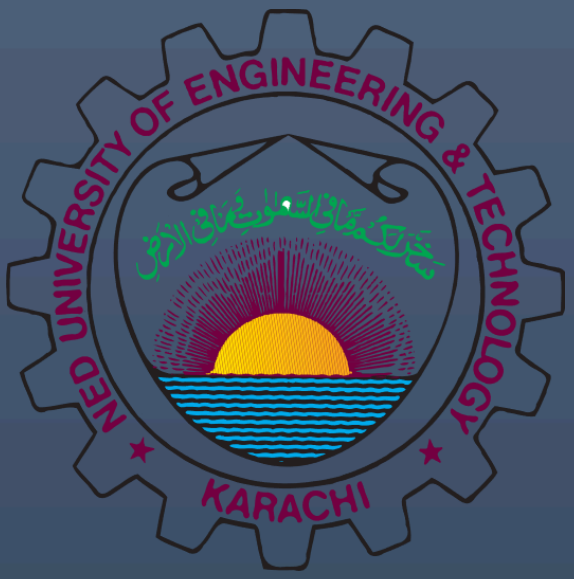

ELECTRICAL MACHINES

OPEN ENDED LAB

ELECTRICAL MACHINES

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INTRODUCTION

A DC machine is an electromechanical energy alteration device. The output of the DC machine is DC output because they convert AC voltage to DC voltage. The conversion of this mechanism is known as the commutator; thus, these machines are also named as commutating machines. DC machine is most frequently used for a motor. The main benefits of this machine include torque regulation as well as easy speed. The main function of the DC generator is to convert mechanical power to DC electrical power, whereas a DC motor converts DC power to mechanical power. In today's world the generators work on the principle of electromagnetic induction which was discovered by Michael Faraday in 1831-32. Faraday discovered that the above flow of electric charges could be induced by moving an electrical conductor, such as a wire that contains electric charges, in a magnetic field. In the 1860s and 1870s many inventors sought ways of using Faraday's induction principle to generate electricity mechanically. Two kinds of generators emerged. The first type was a generator of direct current (DC) electricity. The second type was a generator of alternating current (AC) electricity. One of the most important inventors of generators was German Werner von Siemens, who designed improved DC generators and called them dynamos. An even better generator was introduced by French Zénobe-Théophile Gramme in 1867, which produced substantially higher voltages than previous attempts. An electric motor is a device used to transform electricity into mechanical energy opposite to an electric generator. The history of DC motors goes as far back as the 19th century. In 1832, a British scientist, William Sturgeon, created the first DC motor that had the ability to power machinery. Today, DC motors are widely used in many industries, such as healthcare, food service and many industrial settings. The use of DC motors has made industry work far more efficient, with machines able to function with a dependable source of power and speed. DC motors have made many other industries far easier to function in their day-to-day faculties, by taking a lot of manual power off of humans or animals, and replacing it with motorized equipment. An inventor named Julian Sprague invented a DC motor that was capable of maintaining a constant speed under variable loads. Sprague's invention would lead to the commercial use of the DC motor. This would include early variations of the electric elevator and electric trolleys. These developments led to high demand of the motors, for both commercial & residential usage. In this report we shall discuss the tripping of generator on overloading by the help of 2 motors and other components requires 2LEDs of 8V, Pulley, Fuse of 1A and wires.

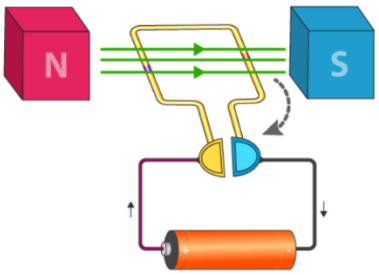
DISCUSSION

A machine is discussed in the form of motor and generator. Firstly, the motor will be discussed then generator and other necessary components for this practical.

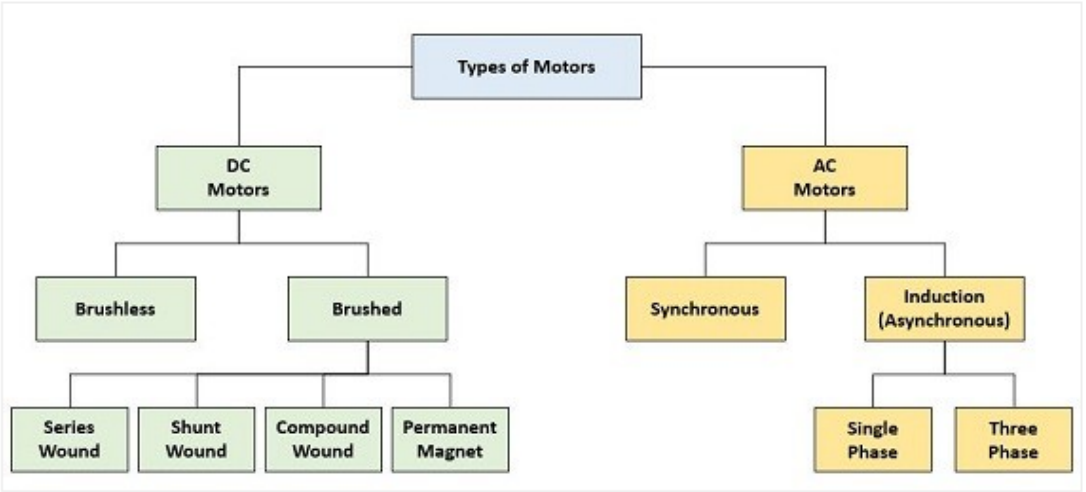
MOTOR

The conversion of energy is from electrical to mechanical in motor. They operate employing principles of electromagnetism, which determines that a force is applied when an electric current is present in a magnetic field. Motors have many various working parts in order for them to continually rotate, providing Power as needed. Motors can run off of direct current (DC) or alternating current (AC).

The current-carrying conductor is placed between the two magnets and is connected to the battery. When the battery is turned on, there is a flow of current in the conductor and magnetic field from the north to the south. By Fleming's left-hand rule, we understand that there is a downward and upward force acting on the conductor.



The types of DC and AC motors are showed by the following tree diagram



Synchronous Motors

In this kind of motors, the speed remains constant with varying loads and the supply current frequency is synchronized with rotor rotation. That is why these motor helps to drive motors at a constant speed and is used in machines.

Asynchronous (Induction) Motors

This motor works on the principle of electromagnetic induction which is produced from the magnetic field on the rotor. These are classified into two types according to the load capacity:

- Single-Phase
- Three-Phase

The single-phase induction motors are used for smaller loads such as household appliances

The three-phase induction motors are used in industries applications such as conveyor belts, lifting gears, etc.

Brushed Motors

These are the traditional variety of DC motors which are used for basic applications where there is a very simple control system. These are used in consumer applications and basic industrial applications. These are classified into four types:

- Series Wound
- Shunt Wound
- Compound Wound
- Permanent Magnet

In the series-wound DC motors, the rotor winding is connected in series with the field winding. Varying the supply voltage will help in controlling the speed. These are used in lifts, cranes, and hoists, etc.

In the shunt wound DC motors, the rotor winding is connected in parallel with the field winding. It can deliver higher torque without any reduction in the speed and increases the motor current. Due to its medium level of starting torque along with constant speed, it is used in conveyors, grinders, vacuum cleaners, etc

In the compound wound DC motors, the polarity of the shunt winding gets added to that of the series fields. It has a high starting torque and runs smoothly

even if the load varies smoothly. This is used in elevators, circular saws, centrifugal pumps, etc.

Permanent magnet as the name suggests are used for precise control and lower torque such as robotics.

Brushless Motors

These motors have a simpler design and have a higher life span when used in higher applications. This has little maintenance and high efficiency. These types of motors are used in appliances that use speed and position control such as fans, compressors, and pumps.

GENERATOR

An electric generator is a device that converts mechanical energy obtained from an external source into electrical energy as the output.

It is important to understand that a generator does not actually 'create' electrical energy. Instead, it uses the mechanical energy supplied to it to force the movement of electric charges present in the wire of its windings through an external electric circuit. This flow of electric charges constitutes the output electric current supplied by the generator. This mechanism can be understood by considering the generator to be analogous to a water pump, which causes the flow of water but does not actually 'create' the water flowing through it.

The modern-day generator works on the principle of electromagnetic induction discovered by Michael Faraday in 1831-32. Faraday discovered that the above flow of electric charges could be induced by moving an electrical conductor, such as a wire that contains electric charges, in a magnetic field. This movement creates a voltage difference between the two ends of the wire or electrical conductor, which in turn causes the electric charges to flow, thus generating electric current.

A conductor coil (a copper coil tightly wound onto a metal core) is rotated rapidly between the poles of a horseshoe type magnet. The conductor coil along with its core is known as an armature. The armature is connected to a shaft of a mechanical energy source such as a motor and rotated. The mechanical energy required can be provided by engines operating on fuels such as diesel, petrol, natural gas, etc. or via renewable energy sources such as a wind turbine, water turbine, solar-powered turbine, etc. When the coil rotates, it cuts the magnetic field which lies between the two poles of the magnet. The magnetic field will interfere with the electrons in the conductor to induce a flow of electric current inside it.

Types of Generators

The generators are divided into two different and basic classes or categories which are AC (Alternating Current) generator and DC (Direct Current) generator.

1. AC Generator

The AC generators or as they are also called the Alternator, are one of the most essential devices of providing electrical power in several conditions in our life. ACs work based on the principle of electromagnetic induction. AC generators are classified into two categories: induction generators and synchronous generators. As there are no brushes in this type of generators, maintenance is almost free. the size of ACs is smaller in comparison to DCs. So, they are more commonly used. And at last, what makes this type more popular is that the losses of ACs are less than DCs.

2. DC Generator

This type of generator is commonly found in off-grid applications. The DCs are classified into three main categories according to the way their magnetic field is developed in the stator: permanent-magnet generators, separately-excite generators, and self-excited generators. Some advantages of DCs are: they are designed plainly. They are usually used for operating large motors and electrical devices requiring direct control. DCs diminishes the fluctuations described by smoothing the output voltage through a regular set of coils around the armature for some steady state applications.

FUSE:

It protects equipment and electrical networks and ensure that the effects of faults, which inevitably occur, are limited and that the continuity of supply to consumers is maintained at a high level

Fuse operation is based on the melting temperature of a wire or other metal element. As current increases, the fuse element heats up and when the rated current is exceeded, the element reaches its melting temperature and opens, thus removing power from the circuit.

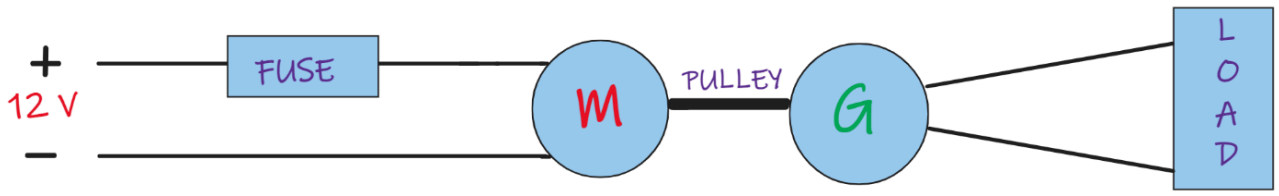
LOAD:

An electrical load is simply any component of a circuit that consumes power or energy. In a household setting, the most obvious examples of electrical loads include light bulbs and appliances. In a more general sense, any resistor or electric motor in a circuit that converts electrical energy into light, heat, or useful motion constitutes a load on the circuit. The load of a circuit is inversely proportional to current flow as bigger loads lower the current in a circuit. However, if no significant load is present in a closed circuit, a short circuit will result and potentially cause significant damage.

PROCEDURE

- Connect the two DC Motors by the help of pulley.
- Connect the LEDs as a load at the terminals of one motor (acting as generator in this case)
- Apply 12V DC supply at the terminal of the other motor.
- A fuse is also connected before giving 12V supply
- When the current exceeds the limit of 1A current the fuse disconnects the supply from the source and the motor is turned off.

CIRCUIT DIAGRAM



CONCLUSION

By the experiment an important application is observed that motor is acting as generator as mechanical energy is being provided and can be saved from excess

current by using the fuse. In order to observe the above phenomena a bulb is used In the present-day world, electrical energy is generated in bulk in the form of an alternating current. Hence, the use of DC machines, i.e., DC generators and motors are very limited. They are mainly used in supplying excitation of small and medium-range alternators. The Industrial Applications of DC Machines are in Electrolytic Processes, Welding processes and Variable speed motor drives.

RECOMMENDATIONS

- It is possible that there is a mechanical overload on the motor that may cause repeated tripping and even damage to the electric motor winding. In this case, it is important to reduce the load as quickly as possible as buying a new motor can be an expensive proposition and will add to the operational costs.
- The main source of power to the motor must be shut off immediately in order to conduct an inquiry to identify the exact reason for the tripping. It is also beneficial to make sure that the overload relay system is adjusted correctly. Generally, this is set at 110% of the total power capacity of the motor.
- In many cases, the drive components may need to be suitably aligned with the motor to avoid any mishaps of this nature.
- The exact voltage that is being supplied to the motor must be checked on a regular basis, including the possibility of loose contacts that can result in tripping or blown fuses.
- The actual source of the trip point of the relay must be located and replaced, if found defective.
- The electrical wiring to the motor must be verified to ensure that all the connections are made in accordance with the requirements. In case of a single or open phase, all the different combinations available must be checked to make sure that all the connections are in order, especially, the red to blue, blue to yellow, and red to yellow phases.
- Use a clamp on the meter to check the amps when the motor is running to identify if there is an overload occurring. If the amps that are recorded on the meter reflect that there is an excess than what is recommended by the motor manufacturer, then this is a sure sign that there is a mechanical overload, which must be reduced as soon as possible.

- There may be instances of less amount of power or amps that is getting to the motor and yet tripping occurs. This is a sure sign that there is a defect in the motor.

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