns are required.

Cutting:

Cutting a workpiece to divide it into smaller portions is a relatively typical method of metal production. While sawing is still the most common way to cut, more recent techniques include laser, waterjet, power scissors, and thermal plasma cutting. Cutting can be done using a variety of instruments, including hand and power tools as well as computer numerical control (CNC) cutters. Cutting could be the initial step of a more involved fabrication process, or it might be the sole one.

Another method of cutting metal that employs a die is die cutting. In rotary die cutting, the material is cut using a rotating cylindrical die that is fed via a press. On heavier metal materials, flatbed die cutting is employed, which involves using dies on a press to carve out shapes[4].

Drawing:

Tensile tension is used in drawing to draw material through and into a tapered die. The metal is thinned by the die's stretching action. Drawing is typically done at normal temperature and is known as "cold drawing," however the metal work can be heated to lessen the effort needed. When the finished result has a thickness that is equal to or more than its radius, the procedure is referred to as deep drawing. It is typically used in conjunction with metal sheet fabrication to create hollow cylinder- or box-shaped containers from sheets of metal.

Folding:

Metal is bent at an angle during this metal manufacturing process. The most typical method is using a brake press, which pinches the metal to make wrinkles in it. Holding the workpiece between a punch and a die, the punch applies pressure, causing the workpiece to crease. Typically, this method is used to form sheet metal. In addition to employing a folding device, also known as a folder, or pounding the product until it bends, folding can also be accomplished manually. The device features a flat platform where flat sheet metal is put, a clamping bar to secure the workpiece, and a front panel that raises upward to bend the metal that is extended over it[5].

Forging:

Metal is shaped by forging using compressive force. The workpiece is struck with a hammer or die until the required shape is created. Cold forging is a type of production that uses metal that is at room temperature. Warm forging, which involves heating the metal to a temperature above room temperature and below the recrystallization temperature, is another method of forging. The procedure is known as hot forging when the material is heated to its recrystallization, which varies per metal. Blacksmiths used forging millennia ago, making it one of the first methods of creating metal[6].

Extrusion:

The workpiece is pushed into or around a closed or open die during the extrusion production process. The diameter of the work is reduced to the pass of the die when it is driven through an open or a closed die. The workpiece develops a cavity when it is compressed around a die. Both of these procedures typically require a ram to carry out the impact operation and a metal slug or cylindrical as the workpiece. Wiring or piping is frequently produced as the resultant cylindrical component. To create variously shaped pieces, the dying pass can be modified. Extrusion may produce very long pieces when it is continuous, or it can produce several shorter pieces when it is semi-continuous[7].

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CHAPTER 12

Design Model

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2D Model:

2D modelling is the process of producing two-dimensional blueprints, drawings, and designs. These papers can outline a site's general organization and the locations of things, but they are missing the depth dimension. These two-dimensional designs can be made on paper or with the use of computer applications that are specifically made for doing so[1].

The use of 2D for site models

2D maps help get a general sense of a place. They provide a clear, readable picture of how your website appears from above. 2D plans help conduct high-level inspections and compare significant changes over time, even if they don't include as much comprehensive information. They are frequently zoomable and high-resolution, allowing you to closely examine different project components. You may rapidly develop a 2D map to satisfy those needs if you need to offer someone a brief overview of a location or the status of a project[2].

2D planning might be helpful even if you only require standardized measurements. Making a 2D map enables you to locate these measures fast and avoid the 3D measurements you don't need because you might not always require three dimensions for some metrics. A 2D map makes it simple to locate specific information, such as a cut and fill number, at a specific area on a project site. Making judgements in the field quickly and accurately is made possible by this skill.

Companies also utilize 2D models rather than 3D models since their machinery is not yet capable of handling 3D data. This issue is becoming less significant as 3D modelling technology spreads, but it may still be a worry for some businesses. For this reason, some businesses might not wish to utilize 3D models at all, while others would use 3D models in the office but 2D models on mobile devices that might not be compatible with the 3D models. It's crucial to keep in mind, however, that certain portable devices can handle 3D models and that many 3D modelling applications let you download models so you can use them wherever you are, even while you're offline[3].

Although many websites and PCs can show 3D models, businesses that are utilizing old machines may not want to upgrade because doing so would require paying for new or upgraded equipment upfront.

3D Model:

The addition of the third dimension in 3D modelling makes it significantly different from 2D modelling in CAD. As a result, 3D models are more detailed than 2D models. They accurately portray how the site will seem when it is complete. On the other side, 2D models offer useful information, but viewers must conjure up the ultimate product's appearance. Advanced computer programs are used to produce 3D models, which include information from aerial photogrammetry, GPS, and light detection and ranging (LIDAR) devices. In addition to the functions of 2D modelling, 3D models may be used for grading, site layout, and other reasons. They can also incorporate a broad variety of information kinds[4].

The use of 2D for site models

Sites are represented in 3D models in a way that is accurate to how they will appear in reality. While 2D models may be used to communicate a plan's concept, doing so involves interpretation, which might lead to various parties having somewhat different notions about how the project will turn out[5].However, 3D models depict locations precisely as they seem in reality, ensuring that everyone can readily comprehend the plan and assisting in maintaining agreement among all stakeholders. Every stakeholder, from engineers to owners to machine operators, can comprehend a project's outcome easily thanks to 3D models. Even 3D models may be modified to demonstrate how the site will seem at various phases.

Unlike 3D models, which may provide a far greater range of project information, 2D models are handy when you simply need a quick glimpse of a few key sorts of data. To have a thorough picture of your project, 3D modelling enables you to gather all of your data in one location.Basic site planning, grading, utility lines, landscaping, and more may all be included in one model thanks to 3D modelling. With this functionality, you can visualize how various components work together and how a project will appear at various stages. To acquire a fuller understanding of a design, you may also examine a model from various perspectives and on multiple levels[6].

With the aid of these tools, you can make sure that your plans are precise and workable and that you strictly adhere to them while you go about your tasks. The increasing volume and level of information make it possible to estimate costs and timelines with more accuracy.Because you can move around objects and see them from various perspectives in 3D models, you can also utilize them to help you take more accurate measurements. In 3D rather than 2D, it is simpler to discern between different pieces and make sure you measure them properly. Even 2D measurements, such as cross-sections, are simpler to obtain when presented in 3D.

Machine control is one of the most advantageous applications of 3D models. Machine control entails using location sensors to steer machines, such as GPS systems, acoustic tracers, spinning lasers, and total stations. These microcontroller systems employ data from 3D models to establish the precise location of a machine on a job site, the position in which a machine's bucket or blade must be, and target grades. To guarantee that the project is finished precisely, sensors on the machinery are connectedto the computer, which is loaded with a 3D model of the project.The use of 3D model machine control improves machine productivity and efficiency, lowers machine-related and raw material costs, and removes the requirement for continual grade checks in addition to boosting accuracy.

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CHAPTER 13

Advantages and Limitations of Welding

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Imagine that a rod in your home's grill has corroded or that the weather has caused damage to a portion of the entry gate. How will you proceed? Will you completely replace the gate or grill? Instead of rebuilding the entire structure, wouldn't it be wiser to replace the damaged metal grill or gate component with a fresh piece of metal? This is the circumstance where the welding procedure is relevant. On every street in the neighbourhood, we notice fabrication businesses [1].

By melting the base metal and the filler metal, welding aids in connecting two metals at a high temperature. Please provide additional information on welding. The pool of molten substances that helps build a solid bond using the base metal is known as the filler material. Following the welding of the metals, the shielding procedure prevents oxidation of the base and filler components. Welding uses a variety of energy, including friction, electron beams, electric arcs, lasers, and gas flames. Let's now examine the many forms of welding.By using heat at high temperatures, the manufacturing technique of welding enables you to combine materials such as metals. While soldering and brazing do not enable the base metal to melt, welding employs high temperatures to unite the components [2]. The base metal and the filler metal get joined after cooling.

While looking for a method to form iron into usable shapes, the welding process was discovered. In the early years of welding, the first product was welded blades because hard steel that was too brittle for use was generated when iron was carbonized. Later, hammer forging and interlacing the stiff and soft iron with high-carbon material produced a robust and resilient blade. The filler material is used during the welding process. By using heat at high temperatures, the manufacturing technique of welding enables you to combine materials such as metals. While solder and brazing do not enable the base metal to melt, welding employs high temperatures to unite the components. The base metal and the filler metal get joined after cooling.While looking for a method to form iron into usable shapes, the welding process was discovered. In the early years of welding, the first product was welded blades because hard steel that was too brittle for use was generated when iron was carbonized[3]. Later, hammer forging and interlacing the stiff and soft iron with high-carbon material produced a robust and resilient blade [4]. The filler material is used during the welding process.

Some materials need the employment of particular procedures and methods. A few are deemed "unwieldable," a phrase that is helpful and descriptive in technology but is rarely seen in dictionaries. Parent material is the term for the pieces that are linked. Filler or consumable refers to the substance that is introduced to the joint to aid in its formation [5].These substances may be referred to as parent plates or pipes, filler wire, disposable electrodes, etc. Consumables are often chosen to have a composition that is comparable to the parent material to create a homogeneous weld, however, there are times when a filler with a significantly different composition and therefore, qualities are employed, such as when fusing brittle cast irons [6].

Advantages:

Strong, long-lasting, and unbreakable joint linkages are created by welding.

1. It is a straightforward procedure that yields a beautiful outcome.
2. The method creates a weld that is stronger than the base material when filler material is added.
3. It can be carried out anywhere
4. It is a cost-effective and efficient procedure
5. It is employed in several industries, including automotive, construction, and many more.
6. It is transportable (we can take it anyplace),
7. It may be used in dangerous situations.
8. It operates in dangerous environments with unsuitable working conditions.
9. It is simple to use.
10. Due to its straightforward operating principles, even a semi-skilled operator can run this machine.

Limitations:

1. When carried out following safety and security regulations it is dangerous.
2. Using welding to separate the bonded materials is a challenging process.
3. Need both an electric source and expert works.
4. Thin materials can be correctly and successfully welded.
5. Kind of welding stretches.
6. It is not appropriate for ongoing processes.

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