LESSON ONE

TOPIC: TRANSFORMER : MEANING, SCOPE AND DESCRIPTION

OBJECTIVES: At the end of this lesson, students should be able to:

1. Explain the concept of Transformer.
2. Explain the Principle of Operation of Transformer.
3. Explain the uses of electrical transformer.
4. Discuss the major Characteristics of Transformer

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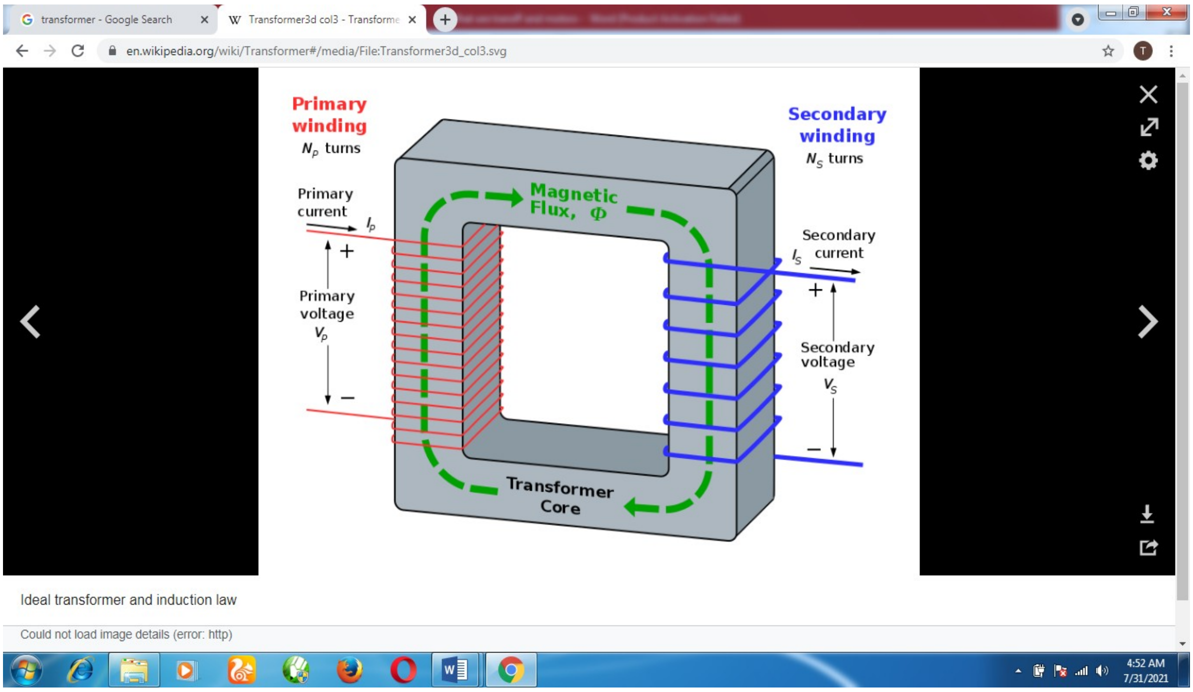
<td>START WITH LONG SHOT (LS) MOVE TO CLOSE UP (CU) FOR EMPHASIS</td>
<td>THE MEANING OF TRANSFORMER, SCOPE AND DESCRIPTION

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<td colspan="2">
<u>NARRATION</u>
<u>TRANSFORMER</u>
A transformer is a passive component that transfers electrical energy from one electrical circuit or multiple circuit. A transformer are most commonly used for increasing low AC voltage at h up transformer) .Transformer is also used for transmission, distribution and utilization of a electric.t It is most commonly used to increase (step-up) or decrease (step-dawn) voltage level l
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<td colspan="2"><u>WORKING PRINCIPLE OF TRANSFORMER</u></td>
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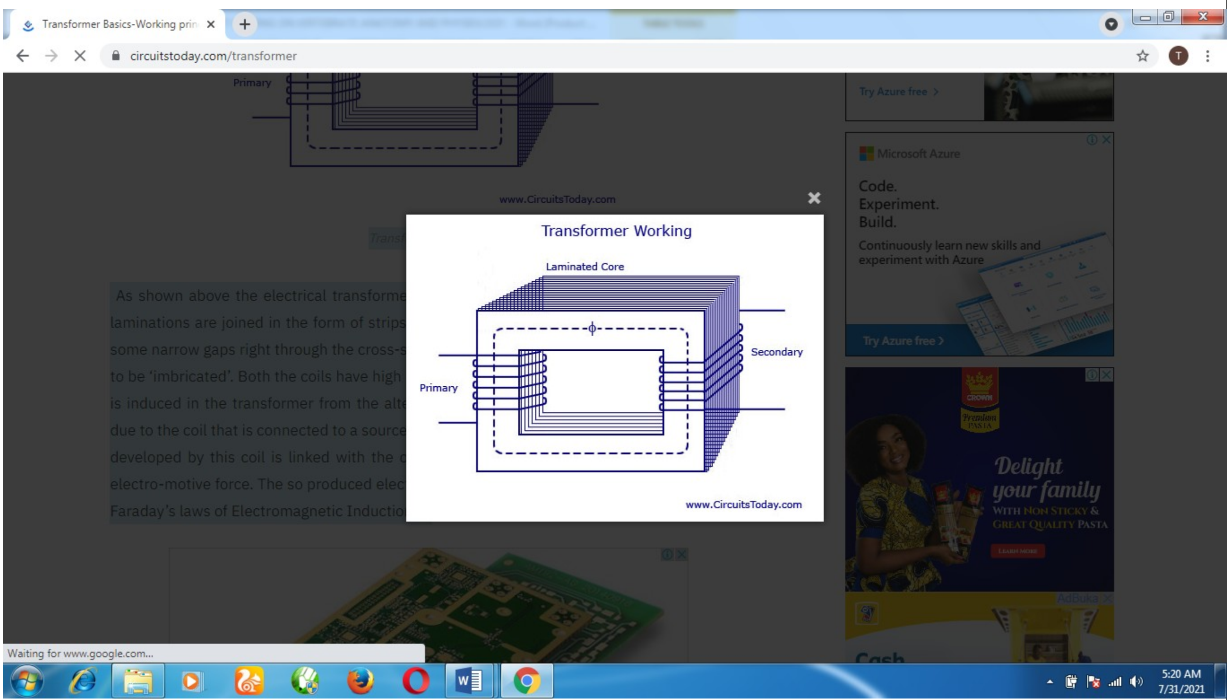
START WITH LONG SHOT (LS) MOVE TO CLOSE UP (CU) FOR EMPHASIS	It works on the principle of **Faraday's Law of Electromagnetic Induction** which states tha voltage is directly proportional to the rate of change of flux." **Transformer – Working Principle** The main principle of operation of a transformer is mutual inductance between two circuits common magnetic flux. A basic transformer consists of two coils that are electrically separate a magnetically linked through a path of reluctance. The working principle of the transformer ca the figure below.  Working As shown above the electrical transformer has primary and secondary windings. The core lam the form of strips in between the strips you can see that there are some narrow gaps right throug the core. These staggered joints are said to be 'imbricated'. Both the coils have high mutual electro-motive force is induced in the transformer from the alternating flux that is set up in the l the coil that is connected to a source of alternating voltage. Most of the alternating flux dev linked with the other coil and thus produces the mutual induced electro-motive force. The motive force can be explained with the help of Faraday's laws of Electromagnetic Induction as

NARRATION

An electrical transformer uses Faraday's electromagnetic induction law to work – "Rate of change of flux li time is directly proportional to the induced EMF in a conductor or coil".

A transformer's physical basis lies in the mutual induction between two circuits that are linked by a commo usually equipped with 2 windings: primary and secondary. These windings share a magnetic core that is lami induction that takes place between these circuits helps transfer electricity from one point to another.

Depending on the amount of linked flux between the primary and secondary windings, there will be different r linkage. To ensure maximum flux linkage, i.e. maximum flux passing through and linking to the seconda primary, a low reluctance path is placed common

to both windings. This leads to greater efficiency in working performance, and forms the core of the transforme

The application of alternating voltage to the windings in the primary side creates an alternating flux in the windings to induce EMF in the primary as well as the secondary side. EMF in the secondary winding causes load current, if there is a load connected to the secondary section.

This is how electrical transformers deliver AC power from one circuit (primary) to another (secondary), throu electrical energy from one value to another, changing the voltage level but not the frequency.

CONSTRUCTION OF AN ELECTRICAL TRANSFORMER

NARATION

The three important components of an electrical transformer are a magnetic core, primary winding, and sec primary winding is the part that is connected to an electrical source, from where magnetic flux is initially prod insulated from each other and the main flux is induced in the primary winding from where it is passed to th linked to the transformer's secondary winding through a low reluctance path.

The core relays the flux to the secondary winding to create a magnetic circuit that closes the flux, and a lo placed within the core to maximize flux linkage. The secondary winding helps complete the movement of the primary side, and using the core reaches the secondary winding. The secondary winding is able to pick mor windings are wound on the same core and hence their magnetic fields help to create motion. In all the types magnetic core is assembled by stacking laminated steel sheets leaving the minimum required air-gap betwee continuity of the magnetic path.

START WITH LONG SHOT (LS)	

MOVE TO CLOSE UP (CU) FOR EMPHASIS	

NARRATION

THE FIVE (5) MAJOR CHARACTERISTICS OF TRANSFORMER

Main Characteristics of a Transformer

All transformers share some common features regardless of their type:

- **The frequency of input and output power is the same**
- **All transformers make use of electromagnetic induction laws**
- **The primary and secondary coils are devoid of electrical connection (except for auto transforme power is through magnetic flux.**
- **No moving parts are required to transfer energy, so there are no friction or windage losses as devices.**
- **The losses that do occur in transformers are smaller than those in other electrical devices, and inc**
  - **Copper loss (electrical power lost in the heat created by circulation of currents around t considered the heaviest loss in transformers)**
  - **Core loss (eddy current and hysteresis losses, caused by lagging of magnetic molecules alternating magnetic flux within the core)**

Most transformers are very efficient, delivering between 94% to 96% energy at full load. Very high ca may deliver up to 98%, especially if they operate with constant voltage and frequency.

NARATION

THE USES OF ELECTRIC TRANSFORMER

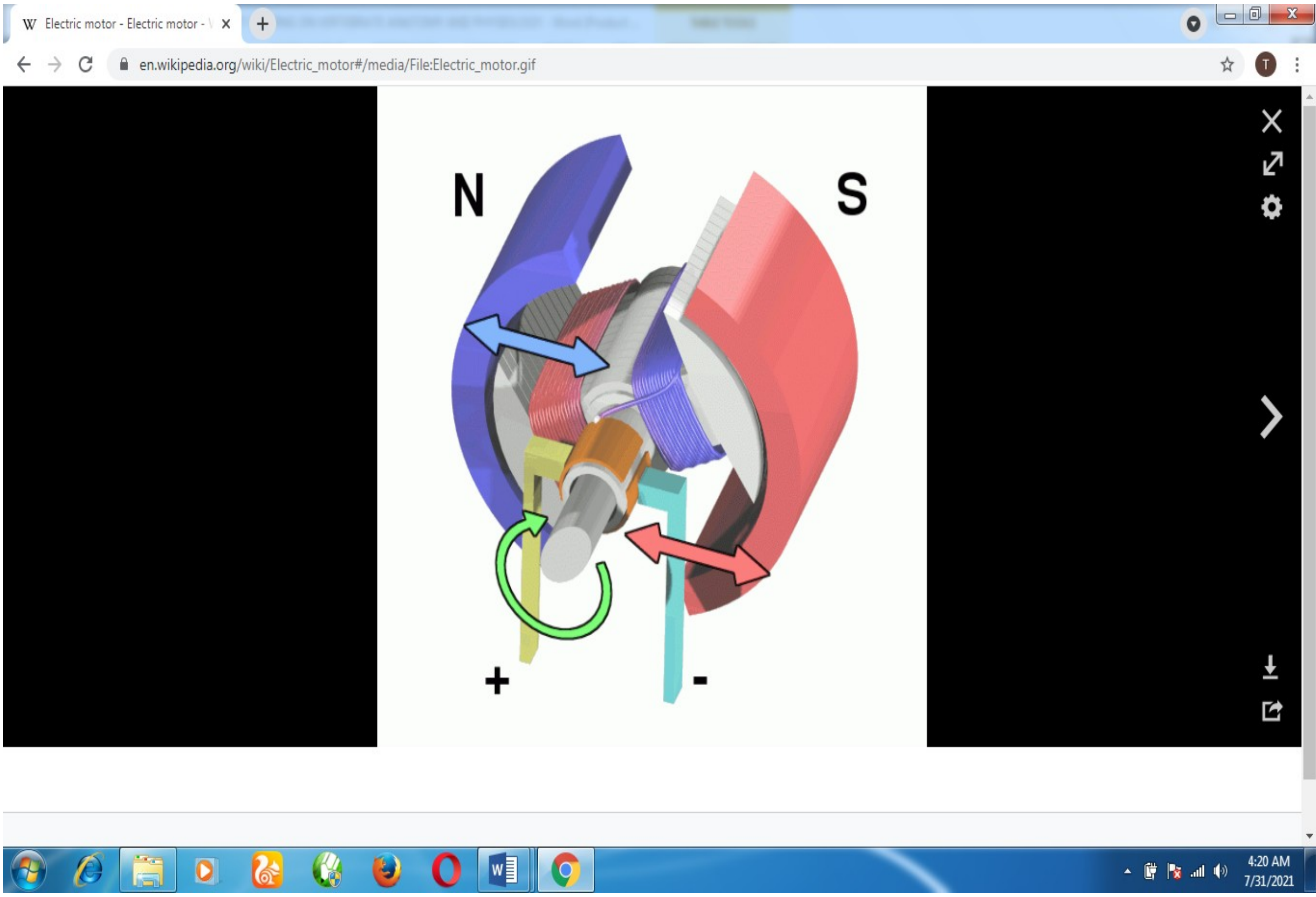
The major uses of an electrical transformer include:

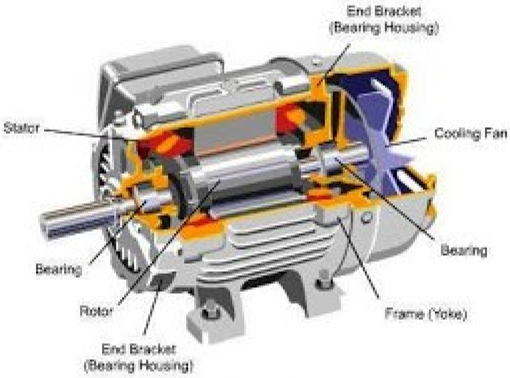
- Raising or lowering the voltage level in the circuit of an AC.

- Increasing or decreasing the value of an inductor or capacitor in an AC circuit.
- Preventing the passage of DC from one circuit to another.
- Isolating two electric circuits.

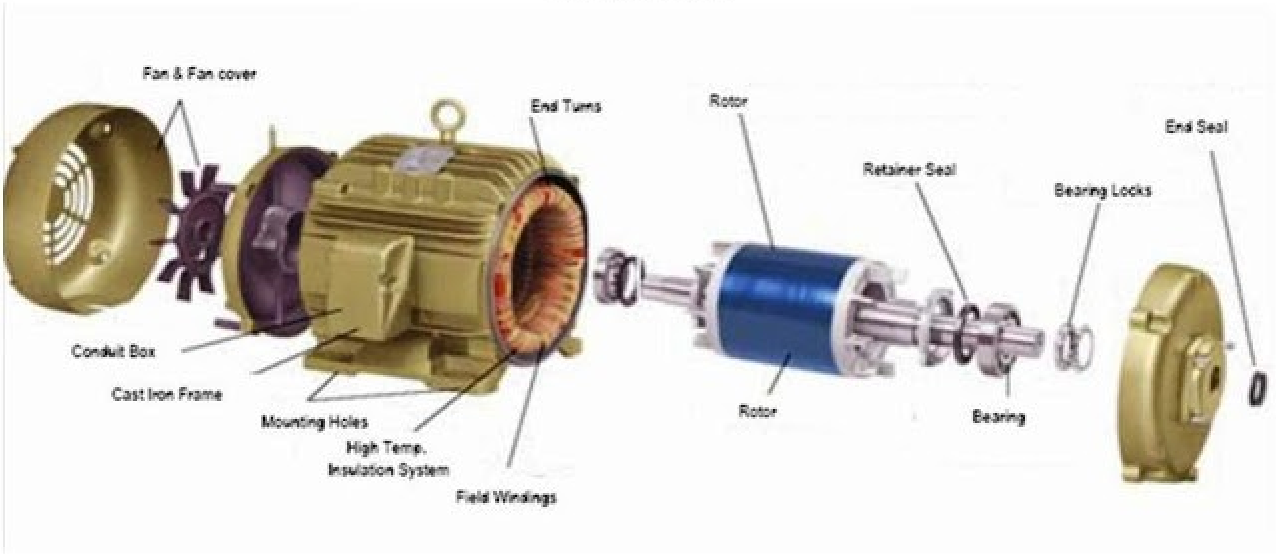
Stepping up the voltage level at the site of power generation before the transmission and distribution can tal

ELECTRIC MOTOR

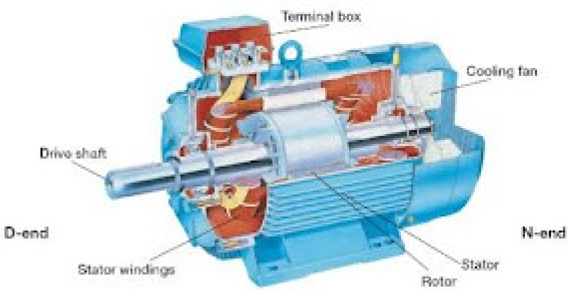




Cutaway View of Motor



Electric Motor main Components



1. Stator Coil
2. Rotor Coil
3. Main Shaft
4. Brush
5. Bearing
6. Drive Pulley

7. Motor Housing

Simple Motor Parts and their function

1. Stator / Armature Coil

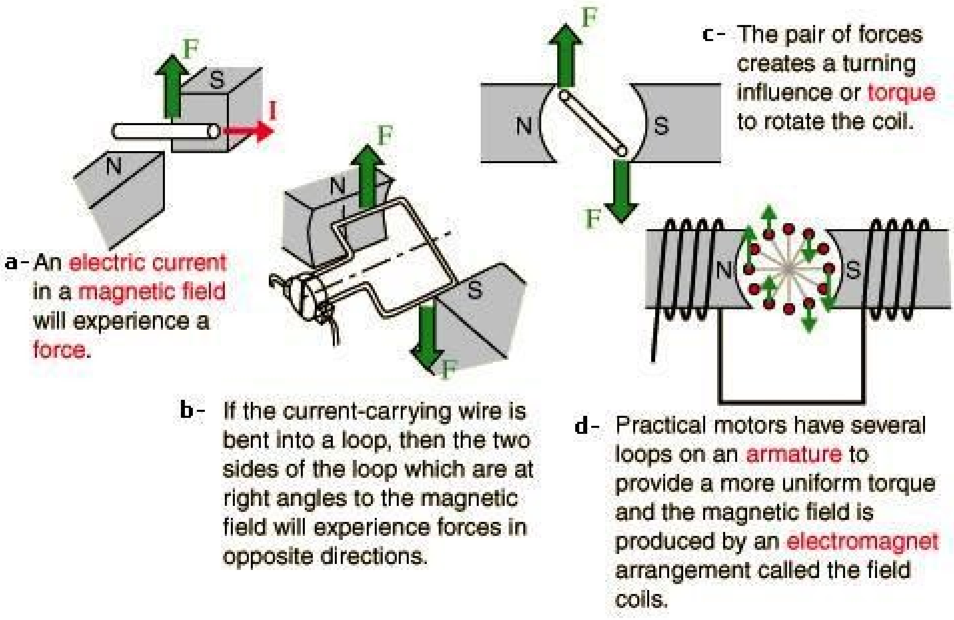
The stator includes the main components of the electric motor. Because this component will be in direct contact with the performance of the motor. The stator is a static copper winding located around the main axis. The function of the stator is to generate a magnetic field around the rotor. This component is composed of iron plates wrapped by copper. This copper is connected to a current source. So when the winding is electric current, will cause magnetism in the stator. On a motor generally has three stator coil. This depends on the capacity of the motor itself of course. The more the number of coils, the greater the magnetism generated. This will certainly affect the speed of the motor.

But for simple electric motors, generally just complement the stator using a permanent magnet. So the current used is also lighter. So, whether permanent magnet can be used on electric motors powerless? Certainly can, but the resulting round tends to be small. That is why the magnetic winding is an option to make the output satisfactory as well.
This part also resembles a stator, except that the rotor is a dynamic copper wire. Why is it dynamic? Because the coil is attached with the main shaft or main axle of the motor that will rotate.

NARRATION

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate as force in the form of torque applied on shaft. Electric motor can be powered by direct current (DC) sources, such as from batteries or rectifiers or by alternating current (AC) sources power grid.

Principle of How Motors Work:

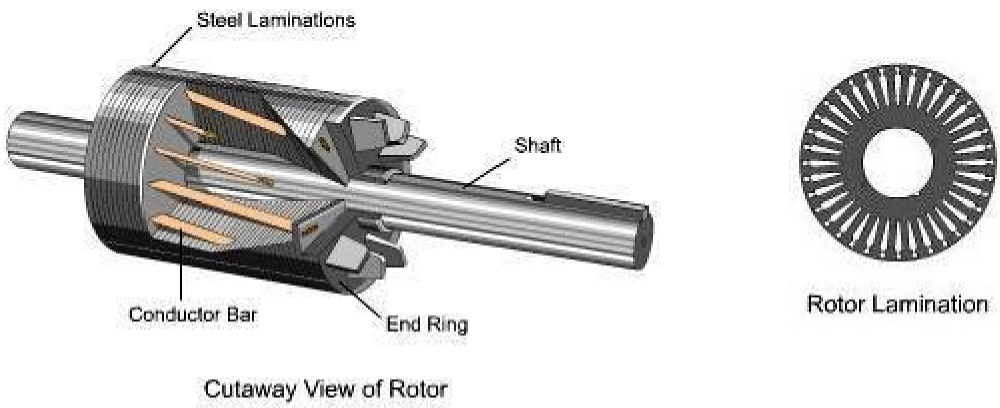


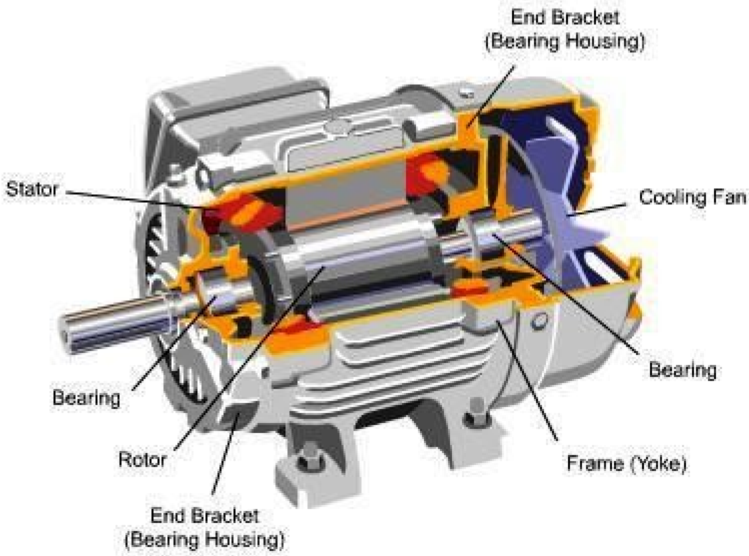
NARRATION

Electric motors work by converting **electrical** energy to mechanical energy in order to create motion. Force is generated within the **motor** through the interaction between a magnetic field and winding alternating (AC) or direct (DC) current. The working principle of the **electric motor** mainly depends on the interaction of magnetic and **electric** field. The **electric motor** is mainly classified into two **types**. They are the AC **motor** and the DC **motor**. The AC **motor** takes alternating current as an input, whereas the DC **motor** takes direct current.

DIFFERENT TYPES OF ELECTRIC MOTOR

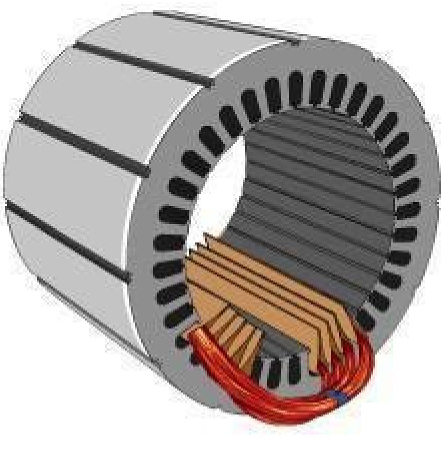
3- Rotor



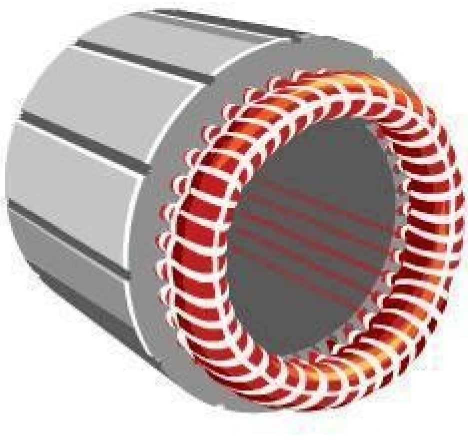


Cutaway View of Motor

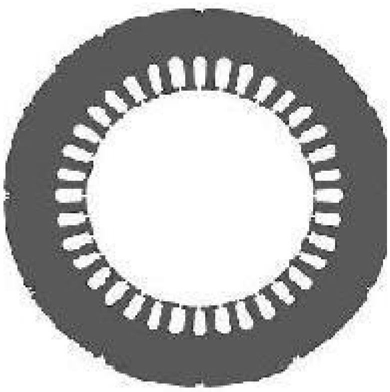
2- Stator



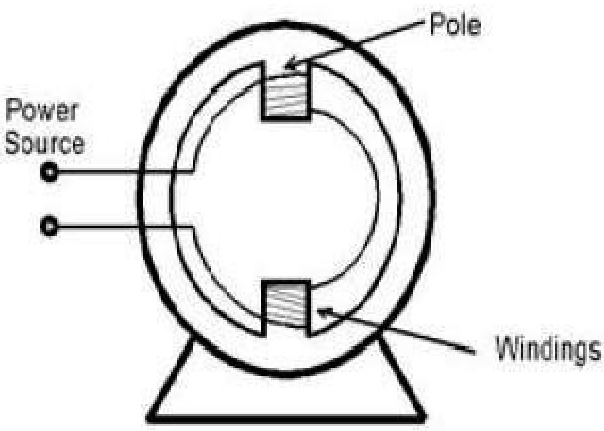
Stator Windings Partially Completed



Stator Windings Completed



Stator Lamination



NARRATION

As we know, an electric motor plays a vital role in every sector of the industry, and also in a wide range of applications. There are a variety of types of electric motors are available in the market. The selection of these motors can be done based on the operation and voltage and applications. Every1. motor has two essential parts namely the field winding & the armature winding. The main function of field winding is to produce the fixed magnetic field, whereas the armature winding looks like a conductor which is arranged within the magnetic field. Because of the magnetic field, the armature winding uses energy to generate an adequate torque to make the motor shaft turn. Currently, the classification of the DC motor can be done based on the winding connections, which means how the two coils in the motor are connected with each other**NARRATION**

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TYPES OF ELECTRIC MOTOR

1. DC shunt motor works on DC and the windings of this electric motor like the armature windings and field windings are linked in parallel which is known as a shunt. This kind of motor is also called as shunt wound DC motor, where the winding type is known as a shunt winding.

2). Separately Excited Motor

In separately excited motor, the connection of stator and rotor can be done using a different power supply. So that the motor can be controlled from the shunt and the armatures winding can be strengthened to generate flux.

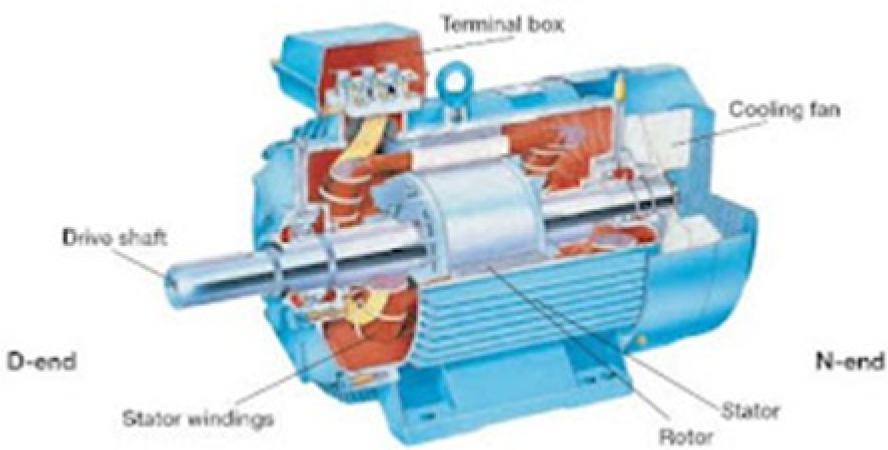
3). DC Series Motor

In DC series motor, rotor windings are connected in series. The operation principle of this electric motor mainly depends on a simple electromagnetic law. This law states that whenever a magnetic field can be formed around conductor & interacts with an external field to generate the rotational motion. These motors are mainly used in
starter motors which are used in elevators and cars. Please refer to this link to know more about DC series motor working & its applications

COMPONENT OF ELECTRIC MOTOR

1. Stator Coil
2. Rotor Coil
3. Main Shaft

4. Brush
5. Bearing
6. Drive Pulley
7. Motor Housing



6 PARTS OF AN ELECTRIC MOTOR

Electric motors play a large role in keeping industrial operations running smoothly. Electric motors have several key parts that allow them to effectively turn electrical energy into mechanical energy, which then creates a shaft rotation to keep your plant operating. As the experts at Kurz Industrial can explain, an electric motor has six key parts that allow it to function correctly.

Rotor

The rotor is a part of the electric motor responsible for turning the shaft, which in turn delivers mechanical power to your plant. The rotor contains other components called conductors, which have currents that work with the magnetic field located in the stator, another part of the motor, to help operate the shaft.

Stator and Stator Core

Unlike the rotor, the stator is a fixed part in an electric motor that does not move. The stator and its related part called the stator core are both parts of the electromagnetic circuit in motors. The stator is made up of either permanent magnets or windings. The stator core is comprised of parts called laminations, which are thin metal sheets. Laminations are designed to minimize energy loss, which would otherwise result if the stator contained a solid core.

Bearings

Bearings are contained in the motor housing. They also support the rotor by allowing it to rotate on its axis. Bearings are connected to the motor shaft, which extends past the bearings to the motor's outer shell.

Windings

Windings are other critical parts of motors. They are often found embedded in coils, and they are generally wrapped around an iron core so that they can create magnetic poles when they are charged with a current. There are two common magnetic pole designs in electric motors, which are salient and non-salient. Salient-pole motors have magnetic poles that are produced when a winding is wrapped around the pole under the pole face. With a non-salient-pole system, the winding is located in the pole face slots instead. Motors may also have a shaded-pole configuration that delays the magnetic field phase.

Air Gap

The air gap is also an important part of a motor. The air gap refers to the distance between the stator and a rotor. It is the term for the space in between the two components, although it is not technically a component itself. The air gap should ideally be small, as a larger air gap can negatively impact the motor’s performance. The air gap is also the motor’s primary source of low power factor.

Commutator

The commutator is the motor’s sixth important component. The commutator is used to change the input of some AC and DC motors. It contains slip-ring segments that are protected from the shaft and other segments with a layer of insulation. The revolving commutator provides power to the equipment used in your plant by allowing the rotor to rotate from one pole to the other. The commutator achieves this through the current reversal.