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***REPORT ON ELECTRIC MOTORS***

Electrical Engineering comprises of a lot of devices that helps the society but we are going to talk about the electric motors. First what is electric motors?, How does it help the society?, How did it originate into the engineering society?, How can it be used in the society to assist us?,. We discuss about all these on this report.

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 force in the form of rotation of a shaft. Electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators. An electric generator is mechanically identical to an electric motor, but operates in the reverse direction, converting mechanical energy into electrical energy.

Electric motors may be classified by considerations such as power source type, internal construction, application and type of motion output. In addition to AC versus DC types, motors may be brushed or brushless, may be of various phase (see single-phase, two-phase, or three-phase), and may be either air-cooled or liquid-cooled. General-purpose motors with standard dimensions and characteristics provide convenient mechanical power for industrial use. The largest electric motors are used for ship propulsion, pipeline compression and pumped-storage applications with ratings reaching 100 megawatts. Electric motors are found in industrial fans, blowers and pumps, machine tools, household appliances, power tools and disk drives. Small motors may be found in electric watches.

In certain applications, such as in regenerative braking with traction motors, electric motors can be used in reverse as generators to recover energy that might otherwise be lost as heat and friction.

Electric motors produce linear or rotary force (torque) intended to propel some external mechanism, such as a fan or an elevator. An electric motor is generally designed for continuous rotation, or for linear movement over a significant distance compared to its size. Magnetic solenoids produce significant mechanical force, but over an operating distance comparable to their size. Transducers such as loudspeakers and microphones convert between electrical current and mechanical force to reproduce signals such as speech. When compared with common internal combustion engines (ICEs), electric motors are lightweight, physically smaller, provide more power output, are mechanically simpler and cheaper to build, while providing instant and consistent torque at any speed, with more responsiveness, higher overall efficiency and lower heat generation. However, electric motors are not as convenient or common as ICEs in mobile applications (i.e. cars and buses) as they require a large and expensive battery, while ICEs require a relatively small fuel tank.

***Early Motors***

The first electric motors were simple electrostatic devices described in experiments by Scottish monk Andrew Gordon and American experimenter Benjamin Franklin in the 1740s. The theoretical principle behind them, Coulomb's law, was discovered but not published, by Henry Cavendish in 1771.

This law was discovered independently by Charles-Augustin de Coulomb in 1785, who published it so that it is now known with his name.[4] The invention of the electrochemical battery by Alessandro Volta in 1799[5] made possible the production of persistent electric currents. After the discovery of the interaction between such a current and a magnetic field, namely the electromagnetic interaction by Hans Christian Ørsted in 1820 much progress was soon made. It only took a few weeks for André-Marie Ampère to develop the first formulation of the electromagnetic interaction and present the Ampère's force law, that described the production of mechanical force by the interaction of an electric current and a magnetic field.[6] The first demonstration of the effect with a rotary motion was given by Michael Faraday in 1821. A free-hanging wire was dipped into a pool of mercury, on which a permanent magnet (PM) was placed. When a current was passed through the wire, the wire rotated around the magnet, showing that the current gave rise to a close circular magnetic field around the wire.[7] This motor is often demonstrated in physics experiments, substituting brine for (toxic) mercury. Barlow's wheel was an early refinement to this Faraday demonstration, although these and similar homopolar motors remained unsuited to practical application until late in the century.

***Types of Electric Motors***

There are two types of the electric motors,

1. AC Motors
2. DC Motors

**AC Motors**: This is an electric motor driven by an alternating current (AC). The AC motor commonly consists of two basic parts, an outside stator having coils supplied with alternating current to produce a rotating magnetic field, and an inside rotor attached to the output shaft producing a second rotating magnetic field. The rotor magnetic field may be produced by permanent magnets, reluctance saliency, or DC or AC electrical windings.

**DC Motors**: This is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

***Components of an Electric Motors***

1. **Rotor (electric):** In an electric motor, the moving part is the rotor, which turns the shaft to deliver the mechanical power. The rotor usually has conductors laid into it that carry currents, which interact with the magnetic field of the stator to generate the forces that turn the shaft. Alternatively, some rotors carry permanent magnets, and the stator holds the conductors.

2**. Bearings**: The rotor is supported by bearings, which allow the rotor to turn on its axis. The bearings are in turn supported by the motor housing. The motor shaft extends through the bearings to the outside of the motor, where the load is applied. Because the forces of the load are exerted beyond the outermost bearing, the load is said to be overhung.

3**. Stator:** The stator is the stationary part of the motor's electromagnetic circuit and usually consists of either windings or permanent magnets. The stator core is made up of many thin metal sheets, called laminations. Laminations are used to reduce energy losses that would result if a solid core were used.

4**. Air gap**: The distance between the rotor and stator is called the air gap. The air gap has important effects, and is generally as small as possible, as a large gap has a strong negative effect on performance. It is the main source of the low power factor at which motors operate. The magnetizing current increases with the air gap. For this reason, the air gap should be minimal. Very small gaps may pose mechanical problems in addition to noise and losses.

5. **Windings**: Windings are wires that are laid in coils, usually wrapped around a laminated soft iron magnetic core so as to form magnetic poles when energized with current.

Electric machines come in two basic magnet field pole configurations: salient- and nonsalient-pole configurations. In the salient-pole machine the pole's magnetic field is produced by a winding wound around the pole below the pole face. In the nonsalient-pole, or distributed field, or round-rotor, machine, the winding is distributed in pole face slots. A shaded-pole motor has a winding around part of the pole that delays the phase of the magnetic field for that pole. Some motors have conductors that consist of thicker metal, such as bars or sheets of metal, usually copper, alternatively aluminum. These are usually powered by electromagnetic induction.

**Commutator:** A commutator is a mechanism used to switch the input of most DC machines and certain AC machines. It consists of slip-ring segments insulated from each other and from the shaft. The motor's armature current is supplied through stationary brushes in contact with the revolving commutator, which causes required current reversal, and applies power to the machine in an optimal manner as the rotor rotates from pole to pole.In absence of such current reversal, the motor would brake to a stop. In light of improved technologies in the electronic-controller, sensorless-control, induction-motor, and permanent-magnet-motor fields, externally-commutated induction and permanent-magnet motors are displacing electromechanically-commutated motors. The term electronic commutator is usually associated with self-commutated brushless DC motor and switched reluctance motor applications.

**Motor supply**: A DC motor is usually supplied through slip ring commutator as described above. AC motors' commutation can be either slip ring commutator or externally commutated type, can be fixed-speed or variable-speed control type, and can be synchronous or asynchronous type. Universal motors can run on either AC or DC.

**Motor control**: Fixed-speed controlled AC motors are provided with direct-on-line or soft-start starters. Variable-speed controlled AC motors are provided with a range of different power inverter, variable-frequency drive or electronic commutator technologies.

**APPLICATIONS OF ELECTRIC MOTORS IN THE SOCIETY**

 Electric motors impact almost every aspect of modern living. Refrigerators, vacuum cleaners, air conditioners, fans, computer hard drives, automatic car windows, and multitudes of other appliances and devices all use electric motors to convert electrical energy into useful mechanical energy. In addition to running the commonplace appliances that we use every day, electric motors are also responsible for a very large portion of industrial processes. Electric motors are used at some point in the manufacturing process of nearly every conceivable product that is produced in modern factories. Because of the nearly unlimited number of applications for electric motors, it is not hard to imagine that there are over 700 million motors of various sizes in operation across the world. This enormous number of motors and motor drives has a significant impact on the world because of the amount of power they consume. The systems that controlled electric motors in the past suffered from very poor performance and were very inefficient and expensive. In recent decades, the demand for greater performance and precision in electric motors, combined with the development of better solid-state electronics and cheap microprocessors has led to the creation of modern ASDs. An ASD is a system that includes an electric motor as well as the system that drives and controls it. Any adjustable speed drive can be viewed as five separate parts: the power supply, the power electronic converter, the electric motor, the controller, and the mechanical load. The power supply can provide electric energy in the form of AC or DC at any voltage level. The power electronic converter provides the interface between the power supply and the motor. Because of this interface, nearly any type of power supply can be used with nearly any type of electric motor. The controller is the circuit responsible for controlling the motor output. This is accomplished by manipulating the operation of the power electronic converter to adjust the frequency, voltage, or current sent to the motor. The controller can be relatively simple or as complex as a microprocessor. The electric motor is usually, but not always, a DC motor or an AC induction motor. The mechanical load is the mechanical system that requires the energy from the motor drive. The mechanical load can be the blades of a fan, the compressor of an air conditioner, the rollers in a conveyor belt, or nearly anything that can be driven by the cyclical motion of a rotating shaft. More advanced electric motor drives are now replacing older motor drives to gain better performance, efficiency, and precision. Advanced electric motor drives are capable of better precision because they use more sophisticated microprocessor or DSP controllers to monitor and regulate motor output. They also offer better efficiency by using more efficient converter topologies and more efficient electric motors.