SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

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DEPARTMENT OF MECHATRONICS ENGINEERING

19MCT302 – CNC TECHNOLOGY

UNIT 1 – INTRODUCTION TO CNC MACHINE TOOLS

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Evolution of CNC Technology

The evolution of CNC machines is unique. Starting from a simple machine controlled with a punch card to a software-powered machine is enigmatic. Because of the evolution, CNC machining became faster, more precise, and accurate than NC and the first CNC machine.

The first CNC machine was credited to James Parsons in 1949. Parsons was a computer pioneer who worked on an Air Force Research Project. The research was on how to produce helicopter blades and better aircraft skin.

Evolution of CNC Technology

1952 – 1958

As the Cold War became intense, there was a need to improve efficiency and productivity in making many machines and weapons. Therefore, in 1952, Richard Kegg, together with MIT, made the first CNC milling machine known as Cincinnati Milacron Hydrotel. Richard Kegg would later file for a patent for the Motor Controlled Apparatus for Positioning Machine tool in 1958.

1967 – 1972

CNC machining was becoming more recognized across the world. This was due to the Computer-Aided Design (CAD) and Computer-Aided Machining (CAM) development in 1972. CAD and CAM inclusion in CNC machining led to massive developments in CNC machining. However, the two were not regarded as a standard part of the manufacturing process.

1976 -1989

In 1976, 3D Computer-Aided Design and Computer-Aided Machining were included into CNC machining. In 1989, CAD and CAM software-controlled machines became the industrial standard for CNC machines.

Principles of CNC Technology

The principles of CNC operation.

•Movement of X, Y, Z axis are controlled by a motor which supplies either Alternating current or Direct current.

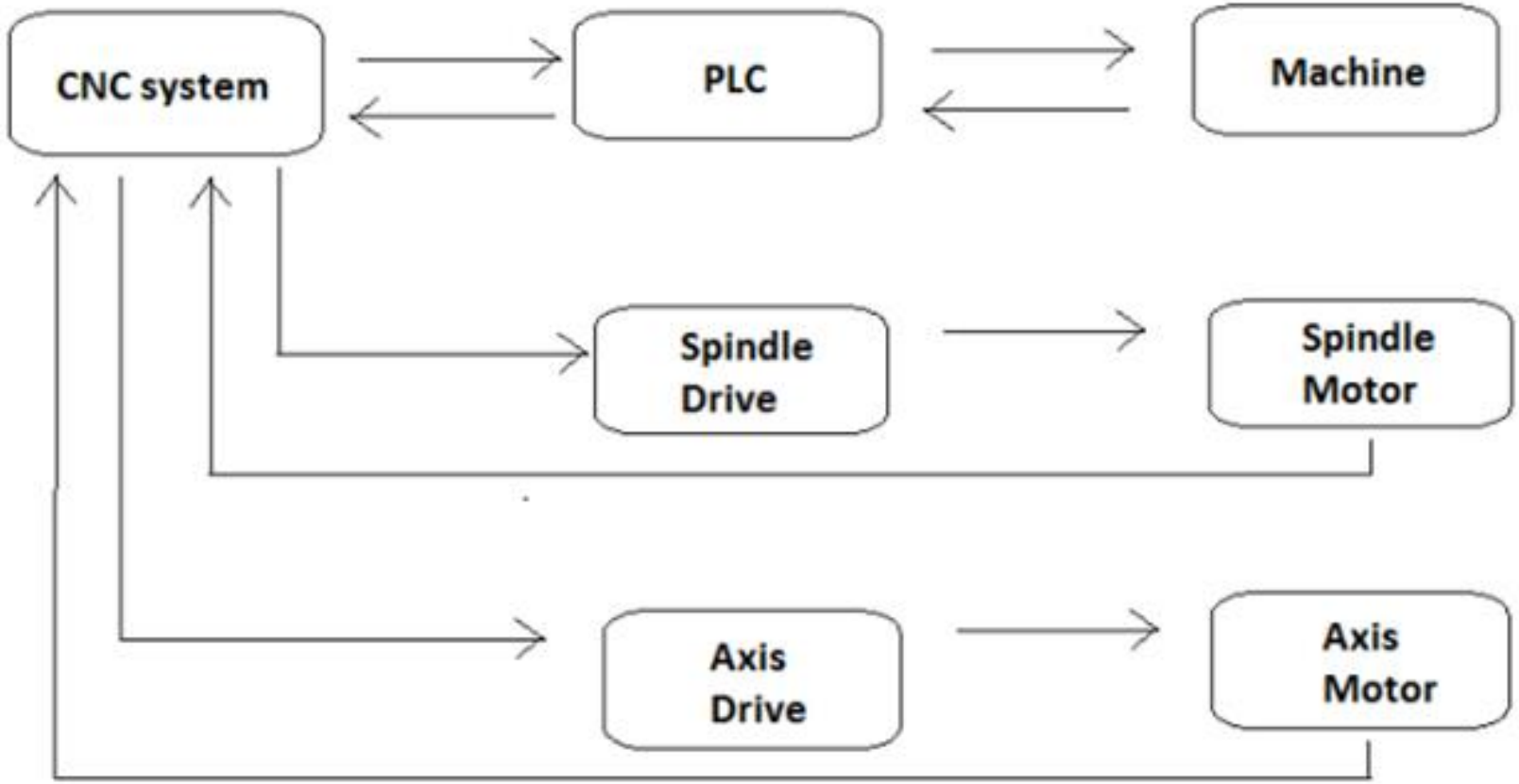
•Movement of the machine is done by giving commands.

•All the operations are carried out by codes like speed, feed, depth of cut, etc.

•For each operation separate code is available.

•The warning system is available to save guard the various operations and components.

Principles of CNC Technology



Features of CNC Technology

Features of CNC milling

1. Flexible And Versatile

2. High Machining Accuracy

3. High Production Efficiency

4. It Can Process Complex Shapes

5. Reduce The Labor Intensity Of The Operator

Applications

Industrial Applications

•Automotive

The Automotive industry is a major user of CNC machining. They depend on the manufacturing process in making their prototypes and in production.

•Consumers Electronics

While it might be surprising, the consumer electronics industry also uses CNC machining. Companies such as Apple use CNC machining in their production. For example, the Apple MacBook's chassis comes from aluminum subjected to CNC machining.

•Aerospace/Military

The two industrial sectors are major users of CNC machining. This is because of its high precision and accuracy. CNC machining is also ideal because it can produce on-demand replacement and upgraded versions of any parts.

Applications

Manufacturing Applications

•Prototyping

CNC machining is a good process for making prototypes because it is autonomous. Once you have a CAD file, you can send it to a CNC machine, and fabrication will be done in a short time. These properties make it ideal for making prototypes.

•Production

CNC machining has high precision and accuracy, which makes it ideal for making high-quality components. Its wide material supports also improves its use in parts fabrications. Consequently, companies that use it to make prototypes also use it to create usable final parts.

•Tooling

CNC machining is a gem in the direct manufacturing process and has been of immense help. However, it can also be used in the indirect manufacturing process to help in many processes, such as injection molding.

CNC AND DNC

Difference between CNC and DNC

The main difference between CNC and DNC is that CNC is transferring machine instruction while in DNC is control the information distribution to a wide variety of machines.

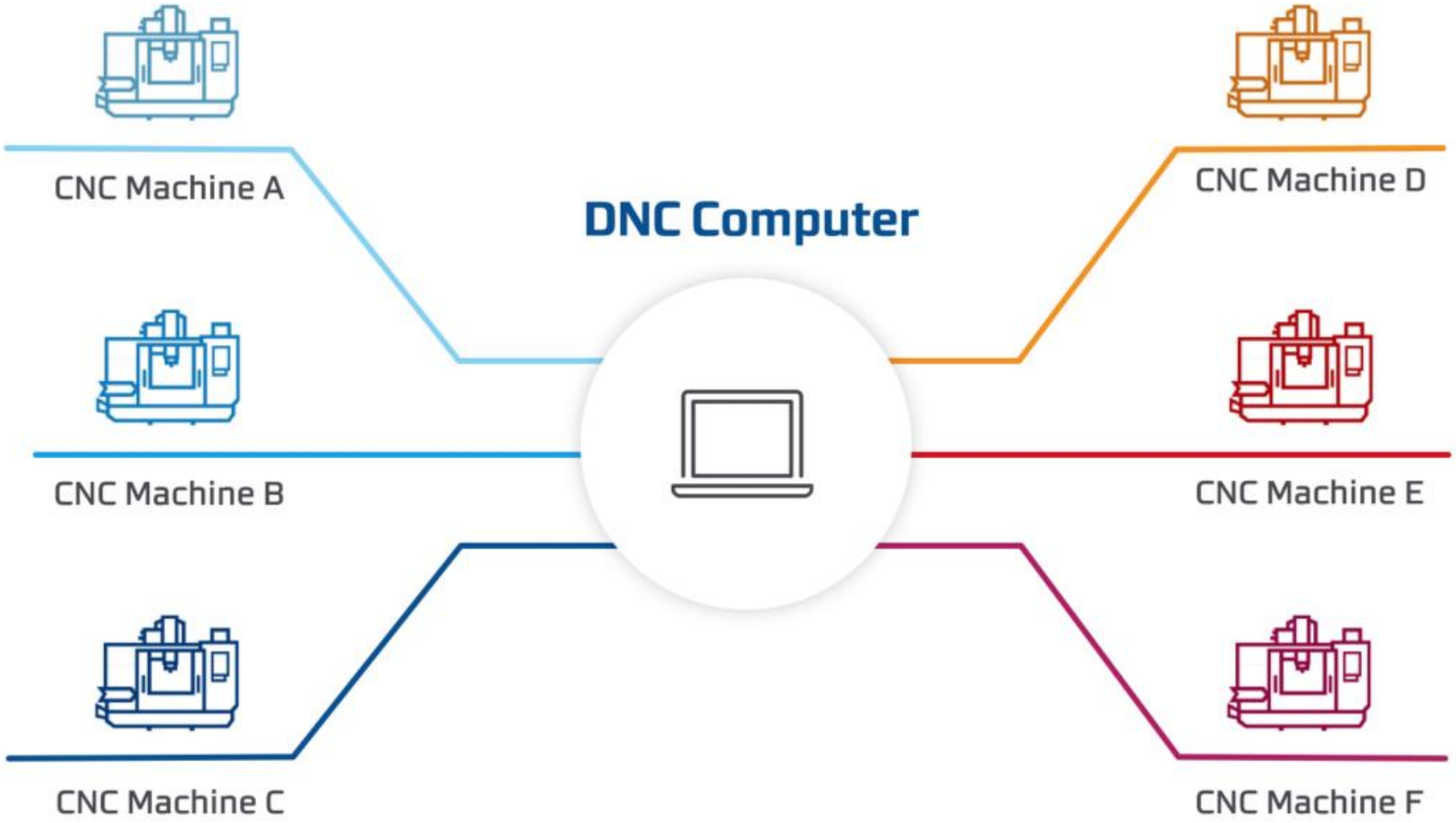
What is CNC?

CNC stands for computer numerical code, the machine is operated through numerical codes. A computer virus is a custom for additionally, the machines can be used to, and it is coded with the CNC machining language that is G code and mainly control all picks like coordination feed rat speed and location, CNC can be used in growing each plastic steel and elements.

What is DNC?

DNC called direct numerical control, it denotes the networking of CNC machines. DNC machine that is uses a giant mainframe PC to manage a range of NC machines. The program is performed externally then dispatched to the person machine.

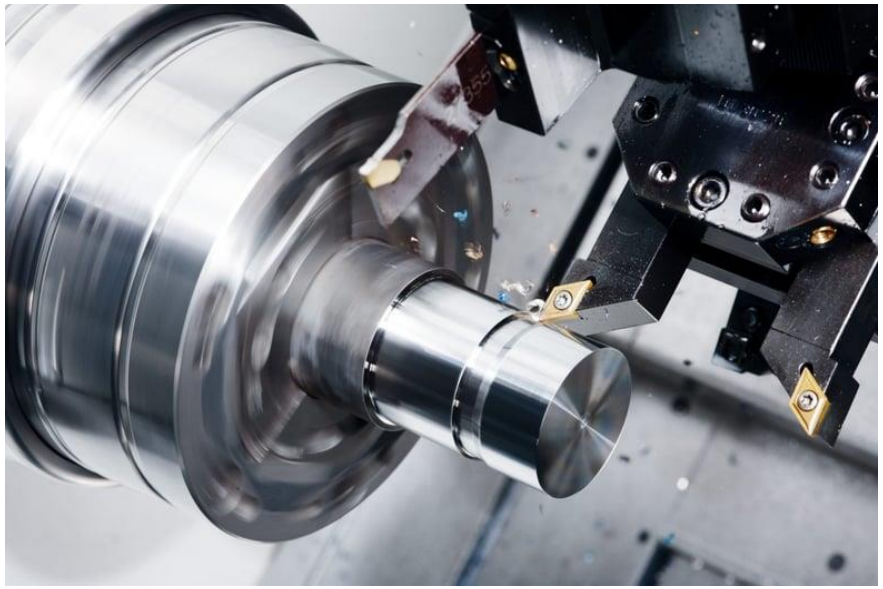
DIRECT NUMERICAL CONTROL (DNC)



CLASSIFICATION OF CNC MACHINES

Turning Centre

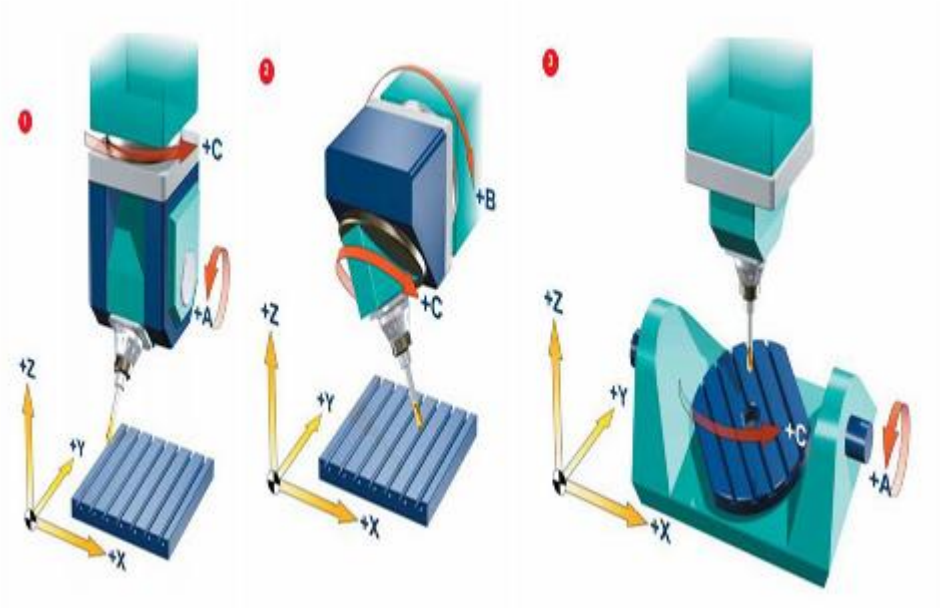
CNC turning machines, also known as CNC lathes, are a type of computer numerical control (CNC) machine used for the precision machining of cylindrical workpieces. These machines are widely used in manufacturing processes to create parts with rotational symmetry, such as shafts, pins, bolts, and various other components. CNC turning machines are commonly found in industries like aerospace, automotive, electronics, and more, where high precision and efficiency are essential.



CLASSIFICATION OF CNC MACHINES

5 Axis Machining Centre

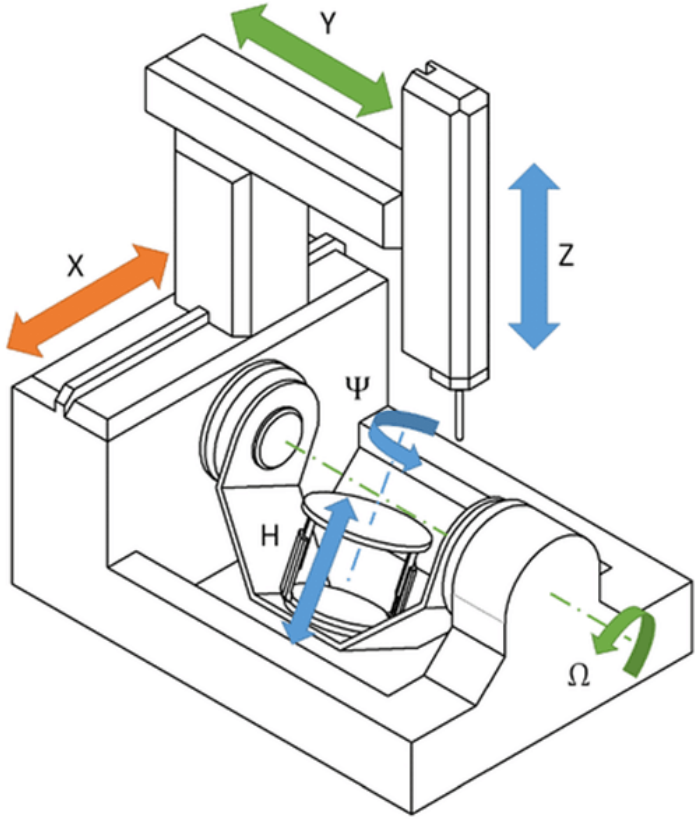
A 5-axis machining center is a type of computer numerical control (CNC) machine that is capable of performing machining operations on a workpiece along five different axes simultaneously. This capability allows for complex and intricate machining tasks that would be difficult or impossible to achieve using traditional 3-axis or 4-axis machines. The five axes refer to three linear axes (X, Y, and Z) and two rotary axes (A and B).



CLASSIFICATION OF CNC MACHINES

6 Axis Machining Centre

A 6-axis CNC machine, often referred to as a 6-axis machining center or a 6-axis CNC mill, is an advanced type of computer numerical control (CNC) machine that can perform machining operations along six different axes. In addition to the three linear axes (X, Y, and Z) and the two rotary axes (A and B) found in 5-axis machines, 6-axis machines introduce a sixth rotary axis (C).



TYPES OF CONTROL SYSTEMS

1. Open-Loop Control System: In an open-loop control system, the machine operates based on pre-programmed instructions without continuously monitoring the actual position or feedback. While simple and cost-effective, open-loop systems do not provide feedback on the actual performance of the machine, which can lead to inaccuracies and errors.

2. Closed-Loop Control System: Closed-loop control systems incorporate feedback mechanisms to continuously monitor the machine's position and performance. Feedback is obtained through sensors and encoders, allowing the control system to make real-time adjustments and corrections during machining operations. This leads to greater accuracy and precision.

3. Servo Control System: Servo control systems use servomotors to drive the machine's axes. These systems receive feedback from encoders or resolvers that provide information about the actual position of the machine. The control system compares the desired position with the actual position and makes adjustments as needed to achieve accurate positioning and movement.

TYPES OF CONTROL SYSTEMS

4. Stepper Control System: Stepper control systems utilize stepper motors to control the machine's movements. Stepper motors move in discrete steps, and the control system sends pulses to the motor to determine the step size and direction. While stepper systems are simple and cost-effective, they may lack the precision and speed of servo systems.

5. Hybrid Control System: A hybrid control system combines elements of both open-loop and closed-loop control. It may use open-loop control for some operations and closed-loop control for others, depending on the required precision and complexity of the task.

6. Distributed Numerical Control (DNC) System: In a DNC system, multiple machines are controlled by a central computer. The central computer manages the distribution of programs and data to individual machines, allowing for coordinated operations and centralized monitoring.

TYPES OF CONTROL SYSTEMS

7. Adaptive Control System: Adaptive control systems incorporate real-time monitoring and adjustments based on changing conditions, such as tool wear, material variations, and environmental factors. These systems optimize machining processes to maintain accuracy and efficiency.

8. Direct Numerical Control (DNC) System: In a DNC system, each CNC machine has its own dedicated computer (controller), allowing it to operate independently without a central server. Each machine receives its program directly and executes the machining operations accordingly.

9. Fanuc, Siemens, and Heidenhain Systems: These are examples of specific CNC control systems that are widely used in the industry. Different manufacturers offer their own proprietary control systems with unique features and capabilities.

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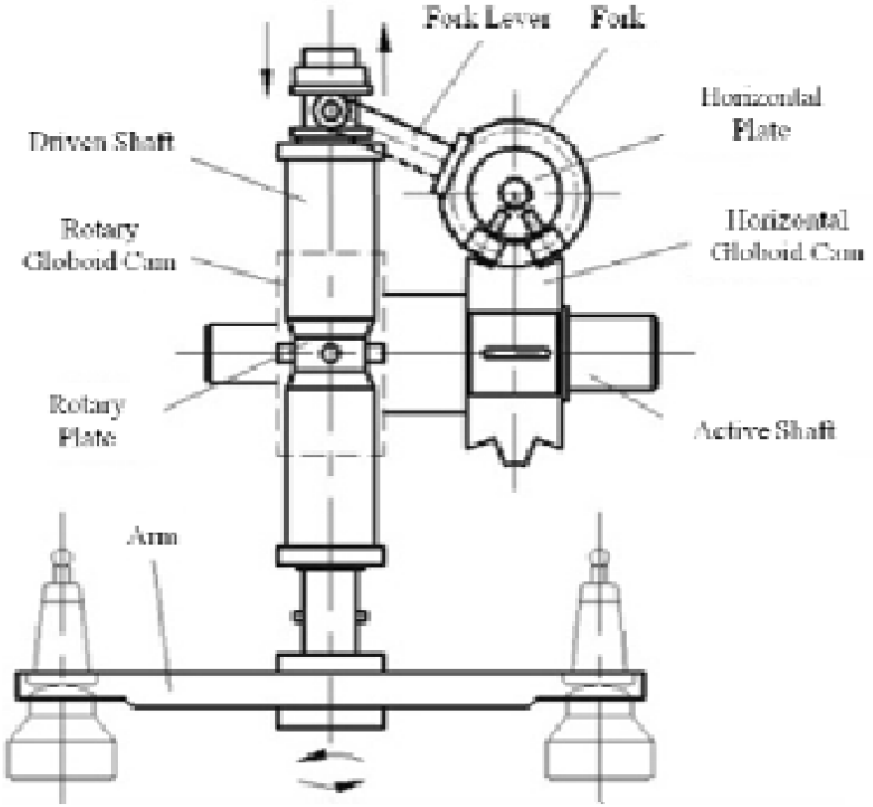
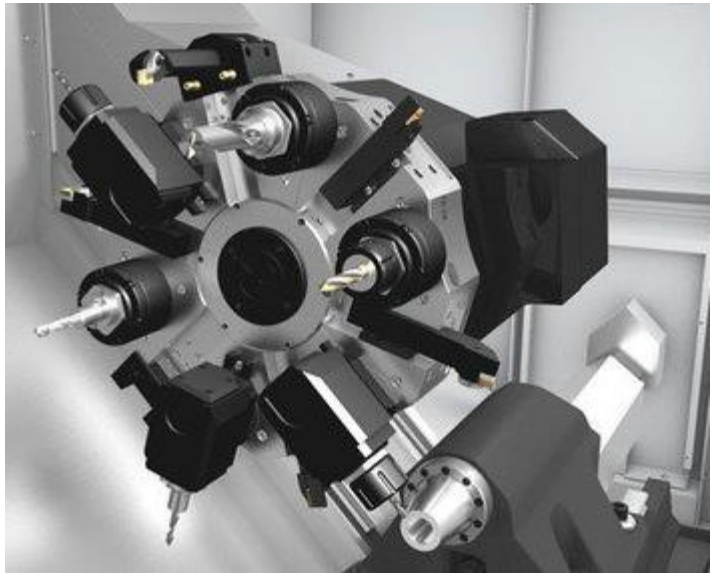
AUTOMATIC TOOL CHANGE(ATC)

ATC stands for "Automatic Tool Changer" in the context of CNC (Computer Numerical Control) machines. An ATC is a mechanism or system integrated into CNC machines, such as machining centers and lathes, to automatically change cutting tools during the machining process. The primary purpose of an ATC is to improve the efficiency and productivity of the machine by reducing manual intervention and downtime associated with tool changes.



TURRET MECHANISM

A turret mechanism in the context of CNC (Computer Numerical Control) machines, particularly in CNC lathes and some machining centers, refers to a rotating tool holder that holds multiple cutting tools. The turret is a key component that allows for the automatic selection and indexing of different tools during the machining process. It plays a crucial role in improving efficiency, reducing setup time, and enabling a CNC machine to perform a variety of machining operations without manual intervention.



Thank You